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Bridging the Knowledge Gap through Organic Field School (OFiS) Method for Long Pepper *(Piper longum)* Farmers in Wonogiri, Indonesia

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ABSTRACT

Organic certification is urgently needed for long pepper to meet global market standards and enhance product credibility. Wonogiri Regency is the largest center for long pepper production in Central Java, with this biopharmaceutical commodity cultivated for generations. Its promising market potential necessitates meeting global standards, including organic certification. This community service initiative aims to bridge knowledge gaps and improve farming practices through Good Agricultural Practices (GAP) for organic long pepper. The methods used include classroom activities to assess farmer knowledge and transfer knowledge through socialization and field activities in demonstration plots, starting with the identification of farmer training priorities. A pre-test survey revealed that while over 65% of farmers understood the planting stage, less than 50% were familiar with land preparation, planting, and harvesting. This low level of knowledge is due to a lack of information on farming practices that comply with organic Good Agricultural Practices (GAP). Key training priorities identified include: (1) preparation and application of organic fertilizers and pesticides, (2) propagation of organic long pepper seeds, and (3) post-harvest handling. To address these, the Organic Field School (OFiS) was established as a training platform, equipping farmers with practical skills. The results indicate that farmers gained significant knowledge and can now independently implement organic long pepper cultivation. OFiS method can bridge the farmer's knowledge gap, increase farmers' knowledge in preparation, growing, planting, and harvesting based on Good Agricultural Practices (GAP). OFiS serves as an effective solution to enhance sustainable agricultural practices, supporting farmers in producing high-quality organic long pepper that meets global standards.

Keywords**:** farmers' knowledge, field school, good agricultural practices, long pepper

INTRODUCTION

Based on the Gross Regional Domestic Product (GRDP) data by economic sector from 2012 to 2023, the regional income of Wonogiri Regency is dominated by the agriculture, forestry, and fishery sectors so, the agricultural sector is the primary source of livelihood for the people in Wonogiri (BPS, 2024). It is also supported by the geographical location, where Wonogiri is located in the southernmost region of Central Java Province and directly borders the Indian Ocean. Thus, the diversity of natural resources available in Wonogiri has great potential to support the regional economy.

The great potential of the variety of natural resources, which contributes significantly to regional income, contrasts with data showing the high number of smallholder farmers in Wonogiri. The Agricultural Census 2023 data showed that 77.73% of farmers in Wonogiri were classified as small farmers with less than 0.5 hectares of land under cultivation. Farmers implemented diversification through the agroforestry system to overcome the problem of limited land (Arum et al., 2023).

Agroforestry is a way of diversifying land use to improve farmers' livelihoods while conserving natural resources and biodiversity based on census data, where 52.47% of

farmers rely on the plantation or mixed garden sub-sector as a source of livelihood (BPS, 2024) and it can help build livelihood resilience in uncertain conditions (Bellon et al., 2020). The characteristics of agroforestry land ownership in Wonogiri Regency are unique compared to other regions (Afriawan et al., 2024). Wonogiri's limestone soil creates a dry environment that supports the cultivation of region-specific crops, including high-quality biopharmaceutical raw materials (Dewi et al., 2023). The district is known for its many traditional herbal medicine entrepreneurs who use local natural resources to produce herbal preparations that support the local economy and the development of herbal-based businesses in the Wonogiri Regency.

One of the typical biopharmaceutical raw materials from Wonogiri is long pepper, often called *cabe jamu*. This indigenous Indonesian spice, scientifically known as *Piper retrofractum*, which is related to pepper and cubeb (Spence, 2024). It is a local product cultivated by Wonogiri Regency people from generation to generation, and has many health benefits (Yadav et al., 2020). It is evident from the data on the area of harvest and production that Wonogiri is one of the producers of this spice in Central Java, with the largest production center in Paranggupito District (Directorate General of Plantations or Ditjenbun, 2022).

Farmers in the Paranggupito area cultivate long pepper as one of the most promising commodities. However, due to the farmers' lack of knowledge about the cultivation techniques and post-harvest handling (Shimelis, 2021). Local farmers have yet to treat long pepper as a high-value crop. Instead, it is commonly grown as an intercrop in conventional agroforestry systems, relying on main crops for support due to its growth habit.

The long pepper business shows strong growth potential in the global market, as reflected in export data from 2016 to 2021 (Susetiyo & Hayati, 2021). Long pepper presents a profitable opportunity, particularly as a leading commodity in Wonogiri Regency and Paranggupito District, with higher prices than many other biopharmaceutical commodities (Astutik et al., 2023) and more stable price guarantees (Busthanul et al., 2020). However, realizing this potential requires meeting global market standards, such as organic certification, which ensures supply chain integrity and helps producers identify their products as certified organic (Esteves et al., 2021; Sacchi et al., 2024).

This study aims to bridge the gap in knowledge and farming practices, so it is necessary to carry out a detailed observation and assessment of the compatibility of knowledge and practices with organic farming standards through the implementation of organic Good Agricultural Practices (GAP). This observation and evaluation must determine the level of farmers' knowledge in relation to the farming practices applied in accordance with the principles of sustainable organic agriculture. Based on the observation and evaluation results, priority activities were formulated to support the development of high-quality long pepper, focusing on increasing productivity, quality, and competitiveness in the market.

The Good Agricultural Practices (GAP) Activity Program is packaged with the Organic Field School (OFiS) activity to bridge the knowledge and growing practices that farmers have implemented with practices that are in accordance with the Standard Operating Procedure (SOP) for growing organic standard long pepper. OFiS activities are designed to deliver knowledge through face-to-face classroom activities and direct practice through demonstration plots to long pepper farmers. Thus, the ultimate goal of this activity is to prepare farmers to export standard long pepper products and compete in the international market.

METHOD

The community-based empowerment (PBM: *Pemberdayaan Berbasis Masyarakat*) activities in the Gudangharjo Farmers Group, Gudangharjo Village, Paranggupito District, Wonogiri Regency, chose this location due to its status as the area with the most significant production of long pepper in the Wonogiri Regency. The Gudangharjo Farmers Group consists of eight farmer groups with a total membership of 372 farmers. The participants for this activity were selected from the pioneer farmers, with three people from each farmer group, and six people from the farmer group

officers, so the total number of participants in the activity consisted of 31 people.

The community service activities took place in July-August 2024. The methods of activity used in the Organic Field School (OFiS) program include knowledge socialization, practical training through demonstration plots, and technical assistance in the form of production advice.

The OFiS series of activities is divided into four stages (Fig 1).

1. Stage 1: Determine the level of farmers' knowledge and practices of growing long peppers according to organic standards through a pre-test. The assessment will be done using a Likert scale where the level of knowledge of the farmers will be measured based on the value of 5 = very high knowledge, 4 = high knowledge, 3 = moderate knowledge, 2 = low knowledge, and 1 = very low knowledge. Then the responses were categorized into three groups, first poor knowledge that covers very low and low knowledge, second moderate knowledge, and the last good knowledge that represents high and very high knowledge.

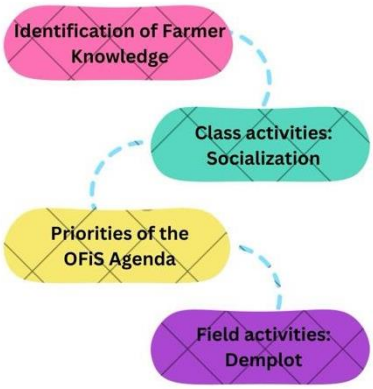

Figure 1. OFiS activity program

2. Stage 2 : Direct face-to-face socialization in the OFiS activity class to provide farmers with comprehensive knowledge on the cultivation of organic standard long pepper, starting from land conversion, water management, fertilization, and pest and disease control to harvesting and post-harvest handling.
3. Stage 3 : Formulation of priority OFiS activities that need to be further explored and studied by farmers in the cultivation of organic standard long pepper to design OFiS activities that are more targeted and in line with the needs of the farmers. The priority of training activities is measured using a Likert scale with a value of 5 = very important, 4 = important, 3 = fairly important, 2 = slightly important, and 1 = not important. After calculating the priority activities or training needs, the activities were classified into four groups based on the highest training need score, 1). Need primary training; 2). Need Training; 3)-4). Need strengthening.
4. Stage 4 : Implementation of practical activities in the field through demonstration plots with farmers. In this stage, farmers are accompanied by facilitators to practice activities as a priority to be further explored in the field. In addition, in this community service activity, farmers are supported by the team in terms of infrastructure to support the business of organic standard long pepper products.

RESULT AND DISCUSSION

Sociodemographic Characteristics

Representatives from each farmer group attended the Organic Field School (OFiS) activity as part of the Gudangharjo Farmer Group. Each farmer group sent three representatives to participate fully in the entire series of activities. Socio-demographic characteristics are shown in Table 1.

Table 1. Sociodemographic characteristics

Variable	Mean
Number of male farmers	31
Farmers' age (year)	55
Farmers' education (year)	8.3
Farming experiences (year)	30.9

Table 1 describes the socio-demographic characteristics of the participants in this community service activity, consisting of 24 farmer group representatives and 6 Farmer Group Association (*Gapoktan)* administrators. All participants in this activity were male, with an average age of 55 years. The average level of education of the participants was 8.3 years, or equivalent to not having completed Junior High School (SMP), showing that the level of education of the participants was still relatively low. Therefore, in order to facilitate the transfer of information, the OFiS activity

was designed as a two-way activity that involved the active role of the participants in each training session. Furthermore, the average farming experience of the training participants was 30.9 years. With this length of experience, it became one of the farmers' strengths to know the cultivation practices and development of long pepper in Wonogiri Regency.

Farmers' Knowledge about Organic Farming for Long Pepper

The results of the pre-test survey measuring farmers' knowledge of long pepper production are shown in Figure 2.

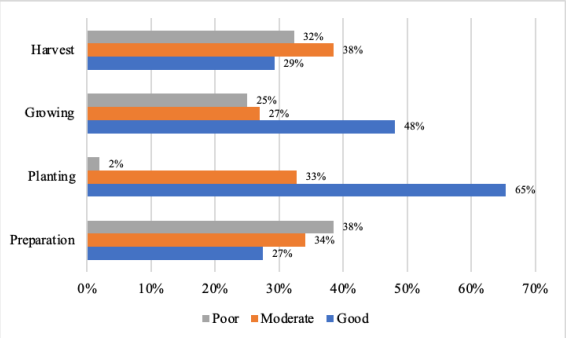

Figure 2. Farmers' knowledge of organic farming

At the preparation stage, 27% of the farmers had good knowledge, 34% had moderate knowledge, and 38% had poor knowledge. At the planting stage, the majority of farmers, 65%, had good knowledge, 33% had moderate knowledge, and only 2% had poor knowledge. Similarly, at the growing stage, 48% of the farmers had good knowledge, 27% had moderate knowledge, and 25% had poor knowledge. Meanwhile, at the harvest, 29% of farmers had good knowledge, 38% had moderate knowledge, and 32% had poor knowledge.

Indicators at each stage of activity are shown in Table 2. Based on these results, it can be seen that 65% of the farmers had good knowledge of organic long pepper growing practices, especially at the planting stage. It showed that the farming practices applied were not very different from the organic standards in force. Thus, it can be concluded that the cultivation practices followed based on local wisdom were pure, uncontaminated, and naturally organic activities (Minah et al., 2019). It was reflected in the activities of seed selection, seed propagation, seed handling from contamination, and adaptation to climate, soil, and water conditions in the local area.

Although farmers had a good knowledge of the planting stage, it was unbalanced with an adequate understanding of the land preparation, maintenance, and harvest stages. At these three stages, almost 50% of farmers showed moderate and low knowledge. It indicated that the majority of farmers did not have a comprehensive understanding of the entire process of organic long pepper cultivation, from land preparation, planting, and maintenance to harvest and post-harvest handling.

The results of the pre-test and interview surveys showed that the practice of long pepper cultivation carried out by farmers in Paranggupito District had a relatively low risk of contamination. However, the lack of access to information and sources of knowledge regarding organic cultivation standards hindered farmers' understanding of these practices. Therefore, the Organic Field School (OFiS) program is the right solution to bridge the knowledge gap and assist farmers in implementing long pepper cultivation practices according to organic standards.

OFiS Class Activities: Socialization

The Organic Field School (OFiS) activity was designed through two activity schemes, the first being in-class activities and field practice. In-class activities were face-to-face activities carried out by bringing in expert facilitators who have competencies in accordance with the field of the planned activity. Field activities are the implementation and direct practice of information and knowledge obtained from the class to be applied in the demonstration plot. Socialization of OFiS class activities shown in Figure 3.

Figure 3. OFiS socialization

In the class meeting, farmers were given socialization related to the practice of Good Agricultural Practices (GAP) for organic long pepper. The material presented was comprehensive, starting from land conversion, water management, fertilization, and pest and disease control to harvest and post-harvest handling. After the presentation of the material, discussion and question-and-answer sessions were conducted directly by the participants and the present speakers. It aimed to provide space for farmers to consult and share the obstacles they face in the field when growing long pepper.

In addition to discussing the obstacles faced, the face-to-face session also aimed to formulate practices in the form of SOPs related to the cultivation of organic standard long pepper. Thus, the result of this face-to-face activity was to reach an agreement on the SOPs for organic Good Agricultural Practices (GAPs) for long pepper in accordance with the agricultural conditions in Paranggupito District, Wonogiri Regency, and could be fully implemented.

Results of Prioritizing the Farmers' Training Needs for Long Pepper Production

The Organic Field School (OFiS) was a training program designed not only to provide farmers with knowledge about organic long pepper production in a one-way manner but also to take into account farmers' perspectives on chile production practices. This program considered farmers' needs in determining which farming practices need to be prioritized and deepened so that training was more relevant and effective in improving farmers' skills according to field conditions.

Borich's 20-item needs assessment model was used to identify training needs from the farmer's perspective (Mohammadian & Niknami, 2022). For each question in the questionnaire, farmers used a Likert scale (1-5) to indicate how much knowledge or importance they had in each educational area measured. Table 2 shows the priority training needs of farmers for long pepper production based on the Borich needs assessment model.

Based on the results of the OFiS activity priority measurement, 11 training topics scored above four and were considered top priorities for this activity. The topics most needed by the farmers included how to make organic fertilizer, how to make organic long pepper seeds, the characteristics of the shade plants used, and the process and procedures for drying long pepper. In addition, the training required included the procedures for using organic fertilizers and pesticides, the selection of long pepper seeds, the timing and procedures for applying organic fertilizers, and the method for sorting or grading long pepper results. In addition, the calculation of the priority score showed that materials related to soil fertility management according to organic standards and procedures for packaging products according to organic standards are topics that require strengthening in this training.

In addition, the results of the calculation of the prioritization of training activities in OFiS were confirmed and reinforced by the Focus Group Discussion (FGD) activities related to the formulation of activity priorities. The results of the FGDs showed that the low level of knowledge of the farmers did not mean that they were not using organic long pepper farming practices, but rather that they lacked information on practices that were in line with the SOPs for organic farming. This underscored the importance of providing more comprehensive information to farmers so that they could better understand and adopt the correct standards of cultivation (Chang et al., 2024). In addition, the majority of farmers indicated that some organic long pepper production practices have been practiced for a long time and have become local wisdom. However, several organic standard training practices need to be prioritized and further explored in the OFiS activity program so that the farmers' hope after participating in this activity is to have better knowledge and skills that can be directly applied in organic long pepper cultivation.

"I believe our current long pepper cultivation has minimal contamination since it's grown among low-maintenance plants." (Chairman of Gapoktan/Farmer Group)

"We don't use organic or inorganic fertilizers in cultivating long pepper because we're not yet familiar with proper organic fertilizer processing" (Member of the Farmer Group – 1)

Table 2. Prioritize the farmers' training needs for organic long pepper production

Stages	Items	Average Knowledge	Average Importance	Training Need Score	Priority
Preparation	Knowledge of the criteria and conditions for the conversion of Long Pepper	2.69	4.00	4.00	4
	Knowledge of how to prevent contamination from inorganic substances that may be released through air, water, soil, agricultural inputs, storage facilities, packaging, and transportation.	3.77	3.15	1.92	-
	Knowledge of how to make organic fertilizer according to organic SOP	2.08	4.23	4.69	1
	Knowledge of procedures for using commercially available organic fertilizers and pesticides	2.54	4.08	4.46	2
	Knowledge of how to make organic pesticides according to the organic SOP	2.54	4.31	4.31	3
Planting	Knowledge of organic soil fertility management practices	3.23	3.08	1.85	-
	Knowledge of identifying water sources for organic farms	3.31	2.54	1.46	-
	Knowledge of the characteristics of standard organic Long Pepper seeds	4.15	4.00	4.00	2
	Knowledge of contamination prevention and management of organic Long Pepper seeds/planting materials	3.85	2.77	2.08	-
	Knowledge of how to grow Long Pepper according to organic SOPs	4.15	4.15	4.15	1
	Knowledge of climate, soil, and water conditions in the growing area	3.77	2.77	2.54	-
	Knowledge of non-chemical (organic) methods of pest, disease, and weed control	3.85	3.15	2.92	-
Growing	Knowledge of the time, type, method, and amount of organic fertilizer applied	2.77	4.23	4.00	2
	Knowledge of biological organisms (natural enemies) useful in the field and how to use them	4.15	3.08	1.77	-
Harvesting	Knowledge of the characteristics of hedgerow plants for Long Pepper	2.31	4.31	4.23	1
	Knowledge of how to dry Long Pepper according to organic SOP	2.08	4.38	4.15	1
	Knowledge of how to grade Long Pepper according to organic SOP	2.08	4.15	4.00	2
	Knowledge of proper packaging for organic Long Pepper	3.15	3.38	3.69	3
	Knowledge of organic transportation regulations	3.85	2.85	2.00	-
	Knowledge of proper storage procedures for organic Long Pepper	3.54	3.46	2.23	-

Notes for ranking:

1 Need primary training 2 Need training 3 4 Need strengthening

"Throghout the cultivation process, we haven't focused much on each stage. We usually just prepare the seedlings, plant them near sturdier crops, and wait for the results without apllying any special treatment" (Manager of Farmer Group– 1)

"We hope this training inspires enthusiasm for cultivating long pepper using proper planting methods." (Member of the Farmer Group – 2).

OFiS Field Activity: Demonstration Plots

The next step was the implementation of the prepared SOP GAP Organic. Practical activities are carried out based on priorities that have been formulated together, covering 11 training topics (Table 2) with four main discussion areas. These practical activities included: 1). making and applying organic fertilizers and pesticides, 2). propagation of organic long pepper seeds, and 3). post-harvest handling. At this stage, farmers were given practical training that could be applied through joint management of demonstration plots. Hopefully, after participating in this OFiS activity, farmers can disseminate the knowledge and science they have gained to other farmers at the level of their respective farmer groups.

Practical training activities related to the manufacture of solid organic fertilizers are carried out by creating a *"rumah pupuk bersama"*. The joint fertilizer house was a place that farmers had agreed upon as a place for making, processing, and storing the results of making organic fertilizers. In the practice of making solid organic fertilizers, several basic materials were needed, which farmers provided, including livestock manure, rice husks, and wood ash. In addition, other complementary materials in the form of molasses and organic bacteria were provided by the community service team. The solid organic fertilizer produced could be used to increase soil fertility and support plant growth naturally. Organic fertilizer training is shown in Figure 4.

Figure 4. Organic fertilizer training

The next activity was the production of organic pesticides using organic materials available around the site (Fig 5). The objective of making this pesticide was to create a product that can be sustainably produced by farmers using local resources in the Paranggupito District. The materials used include garlic, turmeric, ginger, green leaves with a strong smell, water, and bacteria. The manufacturing process began by mixing all the ingredients in a blender and then mixing the resulting mixture with water. The mixture was then left to ferment for 24 hours. After fermentation was complete, the pesticide could be stored in a tightly sealed container. In addition to making pesticides, farmers were also taught how to use them by diluting pure pesticides before spraying. This pesticide could be applied to any part of the plant, especially the leaves of the long pepper that were affected by pests or diseases.

Figure 5. Organic pesticide training

The next practical activity was the multiplication of the production of organic standard long pepper seeds (Fig 6). At this stage, farmers were trained to produce long pepper seeds by propagating long pepper plants that were not contaminated with chemicals. The results of the propagation were managed and treated organically so that they could be planted in the field. When planted in the field, the seeds were planted in understanding plants that have not been treated with inorganic chemicals such as fertilizers and pesticides. In addition, seeds planted in the field were periodically inspected and replanted if necessary. Thus, the result of this nursery activity was the production of long pepper seeds that met organic standards and were ready to be planted in the field (Fig 7).

Figure 6. Seedling process

Figure 7. Nursery

In the final hands-on activity, the post-harvest handling of organic standard long pepper, participants obtained an in-depth understanding of the proper procedures to ensure the quality and safety of the product after harvest (Fig 8). This activity included several key steps, such as selecting and separating ripe long peppers from unfit ones, as well as effective cleaning and drying techniques to avoid damage and contamination. Participants were also taught how to store long peppers under optimal conditions to maintain freshness, including the use of appropriate storage containers and proper temperature settings. In addition, this training included methods for identifying and managing potential post-harvest problems, such as disease or pest infestation, to maintain the quality of organic standard long pepper until it reached the consumer.

Figure 8. Post-harvest management training

Figure 9. Production facilities support

The outcomes of the community service activities in Gapoktan Gudangharjo were to bridge the farmers' knowledge related to the long pepper cultivation practices that have been carried out so far with the organic long pepper cultivation practices in accordance with the Good Agricultural Practice (GAP) Organic. Comprehensive knowledge was acquired by farmers through Organic Field School (OFiS) activities in face-to-face socialization activities in the classroom. It was reinforced through direct implementation practices by farmers in demonstration plots. Thus, the involvement of farmers in demonstration plot practices on the land allowed farmers to practice organic long pepper cultivation on their respective lands independently.

Based on the results of the pre-test survey, it was found that 65% of the farmers had good knowledge at the planting stage, but less than 50% understood the stages of land preparation, maintenance, harvest, and post-harvest. This knowledge gap was the basis for the implementation of the Organic Field School (OFiS) activity, which consisted of classroom activities through socialization and field activities in the form of processing demonstration plots. The socialization aimed to provide farmers with comprehensive knowledge of organic long pepper production standards. In addition, farmers were equipped with practical knowledge that would be adapted to the priority of activities based on their interests and needs. The main focus of the training was on the production and application of organic fertilizers and pesticides, propagation of organic herbal chili seeds, and post-harvest handling (Figure 9). The data before OFiS was carried out, shown in Figure 1, is the initial data for testing farmers' knowledge about organic cayenne pepper production, which was then compared with the final data for testing farmers' knowledge shown in Figure 10.

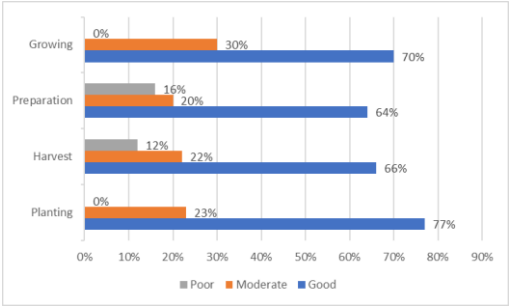

Figure 10. Post-test farmers' knowledge

The data shows that the OFiS method can improve farmers' knowledge and bridge the knowledge gap between farmers. Thus, the OFiS activity has succeeded in bridging the farmers' knowledge gap in organic long pepper cultivation. Advance recommendations for the OFiS program are that it can be continued in relation to the handling of harvested products in accordance with Good Handling Practices (GHP) in order to improve farmers' knowledge and skills in producing long pepper that meets standards.

CONCLUSION

Organic certification for long pepper is imperative to comply with worldwide market standards and bolster product credibility. Wonogiri Regency is the predominant hub for long pepper cultivation in Central Java, with this unique commodity being grown for generations. The significant market potential requires compliance with worldwide standards, including organic certification. This community service effort seeks to address knowledge deficiencies and enhance agricultural methods via Good Agricultural Practices (GAP) for organic long pepper. The findings demonstrate that farmers acquired substantial expertise and can now autonomously execute organic long pepper growing. The OFiS technique can close the knowledge gap for farmers and enhance their understanding of preparation, cultivation, planting, and harvesting in accordance with Good Agricultural Practices (GAP). OFiS functions as an efficient solution to improve sustainable agricultural practices, assisting farmers in cultivating high-quality organic long pepper that complies with worldwide standards. It is recommended that the OFiS program continue to focus on the management of harvested products in alignment with Good Handling Practices (GHP) to enhance farmers' knowledge and skills in producing long pepper that fulfills established standards.

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