
Diversification of Lontar Fruit and Community Empowerment by Thematic KKN Students in Awangpone District

Annisa Zakiyah Darajat¹, Ade Muspa², Indah Ayu Risnah³, Riskawati⁴, Nur Eva Sapartina⁵,
Rahmawati⁶, Karmilasari⁷, A. Nurlianih⁸

^{1,2} Biology, Universitas Sibatokkong Mambo

Email: annisazakiyahd@gmail.com

^{3,4} Chemistry, Universitas Sibatokkong Mambo

⁵ Midwifery, Universitas Sibatokkong Mambo

^{6,7} Health Administration, Universitas Sibatokkong Mambo

⁸ Nutrition, Universitas Sibatokkong Mambo

Article info

Abstract. *The Thematic KKN of Sibatokkong Mambo University is a student community service program. This activity took place in Awangpone District, spanning Jaling, Cumpiga, Abbanuang, and Carebbu Village, from September 15 to October 17, 2025, under the theme of diversification of lontar fruit (*Borassus flabellifer*). This Thematic KKN aimed to provide community living experiences for students and introduce innovations in diversifying lontar fruit into nata de lontar and lontar jam. The method of this activity consisted of observation, formulation of main and additional programs, implementation of work programs, monitoring, and evaluation. The results are the implementation of the main program in the form of training in making nata de lontar and lontar jam, logo design, and digital marketing. The additional program is community programs in health, hygiene, and social matters. The products produced from this Thematic KKN are nata de lontar and lontar jam.*

Abstrak. KKN Tematik Universitas Sibatokkong Mambo merupakan program pengabdian mahasiswa. Kegiatan ini berlangsung di Kecamatan Awangpone yang tersebar di Desa Jaling, Desa Cumpiga, Desa Abbanuang, dan Desa Carebbu pada 15 September – 17 Oktober 2025 dengan mengusung tema pengelolaan buah lontar (*Borassus flabellifer*). KKN Tematik ini bertujuan untuk memberi pengalaman hidup bermasyarakat bagi mahasiswa dan mengenalkan inovasi diversifikasi buah lontar menjadi nata de lontar dan selai lontar. Metode pelaksanaan kegiatan ini terdiri dari observasi, perumusan program kerja utama dan tambahan, pelaksanaan program kerja, monitoring, dan evaluasi. Hasil pengabdian berupa terlaksananya program kerja utama berupa pelatihan pembuatan nata de lontar dan selai lontar, pelatihan desain logo kemasan, dan pelatihan pemasaran digital. Sedangkan

program kerja tambahan berupa kegiatan yang melibatkan masyarakat dalam hal kesehatan, kebersihan, dan sosial kemasyarakatan. Produk yang dihasilkan dari KKN Tematik ini berupa nata de lontar dan selai lontar.

Keywords:

Bone; KKN; lontar; nata de lontar; jam.

Corresponden author:

Email: annisazakiyahd@gmail.com



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INTRODUCTION

The 2025 Thematic KKN (Community Service Program) of Sipatokkong Mambo University was held in Awangpone District, spread across Jaling Village, Cumpiga Village, Abbanuang Village, and Carebbu Village. Thirty four of Thematic KKN participants consisted of male and female students from four different degree program at Sipatokkong Mambo University. The diversity of academic backgrounds was expected to enhance the creativity of program implementation and increase the potential benefit of each field of study at the Thematic KKN site.

The activities of the Thematic KKN students of Sipatokkong Mambo University in each designated village referred to the predetermined main work programs and additional work programs adjusted to the needs of the village community. The main work programs were developed based on the theme: 'Lontar: An Asset for the Health and Welfare of the Bone Community.' Based on this theme, the main work programs implemented were related to the utilization of lontar fruit (*Borassus flabellifer*), which was abundantly available in each village. Meanwhile, additional work programs could take the form of weekly activities tailored to the habits and needs of the community. Thus, in addition to serving as work programs, these activities also served as a medium for students to integrate with the community.

The Thematic KKN theme arose from the abundance of lontar fruit in Bone Regency, particularly in the destination villages in Awangpone District. The territory of Bone Regency has a varied elevation ranging from 0 - >1,001 meters above sea level (BPS, 2025). This geographical position enables Bone Regency to serve as one of the habitat areas for the distribution of lontar (*Borassus flabellifer*). The lontar tree is known to thrive in areas with an altitude of 0–500 meters above sea level (Fajeriadi, Dharmono, & Anwar, 2019).

As many as 4,800 farmers in Bone Regency grow lontar trees as their plantation crops; however, lontar fruit production is not yet included as a fruit commodity calculated in annual statistics (BPS, 2025). Lontar fruit has been reported to be rich in carbohydrates, protein, fiber, and various minerals needed by the body such as zinc, iron, copper, sodium, and potassium, as well as carotenoids that function as antioxidants (Rahman, Salauddin, Rahman, Muhsin, & Rouf, 2021). Fresh lontar fruit vendors can be found along the roadsides of lontar-producing villages. In addition to being a fruit option enjoyed by the community, lontar fruit is also a commodity with economic value. Therefore, management and utilization efforts are needed to add variety to the enjoyment of lontar fruit and increase its selling value (Arfah, 2019).

Nata de lontar and lontar jam are types of lontar fruit products that can be a viable option. Nata that is commonly consumed by the public is usually made from coconut water, but recently many innovations in nata production have been made from various types of palm sap and fruit juice, such as nata de siwalan made from lontar palm sap (Apriliyanti & Asri, 2020). To provide a solution to the abundance of lontar fruit and to offer new ways of enjoying it, lontar fruit can be processed into nata de lontar and lontar jam. The simplicity of the production process is considered suitable for application to the community in the Thematic KKN destination villages.

Kuliah Kerja Nyata (KKN), or Community Service Program, is a community engagement activity expected to serve as an empowerment and learning experience for students to see the actual social realities of the community. In this activity, students are required to interact and strive to find creative solutions to various problems existing in the community, as well as to identify potentials that can be developed and utilized to become sustainable activities (Al Umar, Savitri, & Pradani, 2021; Hariana, Mardin, & Lasalewo, 2021). Studies had shown that the involvement of KKN students in rural community empowerment can increase the activeness, attitudes, knowledge, and skills of the community (Amelia & Safitri, 2020).

The implementation of the Thematic KKN of Sipatokkong Mambo University involved students from four different study programs. Collaboration among students from diverse academic backgrounds was expected to foster leadership spirit, improve communication skills, and strengthen students' confidence (Setyaningsih dkk., 2023). Furthermore, through this Thematic KKN activity, it was hoped that sustainable cooperation between Sipatokkong Mambo University and the Local Government could be established in the context of community empowerment and local natural resource management.

Method

The Thematic KKN activity of Sipatokkong Mambo University was held from September 15 to October 17, 2025, in Awangpone District, spread across Jaling Village, Cumpiga Village, Abbanuang Village, and Carebbu Village. The series of activities carried out included the reception of Thematic KKN participants, observation, programs seminar, implementation of work programs, seminar of work programs results, and withdrawal.

Upon arrival, the Thematic KKN participants were officially received by the Head of Awangpone District (Camat) at the Awangpone District Office. Representatives from each village then collected the participants and brought them to their respective locations, where they were officially received by the Village Head.

During the first week at the Thematic KKN site, participants conducted observations through interactions with the community. Observations were carried out to identify the potential of lontar fruit in each village and to understand the habits and needs of the local community in order to develop additional work programs.

In order to introduce the Thematic KKN theme as reflected in the main work programs and to present proposals for additional work programs, a village seminar was held by the Thematic KKN participants through the presentation of the work program plan. The village seminar was attended by the village head, village officials, and community members.

The main and additional work programs were implemented during the period between the programs seminar and the results seminar. The main work programs were determined by the Thematic KKN organizing committee, while the additional work programs were jointly agreed upon by the

Thematic KKN participants and the local village community. The following are the main work programs carried out:

- a) Training in making nata de lontar and lontar jam
- b) Packaging logo design training
- c) Product marketing training
- d) Product making and packaging together with community members

After the series of work programs had been completed, the Thematic KKN participants presented the results in the form of the extent to which the goals of the Thematic KKN—as elaborated through the work programs—were achieved. The village results seminar was attended by the village head, village officials, and community members. The results seminar also coincided with a farewell gathering.

The Thematic KKN participants were collected by the organizing committee through a withdrawal ceremony at the Awangpone District Office on October 17, 2025. Participants brought along the lontar fruit diversification products as the outcome of training during the main work programs.

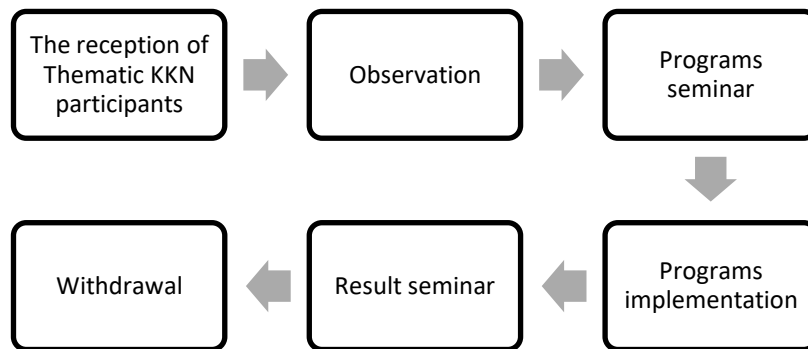


Figure 1. Flowchart of Thematic KKN implementation of Sipatokkong Mambo University

Result and Discussion

The 2025 Thematic KKN of Sipatokkong Mambo University began with the send-off of participants by the Rector in the university courtyard on September 15, 2025. The participants, totaling 34 students from the undergraduate programs of Nutrition, Health Administration, Biology, and Chemistry, were divided among 4 villages: Jaling Village, Cumpiga Village, Abbanuang Village, and Carebbu Village. Each post/village was accompanied by 2 Field Supervisor Lecturers.



Figure 2. Send-off of Thematic KKN students by the Rector of Sipatokkong Mambo University

The Thematic KKN participants of Sipatokkong Mambo University, along with the organizing committee and DPL, arrived at the Awangpone District Office and were officially received by the Head of Awangpone District. In his remarks, the District Head expressed his support for the implementation of the Thematic KKN. Afterward, the designated representatives from each village collected the participants and brought them to their service locations.



Figure 3. Reception of Thematic KKN students by the Head of Awangpone District

The initial activity carried out by the Thematic KKN participants at the service location was observation. The participants, together with residents, explored the village and met with community members to delve deeper into the lontar fruit resources and their utilization, as well as to listen to the community's needs that could inspire the development of additional work programs.



Figure 4. Thematic KKN students conducting observations in each Thematic KKN village location

Information obtained through observation was followed up at post meetings by the Thematic KKN participants. The agenda of these meetings was to formulate strategies for implementing the main

work programs and to develop additional work programs. The additional work programs took the form of participation in the community's weekly activities and collaborative activities with schools and community health centers. All work program formulations were subsequently presented at the Village Seminar.



Figure 5. Work program seminar at each Thematic KKN village location

1. Main Work Program

1.1. Training in Making Nata de Lontar and Lontar Jam

The training activities in making nata de lontar and lontar jam involved village women and youth. The training was held in the hall of each village office. The lontar fruit used was harvested from the respective villages. Starter culture and other supporting ingredients were prepared by the KKN organizing committee, while cooking equipment was provided by the community. The training was guided by the Thematic KKN students designated as the training coordinator for each village/post. Students and training participants mingled and cooked together.

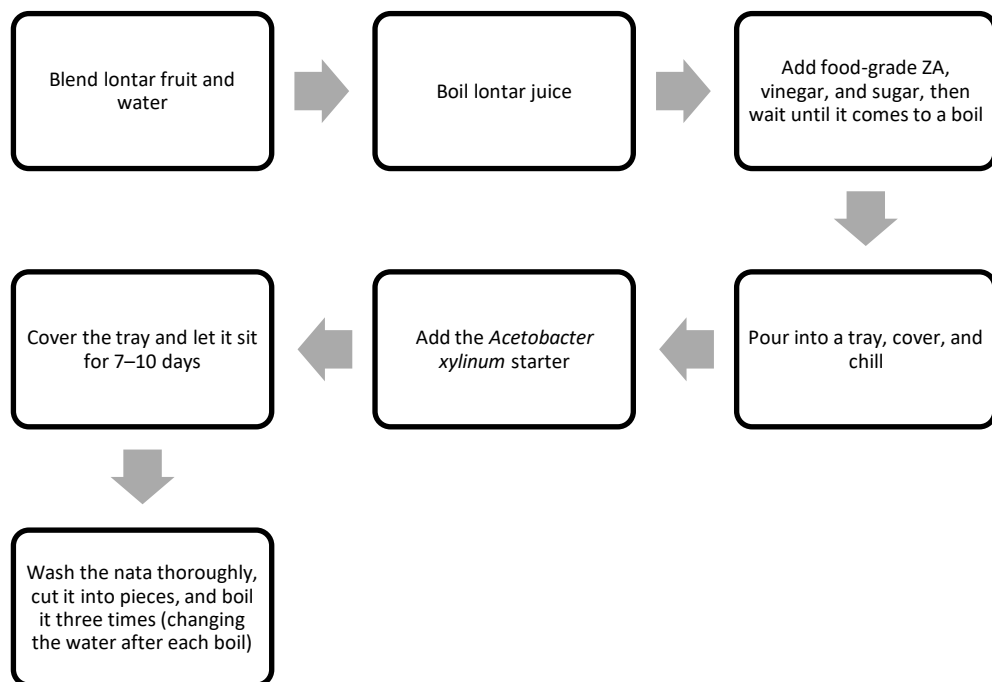


Figure 6. Flowchart of nata de lontar production procedure

Nata de lontar is made using a starter consisting of the bacterium *Acetobacter xylinum*. The bacteria ferment sugar and convert it into dense and chewy cellulose fibers (Swissa, Aloni, Weinhouse,

& Benizman, 1980; Widiyanti, Mulyadiharja, Sukarta, & Pradnyandari, 2018). Meanwhile, lontar jam is made by mixing lontar fruit with sugar and heating it until the water content decreases. Sugar dominating in materials with low water content can act as a natural preservative for the jam itself.

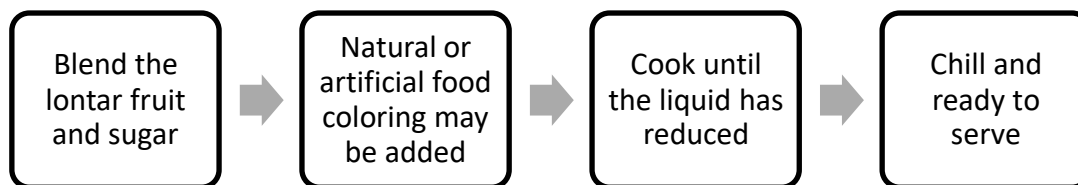


Figure 7. Flowchart of lontar jam production procedure

The training in making nata de lontar and lontar jam represents an introduction to local food diversification efforts. Food diversification offers opportunities for food ingredients to be processed into various varieties, giving the community more choices in enjoying them. Furthermore, the processing of local food sources can enhance conservation efforts in the wild, provide new skills for the community, open employment opportunities, require small capital (Hanafie, 2018), improve community welfare, and ensure food security (Lestari & Bambang, 2017; Mulwa & Visser, 2019; Srinita, 2018).



Figure 8. Training in making nata de lontar and lontar jam with residents of Carebbu Village and Abbanuang Village

1.2. Packaging logo design training

To make the product easily recognizable and visually appealing, packaging logo design training was conducted. The packaging logo serves as a marker or product identity that distinguishes it from other products, represents the product visually (Listya & Rukiah, 2018), and supports marketing (Agustina, Dwanoko, & Suprianto, 2021). The packaging logo used in the training featured a simple design incorporating a visual representation of lontar fruit and the Thematic KKN of Sipatokkong Mambo University. Through this training, it is hoped that the community will be able to develop their creativity in designing other packaging logos.

The logo design training was organized by the Thematic KKN students at each of their respective village service locations. The target participants were young community members representing each hamlet who were already accustomed to operating mobile devices, thus facilitating

the training process. The design platform used in this training was Canva.



Figure 9. Group photo after the packaging logo design training

1.3. Digital marketing training

In order to broaden consumer reach for the marketing of lontar fruit products, the Thematic KKN students invited the community in each service village to participate in online/digital marketing training. Digital marketing is considered capable of stimulating consumer demand interactively through the use of the internet (Khairunnisa, 2022). The target participants of this training ranged from housewives to young adults. The platforms used as digital marketing media were social media commonly used daily by the community, including WhatsApp, Facebook, Instagram, and TikTok.



Figure 10. Group photo after the digital marketing training

2. Additional Work Programs

2.1. Jaling Village

The additional work programs agreed upon in Jaling Village included GERGAJI (*Gerakan Wajib Mengaji*/Mandatory Recitation Movement), healthy living socialization, SAKU (*Sampah Karyaku*/My Waste Creation), and repainting of the village office hall. These programs provided reinforcement in the areas of religious values, health, and community participation.

GERGAJI is a program intended to increase the participation of the younger generation in Islamic activities. GERGAJI activities took the form of regular Qur'an recitation sessions every Thursday evening at the nearest mosque to the post. The target participants of this activity were the residents of Jaling Village, particularly the younger generation.

The healthy living socialization covered education on proper handwashing and toothbrushing techniques. The goal of this program was to instill clean living habits from an early age through educational and interactive activities. The target participants were children at TK Wahyu Lestari, Jaling Village.



Gambar 11. Handwashing education at TK Wahyu Lestari and the SAKU program at SD Inpres 3/77 Jaling

The SAKU program was initiated by the Thematic KKN students through education and hands-on practice in managing waste into useful creations. The purpose of this activity was to foster environmental awareness and creativity among students of SD Inpres 3/77 Jaling.

The hall of the Jaling Village office also received attention from the Thematic KKN students. As the center of community and village government activities, maintenance efforts were necessary, including wall repainting. This activity was expected to improve the comfort and aesthetic appeal of the public facility.

2.2. Cumpiga Village

The Thematic KKN students in Cumpiga Village had 3 additional work programs: free health check-up, Friday Clean-Up, and Healthy Sunday. These programs were designed to contribute to maintaining physical health and environmental cleanliness.

The free health check-up was conducted once during the Thematic KKN period. A total of 50 residents of Cumpiga Village enthusiastically participated in the health check-up, organized through collaboration between students and local health workers. The examinations conducted included measurements of body weight, height, blood pressure, blood sugar levels, uric acid, and nutritional consultation.



Figure 12. Free health check-up at the Cumpiga Village Office and Friday Clean-Up activity

The Friday Clean-Up activity was conducted every Friday, involving community members in cleaning the village environment, particularly public areas such as village roads, mosques, and other public spaces. This weekly activity not only increased awareness of environmental cleanliness but also served as an effort to strengthen the spirit of communal work (gotong royong) in Cumpiga Village.

To promote a healthy lifestyle, the Thematic KKN students also invited the community to

participate in exercise together on Sundays. In addition to improving physical fitness, this activity also served as an opportunity for residents who were busy working on weekdays to strengthen community bonds.



Figure 13. Exercise activity with the community on Sunday

2.3. Abbanuang Village

The additional work programs initiated by the Thematic KKN students in Abbanuang Village included the creation of educational boards and trash bins, counseling on the prevention of stunting and obesity, group exercise, and communal clean-up with residents. These activities represented the students' participation in raising awareness of cleanliness and healthy living.

The creation of educational boards and trash bins involved the residents of Abbanuang Village. This program was expected to increase community awareness of environmental cleanliness.



Figure 14. Trash bin construction together with residents

Stunting is a health issue targeted for resolution at the national level. Stunting is a condition of disrupted child growth and development, partly due to insufficient intake of macro and micronutrients (Huljannah & Rochmah, 2022; Siringoringo, Syauqy, Panunggal, Purwanti, & Widyastuti, 2020). To support the government's movement, the Thematic KKN students initiated a stunting and obesity counseling program. The target of this activity was students at MTs At-Taqwa. Through this activity, students were expected to understand efforts to meet balanced nutritional needs and avoid the potential for obesity. To support a healthy lifestyle, the Thematic KKN students also invited the students to exercise together.



Figure 15. Counseling on stunting and obesity prevention at MTs At-Taqwa and communal clean-up of Abbanuang Village environment

To maintain the cleanliness of the village environment, the Thematic KKN students joined the residents of Abbanuang Village in a communal clean-up of the village. The students' participation in this activity served as a medium for interaction and socialization with the community.

2.4. Carebbu Village

The additional work programs at the Carebbu Village post included group exercise and communal clean-up, handwashing education, and the creation of a letter circulation logbook at the Carebbu Village Office. These programs were intended as a form of students' contribution to improving village health and cleanliness, as well as the application of academic knowledge in the field of administration.

The group exercise and communal clean-up activities were conducted once a week every Friday. These activities were attended by community members and local posyandu cadres. Through these activities, the community could improve physical fitness, environmental cleanliness, and strengthen social bonds.



Figure 16. Communal clean-up in Carebbu Village and handwashing education at TK Sipakario Sipurennu

Handwashing education was a program aimed at introducing proper handwashing techniques. This activity was conducted three times at different locations: SDN 52 Carebbu, SD Inpres 5/81 Carebbu, and TK Sipakario Sipurennu. This activity was expected to serve as an educational effort on the importance of handwashing with soap to prevent disease.

The third program was the creation of a letter circulation logbook at the Carebbu Village Office. This program was intended as an application of academic knowledge in the field of administration as well as a learning medium for students regarding the world of office work. Furthermore, the

implementation of this activity was expected to improve the effectiveness and efficiency of village administrative management.



Figure 17. Results seminar of Thematic KKN work program implementation combined with a farewell gathering with village community

The series of main and additional work program implementations in each village was finally concluded with a village results seminar. This seminar was intended to present the outcomes of the work programs that had been committed to at the beginning. The seminar also served as a farewell gathering between the Thematic KKN students and the local community.



Figure 18. Lontar jam products from the training



Figure 19. Nata de lontar products from the training

The Thematic KKN of Sipatokkong Mambo University officially concluded with the withdrawal of students by the organizing committee at the Awangpone District Head's Office. At this event, students brought along the products that had been successfully made in each village. These products represented the realization of the theme carried by the 2025 Thematic KKN and served as evidence

that local food products can become products with enhanced taste, nutritional value, and economic value.

Conclusion and Recommendations

The 2025 Thematic KKN of Sipatokkong Mambo University was successfully implemented in Awangpone District, spread across Jaling Village, Cumpiga Village, Abbanuang Village, and Carebbu Village. The work programs implemented constituted community empowerment encompassing main work programs related to the management and diversification of lontar fruit, and additional work programs in the areas of health and social community affairs. The community enthusiastically participated in each work program carried out. The products produced were nata de lontar and lontar jam, which have the potential to become value-added lontar fruit products and lontar commodities with increased selling value.

References

- Agustina, R., Dwanoko, Y. S., & Suprianto, D. (2021). Pelatihan Desain Logo Dan Kemasan Produk UMKM di Wilayah Sekarpuro Kecamatan Pakis Kabupaten Malang. *Jurnal Aplikasi Dan Inovasi Ipteks "Soliditas"(J-Solid)*, 4(1), 69.
- Al Umar, A. U. A., Savitri, A. S. N., & Pradani, Y. S. (2021). Peranan kuliah kerja nyata sebagai wujud pengabdian kepada masyarakat di tengah pandemi COVID-19 (studi kasus IAIN Salatiga KKN). *Jurnal Pengabdian Kepada Masyarakat*, 1(01). Diambil Desember 8, 2025, dari https://www.academia.edu/download/69156754/377_Article_Text_995_3_10_20210215.pdf
- Amelia, R., & Safitri, R. (2020). Peningkatan Sumber Daya Manusia Melalui Program Kuliah Kerja Nyata-Pembelajaran dan Pemberdayaan (KKN-PPM) Desa Penagan Kabupaten Bangka. *Jurnal Pengabdian Kepada Masyarakat (MEDITEG)*, 5(1), 61–72.
- Apriliyanti, E. T., & Asri, M. T. (2020). Kualitas Nata De Siwalan dengan Penambahan Berbagai Konsentrasi Pengawet Ekstrak Kunyit (*Curcuma longa*). *LenteraBio: Berkala Ilmiah Biologi*, 9(1), 58–66.
- Arfah, A. (2019). *Pemanfaatan Buah Lontar (Boraccus Flabellifer L) Menjadi Permen Untuk Meningkatkan Nilai Jual* (PhD Thesis). UNIVERSITAS NEGERI MAKASSAR. Diambil Agustus 5, 2025, dari <https://eprints.unm.ac.id/15747/>
- BPS. (2025). *Kabupaten Bone Dalam Angka 2025*. Bone: BPS Kabupaten Bone. Diambil Agustus 5, 2025, dari <https://bonekab.bps.go.id/id/publication/2025/02/28/48d59750f9d5a0ea6c2c5dea/kabupaten-bone-dalam-angka-2025.html>
- Fajeriadi, H., Dharmono, D., & Anwar, M. R. (2019). Kerapatan lontar (*Borassus flabellifer L.*) di Hutan Pantai Desa Tabanio, Kalimantan Selatan. *EnviroScienteeae*, 15(2), 190–194.
- Hanafie, S. (2018). R., Soetriono, & Myh, SR (2018). Sentra produksi dan diversifikasi pangan olahan berbasis pangan lokal di Jawa Timur. *Conference on Innovation and Application of Science and Technology (CIASTECH)* (hlm. 343–351).
- Hariana, H., Mardin, H., & Lasalewo, T. (2021). Peranan mahasiswa KKN dalam melaksanakan kegiatan tambahan di lokasi pengabdian desa Botuwombato. *Jurnal Abdimas Terapan*, 1(1), 10–16.
- Huljannah, N., & Rochmah, T. N. (2022). Program pencegahan stunting di indonesia: A systematic review. *Media Gizi Indonesia*, 17(3), 281–292. FKM UNAIR.
- Khairunnisa, C. M. (2022). Pemasaran Digital sebagai Strategi Pemasaran: Conceptual Paper. *JAMIN: Jurnal Aplikasi Manajemen Dan Inovasi Bisnis*, 5(1), 98–102.
- Lestari, S., & Bambang, A. N. (2017). Penerapan minapadi dalam rangka mendukung ketahanan pangan dan meningkatkan kesejahteraan masyarakat. *Proceeding Biology Education Conference:*

- Biology, Science, Environmental, and Learning* (Vol. 14, hlm. 70–74). Diambil November 24, 2025, dari <https://jurnal.uns.ac.id/prosbi/article/view/17616>
- Listya, A., & Rukiah, Y. (2018). VISUAL BRANDING PRODUK BELIMBING OLAHAN UMKM DEPOK MELALUI DESAIN LOGO. *Demandia: Jurnal Desain Komunikasi Visual, Manajemen Desain, dan Periklanan*, 3(02), 199–218.
- Mulwa, C., & Visser, M. (2019). Farm diversification and climate change: Implications for food security in northern Namibia. Diambil November 24, 2025, dari <https://ageconsearch.umn.edu/record/295846/files/321.%20Farm%20diversification%20in%20Namibia.pdf>
- Rahman, S. S., Salauddin, H. M., Rahman, M., Muhsin, M. M., & Rouf, S. M. (2021). Nutritional composition and antidiabetic effect of germinated endosperm (*Borassus flabellifer*), tuber (*Amorphophallus paeoniifolius*) and their combined impact on rats. *Biochemistry and Biophysics Reports*, 25, 100917.
- Setyaningsih, M., Gunawan, A. R., Srimurni, R. R., Nugraha, F., Munawaroh, S., & Kurniati, N. J. (2023). Peran Mahasiswa dalam Melaksanakan Kuliah Kerja Nyata (KKN) di Desa Ciptasari. *JURPIKAT (Jurnal Pengabdian Kepada Masyarakat)*, 4(3), 699–711.
- Siringoringo, E. T., Syauqy, A., Panunggal, B., Purwanti, R., & Widyastuti, N. (2020). Karakteristik Keluarga Dan Tingkat Kecukupan Asupan Zat Gizi Sebagai Faktor Risiko Kejadian Stunting Pada Baduta. *Journal of Nutrition College*, 9(1), 54–62. Department of Nutrition Science, Faculty of Medicine, Universitas Diponegoro.
- Srnita, S. (2018). Factors affecting the food security and community welfare of farmer households in Sumatera, Indonesia. *World Journal of Science, Technology and Sustainable Development*, 15(2), 200–212. Emerald Publishing Limited.
- Swissa, M., Aloni, Y., Weinhouse, H., & Benizman, M. (1980). Intermediary steps in *Acetobacter xylinum* cellulose synthesis: Studies with whole cells and cell-free preparations of the wild type and a celluloseless mutant. *Journal of Bacteriology*, 143(3), 1142–1150.
- Widiyanti, N., Mulyadiharja, S., Sukarta, I. N., & Pradnyandari, N. W. I. (2018). The effect of addition sucrose concentrations toward weight of Nata DE Lontar (*Borassus flabellifer*) Linn. *Journal of Physics: Conference Series* (Vol. 1040, hlm. 012006). IOP Publishing. Diambil November 24, 2025, dari <https://iopscience.iop.org/article/10.1088/1742-6596/1040/1/012006/meta>

