

Development of Coffee Waste Utilization in Indonesia (A Review)

Herlin Herliansah¹, Mochamad Rudyansyah Ismail²

¹ Program Study of Agrotechnology, Universitas Halim Sanusi, Indonesia

² Marine Affair Department, Universitas Padjadjaran, Indonesia

ABSTRACT

Indonesia is the third largest coffee producer. Coffee production results in potential waste that is not utilised. This article aims to describe the development of using coffee waste from coffee skin, coffee grounds and unsold coffee. The method used in writing this article is by searching for 50 scientific articles, then analysing descriptively quantitatively regarding the utilization of coffee waste in Indonesia. The scientific articles were collected from 2017 to 2024. The collection of scientific articles produced a picture that Indonesia has experienced an increase in research in processing coffee waste starting in 2022. This is in line with the empowerment of the community in providing knowledge for processing coffee waste. In general, the utilization of coffee waste can be in the form of: food ingredients, renewable energy, fertilizers or pesticides (agriculture), cosmetic or soap ingredients, animal feed, biotechnology and other non-food ingredient.

Keyword : coffee skin waste, coffee ground, Development, Indonesian, Product, Waste

1. INTRODUCTION

Indonesia is one of the world's top ten coffee-producing countries and produced around 711.3 tons per year from 2015 to 2020 [1]. In terms of quality, Indonesia is ranked third in the world with export destinations to developed countries, such as the USA, Japan, Germany, and other countries [2]. Almost all areas in Indonesia can be planted with different types of coffee and produce different qualities. This is what makes Indonesia one of the best coffee havens in the world.

The potential for waste produced from coffee production is a threat. Because the part of the coffee plant that is utilized is coffee beans, while other parts of the coffee plant are not utilized or will become waste. The coffee-making process usually produces 65% ready-to-roast coffee beans and 35% coffee skin waste [3]. In addition, the quality of coffee beans that are not suitable for sale becomes additional waste in the production process. After becoming coffee and finishing brewing, coffee grounds become waste afterward. So coffee waste can be in the form of coffee skin waste, low-quality coffee, and coffee grounds.

Coffee waste is very dangerous to the environment and must be processed so that it does not endanger health. This is because coffee waste contains toxic chemicals such as alkaloids, tannins, and polyphenolics, making the decomposition process of organic material biologically difficult. Research activities and their application in the community have been carried out to utilize optimal coffee waste. Researchers in Indonesia are still developing the utilization of this coffee waste. The techniques used in processing coffee waste by the community are still carried out with a simple process. Therefore, this article aims to provide knowledge and information related to the utilization that has been carried out in Indonesia to increase the added value of coffee waste so that it can be a solution for the utilization of coffee waste.

2. METHOD

This article was written using 50 national journals and proceedings consisting of research articles and community service. The selection of articles was done randomly on the search engine www.scholar.google.com with a journal publication period of 2016-2024. Then sorted based on the type of coffee waste, namely coffee skin, dregs and unmarketed coffee. The method used in writing this journal is quantitative descriptive, comparing one article with another.

3. RESULT AND DISCUSSION

3.1 Development of Coffee Waste Utilization

From 2016 to 2024, research has been conducted with the output of 24 scientific articles and 26 community service articles. This illustrates that the development of coffee waste processing in Indonesia is accompanied by implementation in the community for appropriate solutions. There has been an increase in research and implementation of coffee waste processing starting from community service in 2022. This can be seen from the number of articles in that year which reached 10 articles.

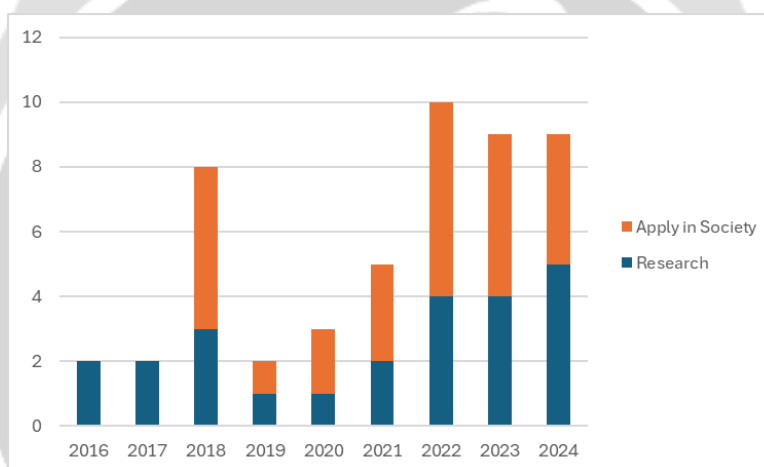


Chart – 1 : Bar Chart of Number of Coffee Waste Processing Articles from 2016-2024

The most processed or utilized source of coffee waste is from coffee skin or pulp. When compared to the article source, around 73.08% of coffee waste utilization comes from coffee skin, 25% from coffee grounds, and the remaining 1.92% from unsold coffee. The proportion of coffee skin ranges from 40-45% of coffee processing, or one kilogram of coffee beans produces one kilogram of coffee skin waste [4], [5].

3.2. Coffee Waste Utilization Products

Coffee waste utilization is often done by producing several products with high added value or used for coffee plantations. The final product of coffee waste utilization is in the form of food ingredients, renewable energy, fertilizers or pesticides (agriculture), cosmetic or soap ingredients, animal feed, biotechnology, and other non-food ingredients. This scientific article investigation proves that the utilization of coffee waste is only limited to the household scale. In addition, the final product of this waste utilization is mostly used as fertilizer, compost or pesticide.

Table – 1 : Utilization of Coffee Waste in Several Regions

No	Waste Utilization	Product	Sources

1	Food	Cascara tea, Probiotics drink, bread flour	[6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17]
2	Renewable Energy	Briket, Bioethanol, Biopellet	[11], [18], [19], [20], [21], [22], [23]
3	Fertilizer / Compost / Pesticide	Fertilizer (Liquid / solid), Pesticide	[8], [11], [12], [14], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41]
4	Soap	Soap	[42], [43], [44]
5	Animal feed	Animal feed	[8], [14], [45], [46]
6	Biotechnology	Ekoenzim	[8], [47], [48]
7	Non-Food (etc)	Incense, Candles, Paper and cloth dyes, doll	[3], [5], [13], [33], [49], [50], [51], [52]

The product of making compost or fertilizer from basic materials from coffee skin waste is easier to do. The use of simple technology is one of the reasons for this processing. The use of facilities and technology that are not simple for processing coffee waste is done to make biotechnology products.

3.2.1. Food

The product produced from coffee skin waste is cascara tea. This product is most widely socialized in communities around coffee plantations because the raw materials are abundant and have not been utilized properly. Cascara tea is popular in Yemen and Ethiopia and is sold in bulk [15]. According to research conducted by Carpenter, cascara tea has a sweet taste and smell similar to herbal drinks with smells like roses, tamarind, or cherries [53].



Fig – 2 : Cascara Tea (Source : Carpenter 2015)

In addition to cascara tea, coffee skin waste is processed into sweet drinks with the addition of orange or lemon and also probiotic drinks. The active ingredients contained in coffee skin are tannin 1.8-8.56%, pectin 6.5%, caffeine 1.3%, chlorogenic acid 2.6%, caffeic acid 1.6%, in addition it contains Cyanidin 3-glycoside, delphinidin 3-glycoside, total anthocyanin 43% (cyanidin, pelargonidin 3-glycoside and delphinidin [16]. Processing probiotic drinks by mixing coffee skin with selected fruit juice plus ice. This probiotic drink is an alternative to the currently popular drink, namely kombucha. Where Kombucha is a fermented tea drink containing sugar and a consortium of microorganisms from the acetic acid bacteria group, namely *Komagataebacter xylinus* (*Acetobacter xylinum*) and *Saccharomyces sp* yeast [54]

3.2.2. Renewable Energy

The use of coffee skin and coffee grounds can be used as basic materials for making biopellets or briquettes. With low water content, low sulfur content, and high heat content, coffee skin is an ideal biomass for renewable energy use. The pyrolysis method can be used by utilizing coffee fruit skin waste into biomass products in the form of biogas and bio-briquettes[23]. Meanwhile, biopellets are produced using the biomass compression process method. The results of research conducted by Meriatna in making biopellets, the greater the percentage of adhesive mixed with coffee grounds powder, the higher the percentage of water content, and vice versa [21].



Fig – 3 : Briquettes and Biopellets from Coffee Husk

Bioethanol is one of the bioenergy used as a substitute for gasoline and is environmentally friendly. Making bioethanol from coffee skin waste involves several stages: hydrolysis, fermentation, filtration, distillation, and drying. The coffee skin is dried in direct sunlight for two days and ground using a blender before the hydrolysis stage. Research conducted by Retanubun, showed that Arabica coffee skin produces ethanol with a content of 65% in the third distillation with an initial volume of 2,000 ml of Arabica coffee skin waste [20].

The application of coffee waste utilization as renewable energy in the community is still limited, especially for the manufacture of biopellets or briquettes. It is necessary to provide understanding and assistance to the community so that the community can produce independently as done by the community service team from the university [19].

3.2.3. Fertilizer, Compost or Pesticide

Coffee skin waste and coffee grounds are considered useless waste and are usually thrown away in the global coffee industry. However, in sustainable agriculture, this waste can be turned into a very valuable resource. Making compost from coffee skin produces organic C which is used by plants in growth. The organic C content in coffee skin waste was obtained at 45.22% [41]. In addition to making compost, processed products from coffee waste are in the form of liquid organic fertilizer (POC) which comes from the fermentation of coffee skin and coffee grounds. In the study by Frasty, fermented coffee skin liquid organic fertilizer had a significant positive effect on the growth and vegetative development of robusta coffee seedlings [28].

The stages of making compost from coffee waste are as follows:

- Fermentation of coffee fruit skin using EM4 solution. This EM4 solution contains fermentation microorganisms. The number of fermentation microorganisms in EM4 is very large, with around 80 genera.
- Of the many microorganisms, there are five main groups that are the main components, namely photosynthetic bacteria, lactobacillus sp, streptomyces sp, and yeast.
- After the process takes place, the temperature in the tarpaulin rises to approximately 50 Celsius, but after that the temperature will drop again.
- Every 2 weeks the material is turned over and if it turns out to be too dry, watering is carried out.

The use of chemical pesticides has negative impacts on human health and the environment. Therefore, finding safer and more environmentally friendly alternatives, such as botanical pesticides, is very important. One source of raw materials that can be used to make botanical pesticides is coffee skin waste produced from the coffee bean processing process. Research shows that this waste contains active compounds that can be used to combat plant pests and diseases [32].

3.2.4. Soap

The use of coffee grounds to make a traditional bar or liquid soap can be done because of its caffeine, organic acid, mineral, and antioxidant content which is good for smoothing, moisturizing, and protecting the skin from free

radicals. Coffee grounds contain carbon, nitrogen, lipophilic compounds, ethanol, alkaloids, polyphenol compounds, tannins, polysaccharides, and chlorogenic acid [42]. Making soap from coffee waste has been carried out in several places, either still in the form of counseling or has entered the household production level.



Figure 4. Commercial Soap Made from Coffee Waste (Source : Liputan 6, 2019)

3.2.5. Animal Feed

Coffee skin waste still contains nutrients needed by livestock, such as 8.6–9.5% crude protein, 18.17% crude fiber, and 1.97% fat. It also contains calcium and phosphorus needed by livestock [8], [46]. This coffee skin waste is an additional ingredient in making animal feed. Several research results show that the addition of coffee skin waste helps increase the weight of broiler chickens . Meanwhile, for the fisheries sector, the addition of coffee waste can cause losses to no impact[45].

3.2.6. Biotechnology

Coffee skin contains macronutrients of carbohydrates, proteins, lipids, and fibers which can be a medium for microbial growth or in other words, coffee skin can become an ecoenzyme. Microbes produce various compounds, enzymes, and secondary metabolites during the fermentation process. Ecoenzyme applications can be used in many ways, such as fertilizers, pesticides, disinfectants, soaps, and shampoos. The results of the study by Kamila, the ecoenzyme from coffee skin has the characteristics of dark brown color and sour aroma, tannin content reaches 10.05% and saponin [48]. The highest total phenol compound occurred in the 2nd month, which was 169.89 ± 6.58 ppm and decreased in the following month. Antibacterial activity in coffee skin eco-enzymes showed a decrease with increasing fermentation time. The largest inhibition zone was formed in the 2nd month, which was 14.43 ± 2.71 mm against *E. coli* and 15.33 ± 0.58 mm against *S. aureus*. This value is included in the category of strong inhibitory effects.

3.2.7. Other Non-Food

Other uses of coffee waste in the form of dregs, skin, and unsold coffee are as basic materials for making natural dyes for paper and cloth (batik), incense, dolls, and building composite materials or other crafts. Concrete composite materials are used because they are expected to change the initial binding of concrete. The high CaO content in coffee skin will cause the calcium hydroxide compound ($\text{Ca}(\text{OH})_2$) to increase and be released by cement when the cement reacts with water. As a result, $\text{Ca}(\text{OH})_2$ will not form calcium silicate hydrate (CHS), a solid compound that is not easily soluble in water, which will fill the pores of the concrete and cause traction.



Fig – 4 : Coffee Waste Becomes Incense

(Source: Sumadewi & Puspaningrum, 2020).

4. CONCLUSIONS

Coffee waste from coffee skin, coffee grounds and unsold coffee can be made into products that have higher selling value, such as drinks, biotechnology products or other non-food products. However, the most widely used by the community is limited to making fertilizer or compost. In general, the use of coffee waste can be in the form of: food ingredients, renewable energy, fertilizers or pesticides (agriculture), cosmetic or soap ingredients, animal feed, biotechnology and other non-food ingredients.

5. REFERENCES

- [1] M. Ibnu and N. Rosanti, "TREN PRODUKSI DAN PERDAGANGAN NEGARA-NEGARA PRODUSEN KOPI TERBESAR DI DUNIA DAN IMPLIKASINYA BAGI INDONESIA," *Buletin Ilmiah Litbang Perdagangan*, vol. 16, no. 2, Dec. 2022, doi: 10.55981/bilp.2022.5.
- [2] R. H. Raharjo and Z. A. Alianto, "Potensial Ekspor Komoditas Kopi Dari Indonesia Ke Malaysia dan Singapura," *Jurnal Pengabdian Kepada Masyarakat Nusantara*, vol. 3, no. 3, pp. 2959–2965, Sep. 2023, doi: <https://doi.org/10.55338/jpkmn.v4i2.1680>.
- [3] N. Sumadewi and D. Puspaningrum, "PKM PEMANFAATAN LIMBAH KOPI DI DESA CATUR KABUPATEN BANGLI," *Jurnal Pendidikan dan Pengabdian Masyarakat*, vol. 3, no. 2, pp. 130–132, May 2020.
- [4] D. Indra Wardhana *et al.*, "KARAKTERISTIK KULIT KOPI ROBUSTA HASIL SAMPING PENGOLAHAN METODE KERING DARI PERKEBUNAN KOPI RAKYAT DI JAWA TIMUR Characteristics of Robusta Coffee Husk Obtained from Dry Processing Method of Smallholder Coffee Plantation in East Java," vol. 17, no. 2, pp. 220–229, 2019, [Online]. Available: <http://jurnal.unmuhjember.ac.id/index.php/AGRITROPEISSN>
- [5] V. Kharishma, H. Agustin, and L. Baskoro, "Limbah Kulit Kopi Sebagai Pewarna Alam Pada Media Kertas Daur Ulang, Pemanfaatan," *Jurnal Seni dan Desain*, vol. 1, no. 2, pp. 71–82, Dec. 2022.
- [6] S. Andi Nugroho, R. Nirmala Kusumaningtyas, and Suhajono, "PEMANFAATAN LIMBAH KULIT KOPI SEBAGAI TEPUNG ROTI UNTUK PEMBERDAYAAN IBU RUMAH TANGGA DI DESA KEMUNING LOR KABUPATEN JEMBER," *Prosiding Seminar Nasional Terapan Riset Inovatif (SENTRINOV) Ke-7*, no. 3, 2021.
- [7] N. Arpi, R. Rasdiansyah, H. P. Widayat, and R. F. Foenna, "Pemanfaatan Limbah Kulit Buah Kopi Arabika (*Coffea arabica* L.) Menjadi Minuman Sari Pulp Kopi dengan Penambahan Sari Jeruk Nipis (*Citrus aurantifolia*) dan Lemon (*Citrus limon*)," *Jurnal Teknologi dan Industri Pertanian Indonesia*, vol. 10, no. 2, pp. 33–39, Oct. 2018, doi: 10.17969/jtipi.v10i2.12593.
- [8] R. R. Aulia, N. K. P. C. Dewi, and K. A. Y. Indrawan, "PENGOLAHAN LIMBAH KULIT KOPI ARABIKA KINTAMANI SEBAGAI ALTERNATIF MENUNJANG SUSTAINABLE DEVELOPMENT GOALS," in *Prosiding Webinar Nasional Pekan Ilmiah Pelajar (PILAR)*, Denpasar: Unit Kegiatan Mahasiswa Kelompok Ilmiah Mahasiswa Universitas Mahasaraswati, Jan. 2022.
- [9] P. Garis, A. Romalasari, and R. Purwasih, "Pemanfaatan Limbah Kulit Kopi Cascara Menjadi Teh Celup," in *Prosiding Industrial Research Workshop and National Seminar*, Bandung: Politeknik Negeri Bandung, 2019.
- [10] E. Kurnia Novita Sari, A. Mardiana Handayani, D. Kusuma Wardani, B. Hariono, A. Brilliantina, and R. Wijaya, "PEMANFAATAN LIMBAH KULIT KOPI MENJADI PRODUK CASCARA BERNILAI EKONOMIS TINGGI DI DESA KEMUNING LOR," *Seminar Nasional Terapan Riset Inovatif (SENTRINOV) Ke-7 ISAS Publishing Series: Community Service*, vol. 7, no. 3, 2021.
- [11] A. P. Renovan, B. P. Prawiranegara, Y. L. A. Situmorang, and W. K. Sugandi, "Analisis Rantai Pasok Berkelanjutan Pada Produk Limbah Kopi dengan Pendekatan Sirkular Ekonomi di Perusahaan Lestari Kopi, Kabupaten Garut," in *Seminar Nasional Sains dan Teknologi 2024*, Jakarta: Fakultas Teknik Universitas Muhammadiyah Jakarta, Apr. 2024.
- [12] H. Sastra and S. Bawono, "PEMANFAATAN LIMBAH KULIT BIJI KOPI SEBAGAI BAHAN KOMPOS DAN CASCARA," *JURNAL ABDIMAS HASIL PENGABDIAN DI LAPANGAN*, vol. 1, no. 1, pp. 55–61, Dec. 2018.
- [13] S. Setiyono, A. P. Arum, S. B. P. SM, D. A. Savitri, F. F. Andean, and Z. S. Putri, "PELATIHAN PENGOLAHAN LIMBAH KOPI SEBAGAI TEH CASCARA DAN PRODUK KERAJINAN," *JMM (Jurnal Masyarakat Mandiri)*, vol. 7, no. 1, p. 607, Feb. 2023, doi: 10.31764/jmm.v7i1.12403.

- [14] B. Supeno, N. Md, and L. Ernawati, "DIVERSIFIKASI PEMANFAATAN LIMBAH KULIT BUAH KOPI UNTUK PRODUK YANG BERNILAI EKONOMIS TINGGI DI KABUPATEN LOMBOK UTARA," *Prosiding PKM-CSR*, vol. 1, 2018.
- [15] A. Susanti, A. Liliyan, and M. S. Irdianty, "Pemanfaatan Limbah Kulit Kopi (Cascara) Menjadi Minuman Teh Kemasan UMKM Kopipa.id di Surakarta," *KANGMAS: Karya Ilmiah Pengabdian Masyarakat*, vol. 2, no. 3, pp. 239–246, Nov. 2021, doi: 10.37010/kangmas.v2i3.433.
- [16] M. Thamrin, D. Ardilla, and B. R. Ketaren, "INOVASI MINUMAN PROBIOTIK BERBASIS LIMBAH KULIT KOPI," *JMM (Jurnal Masyarakat Mandiri)*, vol. 6, no. 6, p. 4439, Dec. 2022, doi: 10.31764/jmm.v6i6.10733.
- [17] S. Wulandari, R. Fernandez, and E. Hasri Windari, "Pemanfaatan Limbah Kulit Kopi sebagai Cascara untuk Pemberdayaan Kelompok Tani di Desa IV Suku Menanti," *Jurnal Pengabdian Pada Masyarakat*, vol. 9, no. 3, pp. 763–770, 2024, doi: 10.30653/jppm.v9i3.895.
- [18] R. P. Dewi, T. J. Saputra, and S. Widodo, "STUDI POTENSI LIMBAH KULIT KOPI SEBAGAI SUMBER ENERGI TERBARUKAN DI WILAYAH JAWA TENGAH," *Journal of Mechanical Engineering*, vol. 5, no. 1, Mar. 2021.
- [19] A. Hadiyane, A. Rumidatul, and Y. Hidayat, "Aplikasi Teknologi Biopellet Limbah Kopi sebagai Bahan Bakar Alternatif dalam Rangka Pengembangan Desa Mandiri Energi di Desa Jatiroke Kawasan Sekitar Hutan Pendidikan Gunung Geulis ITB," *Jurnal Panrita Abdi*, vol. 5, no. 3, May 2021, Accessed: Jan. 18, 2025. [Online]. Available: <http://journal.unhas.ac.id/index.php/panritaabdi>
- [20] G. Retanubun, N. Ana Mufarida, and J. Teknik Mesin, "PEMANFAATAN LIMBAH KULIT KOPI ARABIKA (ARABICA COFFEE) DIJADIKAN BIOETANOL Utilization of Arabica Coffee Skin Waste to Bioetanol," *J-Proteksion*, vol. 2, no. 1, pp. 15–20, 2017.
- [21] M. Meriatna, S. Bahri, and I. Ibrahim, "PEMANFAATAN LIMBAH AMPAS KOPI MENJADI BIOMASSA PELET (BIOPELET) SEBAGAI SUMBER ENERGI TERBARUKAN," *Chemical Engineering Journal Storage*, vol. 2, no. 3, pp. 85–94, Aug. 2022.
- [22] N. S. Noprianti, Hamdi, and N. Y. Sudiar, "Analisis Pemanfaatan Biobriket Dari Limbah Kulit Kopi Sebagai Basis Pengembangan Energi Terbarukan," *JOURNAL OF APPLIED MECHANICAL ENGINEERING AND RENEWABLE ENERGY (JAMERE)*, vol. 4, no. 2, pp. 1–9, Aug. 2024, [Online]. Available: <https://journal.isas.or.id/index.php/JAMERE>
- [23] A. Prastika and S. Sultan Ali Muzakhar, "Analisis Pemanfaatan Limbah Biomassa sebagai Basis Pengembangan Energi Terbarukan di Kabupaten Jember," *Jurnal Kajian Ilmiah dan Teknologi Teknik Mesin*, vol. 8, no. 1, pp. 19–29, Aug. 2023, doi: 10.32528/jp.v8i1.472.
- [24] D. H. Adi, C. Winarti, and Warsiyah, "KUALITAS PUPUK ORGANIK LIMBAH AMPAS KELAPA DAN KOPI TERHADAP PERTUMBUHAN TANAMAN," *JURNAL REKAYASA LINGKUNGAN*, vol. 18, no. 2, Oct. 2018.
- [25] A. Amran, "PENINGKATAN KETERAMPILAN MASYARAKAT PETANI KOPI DESA KURRAK DALAM BIKONVERSI LIMBAH KULIT BUAH KOPI MENJADI KOMPOS," *Jurnal Abdimas Ilmiah Citra Bakti*, vol. 4, no. 2, pp. 360–368, May 2023, doi: 10.38048/jailcb.v4i2.1452.
- [26] H. Arwaa Marden, A. Julia Nanda, S. Maulida Herika, S. Mulyani, U. Idayana, and J. Irawan, "Pemanfaatan Limbah Kulit Kopi Sebagai Pupuk Organik Cair di Desa Arul Item, Kabupaten Aceh Tengah (Utilization of Coffee Skin Waste as Liquid Organic Fertilizer in Arul Item Village, Central Aceh Regency)," *Jurnal Pengabdian Masyarakat*, vol. 3, pp. 20–31, 2024, doi: 10.58545/djpm.v2i3.251.
- [27] I. Falahuddin, A. Restu, P. Raharjeng, and L. Harmeni, "PENGARUH PUPUK ORGANIK LIMBAH KULIT KOPI (*Coffea Arabica* L.) TERHADAP PERTUMBUHAN BIBIT KOPI," *Jurnal Bioilmi*, vol. 2, no. 2, p. 108, 2016.
- [28] D. Frastyo, F. Y. Ali, E. Rosdiana, and D. G. Pratita, "AGROPROSS National Conference Proceedings of Agriculture," in *AGROPROSS: National Conference Proceedings of Agriculture*, Jember: Seminar dan Bimbingan Teknis Pertanian Politeknik Negeri Jember 2024, Jun. 2024, pp. 655–660.
- [29] S. Ginting, D. Handayani, and M. Sutrawati, "Pengolahan Limbah Kulit Kopi sebagai Pupuk Organik Tanaman Kopi di Desa Tapak Gedung Kabupaten kepahiang," *ANDROMEDA: Jurnal Pengabdian Masyarakat Rafflesia*, vol. 2, no. 2, pp. 9–15, 2022.
- [30] F. R. Lia, "Edukasi Pemanfaatan Ampas Kopi di Desa Jamusan Kecamatan Jumo Kabupaten Temanggung," *Jurnal Bina Desa*, vol. 5, no. 2, Jun. 2023, Accessed: Jan. 18, 2025. [Online]. Available: <https://journal.unnes.ac.id/nju/index.php/jurnalbinadesa>

- [31] D. Maulida, L. Erfa, and Yusanto, *Pemanfaatan Limbah Kulit Kopi Melalui Pelatihan Pembuatan Kompos, Teknologi*. Lampung: Politeknik Negeri Lampung, dan, 2018. [Online]. Available: <http://jurnal.polinela.ac.id/index.php/SEMTEKS>
- [32] I. Muthahanas, D. Putra Buana Sakti, K. Yuniarto, and Y. AP, "Pemanfaatan Limbah Kulit Kopi sebagai Pestisida Nabati di Desa Sajang," *Jurnal Pengabdian Magister Pendidikan IPA*, no. 3, Sep. 2024, doi: 10.29303/jpmpti.v7i3.9965.
- [33] M. Nasution, N. Siti, S. Siregar, and M. Irwansyah, "PENINGKATAN PENDAPATAN PETANI KOPI DARI PEMANFAATAN LIMBAH KULIT KOPI SEBAGAI BAHAN KOMPOS DAN SEBAGAI AGREGAT CAMPURAN BETON RINGAN," *Jurnal Masyarakat Mandiri*, vol. 8, no. 3, Jun. 2024, doi: 10.31764/jmm.v8i3.22364.
- [34] E. Novita, A. Fathurrohman, and H. Andiananta Pradana, "PEMANFAATAN KOMPOS BLOK LIMBAH KULIT KOPI SEBAGAI MEDIA TANAM (the Utilization of Coffee Pulp and Coffee Husk Compost Block as Growing Media)," *Agrotek*, vol. 2, no. 2, Sep. 2018.
- [35] D. M. Rahmah, E. Mardawati, R. Kastaman, T. Pujiyanto, and R. Pramulya, "Coffee Pulp Biomass Utilization on Coffee Production and Its Impact on Energy Saving, CO2 Emission Reduction, and Economic Value Added to Promote Green Lean Practice in Agriculture Production," *Agronomy*, vol. 13, no. 3, Mar. 2023, doi: 10.3390/agronomy13030904.
- [36] T. Ramadhani *et al.*, "Analisis Pemanfaatan Limbah Bubuk Kopi Menjadi Pupuk Organik di Coffee Shop," *Jurnal Pendidikan Tambusai*, vol. 2, no. 3, pp. 32361–32365, 2023.
- [37] R. Riga *et al.*, "Pembuatan Pupuk Kompos Dari Limbah Kulit Kopi Di Daerah Penghasil Kopi Nagari Koto Tuo, Sumatera Barat," *Jurnal Pengabdian Pada Masyarakat*, vol. 7, no. 3, pp. 584–591, Aug. 2022, doi: 10.30653/002.202273.145.
- [38] S. J. Santosa and T. Yuwono, "PEMANFAATAN LIMBAH AMPAS KOPI UNTUK TANAMAN HIAS DALAM POT DI DESA SUMBER KECAMATAN BANJARSARI KOTAMADYA SURAKARTA," *ADIWIDYA*, no. 2, Nov. 2018, [Online]. Available: <http://tipspetani.blogspot.co.id/20>
- [39] Solikhin, B. Irawanto, Sunarsih, and Suryoto, "PENDAMPINGAN INVENTORY PRODUKSI KOPI DAN PEMANFAATAN LIMBAH KOPI SEBAGAI PENDUKUNG PROGRAM REDUCE FOR ENVIRONMENT," *JURNAL PASOPATI*, vol. 4, no. 2, pp. 92–96, 2022, [Online]. Available: <http://ejournal2.undip.ac.id/index.php/pasopati>
- [40] I. A. Teatrawan, K. Madyaningrana, C. A. Ariestanti, and G. Prihatmo, "Pemanfaatan Limbah Ampas Coffea Canephora sebagai Pupuk Pendukung Pertumbuhan Altenanthera Sissoo," *Bioma: Jurnal Biologi dan Pembelajaran Biologi*, vol. 7, no. 1, pp. 90–104, Mar. 2022, doi: 10.32528/bioma.v7i1.5822.
- [41] D. Wahyuni, I. Darliana, R. Srimulyaningsih, A. Purwanto, and I. Tan, "Pemanfaatan Limbah Kulit Kopi sebagai Pupuk Kompos di kelompok Tani LMDH Campaka Bentang Desa Loa Majalaya," *Abdi Wiralodra: Jurnal Pengabdian Kepada Masyarakat*, vol. 5, no. 2, pp. 255–269, Sep. 2023, doi: 10.31943/abdi.v5i2.124.
- [42] D. Anjarwati, U. Mu'azaroh, R. A. Salsabila, and A. Bakhrudin, "Pemanfaatan Limbah Ampas Kopi Dalam Pembuatan Sabun Batang Bagi PKK Desa Perdopo," *Jurnal Muria Pengabdian Masyarakat*, vol. 1, no. 2, pp. 217–224, Jul. 2024.
- [43] A. Purwaningtyas, Yusita Aprilia Devi, and S. W. Utami, "PEMANFAATAN LIMBAH AMPAS KOPI DALAM PEMBUATAN SABUN BATANG DI KAMPUNG WISATA KOPI LEREK GOMBENG SARI BANYUWANGI," *Dinamisia: Jurnal Pengabdian Kepada Masyarakat*, vol. 6, no. 4, Aug. 2022, doi: 10.31849/dinamisia.v6i4.10615.
- [44] L. Roza, W. Dian Laksanawati, and M. Hamka, "PEMANFAATAN LIMBAH SISA MINYAK GORENG DAN SERBUK KOPI MENJADI SABUN WANGI UNTUK KEPERLUAN RUMAH TANGGA DAN ALTERNATIF INDUSTRI SKALA RUMAH TANGGA SEBAGAI KONSEP MANDIRI EKONOMI BAGI ANGGOTA KOPERASI WANITA FLAMBOYAN CIRACAS JAKARTA TIMUR," *SEMBHADA 2018*, vol. 1, 2018.
- [45] W. A. Diamahesa and N. Muahiddah, "Potensi Pemanfaatan Limbah Kulit Ari Kopi (Coffee Husk) dalam perikanan (Review)," *Journal of Fish Nutrition*, vol. 3, no. 1, pp. 8–18, Jun. 2023, doi: 10.29303/jfn.v3i1.2760.
- [46] M. Khalil, "PENGARUH PEMBERIAN LIMBAH KULIT KOPI (Coffea sp.) AMONIASI SEBAGAI PAKAN ALTERNATIF TERHADAP PERTAMBAHAN BOBOT AYAM BROILER," *Jurnal Ilmiah Mahasiswa Pendidikan Biologi*, vol. 1, no. 1, pp. 119–130, Aug. 2016.
- [47] A. Ita Juwita, A. Mustafa, and R. Tamrin, "STUDI PEMANFAATAN KULIT KOPI ARABIKA (Coffee arabica L.) SEBAGAI MIKRO ORGANISME LOKAL (MOL)," *AGROINTEK*, vol. 11, pp. 1–8, Mar. 2017.

- [48] Z. A. Kamila, H. Mulyadi, N. Yoshi Haryono, and Sumarti, "Optimasi Pembuatan Ekoenzim dari Limbah Kulit Kopi dan Pepaya," *Live and Applied Science*, vol. 1, pp. 129–137, Aug. 2022.
- [49] C. Febrianti, M. Ulfah, and K. Kusumastuti, "Pemanfaatan Ampas Kopi sebagai Bahan Karbon Aktif untuk Pengolahan Air Limbah Industri Batik," *agriTECH*, vol. 43, no. 1, p. 1, Feb. 2023, doi: 10.22146/agritech.68014.
- [50] I. S. Melati, U. Jamilah, N. Mutiara, R. Ni'am, D. Indriyani, and F. T. R., "Pemanfaatan Limbah Kulit Kopi sebagai Bahan Pewarna Tekstil Alami untuk Pembuatan Batik Shibori di Desa Sidoharjo, Kecamatan Candiroto, Kabupaten Temanggung," in *Seminar Nasional Kolaborasi Pengabdian Kepada Masyarakat UNDIP-UNNES 2019*, Universitas Diponegoro dan Universitas Negeri Semarang, 2019, pp. 88–91.
- [51] Purwanto and G. Diasmara, "PEMANFAATAN LIMBAH AMPAS KOPI MENJADI BAHAN KOMPOSIT SEBAGAI BAHAN DASAR ALTERNATIF PEMBUATAN PRODUK DOMPET," *Jurnal Strategi Desain dan Inovasi Sosial*, vol. 1, no. 2, pp. 175–186, Apr. 2020, [Online]. Available: <https://industri>.
- [52] L. D. Saraswati, V. E. Herawati, M. Arfan, and G. P. Ananto, "Diversifikasi Produk Olahan Limbah Kopi di Kecamatan Tretep Kabupaten Temanggung," in *Seminar Nasional Pengabdian Kepada Masyarakat UNDIP 2020*, Universitas Diponegoro, 2020.
- [53] M. Carpenter, "Casara 'Tea': A Tasty Infusion Made From Coffee Waste : The Salt : NPR." Accessed: Jan. 20, 2025. [Online]. Available: <https://www.npr.org/sections/thesalt/2015/12/01/456796760/casara-tea-a-tasty-infusion-made-from-coffee-waste>
- [54] N. Arfa Yanti, S. Ambardini, and W. Ode Leni Marlina, "Aktivitas Antibakteri Kombucha Daun Sirsak (*Annona muricata* L.) Dengan Konsentrasi Gula Berbeda (Antibacterial Activity of Soursoup Leaves Kombucha (*Annona muricata* L.) With Different Sugar Concentration)," 2020.

