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The Potential of Hydroponics as a Solution for Food Security and Economics Resilience: Issues and Challenges of Smart-Agriculture

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Abstract: *Food and economic resilience issues have turned into strategic and hot topics amid the global Covid-19 pandemics. Many nations severely struggle to deal with the potential alternate ways in coping up with the Covid-19 issue. Apart from that, the limited space of productive land and the inconsistent bargaining power of local farmers in Bengkulu, Indonesia, has also brought a new problem to society. To deal with these issues, a smart-agriculture-based concept through hydroponic planting has emerged as a solution. Thus, thorough service learning has been conducted in the form of community service activity at the secondary school of Sint Carolus, Bengkulu city. In this community service, the stakeholders of Sint Carolus school have been trained to seek the potential benefits of surviving amid the pandemic by focusing on society's food and economic resilience.*

Introduction

The application of smart-agriculture methods using hydroponic technology has been developed progressively in Indonesia. Many regions have adopted this smart farming technique as an alternative step in dealing with the decreasing amount of productive land over the years. In addition, hydroponic-based plant production is also increasingly popular and in demand. Some of the reasons hydroponic vegetable products are getting more and more preferred is because hydroponic vegetables are considered to be much healthier and pesticide free. Moreover, the harvested products tend to be fairly standardized with the similar shape, size, color, taste texture, and product conditions that are free of pests and diseases. This also makes many consumers who adopt a healthy lifestyle prefer to consume hydroponic vegetables, even though in reality, the price of vegetables produced by this method is relatively higher when compared to conventional vegetable production. However, because the market opportunity is still widely open,

there have been many supermarkets, restaurants, cafes, and large hotels in Indonesia that have started to use food materials taken from hydroponic vegetables.

Although the trend of farming using the hydroponic method is increasing sharply, the same trend has not been found in Bengkulu. Land conversion activities have occurred in Bengkulu Province significantly[1]. Most of the productive agricultural lands (e.g., rice fields and plantations) are converted into non-paddy and non-agricultural agricultural lands such as oil palm, rubber, and coffee commodities. This also causes land fragmentation, in which land shifts have a major impact on the socio-economic conditions of farmers. This transition also forced farmers to relinquish some of their land ownership rights, so that more and more land had to be converted with the aim and hope of getting better profits by cultivating oil palm, rubber, and coffee. However, the economic benefits that can be perceived by farmers cannot be felt in a short time, especially because the prices of these commodities are highly volatile in the market, and incline to fall significantly when the amount of harvest is excessive. In addition, more and more countries (in Europe) which initially imported and used palm oil commodities, have turned to ban the use of palm-based products because of the negative impact on the environment it causes. Therefore, as an alternative measure to the increasingly narrow availability of productive agricultural land, and the lower bargaining power of oil palm, rubber, and coffee farmers in Bengkulu province and Bengkulu city in particular, members of the community service team from Bengkulu University and Fatmawati Soekarno State Islamic University initiated to conduct education/training on hydroponic farming methods to the younger generation in Bengkulu City. The targets or subjects for the implementation of this farming technique training were set at the residents (teachers; 27 people, students: 330 people, and other stakeholders; guards and the community living around the school) at Sint Carolus Middle School, Bengkulu City.

SMP Sint Carolus was chosen as the location for the implementation of service activities because this school was considered successful and at the same time committed to the development of the green school concept. As an educational institution, SMP Sint Carolus always views the importance of environmental sustainability issues, so that students are always taught about the importance of maintaining environmental sustainability for the younger generation and future generations. In line with the goals of the service team, the service was carried out at the Sint Carolus Middle School located on Jln Todak, Sumur Meleleh, Teluk Segara District, Bengkulu City. Its strategic location, directly adjacent to the Regional Building which is the official residence of the Governor of Bengkulu Province. With these geographical conditions, it is hoped that later the outcome of the training on hydroponic-based vegetable cultivation techniques can attract

[1] Alvian Zamhari, Satria Putra Utama & Rohidin Mersyah, "Ekonomi Konversi Lahan Sawah Menjadi Kebun Kelapa Sawit di Kecamatan Kedurang Kabupaten Bengkulu Selatan Provinsi Bengkulu," *NATURALIS – Jurnal Penelitian Pengelolaan Sumberdaya Alam dan Lingkungan* Volume 8, no 1 (2019):1-8.

the attention of the local government, and make it the basis of a "social and environmental pilot project" that can be a potential example to be applied in other schools in Bengkulu City, especially to deal with the issue of the land crisis and increase attention to the issue of food security in the city of Bengkulu.

Furthermore, regarding the operationalization of service activities, the method of plant cultivation through hydroponics is a technique that does not require soil, and only requires water as a growing medium[2]. This causes the hydroponic method does not require nutrients from the soil[3], so it does not need watering the plants[4]. In addition, hydroponic plant maintenance is relatively easy, because the media is clean, sterile, and protected from rainwater[5]. In this context, residents of the Sint Carolus Middle School were given special training on methods of growing plants using hydroponic media using a wick system, by utilizing several types of household waste that can be found around people's homes, such as fruit stereo foam box waste. Community service based on practical training also aims to develop knowledge as well as provide skills and increase the environmental awareness among residents of the Sint Carolus Middle School.

Method

The method used in this community service activity is Service Learning. The Service-Learning method in this service activity is through mentoring with several stages, such as, preparation, implementation and evaluation[6]. At the preparation stage for the implementation of the activity, it begins with a team coordination and licensing, by visiting the location where the activity will be carried out to ask permission from the *Tarakanita* Bengkulu Foundation and the Sint Carolus Bengkulu Middle School to carry out the activity. After obtaining the approval, the team draws up a plan and schedule of activities as well as the division of work tasks for team members. This community service

[2] Mareli Telaumbanva, Bambang Purwantana, Lilik Sutiarso & Mohammad Affan Fajar Falah, "Studi Pertumbuhan Tanaman Sawi *Brassic rapa var Pafachirensis L* Hidroponik dalam Greenhouse*." Jurnal Agritech* Vol 136, no 1(2016):105-110.

[3] Reno Suryani, *"Hidroponik Budidaya Tanaman Tanpa Tanah*," PT Pustaka Baru Yogyakarta, 2017.

[4] Mutia Tri Satya, Ayi Tejaningrum & Hanifah, "Manajemen Usaha Budidaya Hidroponik," *Jurnal Dharma Bhakti Ekuitas* I, no 2 (2017):55-57.

[5] Zamriyetti, Maimunah Siregar & Refnizuida, "Pertumbuhan dan Produksi Tanaman Sawi (Brassica Juncea L.) Dengan Aplikasi Beberapa Konsentrasi Nutrisi AB Mix dan Monosodium Glutamat pada Sistem Tanam Hidroponik Wick," *Jurnal Agrium* Vol. 22, no. 1 (2019): 56-61.

[6] Muh Barid Nizarudin Wajdi et al., "Pendampingan Redesign Pembelajaran Masa Pandemi Covid-19 Bagi Tenaga Pendidik Di Lembaga Pendidikan Berbasis Pesantren Di Jawa Timur," *Engagement: Jurnal Pengabdian Kepada Masyarakat* 4, no. 1 (2020): 266–277; Leora S Waldner, Murray C Widener, and Sue Y McGorry, "E-Service Learning: The Evolution of Service-Learning to Engage a Growing Online Student Population," *Journal of Higher Education Outreach and Engagement* (2012): 123–150; Amang Fathurrohman et al., "Peningkatan Kapasitas Fotografer Pemula Melalui Sekolah Fotografi Online (SeFO) Tingkat Jawa Timur Untuk Mewujudkan Fotografer Mahir Dengan Handphone Di Masa Pandemik Covid-19," *SOEROPATI* 2, no. 2 (2020): 1–8.

activity is carried out using specific and conditioned subjects of service. In this context, the residents of the SMP Sint Carolus Bengkulu consisting the Principal, Teachers and Staff. The service subject already has basic insight about the value and importance of awareness of environmental sustainability in supporting aspects of national food security. Therefore, service subjects already have the same perception about the importance of producing food sources (i.e., vegetables) in the context of limited (narrow) land using hydroponic techniques. The enthusiasm of the training participants (school residents) was very high, so the activities were organized into several meeting sessions. In addition, in relation to the government's recommendation to reduce the impact of increasing Covid-19 cases in the city of Bengkulu, the training carried out during the Covid-19 pandemic period was also carried out by implementing very strict health protocol standards.

The next stage in the Service-Learning method is implementation. At this stage, the team conducted training and workshop activities and gave guided assignments to the residents of the Sint Carolus Bengkulu Middle School. Participants were given an understanding of hydroponic cultivation techniques, issues faced, and challenges in the method of growing plants through hydroponics. In addition, participants also received information on the importance of utilizing waste that can still be used as equipment to apply the method of growing vegetables using hydroponic techniques. Participants were given the opportunity to do direct practice of planting media preparation. With the guidance of the facilitator, participants are taught what materials are needed, as well as how to execute the equipment that has been provided into a suitable planting medium for growing a number of vegetables, such as kangkong, spinach, mustard greens, pokchoi, etc. If participants experience problems, the facilitator from the service team will provide direction and solutions to the problems faced by the participants.

The evaluation stage is carried out as the final part of this service activity. This evaluation activity was carried out in a structured manner by utilizing a number of questionnaires containing questions about the participants' perceptions of the effectiveness and outcomes of the training they participated in. Questionnaires are given at the beginning and at the end of the socialization or training activity, as a form of comparison of knowledge and participant satisfaction responses to the methods and models of service activities used.

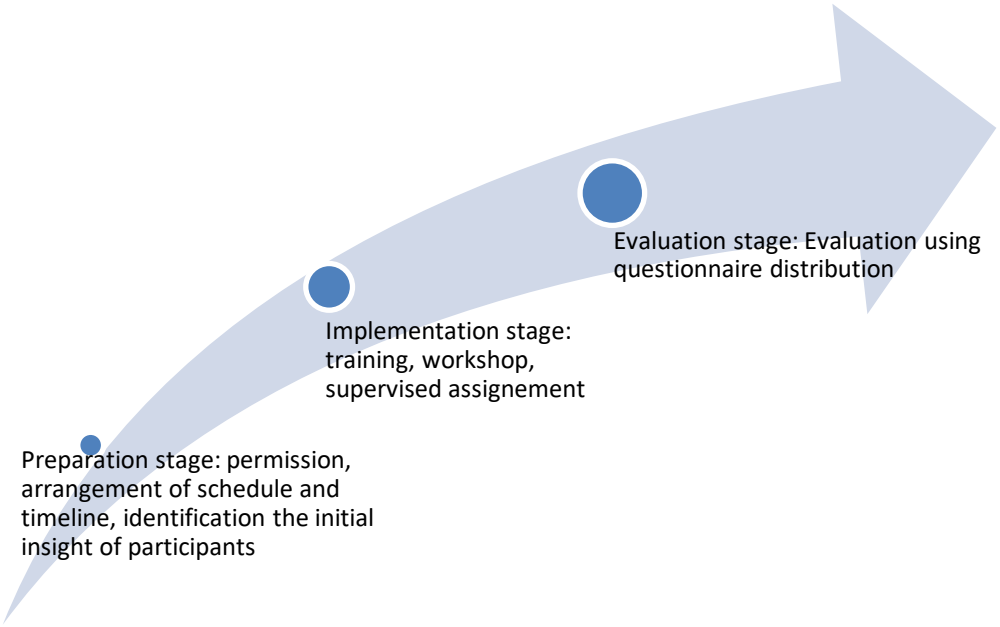

Figure 1. Stages of Service Learning Activities

Results

When the service team started training activities, the team distributed questionnaires aimed at evaluating the participants' initial understanding of hydroponic techniques. The results of the pre-activity evaluation can be seen in the following table.

Table 1. Pre-activity Participant Understanding Assessment Scale

No	Statement	Assessment scale (%)	
		Yes	No
1	I've heard of hydroponic technology (model)	94.44	5.56
2	I've heard the word hydroponic technology (model)	77.78	22.22
3	I know how to do hydroponics (model) technology	22.22	77.78
4	I have made hydroponic technology (model)	11.11	88.89
5	I know the process of making hydroponic technology (model)	22.22	77.78
6	I know the hydroponic technology (model) business opportunity	27.78	72.22
7	I know the constraints of hydroponic technology (model)	16.67	83.33
8	I think hydroponic technology (model) is easy to do myself	94.44	5.56
9	I'm thinking of practicing my own hydroponic technology (model) at home	94.44	5.56
10	I am willing to provide hydroponic technology (model) information to others	100	0

The results of the analysis using the perception data from the pre-activity questionnaire showed that 94.44% of the participants had heard of the technology or model of cultivation using Hydroponics. The majority of participants (77.78%) have also heard of hydroponics. However, the majority of participants did not know the methods,

processes, constraints, and business opportunities in hydroponic technology (model).

Furthermore, the service team also carried out knowledge transfer activities about Hydroponic technology (models) using waste. The material provided at this stage is hydroponic technology, hydroponic technology processes, and the importance of hydroponic technology (model) as an effort to maintain food security in the midst of the Covid-19 pandemic situation (please see Figure 2).

Figure 2. *Materials Delivery (left) and Service Team Demonstrating (right)*

The results of the training at the next stage showed that the practice of seeding, media preparation, preparation of ABmix nutrient solution, planting, and care went well and under control. The first stage of activity begins with nursery or seeding activities. In this activity, participants practice the correct seeding technique. This process is important so that participants understand what kind of seeds are considered good (no defects) seeds to be planted. Furthermore, seeding is done using rockwool media moistened with water.

The next activity is the preparation of the planting media that will be used. Participants are encouraged to use waste or household waste that can still be used and is easily found around the community, such as stereo foam boxes used for fruit. Furthermore, the cover of the stereo foam box is perforated using a preheated wire. When the plant seeds are ready to be transferred from the seedling media to the planting medium, hydroponic nutrients must also be prepared immediately. The preparation of the ABmix nutrient solution is important because the nutritional needs of plants in the hydroponic technique come from the solution. The nutrient solution prepared at this stage is ABmix solution for leaves (leaf vegetables). ABmix solution for leaves was used predominantly because the prepared seedlings were mostly leafy vegetables such as; lettuce, mustard greens, kale, spinach, and pokchoi.

Figure 3. Participant's practice seeding and preparation of planting media

The service team also demonstrated the manufacture of ABmix nutrient stock solution. This stock solution is prepared for a portion of 1000 liters of solution with 800 ppm in the form of a concentrated solution or concentrate which still requires mixing with water for its use. The concentrated solution must be diluted first to become a ready-to-use nutrient solution. After seeding the seeds, media, and nutrient solution is ready, then the next step is planting. Participants remove the seeds from the nursery carefully. This is important so as not to damage the plant roots. After the planting activities were completed, participants carried out maintenance activities and checked plant ppm on a regular basis and periodically. The important thing that participants must know is the need to understand that the older the plant, the more often the water level must be checked, especially because the absorption of water by plants is also getting bigger.

In addition, other results showed that participants did not experience significant difficulties because they had understood the substance and the steps that had to be taken according to the facilitator's directions. The plants that are ready to be planted are then cared for and cared for by the participants until they reach the harvest phase which takes about ± 3 weeks (figure 4 and 5).

Figure 4. The Service Team Demonstrating the Making of Ab Mix Nutrient Solution (left); Participants carry out planting activities (rigt)

Figure 5. Participants carry out maintenance activities and are monitored by the Service Team (left); Participants Together with the team doing harvest activities (right)

After participants have received training/workshop activities and carry out the guided tasks, then participants are asked to participate in the final survey. Participants were asked to fill out a questionnaire aimed at knowing the participants' responses to the materials and methods used during the training. In addition, the distributed questionnaire is also important to determine the level of participants' satisfaction with the training process. The results of the analysis can be seen in the following table.

Table 2. Participants' Responses to Workshop Materials

No	Statement	Mean	Criteria
1	The material is able to reveal the role of hydroponic cultivation technology (model) on narrow land	4.11	Very understanding
2	The workshop material enlightened and made me understand the importance of farming using hydroponic technology (model)	3.83	Understanding
3	The workshop material opened my horizons about how to cultivate hydroponic technology (models)	4.00	Very understanding
4	The workshop material made me understand how to plant the correct hydroponic technology (model)	3.89	Understanding
5	With this workshop material, I can teach hydroponic technology (model) plant cultivation to students	3.78	Understanding

Table 2 indicates that the participants gave a positive response to the workshop materials. This shows that the training activities have had a tremendous impact on the trainees. Participants can understand the material on the role of hydroponic technology cultivation on a narrow land, and be able to open their horizons about the ideal way of cultivating hydroponic plants. In addition, the participants' responses to the workshop method provided can also be seen in Table 3.

Table 3. Participants' Responses to the Workshop Method

No	Statement	Mean	Criteria
1	The workshop method is fun and uplifting	3.94	Understanding
2	The workshop method made me understand how to sow plant seeds with hydroponic technology (model)	3.83	Understanding
3	The workshop method made me understand how to make planting media with hydroponic technology (model)	4.11	Very understanding
4	The workshop method made me understand how cultivation works with hydroponic technology (model)	3.72	Understanding
5	The workshop method allows me to grow with hydroponic technology (model) independently and can teach students	3.78	Understanding

The information contained in table 3 shows that the participants already understand very well how to make planting media with hydroponic technology (model). These results show a high response because the participants directly practiced hydroponic techniques with a wick system. The hydroponic technique using fruit stereo foam box waste is also considered the simplest technique and can be applied by everyone. Participants can also understand how to sow plant seeds well, understand how cultivation works, and understand hydroponic methods, so that they can enable trainees to independently transfer the knowledge they have acquired to students at SMP Sint Carolus. In addition, the results regarding the level of partner satisfaction with hydroponic technique training activities can also be seen in table 4.

Table 4. Partner Satisfaction Level

No	Statement	Mean	Criteria
1	Service material according to partner needs	3.17	Very satisfied
2	The way the presenters present interesting service material	2.44	Satisfied
3	The material presented is clear and easy to understand	2.94	Satisfied
4	The time provided is suitable for the delivery of material and service activities	2.5	Satisfied
5	Every complaint/question/problem submitted is followed up properly by the resource person	2.61	Satisfied
6	Partners get direct benefits from the service activities carried out	3.11	Very satisfied
7	Service activities have succeeded in increasing partner knowledge	3.11	Very satisfied

Table 4 shows that the partners are satisfied with the presentation of the material presented by the facilitator, the time provided for delivering the material, and the follow-up to the questions/problems raised. Partners are very satisfied with the material because it is in accordance with current needs. In addition, partners are of the view that they can feel direct benefits from the implementation of this service activity, so they are considered successful in increasing their knowledge.

Discussion

The results of community service were carried out from August 21 to August 28 2020, and it continued to be monitored until the vegetables entered the harvest phase. In the post-planting period, it was observed that the training participants who attended the workshop cared for and nurtured the vegetables that had been planted together with great enthusiasm and earnestness. Until October 2020, it was recorded that the participants had harvested three times and continued to seed new vegetable to continue planting vegetables using hydroponic techniques (see Figure 6). In addition, the school through the Management Team of the *Tarakanita* Foundation also facilitated the online dissemination of the results of the service to the students of SMP Sint Carolus. The aim is for students to be introduced to plant cultivation techniques that do not require soil media to grow (see Figure 7).

Figure 6. Participants carry out activities independently (left)

Figure 7. Activity with Students (right)

In addition to introducing students to hydroponic cultivation techniques, the socialization of the results of community service to students of SMP Sint Carolus also aims to provide education and strengthen understanding of the Wick System of hydroponic. This axis technique is the simplest hydroponic system and is commonly used by beginners because it only utilizes the capillarity principle of water. The advantage is that the assembly process is very simple and easy, while the drawback is that sometimes the nutrients and oxygen in the water settle quickly because the water does not move (flow)[7].

This service activity also shows that mentoring and community service activities through the process of transferring knowledge about hydroponic techniques really

[7] Heru Agus Hendra & Agus Andoko, *"Bertanam Sayuran Hidroponik Ala Paktani Hydrofarm,"* Agromedia Pustaka Jakarta, 2014.

attract students' attention. The ongoing mentoring program can help students and residents of the Sint Carolus Middle School to apply and utilize their skills as capital in maintaining food security. In addition, the results of this training also have great potential to be explored in more depth in the context of optimizing the economic aspects of agribusiness products[8]. This also indicates that although the amount of agricultural land that is classified as productive is decreasing over years, this can be circumvented by applying farming techniques that are environmentally friendly, smart, and can be applied to narrow areas. Therefore, the findings in this training also confirm a number of research results and the results of community service that have been carried out in previous smart-agriculture literature, where the skills acquired by students and residents can be used to meet the needs of vegetables for household needs[9].

Apart from that, there is enormous economic potential if hydroponic cultivation can be optimized through investment and funding in supporting equipment and supplies. If it goes well and smoothly, it is not impossible that the results of community service carried out at the Sint Carolus Middle School in Bengkulu City can change the mindset of the surrounding community regarding the economic potential that can be achieved by the community. In addition, this pilot project can also be a model for other schools in the city of Bengkulu to apply a similar concept. Indirectly, in addition to the increasing economic impact and skills, school residents can also get a greener beautiful environment in supporting the Government's program on the implementation of a clean green concept. In the end, the effort to implement this training can also contribute to a number of efforts to minimize the amount of household waste through the concept of reusing waste products (circular economics) that can still be used and utilized. Thus, other goals can also be achieved, such as self-sufficiency and food security that can be supplied by the society itself through the utilization of hydroponic techniques.

Conclusion

Community service activities carried out during the period August-December 2020 at SMP Sint Carolus Bengkulu have shown many positive and progressive changes. In accordance with the initial objective, this activity was intended to introduce SMP residents to the importance of environmental sustainability issues, especially the decreasing number of productive agricultural land which continues to decline as a result of the high land use for oil palm, rubber, and coffee commodities in Bengkulu Province.

[8] Sulistyawati, Muchsin Maulana, Fatwa Tentama, Surahma Asti M & Tri Wahyuni Sukesi, " Pendampingan Pembuatan Sistem Hidroponik dan Pengolahan Sampah Organik," *Jurnal Pengabdian dan Pemberdayaan Masyarakat* Vol. 3, no. 1 (2019): 77-82.

[9] Sunardi, Wiwin Tyas Istikowati, & Eni Dwi Pujawati, "Pelatihan Budidaya Sayur dengan Metode Hidroponik di Desa Guntung Payung, Banjarbaru," *Pengabdianmu: Jurnal Ilmiah Pengabdian kepada Masyarakat* Vol. 4, no. 1 (2019): 40-45.

In addition to this phenomenon, the increasingly narrow amount of productive land (paddy fields and agriculture) forces many parties to be able to think creatively so that people do not experience potential food shortage problems. In addition, the pandemic situation has also forced many parties (society) to adopt a new pattern of living behavior that is very different from the previous normal behavior. One alternative problem solving that can be applied to overcome these potential problems is to introduce the importance of food security issues to residents as early as possible. This is what motivated the dedication team from Bengkulu University and Fatmawati Soekarno State Islamic University to take practical steps in educating the community starting from the smallest social group in the Sint Carolus Junior High School (SMP) environment, Bengkulu City.

Theoretically, the assessment of the literacy level of the service subject in the pre-activity and post-hydroponic training phases shows a statistically significant difference, and is positive. Therefore, the service team concludes that the results of this activity are positive for the residents, so it is necessary to carry out other ongoing and periodic trainings. This can also significantly improve the skills of the trainees, thus opening up opportunities not only to meet the needs of their own vegetables, but also smart-agriculture products that have high economic value if the scale of production is raised to a larger level. Therefore, support from the local government is very much needed. The tripartite synergy between the government, universities, and business actors (in this context the community) needs to be systematically increased if the government is to seriously optimize the economic potential that can be generated from vegetable cultivation using the hydroponic method.

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References

Fathurrohman, Amang, Alfian Adi Saputra, Fauziyah Rahmawati, M Wildan Adnan, and M Rifqi Nur Habibi. "Peningkatan Kapasitas Fotografer Pemula Melalui Sekolah Fotografi Online (SeFO) Tingkat Jawa Timur Untuk Mewujudkan Fotografer Mahir Dengan Handphone Di Masa Pandemik Covid-19." *SOEROPATI* 2, no. 2 (2020): 1–8.

Halim Lusy, & Yunita I. " Strategi Pelatihan Hidroponik Sebagai Pemberdayaan Masyarakat Yang Bernilai Ekonomis". *Jurnal Patria* Vol 1, no 1 (2019): 69-76.

Hendra Heru Agus & Agus Andoko. *"Bertanam Sayuran Hidroponik Ala Paktani Hydrofarm."* Agromedia Pustaka Jakarta. 2014.

Satya Tri Mutia, Ayi Tejaningrum & Hanifah. "Manajemen Usaha Budidaya Hidroponik." *Jurnal Dharma Bhakti Ekuitas* I, no 2 (2017):55-57.

Sulistyawati, Muchsin Maulana, Fatma Tentama, Surahma Asti M & Tri Wahyuni Sukesi. " Pendampingan Pembuatan Sistem Hidroponik dan Pengolahan Sampah Organik." *Jurnal Pengabdian dan Pemberdayaan Masyarakat* Vol. 3, no. 1. (2019): 77-82.

Sunardi, Wiwin Tyas Istikowati, & Eni Dwi Pujawati. "Pelatihan Budidaya Sayur dengan Metode Hidroponik di Desa Guntung Payung, Banjarbaru". *Pengabdianmu: Jurnal Ilmiah Pengabdian kepada Masyarakat* Vol. 4, No. 1 (2019): 40-45.

Suryani Reno. *"Hidroponik Budidaya Tanaman Tanpa Tanah*."PT Pustaka Baru Yogyakarta, 2017.

Telaumbanva Mareli, Bambang Purwantana, Lilik Sutiarso & Mohammad Affan Fajar Falah, " Studi Pertumbuhan Tanaman Sawi Brassic rapa var Pafachirensis L Hidroponik dalam Greenhouse*." Jurnal Agritech* Vol 136, no 1 (2016).

Wajdi, Muh Barid Nizarudin, Burhanuddin Ubaidillah, Sri Mulyani, Khoirul Anwar, Lailatul Istiqomah, Fauziyah Rahmawati, Sholihatul Atik Hikmawati, Diah Retno Ningsih, and Hasan Syaiful Rizal. "Pendampingan Redesign Pembelajaran Masa Pandemi Covid-19 Bagi Tenaga Pendidik Di Lembaga Pendidikan Berbasis Pesantren Di Jawa Timur." *Engagement: Jurnal Pengabdian Kepada Masyarakat* 4, no. 1 (2020): 266–277.

Waldner, Leora S, Murray C Widener, and Sue Y McGorry. "E-Service Learning: The Evolution of Service-Learning to Engage a Growing Online Student Population." *Journal of Higher Education Outreach and Engagement* (2012): 123–150.

Zamhari Alvian, Satria Putra Utama & Rohidin Mersyah, "Ekonomi Konversi Lahan Sawah Menjadi Kebun Kelapa Sawit di Kecamatan Kedurang Kabupaten Bengkulu Selatan Provinsi Bengkulu". *NATURALIS – Jurnal Penelitian Pengelolaan Sumberdaya Alam dan Lingkungan* Volume 8, no 1, (2019): 1-8.

Zamriyetti, Maimunah Siregar, dan Refnizuida. "Pertumbuhan dan Produksi Tanaman Sawi (Brassica Juncea L.) Dengan Aplikasi Beberapa Konsentrasi Nutrisi AB Mix dan Monosodium Glutamat pada Sistem Tanam Hidroponik Wick". *Jurnal Agrium.* Vol. 22, no. 1 (2019): 56-61.