



# The Post-Pandemic Phase of Citronella Grass Farming in Indonesia: An Economic Perspective

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**Abstract.** The number of citronella farmers producing essential oils has dropped dramatically during the pandemic. Currently, this business is starting to revive as the situation after the pandemic is getting more stable. This study aims to describe the post-pandemic challenges in citronella farming and essential oil production of the official essential oil business cluster in Indonesia and determine business strategies to support the sustainability of citronella farming and its essential oil production. In-depth interviews and observations were conducted to 9 of 120 farmers who survive during the pandemic and still cultivate citronella. Furthermore, their financial records were analyzed to measure the feasibility of the citronella essential oil business in the post-pandemic period. The circular economy concept is proposed to strengthen the resilience of the post-pandemic citronella farming and its essential oil business. Furthermore, the digital marketing approach becomes one of the core strategies in this post-pandemic era.

**Keywords:** Citronella, Essential Oils, Post-Pandemic, Business, Strategies.

## 1 Introduction

As an agrarian country, Indonesia's agriculture sector has a major contribution in driving the economic sector. *Cymbopogon nardus* or commonly known as citronella grass is one main plantation commodities in Indonesia which has a consistent growth before Covid-19 era. Indonesia is the second supplier of citronella oil after China [1]. The world market demand for citronella oil increases every year, therefore the opportunity to produce citronella oil for global market is quite potential [1]. One of the essential oil-producing areas in Indonesia is Kendal Regency. In 2019, a cluster of essential oil centers had been established, including Sukorejo District and Patean District. Along with increasing market needs and encouragement from the government, many farmers had tried to cultivate and refine citronella. According to Statistic Indonesia [2], from 2018 to 2020, there was an increase in the value of essential oil exports by 25.3% from 4,060.3 tons to 5,088.9 tons. More than 10 ha of citronella

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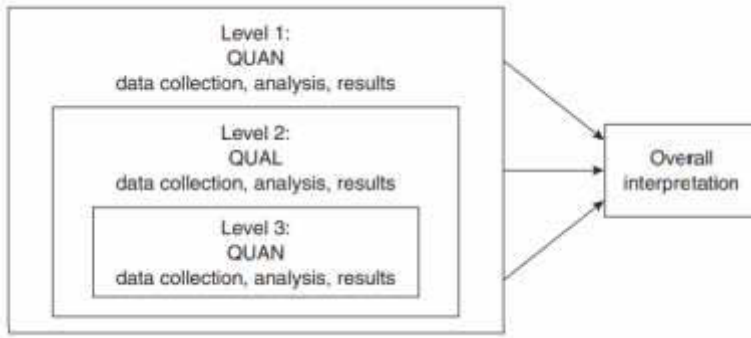
planting areas had been developed in several locations to support the export activities. However, this condition was changed right after the pandemic getting worse in the middle 2020. A policy of restriction on the social scale large in almost all cities in Indonesia, and even around the world cause the supply chain disruption [3]. Prices increase because people bought and hoarded goods, especially the staple ones. Public demand for anti-fungal, antioxidant, anti-bacterial drugs, anti-mosquito lotions, perfumes, cosmetics and aromatherapy has decreased drastically. Therefore, the demand for citronella, as one of their raw materials [1], also decreased and its price dropped dramatically.

This condition is similar to that stated by Aviasti [4] that the challenges faced by the citronella oil industry in its production are large production costs and low market prices. In addition, there is unclear product supply chain in this industry [5]. Furthermore, investment in the product industry also requires huge costs, causing farmers' reluctance to continue production of citronella oil [6], even though the pandemic has been able to be controlled. However, there is evidence of a higher flexibility of smaller business [7]. Hence, the surviving citronella farmers are struggling to get back up to restore their business.

The panic phase is over, and most companies have entered the strategic planning phase [8], as well as local citronella growers in Indonesia. As in other industries, COVID19 has caused the socio-ecological fragility of this industry. A transition to a more socially just, ecologically resilient, local system is urgently needed [9]. This study connected local citronella farmers in Kendal Regency to university research program under the local government guidance in order to find innovative solutions for challenges they face, especially in the post-pandemic phase era. As the resource-based theory of strategic alliances stated that the basis of collaboration between various parties is the value creation potential of company resources pooled together [10]. This study bridges the dialogue between stakeholders in local citronella industry aiming to improve local farmers' well-being.

## **2 Research Methodology**

This study used a mixed-methods approach using triangulation design named multilevel model introduced by Creswell & Clark [11]. This model consists of three levels: the first quantitative, qualitative, and the second quantitative. After passing all levels, researchers analyzed them all to write overall interpretation. The model could be shown in the Figure 1.



**Fig. 1.** A Multilevel Model of Triangulation Design [11]

Level 1 in this study was a survey conducted to 120 citronella farmers in Kendal Regency, Central Java Province, Indonesia which was taken in the early 2020 or before the first wave of pandemic in Indonesia. This survey depicted the condition of local citronella farming before pandemic, including: the demographic data of farmers, production activities, marketing activities, and the challenges faced. The data was interpreted using descriptive percentage analysis.

Level 2 in this study was the qualitative phase to collect the data about the condition of citronella farming during and after the pandemic. The data collected by field observations, in-depth interviews with 9 surviving farmers, and focus group discussion with citronella farmers and the representatives of local government. Furthermore, level 3 was the second quantitative phase, which is the financial report and investment analysis for the new machines applied in citronella essential oil production. All these three levels then would be interpreted to formulate strategies to improve citronella farmers business quality.

### 3 Results and Discussion

#### 3.1 The Condition of Citronella Farming before Pandemic

In 2019, before the cases of Covid-19 were identified in Indonesia, the essential oil business grew rapidly. The government encouraged farmers to plant commodities that can produce essential oils, such as clove leaves, patchouli, nutmeg skin and citronella. The local government of Kendal Regency in Central Java, Indonesia even declared Sukorejo District and Patean District as the essential oil cluster in the society empowerment mapping plan. Along with increasing market needs and encouragement from the government, many farmers tried to cultivate and refine citronella during this period.

In the beginning of 2020, in Pesaren Village, one of village in Sukorejo District, more than 10 ha of citronella planting areas have been developed in several locations. Based on the field observation, distillate products of citronella were sold directly to a local company with a price range of IDR 100,000 – 130,000 per kilograms. At that

time, those prices were below the market price because the citronella essential oil produced did not meet commercial standard specifications which can reach IDR 200,000 – 250,000 per kilograms. Even though their products were bought at a lower price, farmers still get enough profit to keep their business going. Therefore, in this phase, the number of citronella farmers increased significantly as many as 120 farmers. The demographic data of citronella farmers in the early 2020 is described in Table 1.

**Table 1.** The Demographic Data of Citronella Farmers before Pandemic

<b>Respondents Characteristics</b>	<b>Frequency (N)</b>	<b>(%)</b>	
<b>Gender</b>	Male	105	87.50
	Female	15	12.50
<b>Age</b>	< 25 years old	5	4.17
	26-40 years old	28	23.33
	41-55 years old	56	46.67
	>55 years old	31	25.83
<b>Education Level</b>	Uneducated	1	0.83
	Elementary School	60	50.00
	Junior High School	28	23.33
	Senior High School	29	24.17
	University	2	1.67
<b>Family member</b>	0-2 people	29	24.79
	3-4 people	61	52.14
	> 4 people	27	23.08
<b>Cultivated Land Area</b>	< 1 ha	113	94.96
	> 1 ha	6	5.04
<b>Land Ownership</b>	Rented	7	5.83
	Owned and rented	19	15.83
	Owned	94	78.33
<b>Side Business</b>	No side business	57	47.90
	1 side business	40	33.61
	More than 1 side business	22	18.49
<b>Training Experience</b>	Never	108	90.76
	1-2 times	10	8.40
	More than 2 times	1	0.84
<b>Group Involvement</b>	Not a member	73	62.39
	Become a member	44	37.61

The total number of respondents was 120 people dominated by male (87.5%) male farmers in the age range 41-55 years (46.67%). Basically, the age of the farmer influences the development of creativity and innovation in farming activities. An active participation of young farmers is able to create a supportive environment for intensifying farming activities and increasing national sustainable productivity [12]. However, the citronella grass farmers in this area mostly were the older ones. This condition would affect the resilience of their business during the peak of pandemic later.

The majority of farmers graduated only from junior high school (23.33%) with 3-4 family members (52.14%). Education is the main indicator of development and the

quality of human resources [13]. Level of education determines the negotiation skills of farmers which is beneficial for their survival strategies towards any unexpected distraction, including the negotiation skills related to land rent rate [14] due to the fact that the majority of respondents had a citronella grass cultivation area of less than 1 ha (94.96%) and need to rent the wider land if they want to expand their business. Furthermore, other condition such as making citronella cultivation as the main business (47.90%), the lack of training (90.76%), and the poor networking (62.39% of respondents are not members of any farmer group) had made the citronella grass business in this area was very vulnerable facing future uncertainties.

In terms of production and distribution, most of citronella grass farmers (81.51%) had less than 200 citronella trees handled by themselves (60.68%). Annually, the majority of respondents (98.31%) spent less than IDR 20 million as the working capital. In a year, 82.05% of farmers stated that the production capacity of citronella was less than 10 tons. Meanwhile, the income of citronella farmers in one year is mostly 92.11% of respondents answering less than IDR 30 million. All farmers stated that their product was purchased by wholesalers or middlemen who came directly to their production location with a certain selling price determined by the middlemen. Citronella grass farmers hardly had a power to set the price. The comprehensive information about production and distribution aspects are presented in Table 2.

**Table 2.** Production and Marketing Aspects of Citronella Grass Farming

<b>Production Aspects</b>		<b>Frequency (N)</b>	<b>(%)</b>
<b>Number of workers</b>	None	71	60.68
	1-4 people	43	36.75
	> 4 people	3	2.56
<b>Working Capital</b>	< IDR 20,000,000	116	98.31
	> IDR 20,000,000	2	1.69
<b>Total Production</b>	< 10 tons	96	82.05
	10-30 tons	18	15.38
	> 30 tons	3	2.56
<b>Revenue</b>	< IDR 30,000,000	105	92.11
	> IDR 30,000,000	9	7.89
<b>Marketing Aspects</b>		<b>Frequency (N)</b>	<b>(%)</b>
<b>Selling location</b>	Farm	1	0.85
	Company	117	99.15
<b>Buyer</b>	Company	119	100
<b>Selling Price Information</b>	Among farmers	2	1.68
	Wholesaler/middlemen	116	97.48
	Local government	1	0.84

### 3.2 The Condition of Citronella Farming during Pandemic

When the pandemic occurred and reached its first wave peak in July 2020, almost all of economic sectors are collapse, including agriculture sector [3], [15], [16]. Initial

conditions of citronella grass farmers in Kendal Regency that were already vulnerable (low knowledge, limited experience, and poor networking) worsen their survival ability during pandemic. This condition is exacerbated by a drastic decrease in selling prices of citronella grass and its derivative products. Before the pandemic, the price of citronella oil could reach IDR 300,000/kg, then it decreased and is currently only IDR 160,000/kg. For wet leaves, the initial price could reach IDR 1,000/kg and now it is dropping to IDR 500/kg even at some points could drop to IDR 300/kg. This condition forced farmers to replace citronella plants with other more profitable plants, such as coffee. The number of citronella grass farmers had fallen drastically from 120 became only at least 9 farmers in 2022.

Apart from the selling price, citronella farmers in Kendal Regency also have lack of distillation equipment and the location for it. If the distillation equipment has a small capacity, farmers have to go back and forth to harvest and process it so that the costs and labor expended will also increase, especially if the location of the equipment is far from the farm. Those few farmers who are still surviving generally have their own refining equipment, hence they can sell citronella grass as the essential oil and maintain a normal profit or event break event point condition to keep their business survive. Besides, farmers with refining equipment called distillation machine could diversify their products by also distill clove leaves which do not require too much operational costs because they use fallen dry leaves as ingredients. Another challenge related to physical and social distancing was the limited interaction with farming counselor, hence farmers could not consult with any expert due to their low ability using online facilities. Table 3 shows further details about challenges faced by citronella farmers during pandemic.

**Table 3.** Citronella Grass Farming Challenges

Challenges Factors	Indicators	Frequency (N)	(%)
<b>Production factors</b>	Worker availability	1	0.85
	Farming equipment	4	3.42
	Working capital	38	32.48
	Supporting material availability	13	11.11
	Plant pests	5	4.27
	Water availability	4	3.42
	Selling price	52	44.44
	<b>Farming Counselor Role</b>	Not good	87
	Good	14	12.84
	Very good	8	7.34

### 3.3 Strategies to Revive in Post-Pandemic

After the pandemic, most of business sectors have completed their initial COVID-19 crisis management and try to implement some innovations in the post-pandemic period [8], including citronella grass farming. Based on in-depth interviews conducted to 9

citronella farmers left in Sukorejo District, the newest condition related to citronella farming after pandemic are revealed.

In 2022 (post-pandemic phase) the citronella planted by the farmers are the Citrona2 Agribun variety. Farmers get the seeds from Bogor Spice and Medicinal Plants Research Institute (Balitro), either free of charge as a subsidy from the Government or purchased from middlemen. Farmers in Pesaren Village received seed for free from the Government, while farmers in Patean bought these seeds from middlemen at a price of IDR 2,000/stick, and farmers in Sukorejo Village also bought seeds from middlemen from Cilacap for IDR 1,000/stick. In terms of productivity, 1 hectare of land on average produces 10 tons of wet citronella leaves and if it is refined every 2 tons of leaves produce 5 kilograms of essential oils. Some farmers sell directly in the form of leaves and other do their own distillation. The citronella essential oil worth IDR 160,000/kgs, while if it is sold as unprocessed leaves, it costs IDR 300/kgs all through the middlemen.

Some of major problems in citronella industry is the lack of collaboration between industries of refined citronella [17]. Therefore, this study set a FGD between farmers, scientists, and local government to identify collaboration potential to improve citronella business after pandemic, as Khamung & Hsu [18] stated, collaboration with local government is needed to help small business adapt to the change. During the Focus Group Discussion (FGD), farmers expressed their concern about the falling price of citronella leaves and oil. Besides, they also complained about the lack of distillation equipment and the location of them. The existing distiller machines only can process big capacity of production (around 1-2 tons) and located far away from the farm. Farmers have to go back and forth to harvest and process it so that the production cost increases. Farmers hoped they have at least 3 distillation machines and those are located near the farm, so they can reduce transportation costs from harvest to the distillation process.

There was also a discussion about the potential of diversification of processed citronella oil. Most of farmers agree on this. A product development process will enable farmers to not only sell the citronella as a basic essential oil, but also in the form of perfume, floor cleaners and other added value product. Farmers also expected the new distillation machines has lower capacity, adapted to their low working capital. A machine with lower capacity is considered to be more effective and more flexible when it will be used for developing essential plants such as roses, betel and cloves. The implemented strategies during the post-pandemic phase are described in the following sub-sections.

**Modifying the distillation machines.** Henry [19] stated that pandemic taught farmers to invest more in automation machines and minimize manual steps throughout the production chain. By collaborating with researchers and supporting university, farmers have managed to get machines with the specifications they want. The new machines' capacity is 100 kgs, suitable for low production level and it is very possible for ex-citronella farmers who want to restart their businesses that paused during the pandemic. Based on the financial report, this new machine could cut down the investment cost up to 8.5% and variable cost reduced up to 10.8%. Meanwhile, the revenue reported increase for 5.9% using this strategy. Even though the changes of financial report do not seem too significant, according to the feasibility report, the

Benefit Cost ratio the new machine is confirmed higher than the old ones (1.29 versus 1.27), the payback period is shorter (6.19 versus 7.21), the NPV is higher (IDR 7,788,066 versus IDR 7,350,835), and the Accounting Rate of Return is outnumbered the old machine (0.16 versus 0.14). Therefore, it could be concluded that the new machines are worth to buy and operate during the post-pandemic phase in order to reduce the production cost, shorten the payback period and the rate of return on investment as well.

**Implementing circular economy concept in citronella farming.** The low production capacity of new distillation machines not only affect the production cost reduction, but also triggered farmers to focus more on the essential oil waste. The waste of citronella essential oil products has good economic value. However, it has not been explored by local citronella farmers. Citronella essential oil derivatives can be used as raw materials for various products such as soaps, antiseptics, detergents, and perfumes. In addition, essential oil raw materials can also be used as a bio-additive for fuel oil due to the presence of geraniol compounds [20]. The results of other studies also show that waste from the production of citronella essential oil distillation can be used to produce economically valuable products, such as the manufacture of carboric acid [21] and anti-mosquito briquettes [22]. With the circular economy concept, the next agenda for increasing local citronella farmers productivity is by building a zero-waste industrial economy that generates benefits from two types of material inputs namely, biological materials, materials that can return to the biosphere in a restorative manner without harm or waste (degrades naturally) and technical materials, materials that can be continuously used returned without harm or waste [23].

**Optimizing product diversification and the digital marketing approach.** So far, farmers sold citronella leaves and its essential oil to middlemen at low prices, hence when the market price of citronella drops, farmers suffer huge losses. With the independent production of essential oils using new machines with lower capacities, farmers have options for new production methods. The decreased production of citronella allows farmers to explore the cultivation of other aromatic plants, and the low machine capacity allows farmers to make a variety of different essential oils as a form of product diversification. As Altieri & Nicholls [9] stated that crop diversification is necessary because monoculture crops grown on a large scale are highly susceptible to pest, weed and disease outbreaks.

Digital innovation has contributed to many cases of rural farmers in several countries, for example China is working with private companies to digitize their agriculture and Ghana has transformed farmer transactions with digital money [24]. The digital marketing channels are heavily based on collective organizations aiming to build short local and regional chains [25]. It clearly takes time to make such kind of transformation. Therefore, it needs an intensive collaboration between farmers, local government, and researchers to build an inclusive online marketing system to support citronella farming. Along with production activities with new machines, farmers were given trainings to introduce them to the online marketing system and put it into practice.



## 4 Conclusion

As Golovina et al [14] stated that farmers who are able to build wider networking and communication with many parties economically will be more successful and perceive their financial situation to be better than their conventional counterparts. The local citronella farmers in Kendal Regency need to collaborate with universities, local government, and other potential parties to survive in their business. The new distillation machines have proven give more flexibility in producing varies essential oils for farmers. The concept of circular economy is expected reduce the production waste and increase side revenue. Furthermore, in the long term, product diversification and digital marketing approach will be implemented to strengthen business resilience. By implementing these strategies, it is expected the local citronella farmers in Kendal Regency could be back stronger in the market during the post-pandemic phase. This study is limited in the local area citronella farming of Kendal Regency, hence the strategies built have not implemented in other similar farming in Indonesia. The next study is expected to explore other business strategies to citronella farmers in other regions in order to develop a more comprehensive citronella business model for citronella farming improvement in Indonesia.

## References

1. Aviasti, A. Nana Rukmana, I. Bachtiar, and R. Amaranti, "SENSITIVITY ANALYSIS OF INVESTMENT FEASIBILITY ON CITRONELLA OIL DISTILLATION INDUSTRY IN INDONESIA," 2021.
2. Statistic Indonesia, "Volume dan Nilai Ekspor Barang Asal Provinsi Jawa," Badan Pusat Statistik Jawa Tengah," 2020.
3. I. Agustina Gultom, M. Achmad Subing, and A. Kartika Puspa, "The Impact of Pandemic on Rice Farmers in Lampung Province," in *In International Conference Universitas Pekalongan*, 2021, pp. 353–356.
4. N. Aviasti, A. Nasution, and R. Amaranti, "Pemetaan rantai pasok minyak sereh wangi skala kecil dan menengah di Jawa Barat," in *Proceeding 2nd Annual Conference on Industrial and System Engineering*, 2015, p. 33.
5. D. Hariani, A. Aviasti, and R. Amaranti, "The design of improvement for supply chain flow of citronella fragrance oil refinery industry as an effort to meet customer demand in Cimungkal Village of Sumedang Regency," *Prosiding Teknik Industri*, pp. 43–52, 2016.
6. N. Nugraha, A. Aviasti, D. S. Mulyati, R. Amaranti, C. Nursagita, and I. T. Maulana, "Economics Feasibility Analysis of Fragrant Lemongrass (*Andropogon nardus*) Cultivation and Distillation System (Case study in Ganunghalu and Rongga sub-district, Bandung Barat Regency)," in *2nd Social and Humaniora Research Symposium (SoRes 2019)*, 2020, pp. 92–97.
7. C.-E. Popescu, A. Horobet, G. Vranceanu, and L. Belascu, "Business recovery in the European Union after the global financial crisis: lessons for the Coronavirus pandemic.," *Eastern Journal of European Studies*, vol. 12, 2021.
8. U. Lichtenthaler, "A Conceptual Framework for Innovation and New Business Opportunities in the Post-Pandemic Period," *Journal of Creativity and Business Innovation*, vol. 7, pp. 74–89, 2021, [Online]. Available: [www.journalcbi.com](http://www.journalcbi.com)

9. M. A. Altieri and C. I. Nicholls, "Agroecology and the emergence of a post COVID-19 agriculture," *Agriculture and Human Values*, vol. 37, no. 3. Springer, pp. 525–526, Sep. 01, 2020. doi: 10.1007/s10460-020-10043-7.
10. T. K. Das and B.-S. Teng, "A resource-based theory of strategic alliances," *J Manage*, vol. 26, no. 1, pp. 31–61, 2000.
11. J. W. Creswell and V. L. P. Clark, *Designing and conducting mixed methods research*. Sage publications, 2017.
12. L. W. I. Wairegi *et al.*, "Sustainably improving Kenya's coffee production needs more participation of younger farmers with diversified income," *J Rural Stud*, vol. 63, pp. 190–199, Oct. 2018, doi: 10.1016/j.jrurstud.2018.07.009.
13. D. Dayat, O. Anwarudin, and M. Makhmudi, "Regeneration Of Farmers Through Rural Youth Participation In Chili Agribusiness," *International Journal of Scientific & Technology Research*, vol. 9, no. 3, pp. 1201–1026, 2020, [Online]. Available: [www.ijstr.org](http://www.ijstr.org)
14. S. Golovina, S. Hess, J. Nilsson, and A. Wolz, "Networking among Russian farmers and their prospects for success," *Postcommunist Econ*, vol. 31, no. 4, pp. 484–499, Jul. 2019, doi: 10.1080/14631377.2018.1537737.
15. A. Ulfa, A. Nugroho, T. H. Pospos, G. Suherman, and N. Ariyati, "Global pandemic and agriculture in Aceh Province, Indonesia: An initial impact," in *IOP Conference Series: Earth and Environmental Science*, Mar. 2021, vol. 667, no. 1. doi: 10.1088/1755-1315/667/1/012099.
16. N. B. Astuti, V. I. Mutiara, and R. Hariance, "Livelihood strategies of farmers in Padang City during pandemic Covid-19," in *IOP Conference Series: Earth and Environmental Science*, May 2021, vol. 741, no. 1. doi: 10.1088/1755-1315/741/1/012070.
17. A. Aviasti, N. Nugraha, R. Amaranti, and A. A. Nurrahman, "Industrial symbiosis of fragrant lemongrass distillation in West Java," in *Journal of Physics: Conference Series*, 2019, vol. 1375, no. 1, p. 012054.
18. R. Khamung and P. S. Hsu, "Striving for a new normal after the Covid-19 pandemic: taking small businesses at Bangsaen Beach as an example," *Journal of Tourism and Cultural Change*, pp. 1–17, 2021.
19. R. Henry, "Innovations in Agriculture and Food Supply in Response to the COVID-19 Pandemic," *Molecular Plant*, vol. 13, no. 8. Cell Press, pp. 1095–1097, Aug. 03, 2020. doi: 10.1016/j.molp.2020.07.011.
20. W. Astuti and N. N. Putra, "Peningkatan kadar geraniol dalam minyak sereh wangi dan aplikasinya sebagai bio additive gasoline," *Jurnal Bahan Alam Terbarukan*, vol. 3, no. 1, pp. 24–28, 2014.
21. I. Susanti and F. Lestari, "Teknologi pengolahan karbol dari limbah cair Serai wangi (cymbopogon nordus)," *Indonesia Berdaya*, vol. 1, no. 1, pp. 1–6, 2020.
22. D. Erlia, F. Darusman, and G. C. E. Darma, "Pembuatan Briket Penghalau Nyamuk (Repellent) dari Daun Serai Wangi (Cymbopogon winterianus Jowitt) dan Evaluasinya," *Prosiding Farmasi*, pp. 552–558, 2016.
23. J. T. Scott, *The sustainable business: A practitioner's guide to achieving long-term profitability and competitiveness*. Routledge, 2017.
24. M. Quayson, C. Bai, and V. Osei, "Digital Inclusion for Resilient Post-COVID-19 Supply Chains: Smallholder Farmer Perspectives," *IEEE Engineering Management Review*, vol. 48, no. 3, pp. 104–110, Jul. 2020, doi: 10.1109/EMR.2020.3006259.
25. M. Gazolla and J. R. de Aquino, "Reinvention of family farming markets in Brazil: the novelty of digital marketing sites and platforms in times of COVID-19," *Agroecology and Sustainable Food Systems*, vol. 46, no. 6, pp. 902–927, 2022.

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