

## Farmer Perceptions of the COVID-19 Pandemic's Impact on Agriculture: A Case Study from Madura Island, Indonesia

✉Setiani Setiani <sup>1,2</sup>, Eko Setiawan <sup>2,\*</sup> and Wen-Chi Huang <sup>3,\*</sup>

<sup>1</sup>Department of Tropical Agriculture and International Cooperation, National Pingtung University of Science and Technology, Pingtung, Taiwan

<sup>2</sup>Faculty of Agriculture, University of Trunojoyo Madura, Indonesia

<sup>3</sup>Department of Agribusiness Management, National Pingtung University of Science and Technology, Pingtung, Taiwan

Received: July 2022; Accepted: August 2022; Published: October 2022

### ABSTRACT

*The worldwide COVID-19 epidemic has had a great impact on farming and socioeconomic institutions all over the globe. This study aims to understand farmer knowledge and perceptions of the impacts of the one-year COVID-19 pandemic on agricultural systems. We purposefully picked 400 farmers from four regencies in Madura Island, Indonesia. The survey was administered from April to August 2021. Maize, rice, peanuts, tobacco, cassava, and chili peppers are the five most cultivated plants, while chicken and cattle are the main livestock raised. Farmers' perceptions, measured on a 5-point Likert scale (from 1—not affected, to 5—severely affected), showed that COVID-19 had an average minor to moderate effect (average score of  $2.49 \pm 0.9$ ) on the agriculture system. The greatest impact is on farm income (average scale of  $3.76 \pm 0.79$ ), while the ability to plant crops in the upcoming season is the lowest (average scale of  $1.2 \pm 0.56$ ).*

**Keywords:** COVID-19, Farmer Perception, Madurese Ethnic, Cropping System, Livestock System

### INTRODUCTION

The new coronavirus disease (COVID-19) spread fast over the world when it was initially identified in Wuhan in December 2019, killing a large number of people. Furthermore, on March 11, 2020, the World Health Organization (WHO) labeled this outbreak a pandemic (Cevher et al., 2021; Elsahoryi et al., 2020). On March 2, 2020, the first verified COVID-19 cases in Indonesia were reported (Hikmawati & Setiyabudi, 2021; Rozaki, 2020; Tosepu

et al., 2020). In terms of cumulative instances, Indonesia is ranked 18<sup>th</sup> in the globe and 12<sup>th</sup> in terms of deaths. The country's morbidity and death rates have grown to the highest of any Southeast Asian country (Megasari et al., 2021).

The impact of the COVID-19 pandemic on job loss, financial challenges, changes in the types and/or amount of food consumed, and negative emotional effects (Bauza et al., 2021). It also increased farm households'

vulnerability to multidimensional poverty (Liu et al., 2021), and causing hard times for the agriculture sector (Jámbor et al., 2020). The COVID-19 impact on the Indonesian population and economy Amongst the four pillars of sustainable development in Indonesia, the SDGs on the social and economic development pillars are stated to be the most impacted (Safitri et al., 2021). The World Bank and the Ministry of Finance have revised their forecast for 2020 economic growth from 5% to roughly 2% (OCHA, 2020), and cumulatively, Indonesia has grown by minus 2.1 percent (Muhyiddin, M., & Nugroho, 2021). There are differences between regions, which is a concern in terms of the all-of-government response to the pandemic in Indonesia (Sevindik et al., 2021).

Many Indonesians, particularly in rural regions, rely on agriculture for their living (Rozaki, 2020). In 2019, the agricultural sector contributed 12.72% of the national GDP. The agricultural sector development carried out during the 2015–2019 period has recorded positive results for the achievement of national food and nutrition security in Indonesia. During a pandemic, the agriculture sector supports the national economy by being the last sector to survive (the sector of last resort), proving that it is the safest sector (Khairad, 2020). The impacts of COVID-19 on agriculture will be felt on both the biophysical aspects, such as production and access to inputs, as well as socioeconomic aspects (Middendorf et al., 2021).

The objectives of this study were to understand farmer perceptions of the experience impacts of COVID-19 on agriculture. A survey was developed to explore knowledge and perceptions as they relate to agricultural production, covering both the cropping and livestock systems. The results captured these perceptions and highlighted concerns about the resilience of the farming system.

## RESEARCH METHODOLOGY

The survey was designed and implemented according to field standard practices (Middendorf et al., 2021). The target audience for the survey was farmers from four regencies (Bangkalan, Sampang, Pamekasan, and Sumenep) in Madura Island, Indonesia. The study took place between April to August 2021, after a one-year pandemic in Indonesia. Data was gathered by the first and second authors, as well as a team of research assistants. All of the research assistants are originally from Madura Island, graduated from agricultural faculty, have experience in agricultural research project and are fluent in the Madurese language. They were trained on how to collect the data and conduct the interviews.

The sample was designed to ensure representation from across the diverse agro-ecological zones of Madura Island. This study is a small part of research on traditional home gardens (Setiani et al., 2022), food security, farmer households, and COVID-19 in Madura Island. Purposively, we interviewed a farmer who lives in a traditional Madurese ethnic settlement called *Tanean Lanjang*. There was more than one household in each of those settlements, and we only interviewed the farmer household. Finally, we surveyed 200 settlements, and 400 farmers were engaged in this study, and they needed to be at least 18 years old. Verbal informed consent was obtained from all respondents.

The questionnaire included modules on personal and farmer household socioeconomics, agriculture systems, knowledge, and perception of the effects of COVID-19 on cropping and livestock systems. We combined two previous studies (Middendorf et al., 2021; Yegbemey et al., 2021) to determine the perception scale challenge of the cropping and livestock systems. We ask the questions: access to seeds (ASEED), access to fertilizer (AFTZ), access to pesticide (APTC), hired labor (HL), ability to plant crops in the upcoming season (CUS), food storage (FSTR), transportation of agricultural products

(TAP), restriction of markets/selling crop products (RM), access to inputs for livestock (AIL), feeding livestock (FL), selling livestock products (SLP) and farm income (FI). A five-point Likert scale was used to collect perception data: 1 = no effect or no challenge at all (NE), 2 = minor effect (MIE), 3 = moderate effect (MOE), 4 = major effect, 5 = severe effect or severe challenge (SE). All the data collected from the survey was quantified (means, percentages, and frequencies), standard deviation (SD), and analyzed using STATISTICA, a software package used for statistical analysis. Respondent quotations were also used to provide additional discussion and justification for the field finding.

## RESULT AND DISCUSSION

The majority of the respondents were between the ages of 30 and 60 years old, with approximately 63% being male. Furthermore, approximately 78.8% of the respondents were married, with 69% of the respondents having completed elementary school as their formal education. They also had alternative off-farm income, for example from trade, transportation, and construction work. On average, the majority of their income was earned at about 100 to 145 US dollars per month, which is less than the average regional minimum wage (148 US dollars) in Madura Island (BPS-Indonesia Statistic Government Office, 2021). Most households (80.5%) have one to four family members, and only 19.5% have more than four members. The religion of all respondents was Islam. Most households (80.5%) have one to four family members, and only 19.5% have more than four members.

All respondents confirmed they had "heard and known COVID or corona" and it was in line with previous studies (Bauza et al., 2021). However, most of the respondents (87%) didn't believe that it was dangerous; they assumed that it was just the same as the common influenza. They are more common in the spelling of "Corona" than in

COVID. We identified some sources that give information to the farmers, i.e., village leader, neighbor, friend, family, social media, the internet, news television, and religious leader. Among all the trusted sources for information about COVID-19, most of them (81.25%) believe in the religious leader, followed by family (71.25%) and neighbors in the village (43.75). This finding is in line with a previous report that stated that as the country with the highest number of Muslims in the world, the government of Indonesia cannot ignore the religious factors and roles in handling the spread of COVID-19 (Djalante et al., 2020). Through philanthropic activities, Islamic organizations on Madura Island play a part in preventing COVID-19 from spreading (Abidin, 2020).

*"Corona (COVID-19) is just like the common influenza; don't worry, it won't make you die. Even if someone dies because of Corona, it's God's destiny"*

*(Male, 56 years old).*

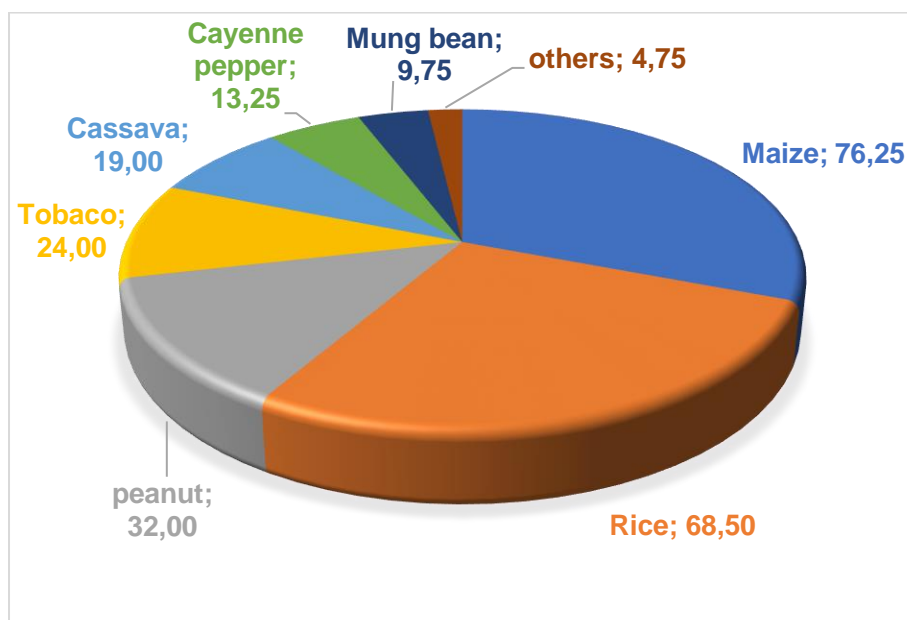
*"Corona (COVID-19) is not a threat; we must trust our religious leaders. All that is required is that you become closer to Allah. The government encourages us to wash our hands frequently. Isn't it true that we're supposed to pray five times every day, including ablution and hygiene? What is it about the corona that makes us so terrified?"*

*(Female, 56 years old).*

The most commonly grown crops among the respondents are shown in Fig. 1. The total percentage of responses shown is greater than the number of

respondents because they had the option of choosing multiple crops as applicable. Maize, rice, peanuts, cassava, and mung beans are five common crops cultivated by farmers. Maize is the main crop, with more than two thirds (76.25%) of farmers growing this commodity. This finding is consistent with the previous study (Nikmah et al., 2013) showing that maize production in Madura Island contributes more than 10% of east Java province, and across the country, East Java contributes the highest (22.66%) of national maize production (Ministry of agriculture, 2021). Sumenep regency has the highest maize production among the four other regencies (BPS-Indonesia Statistic Government Office, 2021). Maize (*Zea mays* ssp.) is also the main carbohydrate source consumed by the Madurese ethnic group.

More than half (68.5%) of the farmers planted rice (*Oriza sativa* L). It is the main staple food of Indonesian households, but among the Madurese ethnic group living in traditional settlements, mixed maize-rice is the more common food consumed. Both of them are important crops that are mostly consumed by themselves, and they have the habit of preserving rice and maize. Peanuts (*Arachis hypogaea* L.) are the third largest commodity cultivated (32%), which is usually grown simultaneously with corn. Cassava (*Manihot esculenta*) was planted by 19% of respondents, and the last was mung bean (*Vigna radiata*), which was cultivated by 9.75% of farmers.



**Figure 1**  
**Main crops and vegetables grown by surveyed farmers**

Chili peppers (*Capsicum frutescens* L.) are the most common horticultural crop, cultivated by 13.25% of farmers. In addition, almost a quarter of farmers (24%) cultivated tobacco (*Nicotiana tabacum* L.). Tobacco was reported as the most important cash or commercial crop in Madura (Faridz &

Pramoedyo, 2018; Hefni, 2008; Jackson, 1991) Other crops grown by the farmers were soybean (*Glycine max*), sweet potato (*Ipomoea batatas*), shallot or onion (*Allium ascalonicum* L.), long bean (*Vigna unguiculata* L.), tomato (*Solanum lycopersicum*), eggplant (*Solanum*

*melongena*), cucumber (*Cucumis sativus*), and mustard (*Brassica juncea* L.).

As shown in Table 1, the most common livestock raised among the respondents is chicken (66.25%) and cattle (50.25%). The frequency of responses shown is greater than the number of respondents because they had the option of choosing multiple livestock as applicable, for example, if they raised both cattle and sheep or goats. Chickens are popular among farmers because they are simple to care for. They are left to

feed for themselves in the *taneyan lanjang* (home garden). Sometimes they are also fed leftover food or crops from fields or home gardens. Farmers in Madura claim that rearing cows is strongly tied to their culture. A Madurese bride and groom would usually get a cow from their parents, which would be used for capital or savings. Madura Island is well known as a livestock breeding region with its enormous ruminant livestock population, especially cattle (Maylinda et al., 2019).

**Table 1**  
**The primary livestock raised by farmer in traditional settlement**

| Livestock   | Frequency (household) | Percent | Average per household |
|-------------|-----------------------|---------|-----------------------|
| Chicken     | 265                   | 66.25   | 9                     |
| Cattle      | 200                   | 50.25   | 2                     |
| Goats/Sheep | 64                    | 16.00   | 3                     |
| Bird        | 34                    | 8.5     | 7                     |
| Duck        | 21                    | 5.25    | 6                     |

Generally, the COVID-19 pandemic had a minor to moderate effect (score of 2.49 ± 0.90) on agriculture system. The most challenges are effect on farm income, followed by sell livestock product, access to inputs for livestock, transportation of agriculture product, restriction of markets/selling crop product, and access to fertilizer. This finding supporting previous study In Java Island that local food systems continued to operate and were even strengthened by higher social capital and adaptive capacities during the pandemic.

Generally, the COVID-19

pandemic had a minor to moderate effect (a score of 2.49 to 0.90) on the agriculture system. The biggest challenges are the effect on farm income, followed by selling livestock products, access to inputs for livestock, transportation of agriculture products, restrictions on markets for selling crop products, and access to fertilizer. This finding supports previous studies in Java Island that reveal that local food systems continued to operate, strengthened by higher social capital and adaptive capacities during the pandemic (Paganini et al., 2020).

**Table 2**

**Scale of perceptions experienced by farmers as a result of one-year COVID-19 pandemic**

| Variable | NE | MIE | MOE | MJE | SE | Mean (SD) |
|----------|----|-----|-----|-----|----|-----------|
|----------|----|-----|-----|-----|----|-----------|

|                |        |       |        |       |       |      |
|----------------|--------|-------|--------|-------|-------|------|
| ASEED (n)      | 253    | 45    | 92     | 4     | 6     | 1.66 |
| (%)            | 63.25  | 11.25 | 23.00  | 1.0   | 1.50  | 0.96 |
| AFTZ (n)       | 26     | 47    | 245    | 59    | 23    | 3.02 |
| (%)            | 6.50   | 11.75 | 61.25  | 14.75 | 5.75  | 0.87 |
| APTC (n)       | 108    | 102   | 154    | 13    | 23    | 2.35 |
| (%)            | 27.00  | 25.50 | 38.50  | 3.25  | 5.75  | 1.09 |
| HL (n)         | 350    | 23    | 23     | 4     | 0     | 1.20 |
| (%)            | 87.50  | 5.75  | 5.75   | 1.00  | 0.00  | 0.58 |
| CUS (n)        | 346    | 31    | 21     | 1     | 1     | 1.20 |
| (%)            | 86.50  | 7.75  | 5.25   | 0.25  | 0.25  | 0.56 |
| FSTR (n)       | 49.00  | 57    | 196    | 43    | 55    | 3.00 |
| (%)            | 12.25  | 14.25 | 49.00  | 10.75 | 13.75 | 1.14 |
| TAP (n)        | 38     | 67    | 156    | 94    | 45    | 3.10 |
| (%)            | 9.50   | 16.75 | 39.00  | 23.50 | 11.25 | 1.11 |
| RM (n)         | 28     | 71    | 180    | 76    | 45    | 3.10 |
| (%)            | 7.00   | 17.75 | 44.75  | 19.25 | 11.25 | 1.05 |
| AIL (n)        | 311    | 22    | 33     | 30    | 4     | 3.2  |
| (%)            | 77.75  | 5.50  | 8.25   | 7.50  | 1.00  | 1.1  |
| FL (n)         | 204    | 44    | 61     | 89    | 2     | 2.1  |
| (%)            | 51.00  | 11.00 | 15.25  | 22.25 | 0.50  | 1.3  |
| SLP (n)        | 40     | 44    | 110    | 196   | 10    | 3.2  |
| (%)            | 10.00  | 11.00 | 27.50  | 49.00 | 2.5   | 1.0  |
| FI(n)          | 4      | 32    | 65     | 254   | 45    | 3.76 |
| (%)            | 1.00   | 8.00  | 16.25  | 63.50 | 11.25 | 0.79 |
| Total (N= 400) | 124.25 | 52.78 | 125.78 | 60.89 | 27.00 | 2.49 |
|                | 33.39  | 13.19 | 31.42  | 15.25 | 6.75  | 0.90 |

Note: NE: no effect or no challenge at all, MIE: minor effect, MOE: moderate effect MJE: major effect, SE: severe effect or severe challenge

Table 2 shows the scales of perception faced by the respondents in the agriculture system. More than half (63.25%) of respondents stated that COVID 19 had no impact on seed access, although almost a quarter (23%) also thought it was doubtful or there was a moderate effect. The farmer's perception score is lower than 2 (the average mean score is about  $1.66 \pm 0.96$ ) and it is slightly higher than other findings of vegetable farmers in Nigeria (Yegbemey et al., 2021). Most farmers on Madura Island use local varieties of seeds. Hybrid varieties are more expensive and are only used by a small number of farmers. Rice, peanuts, mung beans, soybeans, and chili peppers are also part of the

commodities that used to be cultivated using seeds from prior harvests.

*"We select the best parts of the crop to use as seeds in the next planting season. That's what we do with corn, peanuts, chili peppers, cassava, and some other crops. We do it for rice on occasion, but we also receive government seed assistance. So, even if a COVID exists, there will be no difficulty, and we will be unaffected".*

*(Female, 66 years old)*

In terms of access to fertilizers, farmers' perceptions indicate that the majority of respondents feel a moderate impact from a year of pandemic (the average mean score is about  $3.02 \pm 0.87$ ). At the beginning, they found it quite difficult to get fertilizer, but over time, conditions have returned to normal. However, farmers feel that fertilizer prices are still relatively expensive, especially for non-subsidized fertilizers. The justification for this result can be explained by the low use of fertilizers by maize farmers in Madura, which is reported to be lower than the government's recommendation (Fauziyah, 2020).

*"In general, there was actually no problem with access to fertilizer; it's just that at the beginning of the pandemic there was a shortage of fertilizer."*

*(Male, 39 years old)*

The proportion of farmers' perceptions of the impact of COVID on access to pesticides was as follows: not affected (27%), slightly affected (25%), to moderate (38%). Similar to conditions on access to seeds and fertilizers, only a small number of farmers think that COVID-19 has a large (3.25%) to severe (5.75%) impact. Score perception is about  $2.05 (\pm 1.09)$ , slightly higher than access to seed, but lower than access to fertilizer. The high use of pesticides among farmers is common, especially for cash commodities (tobacco). This finding is inconsistent with other research, in Nigeria which shows that COVID-19 mostly has no effect on pesticide access (Yegbemey et al., 2021).

*"We obviously use a fairly large number of pesticides on tobacco plants. We feel that pesticide prices are becoming more expensive. We are also thinking of reducing their use"*

*(Male, 63 years old)*

Farmer perception of the impact of the COVID-19 pandemic on hiring labor is similar to the access of seed, where most respondents (87.5%) state no effect of the COVID-19 pandemic (average score of  $1.2 \pm 0.58$ ). Farmer families are frequently involved in farm field activities. Although hit by the pandemic, farm activity must have been done. They cannot reduce hiring labor because they believe it is enough. They are also not adding too much labor, which will have an effect on cost increases. Hiring labor is also related to crop type and cultivation. Respondents state that staple crops like maize, rice, cassava, and mung beans need less labor than horticultural crops (chili peppers, tomatoes, eggplants, etc.).

*"Corn, rice, peanut, and cassava plants that I grow don't require a lot of labor, so the presence or absence of COVID-19 does not affect the use of labor"*

*(Male, 55 years old)*

The majority of respondents (86.5%) believe that the COVID-19 pandemic has had no effect and poses no challenges (average score  $1.2 \pm 0.56$ ) to their ability to plant crops in the coming season. Farmers did not adjust their agricultural systems throughout the outbreak. During the rainy season, rice was grown, while maize and other crops were grown during the dry season. However, some respondents state that they are facing major and severe challenges in planting tobacco during the pandemic due to a lack of capital. They can borrow money from relatives who work as migrant laborers, although it's a little more difficult during the pandemic.

*"What will be planted in the next growing season is not"*

*affected by this pandemic. Before, and for more than a year in the state of COVID-19, everything was normal. We will continue to grow rice, corn, peanuts, and chili, as usual"*

*(Male, 71 years old)*

Almost half (49%) of respondents believe that there was a minor effect (average score  $3.0 \pm 1.14$ ) on food storage during the pandemic. Similarly, the effect on transportation of agricultural products (average score  $3.10 \pm 1.11$ ) and the restriction of markets for selling crop products (average score  $3.10 \pm 1.05$ ). During the pandemic, some respondents kept extra food on hand to be safe, as well as because some harvests were not sold to the market due to transportation issues and market limits.

*"There are restrictions on going in and out of Madura; you have to take a COVID-19 nasal swab test, which takes extra time and is inconvenient"*

*(Female, 43 years old)*

*"Since the implementation of the Large-Scale Social Restrictions (PSBB), market operating hours have been limited. Prior to COVID, I could sell peanuts and corn at the market until 12 p.m., but since COVID, I can only sell until 10 a.m., and the number of buyers has also decreased"*

*(Female, 43 years old)*

Most of respondent (77.75%) agree that there is no effect and challenges of COVID-19 pandemic to an access of inputs for livestock and only four respondent (1%) states that they have severe effect. More than a half of respondent states that there is also no

effect on feeding livestock. The average score off the effect on feeding ( $2.1 \pm 1.3$ ) is higher than access inputs ( $1.5 \pm 0.5$ ). Chicken and cattle that most raised by the farmer not feeding by company feed, furthermore the increasing of feed price and another livestock input not affect to the farmer. Chickens left to forage on their own in the yard are sometimes given leftovers and a little corn or rice from the harvest. Cows are fed with wild grass in the fields, or elephant grass, and other forages from several food crops such as stalks of corn, rice, peanuts, etc. Since the pandemic, the price of poultry and bird feed has risen.

*"I keep several birds, and I'm starting to feel the corona effects, notably the rise in bird feed prices"*

*(Male, 65 years old)*

*"The rise in animal feed prices as a result of COVID does not perplex us. Our cattle are fed elephant grass that I grow in our home garden, and my hens don't require industrial feed because they can forage for themselves"*

*(Male, 44 years old)*

In terms of the impact on livestock product sales, there are two dominant trends in farmer perceptions, from moderate to major. Nearly half of the respondents (49%) stated that a year ago, the COVID pandemic had a major impact, and 27% said it had a minor impact, and the average score was  $3.2 (\pm 1.0)$ . The farmer sells their livestock in two ways: through the middle man (for cattle and goats or sheep) and directly in the traditional market (for chicken, duck, and birds). Then Due to the pandemic, some traditional markets were restricted, decreasing purchasing power (Tripathi et al., 2021).

*"When I ran out of money, I went to the market and sold chickens, ducks, eggs,*



*and other garden products. However, because of the corona, the market is quieter, there are fewer buyers, and they occasionally bid at a low price”*

*(Female, 53 years old)*

Farm income is the most affected by the COVID-19 pandemic, which has an average scale of 3.76, ranging from moderate to major impact. The pandemic had a significant impact on more than half of the people (63.5%). The problem of accessing input and selling the product directly impacts the farm's income. This finding supports previous studies that found COVID-19 has effects on household income loss (LUO et al., 2020).

*“Because of CoVID-19, the middleman bought our chili peppers at a lower price, lowering my income”*

*(Female, 39 years old)*

*“I think there will still be an impact from COVID. Finding fertilizer is difficult and expensive, the price of crops is falling, labor must also be paid, and finally, our income is reduced”*

*(Male, 51 years old)*

## CONCLUSION

The agriculture system in Madura Island is affected by the agro-climate that is dominated by dry land. Corn and rice are the main staple foods, and tobacco is the most common economic crop. This study reveals that there was a minor to moderate effect of the one-year COVID-19 pandemic on the agricultural system. The biggest impact is on farm income, while the ability to plant crops in the upcoming season becomes the smallest one. This study only covers a small island. This study only covers a small location. Due to the variability of agro-climate,

geographic, and socio-demographic conditions in many parts of Indonesia, this study needs to be followed up in another location.

## ACKNOWLEDGEMENT

The researchers extend their gratitude and appreciation for the valuable insights to all the participants, research assistants, and stakeholders engaged in this study. The first author extends her gratitude to the Taiwan International Cooperation and Development Fund (Taiwan-ICDF) for providing funding for the study in the PhD program in the Department of Tropical Agricultural and International Cooperation (DTAIC).

## REFERENCES

- Abidin, Z. (2020). Islamic Philanthropy and Covid-19 Pandemic Crisis: The Socio-Economic Role of Nahdhatul Ulama. *Al-Uqud: Journal of Islamic Economics*, 5(1), 166–183. <https://doi.org/10.26740/al-uqud.v5n1.p166-183>
- Bauza, V., Sclar, G. D., Bisoyi, A., Owens, A., Ghugey, A., & Clasen, T. (2021). Experience of the covid-19 pandemic in rural odisha, india: Knowledge, preventative actions, and impacts on daily life. *International Journal of Environmental Research and Public Health*, 18(6), 1–17. <https://doi.org/10.3390/ijerph18062863>
- BPS-Indonesia Statistic Government Office. (2021). *East Java province in figures 2021*. BPS-East Java Province. <https://jatim.bps.go.id/publication/2021/02/26/78c43a895e7f8ea378ffafc4/rovinsi-jawa-timur-dalam-angka-2021.html>
- Cevher, C., Altunkaynak, B., & Gürü, M. (2021). Impacts of covid-19 on agricultural production branches: An investigation of anxiety disorders among farmers. *Sustainability (Switzerland)*, 13(9), NAs. <https://doi.org/10.3390/su13095186>
- Djalante, R., Lassa, J., Setiamarga, D., Sudjatma, A., Indrawan, M.,

- Haryanto, B., Mahfud, C., Sinapoy, M. S., Djalante, S., Rafliana, I., Gunawan, L. A., Surtiari, G. A. K., & Warsilah, H. (2020). Review and analysis of current responses to COVID-19 in Indonesia: Period of January to March 2020. *Progress in Disaster Science*, 6, 100091. <https://doi.org/10.1016/j.pdisas.2020.100091>
- Elsahoryi, N., Al-Sayyed, H., Odeh, M., McGrattan, A., & Hammad, F. (2020). Effect of Covid-19 on food security: A cross-sectional survey. *Clinical Nutrition ESPEN*, 40, 171–178. <https://doi.org/10.1016/j.clnesp.2020.09.026>
- Faridz, R., & Pramoedyo, H. (2018). Indexes and Sustainability Status of Availability Madura Tobacco. *Agriekonomika*, 7(2), 197–209. <https://doi.org/10.21107/agriekonomika.v7i2.4784>
- Fauziyah, E. (2020). Risk Associated with Corn Farming in Madura Island. *Agriekonomika*, 9(1), 90–99. <https://doi.org/10.21107/agriekonomika.v9i1.6898>
- Hefni, M. (2008). Local Knowledge Masyarakat Madura : Sebuah Strategi pemanfaatan Ekologi Tegal Di Madura. *Karsa*, 14(2), 131–141.
- Hikmawati, I., & Setiyabudi, R. (2021). Epidemiology of COVID-19 in Indonesia: common source and propagated source as a cause for outbreaks. *Journal of Infection in Developing Countries*, 15(5), 646–652. <https://doi.org/10.3855/JIDC.14240>
- Jackson, R. (1991). Development of water user association on the Madura Groundwater irrigation project, Indonesia. In *Angewandte Chemie International Edition*, 6(11), 951–952.
- Jámbor, A., Czine, P., & Balogh, P. (2020). The impact of the coronavirus on agriculture: First evidence based on global newspapers. *Sustainability (Switzerland)*, 12(11), 1–10. <https://doi.org/10.3390/su12114535>
- Khairad, F. (2020). Sektor Pertanian di Tengah Pandemi Covid-19 Ditinjau dari Aspek Agribisnis. *Journal Agriuma*, 2(2), 82–89. <http://www.ojs.uma.ac.id/index.php/agriuma/article/view/4357>
- Liu, Y. L., Zhu, K., Chen, Q. Y., Li, J., Cai, J., He, T., & Liao, H. P. (2021). Impact of the covid-19 pandemic on farm households' vulnerability to multidimensional poverty in rural china. *Sustainability (Switzerland)*, 13(4), 1–16. <https://doi.org/10.3390/su13041842>
- LUO, R. fu, LIU, C. fang, GAO, J. jing, WANG, T. yi, ZHI, H. yong, SHI, P. fei, & HUANG, J. kun. (2020). Impacts of the COVID-19 pandemic on rural poverty and policy responses in China. *Journal of Integrative Agriculture*, 19(12), 2946–2964. [https://doi.org/10.1016/S2095-3119\(20\)63426-8](https://doi.org/10.1016/S2095-3119(20)63426-8)
- Maylinda, S., Iriany, A., Mashudi, & Mulyanto, A. D. (2019). Analysis of feed carrying capacity for ruminant livestock in Madura Island, Indonesia. *Journal of Rangeland Science*, 9(3), 313–318.
- Megasari, N. L. A., Utsumi, T., Yamani, L. N., Juniastuti, Gunawan, E., Furukawa, K., Nishimura, M., Lusida, M. I., & Mori, Y. (2021). Seroepidemiological study of SARS-CoV-2 infection in East Java, Indonesia. *PLoS ONE*, 16(5 May), 1–9. <https://doi.org/10.1371/journal.pone.0251234>
- Middendorf, B. J., Faye, A., Middendorf, G., Stewart, Z. P., Jha, P. K., & Prasad, P. V. V. (2021). Smallholder farmer perceptions about the impact of COVID-19 on agriculture and livelihoods in Senegal. *Agricultural Systems*, 190(February), 103108. <https://doi.org/10.1016/j.agry.2021.103108>
- Ministry of agriculture. (2021). *Analisis Ketahanan Pangan Tahun 2021*.
- Muhyiddin, M., & Nugroho, H. (2021). A Year of Covid-19: A Long Road to Recovery and Acceleration of

- Indonesia's Developmen. *Jurnal Perencanaan Pembangunan: The Indonesian Journal of Development Planning*, 5(1)(1), 1–19. <https://doi.org/10.36574/jpp.v5i1>
- Nikmah, A., Fauziyah, E., & Rum, M. (2013). Productivity analysis of hybrid corn farm in Sumenep Regency. *Agriekonomika*, 2(2), 96–107.
- OCHA, U. N. O. for the C. of H. A. (2020). *Indonesia Multi-Sectoral Response Plan to COVID-19* (Issue May-October). <https://reliefweb.int/report/indonesia/indonesia-multi-sectoral-response-plan-covid-19-may-october-2020>
- Paganini, N., Adinata, K., Buthelezi, N., Harris, D., Lemke, S., Luis, A., Koppelin, J., Karriem, A., Ncube, F., Aguirre, E. N., Ramba, T., Raimundo, I., Sulejmanović, N., Swanby, H., Tevera, D., & Stöber, S. (2020). Growing and eating food during the COVID-19 pandemic: Farmers' perspectives on local food system resilience to shocks in Southern Africa and Indonesia. *Sustainability (Switzerland)*, 12(20), 1–26. <https://doi.org/10.3390/su12208556>
- Rozaki, Z. (2020). COVID-19, agriculture, and food security in Indonesia. In *Reviews in Agricultural Science* (Vol. 8, pp. 243–261). [https://doi.org/10.7831/ras.8.0\\_243](https://doi.org/10.7831/ras.8.0_243)
- Safitri, Y., Ningsih, R. D., Agustianingsih, D. P., Sukhwani, V., Kato, A., & Shaw, R. (2021). Covid-19 impact on sdgs and the fiscal measures: Case of Indonesia. *International Journal of Environmental Research and Public Health*, 18(6), 1–22. <https://doi.org/10.3390/ijerph18062911>
- Setiani, S., Setiawan, E., & Huang, W. (2022). Plant Diversity and Utilization of Traditional Home Garden in Bangkalan District, Madura Island, Indonesia. *Russian Journal of Agricultural and Socio-Economic Sciences*, 2(February), 91–99. <https://doi.org/10.18551/rjoas.2022-02.11>
- Sevindik, I., Tosun, M. S., & Yilmaz, S. (2021). Local response to the covid-19 pandemic: The case of Indonesia. *Sustainability (Switzerland)*, 13(10). <https://doi.org/10.3390/SU13105620>
- Tosepu, R., Gunawan, J., Effendy, D. S., Ahmad, L. O. A. I., Lestari, H., Bahar, H., & Asfian, P. (2020). Correlation between weather and Covid-19 pandemic in Jakarta, Indonesia. *Science of the Total Environment*, 725. <https://doi.org/10.1016/j.scitotenv.2020.138436>
- Tripathi, H. G., Smith, H. E., Sait, S. M., Sallu, S. M., Whitfield, S., Jankielsohn, A., Kunin, W. E., Mazibuko, N., & Nyhodo, B. (2021). Impacts of covid-19 on diverse farm systems in tanzania and south africa. *Sustainability (Switzerland)*, 13(17), 1–16. <https://doi.org/10.3390/su13179863>
- Yegbemey, R. N., Komlan Ahihou, C. M., Olorunnipa, I., Benali, M., Afari-Sefa, V., & Schreinemachers, P. (2021). Covid-19 effects and resilience of vegetable farmers in north-western Nigeria. *Agronomy*, 11(9), 1–16. <https://doi.org/10.3390/agronomy11091808>