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SMALLHOLDER FARMERS' CHALLENGES OF COPING WITH COVID-19 CONTAINMENTS: INSIGHTS FROM TWO FOOD REGIONS IN INDONESIA

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ABSTRACT

The COVID-19 pandemic has forced governments around the world to impose containment measures to prevent the rapid spread of the corona virus. The Indonesian government implemented "large-scale social restrictions," which have impacted farming and farmers' food security. Farmers are both producers and consumers of food and, therefore, have been facing new challenges due to transport restrictions, price spikes for inputs, price drops for their produce, or conditions which aggravated cooperation, such as social distancing. This study aims at analysing the challenges of the containments from a smallholder farmer perspective and examining farmers' coping potential. A digital survey with 323 farmers has been designed as comparative observational research in Toraja, South Sulawesi, and selected regions of Java. The Bonferroni Multiple Comparison Test was used to test for significance regarding socio-economic factors and space. A logistic regression model extracted determinants for crisis coping. Results reveal, that female farmers worry more about COVID-19 outbreak compared to men at a significant level. In contrast, male farmers, particularly in Java, are more concerned about social restrictions due to limited mobility. Food price spikes were reported in both regions, with sharp increases for fish, fruits, and vegetables in Java, for staples in Toraja, and for meat and sugar in both regions. Food groups, that trade through agents and brokers or are transported longer distances were affected most due to their complex and long supply chains that were disrupted during the restrictions. In Java, farmers face multiple shocks, of which climate change was reported even more often than the pandemic related shocks. Not being able to help each other on the farm due to social distancing is a significant concern of farmers in Toraja. As a result of food market disturbances, farmers began to grow and eat more vegetables and fruits. In conclusion, food security for farmers slightly decreased due to affordability, and market disruptions already point to long-term income losses. The study team recommends to promote smallholders' healthy food production, value addition and direct end-consumer linkages to build back better their livelihoods post-COVID-19.

Key words: COVID-19, food security, smallholder farmers, coping, food prices, Indonesia

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INTRODUCTION

The COVID-19 pandemic has already sparked a lot of research interest in a range of disciplines on the effectiveness of varying containment measures to stop the spread of the virus. Equally, a substantial research interest lies in the assessment of the broader effects of the measures on societies and economies in general. Since the pandemic requires decision-makers to weigh potentially far-reaching consequences against each other under extraordinary conditions, it is often the marginalised communities that bear the brunt of these decisions [1,2]. This study aims to shed light on the effects of COVID-19 containment measures on smallholder farmers' food production and consumption and the impacts on food security in two regions in Indonesia, the southern coast of Java and Toraja in South Sulawesi. In order to understand the context in which Indonesian smallholder farmers navigated the crisis, the study first briefly explores the COVID-19 measures in Indonesia. Then, an overall account of worldwide developments amidst the COVID-19 crisis showcases the global threats to global, national, and local food systems.

After initially downplaying the threat posed by COVID-19 in China, Indonesia began to take steps towards containment once the World Health Organisation (WHO) officially declared the virus outbreak a pandemic on 11 March 2020 [3,4]. Four days later, the President of Indonesia, Joko Widodo ("Jokowi") vaguely called for Indonesians to "work, study, and pray" at home, but did not issue a nationally binding order [3,5]. According to Widodo, his hesitance to implement a national lockdown was due to economic concerns [3,5]. On 31 March 2020, Jokowi signed Government Regulation No. 21/2020, after some local legislators already introduced their own restrictive measures in disregard of the central government [3]. The introduced measures were called Large-Scale Social Restrictions (PSBB - Pembatasan Sosial Berskala Besar). Their implementation has been regulated in the Ministry of Health Regulation No.9, signed on 3 April 2020, and regional governments decided on implementation based on the actual virus outbreak [6]. However, as was the case in most countries at the time, Indonesian's testing capacities could not fulfil the demand for accurate information on the spread of the virus.

In the first month of the pandemic, the restrictions included the closure of schools and workplaces. Worshipping and socio-cultural activities were not allowed in public any longer, or the activities were restricted to a limited number of people through the incorporation of social distancing. Border closures and check points restricted and controlled the movement of individuals and goods within regions. Exempted from these restrictions were the transport of essential goods, such as medical needs, food, and fuel, among others. Jakarta was the first regional government that implemented this partial lockdown, and three provinces, West Java, Gorontalo, and West Sumatera, along with 27 regencies of other provinces with rapidly increasing infections followed [7].

In late March 2020, the Indonesian government announced an economic relief package for citizens hit by the crisis. With a value of US$25 billion initially, it was increased to US$43 billion in May 2020 [3]. Overall, the containment strategy appears to be driven mainly by socio-economic concerns, rather than adequate protection of the population

from the virus. Yet, recent developments indicate increasing economic hardships for farmers. As the general food consumption reduced, farmers' current vegetable harvests exceeded demand and hence faced marketing challenges [8].

At the same time, and at a global level, the International Panel of Experts on Sustainable Food Systems, IPES Food, warned in their recent publication on COVID-19 and the food crisis of the further impact of the corona virus restrictions on the food systems [9]. The disruptions caused by the COVID-19 containment measures are external shocks showing that food systems are much more vulnerable than expected for several reasons, such as institutional challenges, socio-economic inequalities, or the stress imposed by the impacts of climate change [9]. With regard to the global food system, IPES Food identified three destabilising factors which cause food insecurity for millions of people: industrial agriculture and monocultures, global food supply chains, and the already high level of hunger of smallholder farmers as such. Industrial agriculture and monoculture cause habitat loss and enable conditions for viruses to spread faster [10,11]. In Indonesia, paddy rice systems cause already negative environmental impacts through excessive use of chemical fertiliser and pesticides, causing biodiversity loss and soil degradation [12].

Global food supply chains are volatile to external and unexpected shocks, COVID-19, argues IPES Food. Even less complex and shorter supply chains were affected, with lots of perishable vegetables being wasted, like in townships of Cape Town, South Africa, where data collection also took place. The country imposed one of the strictest lockdowns in the world, with stringent curfews, where informal traders and smallholder farmers were not allowed to obtain required permits to work in their food gardens. This led to unharvested food rotting in the fields [13]. On the other hand, extended supply chains usually include complex movements of people, goods, and services, and travel restrictions resulted in very sudden disturbances. Panic buying and hoarding of pasta in Italy resulted in the massive transportation of pasta by large discounters to Germany, where stockpiling of pasta and other food caused empty shelves in both countries [14]. Import bans caused price spikes in countries depending on food imports. This is also an issue in Indonesia, as the majority of the country's garlic (95%), sugar (55%), and beef (24%) consumed were imported in 2018, for example [15]. As a consequence of sky-rocketing garlic prices at the beginning of the pandemic, the Ministry of Trade eased import restrictions [15].

The third aspect that renders food systems' vulnerability is the severe level of hunger worldwide. According to the World Hunger Index, even though the level of hunger continually decreases, Indonesia is still ranked in the category of "serious level of hunger," together with 43 out of 117 countries [16]. Although smallholder farmers are the primary producers of food, they and the rural landless are disproportionately affected by hunger and food insecurity. During the crisis, it is expected that the diets of those who are already at the edge of hunger and malnutrition are particularly diminishing in quality (less nutritious, less diverse).

While COVID-19 monitoring provides information on confirmed and recovered cases and deaths, not much evidence exists regarding the pandemic and its containment from

a farmers' perspective. Hence, this study engages with smallholder farmers' perceptions during the pandemic and aims at increasing the visibility of their challenges, daily struggles, and their coping strategies. Overall, this paper aims to investigate the impacts of COVID-19 on two rural food regions in Indonesia. The following research questions are guiding this paper:

1. How do the containment measures impact the livelihoods of smallholder farmers in both regions? What are differences related to gender, age, and education?
2. In which way do COVID-19 containment measures affect the household's diet and food consumption after two months of PSBB? Are there differences between both regions, as well as for gender, age, and education?
3. Which strategies do farmers develop to cope with the new normal? Are there differences between regions, gender, age, and education? While coping with the situation, which support do farmers receive from outside?

These questions are discussed against the backdrop of three principal aspects that make food systems resilient or less vulnerable according to IPES Food, which were outlined above: a) the ecological aspect of production, b) the resistance of food supply chains against shocks, and c) the overall food security of farmers in both regions.

LITERATURE REVIEW

This study builds on the theory of risk coping and behavior change in times of a crisis by looking through the lens of smallholder farmers [17,18,19]. The community-driven transdisciplinary research approach was deliberately chosen to address challenges in this rapidly changing reality and to disseminate solutions and local coping strategies among participating smallholder farmers. The household economics literature often refers to risk-coping strategies with the household's aspiration to smooth out consumption, maintaining the marginal utility of consumption [20]. To do this, different risk-coping mechanisms come into play. For smallholder farmers in developing countries, there are three common resource mobilisation or consumption reduction coping strategies. The first category comprises behaviour change, like working extra, diversifying agricultural portfolios, reducing consumption and substituting crops. The second category is used by better-off farmers, and consists of asset liquidation or using savings. A third category includes assistance from outside, by seeking support through social networks or government programmes [21]. Several studies from sub-Saharan Africa and Asia reveal that typical farming household's consumption smoothing strategies are sale of livestock, the use of community or social networks to share risks, and looking for wage income and off-farm activities, the latter particularly true for poor farmers [21,22]. An example for searching off-farm income opportunities is the Asian financial crisis in the late 1990s. Many smallholder farmers entered the labor market for additional employment despite the drop in real wages [22].

Shocks like the COVID-19 pandemic, or stress factors such as climate change, entail unpredictable production and marketing shocks that put smallholder farming

increasingly under pressure. Strengthening the resilience of smallholder farming systems is therefore a priority area for action in crisis response [23,24,25]. The nature of this pandemic challenges to consider behavioral change and crisis response mechanisms that go far beyond smoothing out consumption and resource mobilization. Therefore, this study applies a modified behavior change framework as outlined by Béné [26]. His paper defines resilience as an opportunity to alleviate existing fault lines and to build coping, adaptive, and transformative capacity. In this study, smallholder farmers' resilience building is a means to ameliorate a future uncertainty, for example to better cushion with production and marketing shocks. Moreover, it includes farmers' consumption patterns and food environments. Resilient food systems and consumption are a way not to jeopardise food security by mitigating the multiple effects of a shock including its ripple effects through containment measures restrictions.

METHODS

Study region

The Indonesian study areas are located in the densely populated southern coast of Java and the remote mountainous Toraja in South Sulawesi Province. Both food regions are predominantly rural and touristic areas. In Java, most smallholder farmers (81%) also generate off-farm income. However, farming is their main livelihood strategy, with paddy rice, vegetables, coconuts, bananas and poultry (chicken, ducks) playing an important role. Farms are just above sea level on 5 to 32 m. Most of the villages' populations in Toraja raise income from agriculture, with 44% of farmers also generating some off-farm income. The topography of the upland hills is highly suitable for perennial crops such as coffee, cocoa, and cloves with lowest altitudes of 700 m and highest altitudes of 1,646 m. Annual crops like rice, chili and vegetables are common, and most smallholders raise pigs in their backyard.

Sample and data collection

An international and interdisciplinary consortium of co-researchers (farmers), and scientists co-developed the survey within the frame of the project *"*COVID-19 measures: co-research on impacts on local food systems in Indonesia and Southern Africa*"* in March 2020, aiming at documenting the first weeks of lockdowns in four countries. The survey was employed using a mobile phone-based data collection approach targeting smallholder farmers of age 18 and above. This paper only considers data from two rural regions in Indonesia. A stratified snowball sampling strategy was used where the region constituted our strata. The Toraja region included smallholder farmers of two regencies, Tana Toraja and Toraja Utara. The southern coast of Java region included farmers from 13 regencies of West Java, Central Java, and Yogyakarta. On-site research coordinators contacted smallholder farmers through existing social networks. To comply with research ethics, study participants were not asked to name other potential farmers, but encouraged others to fill in the questionnaire. Co-researchers acknowledged that the questions were not distressing or embarrassing, and therefore the sampling method and the survey as such were not problematic from an ethical standpoint. Farmers were even highly motivated to come forward. In Java, the survey was disseminated from farmer to farmer through WhatsApp. In Toraja, village motivators supported the dissemination of the survey link by telephone. Motivators

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assisted data collection by visiting the farmers or by calling them. In total, 323 farmers completed the digital questionnaire (Table 1).

The smartphone-based digital survey covered four weeks in April 2020 and a final round in the first week of June. For this paper, only the data of the June survey are analysed. The used KoboToolbox app. was developed by the Harvard Humanitarian Initiative as open-source app. that allows remote research in challenging environments and during humanitarian crises. Indonesian partner researchers had previous experience in using it for surveys. The app. provides different functions, such as the possibility to send text, to prioritise, to answer with text, to submit geo-data or to send photos. The survey included 56 questions (single-choice, binary, multiple-choice, open-ended, demographic, and likert-scale). The farmers received a link and submitted their questionnaire to the KoboToolBox. The survey language was Bahasa Indonesia. A resident facilitator set up a WhatsApp group with the participating farmers, which grew over the survey period of four months. Through this group, questions of farmers were answered and survey instructions provided. This channel enabled the team to monitor the progress of the data collection. It was also used to inform about major results. Data were anonymised before being shared. Survey participants were supported with mobile phone data to cover communication costs. Limitations of the study are acknowledged. First, only smallholder farmers who own a smart phone could participate in this survey. This may result in a bias towards better-off smallholder farmers. In remote areas, mobile data networks were weak, and surveys of very remote locations could not always been submitted. Due to these biases and the chosen sampling method, the representativeness of this study is limited. However, we believe that it gives valuable insights on the COVID-19 situation in two distinct rural regions using first-hand survey data.

Survey design

The study can be classified as observational comparative research of two food regions in Indonesia. It builds on a two-track research strategy which combines data from a digital survey with a participatory approach that involves farmer organisations to interpret the results and encourage farmers to share their crisis response strategies.

Co-research with smallholder farmers

This co-research involved smallholder farmers at all steps of the research process, from the definition of the research question, data collection, contextualisation of results to the presentation of findings. By doing this, the co-research consortium aims at social inclusion and mutual learning, the two inherent features of action research [27,28,29]. Observational knowledge and the farmers' lived experiences were combined with academic knowledge through regular exchange. The multi-country lens with co-researchers from the farm community allowed for a South-South exchange between Indonesia and southern African countries and mutual learning in times of the crisis. After the end of the project, the consortium continued to work on out-scaling results to the wider community and on up-scaling to policies and new research concepts.

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Data analysis

Qualitative data which was obtained by open-ended questions, were translated from Bahasa Indonesia into English. The answers were coded inductively, on the basis of the provided text material. Quantitative data were cleaned, and analysed in SPSS. Normality tests and correlations were conducted. These tests revealed that a normal distribution cannot be assumed for all variables.

In a first step, means and standard deviations for the impact of COVID-19 on livelihoods, food price and consumption patterns, challenges related to farming and feeding the family and coping strategies were calculated. As explanatory variables, gender, age, and education were chosen inspired by previous studies in South East Asia [30]. The variable 'age' was transformed into a variable with four categories. For the level of 'education', a variable with three categories was formulated. The hypothesis of the study is that the male and female farmers perceive the crisis differently, and region, age and education also influence their perception. In a next step, livelihood challenges towards farming and food were analysed.

The significance tests were conducted with the Bonferroni Multiple Comparison Test in STATA. To check the robustness of the significance results, the non-parametric Kruskal-Wallis test was run. As the significance levels were the same for both tests, a certain robustness of the results can be assumed.

A logistic regression was run to analyse the relationship between the coping capacities and the determining factors as a response to the pandemic. Coping capacities are modelled as a binary variable with 1= at least one solution adopted and 0= no solution adopted and calculated as the dependent variable using logarithmic regression. As explanatory variables, the model uses the selected socio-demographic variables (region, gender, age, and education). The model also included the main farming challenges, the food security status, and supporting networks as explanatory factors (Table 4). In total, the model builds on four categories of explanatory factors. Four categories are based on 16 specific variables to explain what determines the likelihood that a farmer adopts a coping strategy to as crisis response. The first category includes the household socio-demographics described above. The second category contains the shocks farmers are exposed to. These shocks were clustered into the environmental, economic, and COVID-19 related shocks described in the result chapter in Figure 1. It was hypothesised that an exposure to each kind of shock will encourage farmers to become active to develop solutions in the current crisis. The third category outlines the food security challenges, presented in Figure 2. Farmers were directly asked to name food security challenges. Here, the study team referred to three pillars of food security: is food still available, is food still affordable, and is food still accessible. In the model, the food security status is included as determinant for adopting coping strategies, because solutions are only developed when one is aware of the problem. A fourth category comprises the external support the farmer receives from government and NGOs, and it was hypothesised that external support and food aid would reduce the own coping capacities developed autonomously by farmers.

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RESULTS AND DISCUSSION

Socio-demographic characteristics

Of the 323 smallholder farmers a bit more than half of the respondents were female (Table 1). The household size was larger in Toraja, with almost five persons on average compared to four persons on average in Java. With an average age of 43 years, more than half of the respondents have graduated from junior or senior high school, a quarter from elementary school, and 12% had a higher education. Six percent did not graduate from a school. Responding farmers rather worry about COVID-19 in both regions, of which Toraja smallholder farmers worry slightly more than farmer respondents in Java. However, farmers in Toraja perceive the social restrictions less inconvenient than respondents in Java. For the majority (84%) in both regions, there is enough food available as well as accessible. In terms of food affordability, however, small farmers had a very different view. More than half (64%) said that food was now less affordable.

COVID-19 containment measures and impact on livelihoods

Social distancing and worries about COVID-19

It was hypothesised that people in the more densely populated rural region of Java and women in particular worry more about COVID-19 than the population in remote rural areas and man. Indeed, results indicate that women farmers worry more about COVID-19 compared to men (p <0.001). Contrary to our assumption, farmers in Toraja tended to be more concerned about COVID-19 (p <0.001). Farmers in Toraja worried very much, even though the first case of COVID-19 occurred only at the end of April. However, in June the district government announced the implementation of check-points in each village. At each gate, passengers were asked to wash their hands and to use disinfectants. Some villages also sanitised motorcycles and cars, or even used the disinfectant sprayer for passengers themselves.

It was assumed that in the region with stricter social restrictions, farmers would also feel worse about PSBB. Moreover, men in Indonesia are more present in public places, in logistics, and in social gatherings, all of which are primarily affected by containments. One could assume that men have more negative feelings compared to women, and that they feel more restricted in their mobility. Consequently, the hypothesis was tested that farmers in Java feel worse about containment measures compared to farmers in Toraja. At a statistically significant level (p =0.094), the results confirm that farmers in Java felt worse about the large-scale social restrictions compared to those in Toraja. Farmers in Java are often engaged in work outside their farms, and travel restrictions and company shutdowns made this work and earnings impossible. Disagreeing with our assumption, there was no significant difference between genders. Yet, men seemed to be slightly more concerned on average about containment measures than women. Strikingly, education and age did not show any significant differences for both variables.

Access to farms and challenges

Indonesia is one the countries, like New Zealand, for instance, which treated farming as essential business and excluded farming activities from restrictions. Other countries, however, imposed very strict containment measures which did not allow farmers to visit their farms. It was hypothesised that the majority of farmers had access to their farms during PSBB, and men and women were affected similarly. Indeed, the results

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show no significant differences between regions and gender. On average, 96% of farmers had access to their farms (Table 1). The small minority who could not access their farms had land in another district. Border checks and traffic jams made commuting between two districts difficult. While farm access was not an issue at all, farmers in both regions reported that they lost access to their markets. Various other problems have been mentioned by farmers in response to an open-ended question regarding their challenges. Consequently, three clusters were derived inductively from these answers, namely (1) COVID-19 related challenges, (2) environmental, and (3) economic factors.

Figure 1a illustrates that environmental challenges are among the major concerns in Java. Weather and climate change, water stress, and the occurrence of pests and diseases were answered most frequently by almost half of the farmers (48%). COVID-19 related challenges, such as helping each other on the farm, market shutdowns, and the increasing prices of inputs, particularly fertilisers, were of equal importance. Common retail channels broke down and 16% of farmers reported about marketing problems. Already in June, disruptions and losses in purchasing power were evident, and has become much more acute later in 2020 [31]. In contrast, major challenges in Toraja (Figure 1b) were predominantly due to COVID-19, particularly related to social distancing. For almost half of farmers surveyed (45%), the restriction of working in groups was a major obstacle to carry out their field work adequately. As farmers were not allowed to gather and help each other on their farms, they faced challenges for example in producing compost in their community gardening place. As a consequence, they lacked organic fertilisers and delayed their planting activities. In general, farm activities are often labour-intense and still done without the use of farm machinery. Toraja farmers found the lack of mutual help to be a major problem. General farming problems, for example farmers' access to seeds, were also mentioned frequently. Surprisingly, 23% of farmers in Toraja said they faced no challenges at all, which was only valid for a very small number of farmers in Java (6%).

a) Java (n=114) b) Toraja (n=209)

Figure 1 a and b: Farming challenges during large-scale social restrictions in June 2020 in two food regions; the word clouds illustrate the more relevant challenges with larger characters; The font size was adapted to the frequency of the challenges

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Effect on food security, food prices and household food consumption

Household food security

Food security challenges were reported by 90 % of farmers in both regions, yet with no significant differences related to gender, age, and in most cases also education. On a multiple-choice questions on food availability, affordability, and accessibility to food markets, more than half of responding farmers stated that food affordability was a major concern (Figure 2). Price spikes for some goods, along with price falls due to excessive supply and loss of consumers or market closures, caused market imbalances with which farmers could not cope. Farmers' cash income from off-farm informal employment declined sharply, such as earnings from driving a taxi or from selling food on farmer markets broke away.

Nevertheless, physical access to food markets was perceived as a minor challenge, with less than a fifth of the respondents feeling a lack of accessibility. Surprisingly, it seems that higher educated farmers tended to have more difficulties in physically accessing their food markets compared to less educated farmers. Higher educated farmers might have different food purchase behaviour and buy food more often in restaurants or special markets which were often closed or limited in their operating hours. A large proportion of farmers with higher education (29%) could not consume their food as usual. This lack of access was only reported by 12% of farmers with elementary or junior high school certificates ($p=0.006$).

The unavailability of food was not ranked as important, which means that there was enough food available in the markets. Overall, Figure 2 illustrates that Toraja farmers did not experience a worse situation regarding food security during the PSBB compared with Java, even though Toraja faces a higher prevalence of stunting [32]. In another question, the survey asked how often farmers had limited their food intake over the past month. Because of market disturbances, Java and Toraja farmers limited their food intake quite differently. One third of respondents in Java (33%) and 50% of farmers in Toraja admitted a reduction in meal size and quality. More specifically, the survey shows that one quarter of farm households in Java reduced their food portions/food diversity rarely (one to three times per month). This was more pronounced in Toraja. Here, one quarter of farm households indicated that they reduced their food two to three times per week.

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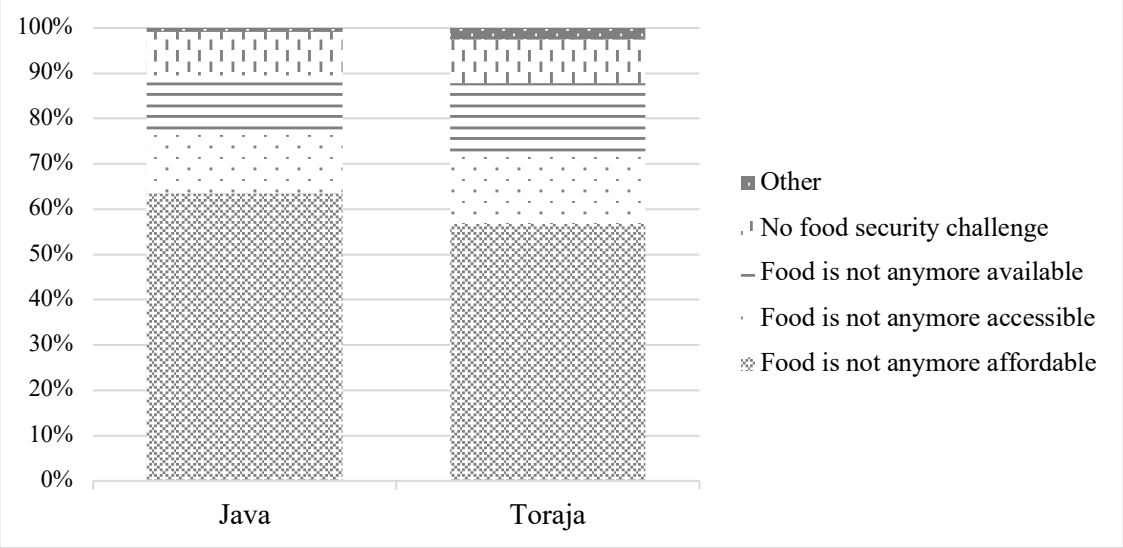

Figure 2: Major challenges of food security perceived by farmers in Java (n=114) and Toraja (n=209) in June 2020

Food price development

Overall, food prices spiked in both regions. The majority of farmers in Java (91%) perceived food prices on the rise, compared to 69% in Toraja, with the difference being highly significant ($p < 0.001$). This stark difference can be largely explained by the prevailing food systems of the distinct regions. The research site in Java is a densely populated peri-urban region with rather formalised and integrated food supply chains, where local farmers act merely as producers of rice and some other products. As consumers, however, farmers largely depend on buying most food groups, apart from staples and some vegetables from kitchen gardens. Fruits, vegetables and fish are distributed by agents and rarely marketed directly by farmers.

A sharp price increase was observed for meat in both regions (Table 2). On the other hand, price drops for chicken were reported later due to oversupply and reduction in demand. People avoided the consumption of chicken meat due to their concerns and experiences on the spreading of the virus through contaminated poultry or living birds. A significant difference was observed for fish, staples, vegetables, fruit, and sugar. Price increases were higher for fruits, vegetables, and fish in Java, as these food groups are distributed by a brokerage and agent system. In Toraja, the prices for sugar and staples increased much more in comparison with Java. These goods are imported from the capital of South Sulawesi, Makassar, where large-scale social restrictions brought the export to Toraja to a standstill. Moving of goods was limited, and rice and sugar came in smaller quantities to the region. Prices for locally grown products provided directly from farms, like fruits and vegetables, reportedly did not increase a lot.

Household food consumption

Smallholder farmers in Indonesia largely belong to the poorer strata of the country's population, for which the price elasticity of demand for the more expensive food groups (meat, fish, oil, fruits) is negative [33]. This means that if the price increases by 1%, the demand decreases by more than 1%. This inverse relation is less pronounced for staples

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and grains, as these count as basic needs and cannot be further reduced unless the household reduces the portions or number of meals. For vegetables, it is difficult to estimate, as these are partly produced in gardens or foraged in the wild and might be a cheap plant-based substitute for meat and fish to diversify the staple-based meal in times of shortage.

These considerations lead to the following two hypotheses. First, farmers have reduced the consumption of more expensive food (meat, fish, and oil) and have increased their consumption of staples and vegetables. Second, the more affluent farmers in Java have reduced their meat, fish, and oil consumption to a lesser degree than the farmers in Toraja. The results illustrated in Table 3 reveal that the majority of farmers in Java (83%) and Toraja (95%) reduced their meat and to a lesser extent their fish consumption (Java: 44%, Toraja: 55%). The results from Java also disclose that farmers' meat and fish consumption decreased less in comparison with Toraja at varying significant levels ($p<0.001$ for meat, $p=0.067$ for fish). Oil consumption decreased rather unambiguously. In fact, 22% farmers in Toraja reduced their oil consumption, while only 5% reported a decline in Java ($p<0.001$). On the other hand, a considerable proportion of farmers in Java (17%) reported having increased their oil consumption. In Toraja only very few farmers (1%) increase oil consumption, which was tested at a lower significance level ($p = 0.062$). In general, the daily diet shifted to more staple food consumption to meet the required caloric intake, which has been found highest in Java, where 70% reported to having eaten more staples compared to 46% in Toraja. The results suggest significant differences for both regions ($p<0.001$ and $p=0.051$). Vegetables were eaten more often in both regions. In Toraja, even more farmers have consumed more vegetables compared to Java ($p=0.017$). This may be related to the health benefit of vegetables, providing vitamins and other micronutrients, as Toraja farmers expressed their worries about the impact of coronavirus on their health status. Almost half of farmers in Toraja consumed more fruits, probably for the same reason, which was not the case in Java. Here, farmers reported that fruit prices have risen the most compared to the other food groups (Table 2). The price elasticity of demand effect probably outweighed the health benefit. Sugar, which is a major import product from Thailand, Australia, and China showed rising prices earlier in 2020. The consumption has been equally reduced by approximately one-quarter of the respondents in both regions. Higher prices due to import and transport restrictions could explain the general reduction, which can be regarded as a positive sign towards the aspiration of a general less sugary, and therefore healthier diet.

Capacities to cope with COVID-19

This research was initiated by a co-researcher, an urban farmer from South Africa, who did not want to see herself as a passive victim of COVID-19, but rather as a responsive actor overcoming the pandemic and its threat to local food systems [13]. The Indonesian partner institutions who co-author this study investigated this motivation within their farmer networks and found that Indonesian smallholder farmers had similar aspirations to participate in the project. Even though market disruptions affected them considerably, farmers wanted to show their competences in building forward better their local food systems. Coping strategies were mentioned by 49% of the farmers in Toraja and 14% in Java. With a wide range of primarily autonomously implemented

strategies, farmers coped with food market disruptions by growing more food, expanding their gardens, and shifting to healthier diets to strengthen their immune systems. They bought cheaper foods and spent less money on processed food and paid more attention to food safety [34]. Overall, almost half of the farmers responded with at least one of the above-mentioned coping strategies with significant differences between both food regions (p<0.001). The solution space in Java was smaller than in Toraja. Java was hit hard by market disruptions, and farmers sharply decreased their sales and lost their off-farm income due to restrictions. This result is contrary to what was observed during the Asian financial crisis, where smallholder farmers flocked to the labour market to smooth out consumption [22]. In this pandemic, restrictions did not allow labour migration and farmers rely on their own resources and networks. Generally, farmers in Java are more dependent on modern food supply chains and on the labour market for their income compared to the farmers in Toraja, who often maintain a neighbourhood subsistence system to fulfil their basic needs. Their cash income largely derives from plantation crops, such as coffee, cocoa, cloves, but also vanilla, pepper, and cinnamon, which was not affected by market disturbances in early June 2020.

Coping strategies were undertaken mainly with the help of social networks, particularly within the family or within their communities. Nevertheless, a majority of farmers in Toraja, and to a lesser extent in Java, received support from the government or NGOs, in the form of food aid, food kitchens, cash transfers, hygiene, or security support. To mention one example, 47% of farmers received cash transfers, and the significance tests show that more farmers in Toraja (p<0.001), more women (p=0.006), and more of the less educated farmers (p=0.015), received cash support during the pandemic in May and June. These results could indicate that the COVID-19 government support package has been implemented in a fairly socially inclusive manner.

Determinants of coping capacities

Farmers in Toraja tend to be stronger in adopting solutions. One reason could be the tendency of subsistence farmers to also count modest and less spectacular solutions, such as changing diets, which have not been often mentioned in Java. Another explanation could be the general isolation of Toraja's farmers, their reliance on local capacities, and their remoteness from the COVID-19 hotspot capital Makassar, which is one day's travel away. Another reason for Toraja's coping capacity could be the primarily locally rooted food economy, which might be a weakness in standard times but turns out to be a strength during the pandemic. The fault lines of modern supply systems are more obvious in the peri-urban Java region. There are many examples of promoting monocropping by agricultural extension services, the commercialisation of all farm products, while neglecting production for own consumption. Moreover, there is the dependency on brokerage systems which supply large processors and retailers. A second powerful determinant was the affordability of food. Farmers were urged to extend their gardens to grow vegetables or change diets by eating smaller quantities, less diverse food, and less meat and fish to survive this economic slowdown. The model also suggests that less physical access to markets and a loss of traditional market channels have encouraged and forced farmers to implement solutions. By growing more food in their own gardens, by eating more fruits and vegetables, or by changing to

a healthier diet, the more costly convenience food was less consumed. Overall, having been affected by COVID-19 challenges has forced many to find new solutions. In the long-run, problems like collapsed marketing channels may add additional stress-factors to farming in the next season.

Similarly, farms that face environmental challenges like water-stress, weather variability and climate change, and pests and diseases are also more likely to cope. The necessity to find new pathways in food production and consumption might be aggravated by the multiple stresses caused by COVID-19 as a short-term shock, its economic consequences and in the long-run the stress factors imposed by environmental problems farmers are facing, above all climate change.

The model further explains that younger and better educated farmers are more likely to adopt solutions compared to older farmers and those with a lower education. They might have better capacities and flexibility to change diets or to invest with more labour and land and were able to extend their gardens for other crops. A similar development can be observed in other countries, as gardening and own food production has become a major activity in many countries worldwide since this pandemic was declared.

Whether farmers ultimately cope or not, according to the model, was affected by receiving cash support from the government/NGOs. This relation is negative, which means those who did not receive support are more likely to cope. Generally, the literature suggests that an enabling environment and external support mechanisms would help people to cope. This may not be the case for the range of coping strategies here, as these are limited to easily implementable strategies (so called low-hanging fruits). Coping strategies that belong to the category of transformative adaptation strategies with the potential to reshape own local food systems, such as investing in soil fertility, setting-up of new market channels, or developing direct end-consumer relationships by digital marketing, may need more inputs and support to encourage farmers to build their own solutions. This has not been observed as short-term reaction in the pandemic, but might be a consequence of the pandemic and may shape the post-COVID food system.

CONCLUSION

This research aimed at discovering the challenges of smallholder farmers during the COVID-19 pandemic. Farmers from peri-urban Java region are much more affected by the crisis, as their farming systems are less oriented towards agroecology, food sovereignty, and less integrated into local and circular food economies. Farmers also operate in a smaller solution space due to higher population density, less available land, the loss of agrobiodiversity, and other problems caused by the impacts of climate change. COVID-19 related shocks such as price spikes for food and inputs are more pronounced. Farmers in the rural, remote Toraja practice traditional farming systems and demonstrate a certain degree of resilience to the crisis by finding simple solutions. Market disturbances and lack of affordable food both force them and allow them to implement solutions in their own family and community, such as by extending their gardens or changing their diets towards locally grown food.

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These results have significant policy implications. In densely-populated peri-urban areas like Java, policies to promote livelihood and food security of smallholder farmers may need to emphasise healthy food production for farming communities. Moreover, farmer associations could gain more influence by connecting directly to end-consumers. Direct marketing of vegetables, fruits, and fish through social media or own transport and logistic systems avoid becoming too dependent on brokerage systems. In regions with predominantly traditional farming systems like Toraja, disaster risk management should refrain from taking excessive precautions that hinder farmers to become active. Policies should rather focus on strengthening local food systems and improved possibilities to generate income through adding value to farm produce at local level. Also marketing through fair trade channels could be promoted. To grant smallholder farmers' innovative capacity and responsive action in times of crisis, it is implied that enabling policies offer a solution, but so do strong farmer networks and collective action that foster mutual knowledge exchange and collaboration.

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Table 1: Socio-demographic characteristics of the sample

Variable	Java	Toraja	Both regencies
Sample size	114	209	323
Male/female respondents	73/41	81/128	154/169
Household size (persons)	4.08	4.97	4.66
Average age (years)	44	42	43
Education level			
High School	60%	54%	56%
Elementary	22%	30%	27%
Higher Education	18%	9%	12%
No school	1%	8%	6%
Worry about COVID-19 (scale 1 to 5)	3.1	3.6	3.4
Feel about social restrictions (scale 1 to 5)	3.0	2.8	2.9
Access to own farm	94.7%	96.1%	95.7%
Food is not anymore available	12.3%	18.2%	16.1%
Food is not anymore accessible	14.0%	17.2%	16.1%
Food is not anymore affordable	64.0%	64.6%	64.4%

Table 2: Food groups' price development as perceived by farmers in Java and Toraja, tested with the Bonferroni multiple comparison test. The answers for perceived price development were coded for the logistic regression as follows: price increased +1; same price = 0; price decreased -1. The numbers in the column could be interpreted as an overall positive increase

Food group	Java	Toraja	*p*	Significance
Meat	0.74	0.84	0.164	
Fish	0.67	0.28	**0.000**	****
Staples	0.5	0.68	**0.005**	***
Vegetables	0.65	0.12	**0.000**	****
Fruits	0.89	0.02	**0.000**	****
Oil	0.54	0.51	0.663	
Sugar	0.76	0.87	**0.025**	**

Level of significance: **** = 99.9% level of confidence; *** = 99%; **=95%

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Table 3: Food consumption reductions or increases by food groups as perceived by farmers in Java and Toraja, tested with the Bonferroni multiple comparison test. The numbers can be interpreted as the percentage of respondents reducing or increasing their food group consumption

Food group	Java	Toraja	*P*	Significance
Less meat	0.83	0.95	**0.000**	****
More meat	0.02	0.01	0.537	
Less fish	0.44	0.55	**0.067**	*
More fish	0.18	0.07	**0.004**	***
Less staples	0.02	0.07	**0.051**	*
More staples	0.7	0.46	**0.000**	****
Less vegetables	0.02	0.01	0.255	
More vegetables	0.85	0.93	**0.017**	**
Less fruits	0.44	0.14	**0.000**	****
More fruits	0.13	0.43	**0.000**	****
Less oil	0.05	0.22	**0.000**	****
More oil	0.17	0.1	**0.062**	*
Less sugar	0.21	0.25	0.338	
More sugar	0.11	0.1	0.705	

Level of significance: **** = 99.9% level of confidence; *** = 99%; **=95%; *=90% significant = bold

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Table 4: Logistic regression model to estimate the determinants of adopting coping strategies in the time of COVID-19 crisis. The model is relatively robust with a Pseudo R^2 of 0.2366. 77.57% of the cases are correctly classified

Number of observations	=	321
LR chi2(13)	=	100.14
Prob > chi2	=	0
Pseudo R2 Mc Fadden	=	0.2366
Sensitivity	=	68.07%
Specificity	=	83.17%
Correctly classified	=	77.57%

Coping capacities	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
Region (Toraja=1)	2,692	0,463	5,810	**0.000******	1,785	3,600
Gender (male=1)	0,058	0,291	0,200	0.843	-0,513	0,628
Age (continuous)	-0,021	0,013	-1,680	**0.094***	-0,047	0,004
Education (three level of low=1, medium=2, and higher=3)	0,530	0,306	1,730	**0.083***	-0,069	1,129
Environmental challenges (Yes=1)	0,798	0,464	1,720	**0.086***	-0,112	1,708
Economical challenges (Yes =1)	-0,453	0,392	-1,160	0.248	-1,222	0,316
Covid-19 challenges (Yes=1)	0,834	0,371	2,240	**0.025****	0,106	1,561
Food availability (No=1)	-0,524	0,444	-1,180	0.238	-1,395	0,347
Food affordability (No=1)	1,352	0,369	3,660	**0.000******	0,628	2,075
Food physical accessibility (No=1)	1,488	0,458	3,250	**0.001****	0,590	2,386
Food aid (Yes=1)	0,151	0,323	0,470	0.640	-0,482	0,784
Cash support (Yes=1)	-0,550	0,323	-1,700	**0.089***	-1,184	0,084
Food kitchen (Yes=1)	0,345	0,582	0,590	0.553	-0,795	1,486
Hygiene facilities (Yes=1)	-0,074	0,346	-0,210	0.831	-0,751	0,604
Security (Yes=1)	-0,349	0,337	-1,040	0.300	-1,008	0,311
NGO support (Yes=1)	0,095	0,407	0,230	0.816	-0,703	0,892
_cons	-3,982	1,207	-3,300	0.001	-6,349	-1,616

Level of significance: **** = 99.9% level of confidence; *** = 99%; **=95%; *=90% significant = bold

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