Forest and Society
Vol. 8(1): 81-99, June 2024
doi: 10.24259/fs.v8i1.28095

REGULAR RESEARCH ARTICLE

Impacts of the COVID-19 Pandemic on Livelihood Assets of Smallholder Agroforestry Farmers in Selected Upland Farming Communities in the Philippines

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RECEIVED 2023-08-03
ACCEPTED 2023-11-14

ABSTRACT

The COVID-19 pandemic has disrupted the social and economic activities of humanity across the globe. It has created immediate negative impacts on the livelihoods and agricultural production activities of smallholder farmers. A study was conducted in 2022-2023 to assess the impacts of the pandemic on smallholder farmers engaged in vegetable-based agroforestry systems in the Philippines. Using mixed methods of data gathering such as focus group discussions, key informant interviews, and a survey of 383 smallholder agroforestry farmers, results revealed that the COVID-19 pandemic resulted in travel restrictions and lockdowns, which has caused the immobility of farmers, farm labor, farm inputs and produce. Most (80%) of the production activities of the vegetable-based agroforestry system of the smallholder farmers were affected by the pandemic because of the lack of access to farm inputs, including labor. Poor marketing of agroforestry produces and the low market prices of the produce have decreased farm income of almost all (92%) of the respondent-smallholder farmers. About 92% of farmers were not able to attend any training courses related to agroforestry during the height of the pandemic. The social capital, particularly the bonding social capital within family members and neighborhoods, was enhanced during the pandemic. This led to the exchange of planting materials, and sharing of farm inputs with fellow farmers in the four study sites. Likewise, the natural capital was enhanced since the farms, soil and the surrounding natural resources such as rivers and springs were left untouched during the pandemic. Increased production for home consumption, reduced production for markets, engaging in additional sources of income, use of organic inputs, shift to online selling, and availing loans from formal and informal credit service providers were among the coping strategies employed by the smallholder farmers. Results imply the need to future-proof smallholder agroforestry systems by developing farmers' capacity to produce their own natural and organic fertilizers and organic pesticides; appropriate and more sustainable seed collection and storage; and expand partnerships with external organizations.

KEYWORDS
Smallholder; COVID-19; Pandemic; Agroforestry; Philippines.

1. INTRODUCTION

Smallholder farmers dominate the agriculture sector worldwide. Many of these smallholder farmers are poor, food insecure, and have limited access to market and basic services (Rapsomanikis, 2015). The upland settlers are the poorest among the rural population because of low farm productivity, limited access to rural advisory services, alternative employment opportunities, and basic social services (Fortenbacher & Alave, 2014). Furthermore, most of the upland farmers cultivate in marginal lands, with generally steep slopes that are prone to soil erosion, and are rainfed or dependent on rainfall as a source of irrigation (Landicho et al., 2015). Hence, they are also vulnerable to climate change impacts and other weather and natural disturbances. Landicho et al. (2022) highlighted that smallholder farmers in downstream and upstream communities in Sta. Cruz Watershed in Laguna, Philippines depend on

agriculture as their main livelihood. They are highly exposed to shocks and uncertainties such as climate change, market and policy shifts, natural disasters, and more recently, the COVID-19 pandemic.

The COVID-19 pandemic has disrupted social and economic activities worldwide. In Southeast Asia, the pandemic has exacerbated many food security risks (Sleet, 2020). Travel restrictions, which disrupted domestic and international food supply chains have undermined food availability and accessibility (ADB Briefs, 2020). Workie et al. (2020) highlighted that the COVID-19 pandemic disturbed the whole food system. The disruptions in upstream food supply chains (including planting, crop management, harvesting, and marketing) have been widely reported in countries across the region.[1]

The World Food Program estimated that 265 million individuals could be affected by acute food insecurity by the end of 2020, compared to 135 million individuals before the health crisis (Food Security and Information Network, 2020). This estimate is validated by the results of proceeding studies, which argue that the immediate impacts of the pandemic have impacted food security (; Stephens et al., 2020; Dixon et al., 2021; Espino et al., 2021). This is primarily because travel restrictions halted the mobility of people, goods and services; and, disrupted the labor availability both on-farm and off-farm, marketing of produce, as well as the input supply chain, among others. Travel restrictions and lockdowns have likewise led to the scarcity and difficulty of accessing farm inputs, which have affected coffee farming, wetland rice farming, and homestead farming in South India (Menon and Schmidt- Vogt, 2022), soybean, dry beans and maize production in South Africa (Mthembu et al., 2022), vegetable farmers in Pakistan (Ullah et al., 2022) and China (Gu & Wang, 2020), and rice production in Southeast Asia (Fox et al., 2020).

This research article examines the extent to which the immediate impacts of the COVID-19 pandemic were experienced across all types of farming systems, particularly smallholder agroforestry systems. The organization Forests, Trees, Agroforestry (FTA) highlights the role of forests, trees and agroforestry in ensuring food security and nutrition for forest-dependent communities, even in times of crisis. In their study, Maraseni et al. (2022) revealed that agroforestry practices in home gardens were among the key alternatives for smallholders during COVID-19. This could be because agroforestry has always been recognized for its ecological services (Baliton, et al., 2017; Baliton et al., 2020; Palma & Carandang, 2014; and socioeconomic contributions (Tolentino et al., 2010; Landicho et al., 2017). However, the livelihoods of some agroforestry farmers were negatively affected by the pandemic because of the reduced farm income brought about by the difficulty in marketing their products, and the reduction in farm productivity in communities in Indonesia (Pieter et al., 2022).

This article highlights the results of a study that assessed the impacts of the COVID-19 pandemic on smallholder upland farmers who are engaged in vegetable-based agroforestry systems in selected upland farming communities in the Philippines. This paper attempts to provide empirical evidence on the immediate impacts of the COVID-19 pandemic, and how these smallholder farmers coped and responded to these impacts.

While there have been quite a number of studies that describe the impacts of the COVID-19 pandemic on agriculture across the globe, there is a dearth of studies conducted in the Philippines, especially on agroforestry systems. Thus, this article will fill in this gap. This article is a product of original research, which emphasized the

[1] 10 ADB briefs on food security in Asia and the Pacific amid the COVID-19 pandemic (https://www.adb.org/sites/default/files/publication/611671/adb-brief-139-food-security-asia-pacific-covid19.pdf).

impacts of the pandemic on the four important livelihood assets, namely: social capital, financial capital, human capital, and natural capital, which have not been addressed by many literature and previous studies. Thus, this study is anchored on the Sustainable Livelihoods (SL) Framework which was forwarded by the Department for International Development (DFID) in 2000.

The SL framework emphasizes vulnerability, the role of assets or capital, as well as the policies and institutions at various levels (i.e., household, community, national, international) in shaping the livelihood strategies of people or communities. Livelihood strategies comprise the range and combination of activities and choices that people undertake to achieve their goals (DFID, 2000).

The technical, practical, and policy recommendations that are highlighted in this article could serve as a reference to develop a policy brief and lobby concerned institutions to help future-proof smallholder farmers by enhancing their four livelihood assets.

2. METHODOLOGY

2.1 The study sites

The study was conducted between February 2022 and May 2023 in four selected upland farming communities in the Philippines, that are known to be engaged in vegetable-based agroforestry system. These are Barangay Pasdong in Atok, Benguet; Barangay Cabua-an in Bayombong, Nueva Vizcaya; Barangay Luquin in Liliw, Laguna; and Barangay Concepcion, Sariaya, Quezon (Figure 1). These communities are dominated by farmers engaged in vegetable-based agroforestry systems or the integration of vegetables with fruit trees, forest trees, and/or livestock, and whose production is both subsistence-oriented and market-oriented.

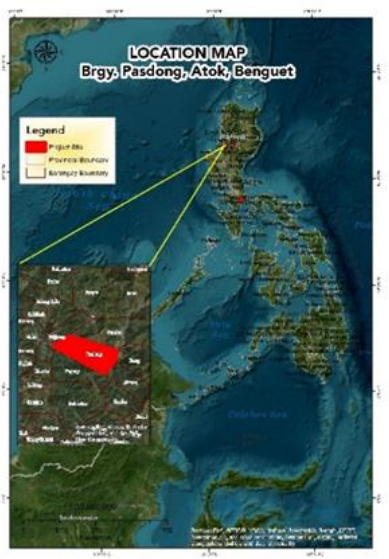

Figure 1. The study sites.

2.2 Data gathering techniques

The study used mixed methods in data collection. Farm household surveys were administered to a total of 383 respondents. The farm household survey, which was administered by the local field enumerators, captured the socioeconomic characteristics of the farmer-respondents; characteristics of their farms and farming system; effects of the COVID-19 pandemic on agricultural production and marketing of their produce, as well as on the health, economic, and social aspects of the households; and the coping strategies employed to manage the effects and immediate impacts of the COVID-19 pandemic.

Focus group discussions (FGD) were also organized in each of the study sites. The FGD involved at most 10-12 participants representing the farmers from the different villages of the study sites. The FGD focused on the degree of effects of COVID-19 on the different aspects of agricultural production, from sourcing out of farm inputs, maintenance and management of the farms, farm productivity, marketing of produce, and farm income. Coping strategies as well as lessons learned from the effects of COVID-19 pandemic were also narrated by the FGD participants.

Key informant interviews (KIIs) were also administered to 1-2 village officials and 1-2 elders per site, as well as the assisting universities. The KIIs centered on the support and assistance provided by the different organizations to the smallholder farmers during the height of the COVID-19 pandemic

2.3 Sampling frame

The sampling intensity for each study site was computed using the formula below:

$$n= N/(1+Ne^2) \quad (1)$$

Where: n = sample size
N = population/total number of farmers
e = sampling error (5%)

As shown in Table 1, a total of 383 farmers were selected as respondents using simple random sampling.

Table 1. Number of farmer-respondents in each of the four study sites.

Study site	Respondents (n)	Total
Barangay Pasdong, Atok, Benguet	104	383
Barangay Cabua-an Bayombong, Nueva Vizcaya	40	
Barangay Luquin, Liliw, Laguna	80	
Barangay Concepcion Banahaw, Sariaya, Quezon	159	

2.4 Data analysis

The data from farm the household survey was analyzed using descriptive statistics such as frequency counts and percentage responses. Meanwhile, findings from the FGDs were analyzed into themes and coded for responses, particularly their coping strategies and lessons learned from the COVID-19 pandemic. The qualitative data were further cleaned by harmonizing the codes (e.g., verb agreements, consolidation of similar coded data, etc.) to minimize errors. To discern the recurring themes and associations within the datasets, the harmonized codes were then processed using an open-sourced data visualization tool – RAWGraphs The RAWGraph generated the Sankey diagram where width of networks represents the frequency of codes. The thicker the width, the higher the frequency of codes.

3. RESULTS AND DISCUSSION

3.1 Socioeconomic profile of farmers engaged in vegetable-based agroforestry system

Most of the farmers engaged in vegetable-based agroforestry systems are male and relatively young with a mean age of 48 (Table 2). As farm households, their primary source of income is farming, from which about 54% generate an annual income range of Php10000-30000, while non-farm activities such as maintaining a store, working as construction workers, drivers, and employment are the secondary sources of household income, which generate an estimated annual household income of less than Php10000-Php20000 as mentioned by majority (54%) of the farmer-respondents. This finding is validated by previous studies conducted in the upland farming communities in the Philippines including that of Baliton et al. (2017), Landicho et al., (2020), and Paelmo et al. (2015). Meanwhile, from a mean household size of six (6), the number of household members involved in farming is only two (2), usually the household head and the spouse.

Table 2. Socioeconomic profile of farmers engaged in vegetable-based agroforestry system in selected upland farming communities in the Philippines (n=383).

Variables	Study sites				Total
	Benguet	Laguna	Nueva Vizcaya	Quezon	
Mean age	46.81	53.27	42.03	52.17	48.57
Mean HH size	4.82	4.31	6.78	6.92	5.7
Gender					
Male	54.8%	76.3%	55.0%	89.9%	69%
Female	45.2%	23.8%	45.0%	10.1%	31%
Primary source of income					
Farming activity	99.0%	98.8%	100.0%	93.7%	97.87%
Non-farming activity	1.0%	1.3%	0.0%	6.3%	2.15%
Est annual HH income from farming activities					

Variables	Study sites				Total
	Benguet	Laguna	Nueva Vizcaya	Quezon	
<10000	12.5%	73.1%	7.5%	14.6%	26.92%
11000-20000	26.0%	11.5%	32.5%	38.0%	27.00%
21000-30000	26.9%	5.1%	25.0%	24.7%	20.42%
31000-40000	11.5%	3.8%	17.5%	11.4%	11.05%
41000-50000	6.7%	2.6%	15.0%	6.3%	7.65%
51000-60000	9.6%	1.3%	2.5%	.6%	3.5%
>60000	6.7%	2.6%	0.0%	4.4%	3.42%
Mean number of HH members engaged in farming activities	3	1	2	2	2
Secondary source of income					
Farming activity	1.0%	1.3%	0.0%	6.3%	2.15%
Non-farming activity	32.7%	66.3%	65.0%	82.4%	61.6%
No other source of income	66.3%	32.5%	35.0%	11.3%	36.27%
Est annual HH income from non-farming activities					
<10000	17.2%	63.9%	36.0%	16.8%	33.47%
11000-20000	17.2%	25.0%	28.0%	34.3%	26.12%
21000-30000	13.8%	5.6%	16.0%	21.2%	14.15%
31000-40000	10.3%	0.0%	16.0%	8.8%	8.77%
41000-50000	3.4%	5.6%	4.0%	7.3%	5.07%
51000-60000	20.7%	0.0%	0.0%	2.2%	5.72%
>60000	17.2%	0.0%	0.0%	9.5%	6.67%
Mean number of HH members engaged in non-farming activities	1	1	1	2	1.25

3.2 Biophysical characteristics of the farms and vegetable-based agroforestry systems

As shown in Table 3, the farmers engaged in vegetable-based agroforestry systems are smallholders with a mean landholding of 0.77 ha. This could be the reason why these farmers practice agroforestry, which integrates various crops with woody perennials, primarily to maximize land use and farm productivity. It may also be noted that from the mean farm size, only 0.64 ha has been developed and is being cultivated. This could be explained by the topography and other prevailing conditions of their farms. While the majority (59%) of the farms are located in flat areas, 35% of farms are located along rolling hills and sloping topographies, which may not be favorable for crop production. Their main source of water for irrigation are springs (44%) and rainfall (38%). Thus, rainfall and climatic variability certainly influence agricultural production. Despite these biophysical limitations, most (62%) of the agroforestry farmers own the farmlands.

Table 3. Biophysical characteristics of the vegetable-based agroforestry systems of smallholder farmers in selected upland farming communities in the Philippines (n=383).

Farm Characteristics	Study Sites				Total
	Benguet	Laguna	Nueva Vizcaya	Quezon	
Mean estimated total farm size (in ha)	0.50	0.50	0.94	1.15	0.77
Mean estimated size of cropped area (in ha)	0.47	0.48	0.67	0.95	0.64

Farm Characteristics	Study Sites				Total
	Benguet	Laguna	Nueva Vizcaya	Quezon	
Mean number of years cultivating the farm	19	21	19	24	20.75
General topography					
Plain	55.8%	75.0%	10.0%	96.2%	59.25%
Rolling	10.6%	3.8%	72.5%	0.0%	21.72%
Elevated	1.9%	3.8%	2.5%	1.9%	2.52%
Slant/slope	27.9%	12.5%	2.5%	1.3%	11.05%
Plain & rolling	1.0%	1.3%	2.5%	0.0%	1.00%
Plain & slant/slope	1.9%	3.8%	0.0%	0.0%	1..0%
Rolling & elevated	0.0%	0.0%	10.0%	0.0%	3.00%
Source of irrigation water					
Spring	35.3%	53.4%	49.1%	38.5%	44.07%
River	25.6%	2.6%	17.0%	5.1%	12.57%
Rainfall	19.5%	44.0%	32.1%	55.6%	37.8%
Irrigation	18.8%	0.0%	1.9%	0.9%	5.4%
Water pump	.8%	0.0%	0.0%	0.0%	0.20%
Status of farm ownership					
Owned	71.2%	48.8%	77.5%	51.6%	62.28%
Rented	15.4%	28.8%	7.5%	6.9%	15.00%
Government owned	1.0%	15.0%	0.0%	10.1%	7.00%
Tenant	8.7%	3.8%	0.0%	26.4%	10.00%
Owned by Parents	0.0%	0.0%	2.5%	1.9%	1.00%
Owned and Rented (50/50)	2.9%	1.3%	0.0%	0.0%	1.00%
Inherited	0.0%	1.3%	12.5%	0.0%	3.00%

3.3 Agricultural production system

As shown in Figure 2, the smallholder farmers in the four study sites are engaged in vegetable-based agroforestry system. Their production system is dominated by vegetables such as bitter gourd (*Momordica charantia*), sayote (*Sechium edule*), bell pepper (*Capsicum annuum*), eggplant (*Solanum melongena*), Chinese cabbage (*Brassica rapa*), mustard (Brassica nigra), okra (*Abelmoschus esculentus*), cucumber (*Cucumus sativus*), onions (*Allium cepa*), tomato (*Solanum lycipersicum*), different types of legumes including peanut (*Arachis hypogea*), ; cereals such as rice (*Oryza sativa*) and corn (*Zea mays*); root crops such as sweet potato (*Ipomoea batatas*), cassava (*Manihut esculenta*), radish (*Raphanus sativus*), ginger (*Zingiber officinale*), potato (*Solanum tuberosum*) and yam (*Dioscorea sp*); fruit trees including coffee (*Coffea sp*), papaya (*Carica papaya*), oranges (*Citrus sinensis*), banana (Musa sp), and coconut (*Cocos nucifera*); and, forest trees such as gmelina (*Gmelina arborea*) and mahogany (*Swietenia macrophylla*). There are few farmers who also integrate livestock in their vegetable-based agroforestry system.

Figure 2 also shows that the primary purpose of cultivating different crops c is for marketing, except for forest trees which are mainly harvested for home consumption, such as construction materials, fenc, and firewood. This practice is also consistent with government policy that regulates the cutting and marketing of forest trees. A mean of 12749 kg of vegetables are allotted by households for marketing per cropping season across the four study sites.

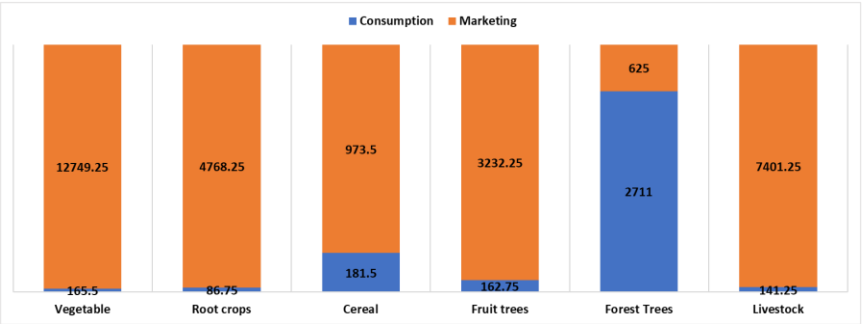

Figure 2. Production orientation of smallholder farmers engaged in vegetable-based agroforestry system in selected upland farming communities in the Philippines.

3.4 General Effects of COVID-19 Pandemic on the Upland Farmers

Upland farmers were generally affected by the COVID-19 pandemic (Figure 3). The effects were felt by almost all of the farmer-respondents (92%) when lockdowns and quarantine took effect. This constrained their mobility as well as the movement of their main agricultural produce, which is vegetables – characterized as perishable produce. The long period of quarantine consequently led to the lack of transportation that would have brought their products to the market, as well as the closure of markets and outlets of their produce. Certainly, these have affected the livelihoods of the smallholder farmers in the four study sites. This finding further confirms the effect of the lockdowns and travel restrictions on the upland farmers engaged in vegetable-based agroforestry systems, whose production orientation is towards marketing their produce.

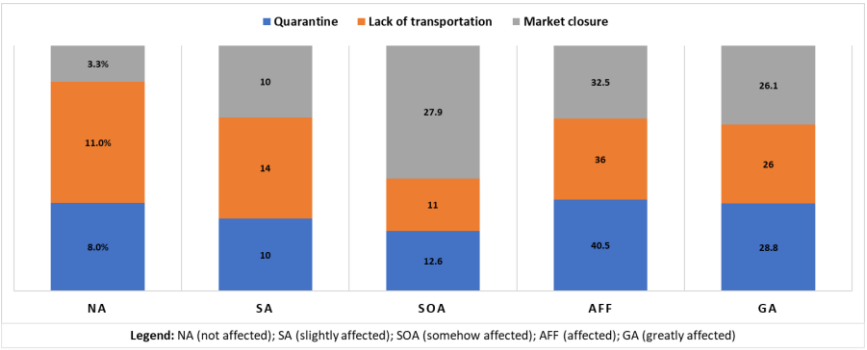

Figure 3. General effects of COVID-19 pandemic on the upland farmers engaged in vegetable-based agroforestry system in selected upland farming communities in the Philippines.

3.5 Effects of the COVID-19 Pandemic on Vegetable-Based Agroforestry Systems

Figure 4 shows that most (84%) of upland farmers' access to sources of planting materials were generally affected by the COVID-19 pandemic. Farmers mentioned that lockdowns and travel restrictions limited their capacity to buy planting materials such as seeds and seedlings from the market. Only a few (16%) of them did not have problems in the access of planting materials because they had stored enough seeds from their harvests.

Likewise, results revealed that accessibility and availability of fertilizers and pesticides were affected by the pandemic. This was reported by most (87%) of the smallholder upland farmers in the four study sites, particularly in Nueva Vizcaya. The

farmers mentioned that their crop components, particularly vegetables, are input-intensive, hence, they rely mostly on chemical fertilizers and pesticides which are bought from the market. However, the lack of transportation facilities brought about by the travel restrictions have affected their access to these inputs. Meanwhile, few (13%) used natural fertilizers, compost and other farm wastes as their source of fertilizers. The lack of access to farm inputs during the pandemic also constrained agricultural production in other countries in Asia (Mahaliyanaarachchi et al., 2022; Ullah et al., 2022; Gu & Wang, 2020), particularly in Vietnam (Thang et al., 2020), India (Harris et al., 2020), and in Africa (Siddiqui et al., 2020), particularly in Liberia (International Trade Centre, 2020).

In general, most (76%) upland farmers mentioned that labor requirements were affected by the COVID-19 pandemic. This is particularly true in the case of those whose farms are far from their residence, as well as those who rely on hired laborers. The lockdowns and quarantine restricted their travels from residences to the farm lots.

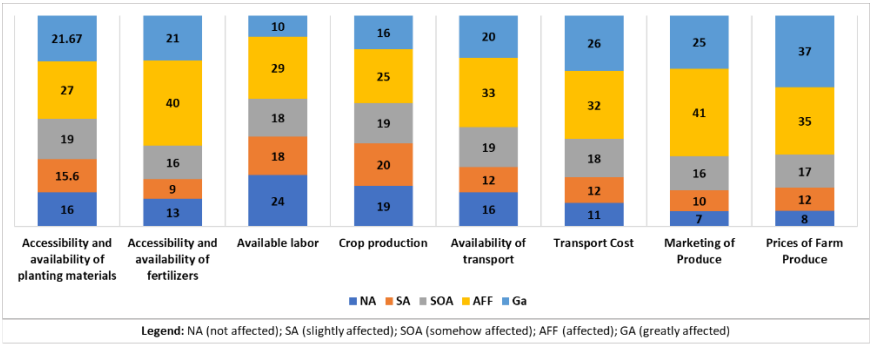

Figure 4. Effects of COVID-19 pandemic on the vegetable-based agroforestry system in selected upland farming communities in the Philippines.

It may be noted, however, that most of the farmers in Benguet have not been affected because their farms are just within their community and near their residences. They have also mentioned that most of the family members working outside the community stayed home during the lockdowns.

Most (80%) of the upland farmers across the four study sites reported that their crop production was affected by the pandemic. This could be because of their lack of access to farm inputs such as fertilizers, pesticides, and even seeds. Travel restrictions have affected the mobility of everyone. There was very limited transport service available in the community to transport their produce to the market as reported by most (84%) of the upland farmers. Consequently, 89% of the upland farmers emphasized that this limited transport service has caused an increase in transportation costs. They had to arrange with the transport service providers for the purchase of farm inputs and the delivery of their produce to the market.

Almost all (93%) of the smallholder farmers stressed that the marketing of their produce was affected by the pandemic. As mentioned earlier, travel restrictions caused immobility of their produce from their farms to the market; and the inability of the consumers to regularly come to the market. As such, the prices of their farm produce have become volatile and tend to become lower during the lockdowns, because of the lack of consumers. These findings were validated by the FGD results across the four upland farming communities as shown in Figure 5. High cost of farm inputs, travel restrictions, reduced farm income, lack of transportation, increased availability of family labor, low market price of produce are among the general effects of COVID-19

pandemic that were articulated by the FGD participants.

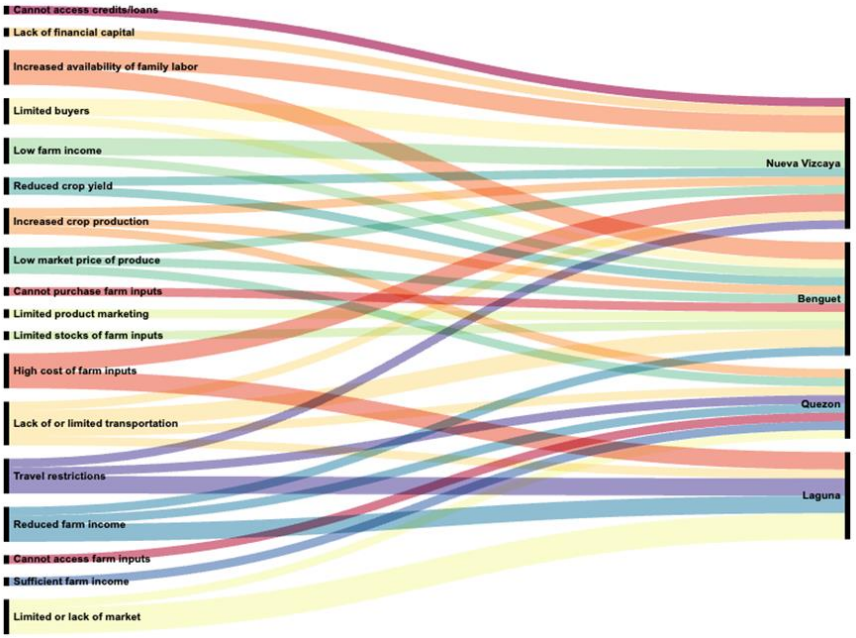

Figure 5. Effects of COVID-19 pandemic on the vegetable-based agroforestry system in selected upland farming communities in the Philippines based on the results of FGDs.

3.6 Effects of the COVID-19 pandemic on livelihoods assets of smallholder farmers engaged in vegetable-based agroforestry system

In general, farming serves as the main livelihood in the upland farming communities. According to DFID (2000), a livelihood is comprised of capabilities, material and social assets as well as activities for a means of living. Thus, essential to the sustainability of their livelihoods are their assets. Livelihood assets refer to the resource base of the communities or the households, which include human, natural, financial, physical and social assets (DFID, 2000).

Research findings revealed that the COVID-19 pandemic has created both positive and negative effects on the livelihood assets of smallholder farmers engaged in vegetable-based agroforestry systems.

(1) Human capital refers to the skills, knowledge, ability to work, and good health of an individual (DFID, 2000). The quality of manpower is very critical in agricultural production and farm development as argued by Crook et al. (2011). Research findings revealed that the human capital of smallholders was affected by the COVID-19 pandemic (Figure 6). Most (70%) of the smallholders were not able to attend training courses related to their farming systems. During the height of the pandemic, organizing events, workshops, training and other group activities were not allowed.

More than half (56%) of the smallholder farmers reported that the pandemic has affected the availability of farm labor. This is explained by the travel restrictions and lockdowns. It may be noted, however, that most (80%) of the smallholder farmers in Benguet did not encounter problems in the availability of farm labor. The household members employed in non-farm activities stayed home and were unemployed during the pandemic. Hence, they were the source of farm labor within the community.

Meanwhile, 71% have reported that they have been exposed to and infected by the COVID-19 virus, which has put their health at risk.

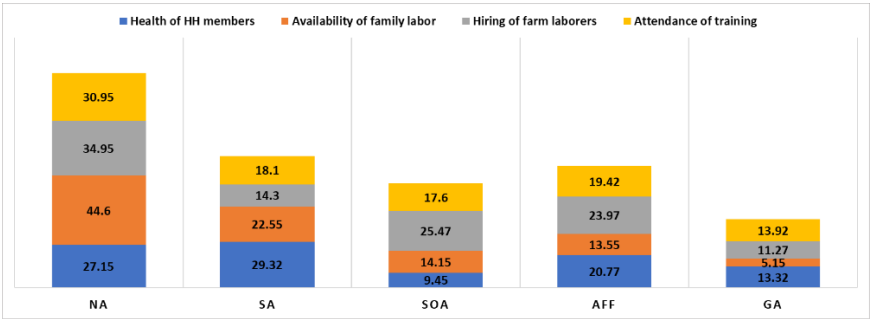

Figure 6. Effects of the COVID-19 pandemic on human capital of smallholder farmers engaged in vegetable-based agroforestry system in selected upland farming communities in the Philippines.

(2) Financial capital refers to the financial resources that people use to achieve their livelihood objectives (DFID, 2000). It provides a buffer for the farm households in case agricultural production fails brought about by pest infestation, natural calamities, market failure, or emergency in the farm households.

Figure 7 shows that almost all (92%) of the upland farmers reported that the pandemic has certainly affected their farm income. As discussed earlier, travel restrictions and lockdowns have caused the immobility of their produce from their farm to the market, which has also led to low market prices because of the lack of consumers. This finding is consistent with that of Thang et al. (2020) where 60% of 1300 farmers in Vietnam have experienced a decline in the price of their farm produce during the pandemic, and that of Harris et al (2020), where over 80% of farmers in India reported a decline in sales and consequently, the decline in farm income.

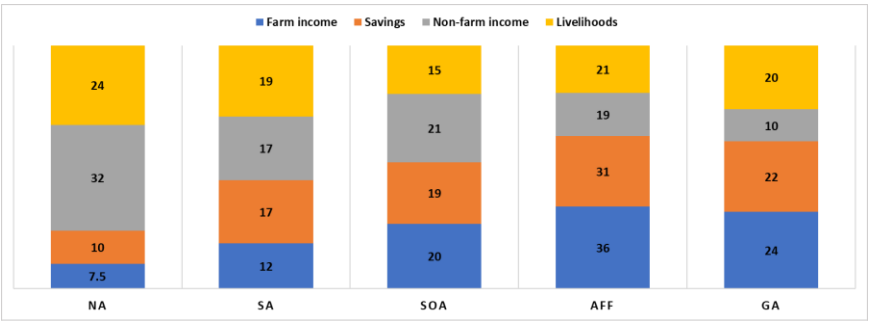

Figure 7. Effects of the COVID-19 pandemic on financial capital of smallholder farmers engaged in vegetable-based agroforestry system in selected upland farming communities in the Philippines.

Because of their decreased farm income brought about by the pandemic, almost all (90%) of the upland farmers did not accrue savings during that period. On the other hand, their secondary source of income which is non-farm employment (i.e., public vehicle/tricycle service and construction) was also affected as a result of lockdowns and travel restrictions, as reported by a great majority (68%) of the upland farmers. Most (75%) of the upland farmers believed that they were not able to acquire appliances

during the pandemic. Besides having a reduced household income, the pandemic has also taught them to prioritize their expenses, which is mostly for the basic household needs, particularly food.

(3) Natural capital refers to the land or farms being cultivated by the farmers; rivers, creeks and springs; forest, and other natural resources that abound in the community, and are utilized by the farmers for their livelihood (Landicho et al, 2017). Results show that the COVID-19 pandemic did not have negative effects on the natural capital, as shown in Figure 8. A great majority (68%) of the smallholder farmers noted that the natural resources were not affected, including the soil quality as noted by more than half (54%) of the respondents. In general, the pandemic enabled the farms to rest from the many chemical-based inputs, and most of them were left uncultivated. This condition provided an opportunity to leave the farms for fallow. Qualitatively, the farmers have observed lush and evergreen surroundings.

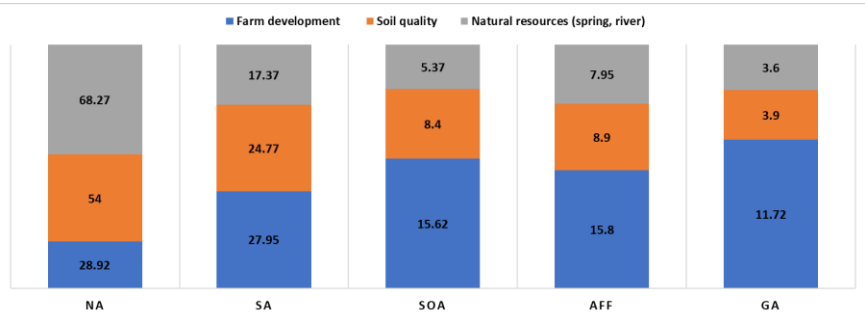

Figure 8. Effects of COVID-19 pandemic on the natural capital of smallholder farmers engaged in vegetable-based agroforestry system in selected upland farming communities in the Philippines.

(4) Social capital refers to the social resources that people draw from to be able to carry out their livelihoods (DFID, 2000). It may be developed through network and connectedness, membership in formalized groups, and relationship of trust. It consists of social structures that facilitate certain action, from individual persons or corporate actors (Coleman, 1988). There are two levels of social capital. The bonding social capital exists within a community that enables people to get by; and, the bridging social capital which refers to the extra community networks that enable individuals or groups to tap outside resources (Cramb, 2006).

Results show that social capital, particularly the bonding capital of smallholder farmers were not negatively affected by the COVID-19 pandemic (Figure 9). More than half (58%) of the smallholder farmers noted that the relationship and bonding among the household members were not affected by the pandemic. In fact, many of them highlighted that the pandemic enabled them to have more quality time together, as they had to stay home because of travel restrictions and lockdowns.

Similarly, there was no significant negative effect of the pandemic on their relationship with other community members. The farmers' narratives highlight that the spirit of helping one another and cooperation was observed and practiced during the pandemic. The exchange of planting materials and other farm inputs such as fertilizers and pesticides were also conducted during lockdowns when they had no access to these inputs.

About half (47%) of the smallholder farmers also recognized that their access to credit facilities was not affected by the pandemic. During the lockdowns, private

lending institutions provided short-term loan programs to help the farmers and other community members. However, technical assistance from development organizations and local government units was affected because of travel restrictions. Bright et al. (2021) argued that farmers' access to extension services in Zimbabwe became limited because of travel restrictions and banning of public gatherings.

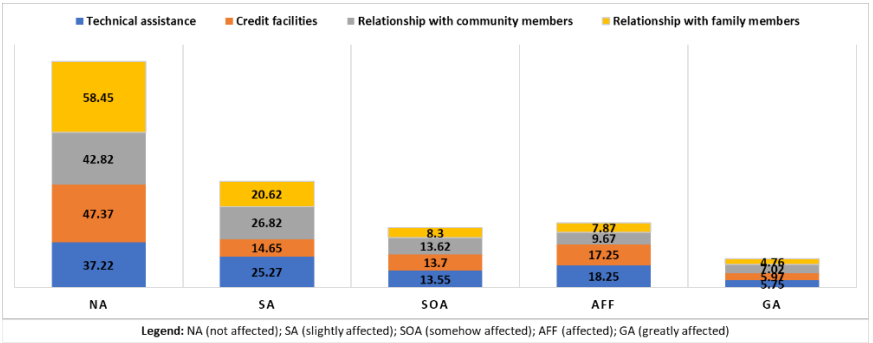

Figure 9. Effects of the COVID-19 pandemic on social capital of smallholder farmers engaged in vegetable-based agroforestry system in selected upland farming communities in the Philippines.

3.7 Strategies employed to cope with the impacts of the pandemic

Table 4 suggests that the smallholder farmers have continued the maintenance of their vegetable-based agroforestry systems generally for home consumption. This is one strategy for ensuring a continuous flow and source of household food needs during the pandemic. These farmers have realized the value of crop diversification. This finding is validated by the International Trade Centre (2020) whose study indicated the farmers' appreciation of integrated cropping systems including agroforestry, during the pandemic.

Table 4. Coping strategies of smallholder farmers on the impacts of COVID-19 pandemic on their agricultural production (n=383).

Coping Strategies	Percentage Response (%)
Maintained the vegetable-based agroforestry farm and increased production intended for home consumption	84%
Maintained the vegetable-based agroforestry farm but reduced production intended for marketing	44%
Explored additional sources of income while maintaining the agroforestry farms	59%
Availed loans from formal and informal credit service providers	53%
Did not do anything; farm in its status quo	21%
Sought assistance from the local government units	8%

Many literatures point out the relevance of crop diversification and agroforestry as strategies for addressing food insecurity and climate change impacts because of the multiple products derived from the system throughout the year. Thus, making food available and accessible to farm households is of key importance. Meanwhile, more than half (59%) of smallholder farmers have explored other sources of household income, while maintaining their agroforestry farms. Income from other sources provide them funds to purchase other household needs and food items that are not found within their agroforestry farms. In the Southern part of the Philippines, farmers have also engaged in non-farm employment while planting vegetables for their consumption

(Nilong et al., 2022). Because of the decline in farm income, about half (53%) of the smallholder farmers have availed of loans either from formal (i.e., bank, credit institutions) or informal (i.e., neighbors, friends) sources.

The results of farm household survey in Table 4 were validated by FGD results. The Sankey Diagram (Figure 10) suggests that the use of organic inputs was a common strategy employed by smallholder farmers across the four upland farming communities to cope with the impacts of COVID-19 pandemic. This is evidenced by the width of network cutting across the four study sites as shown in Figure 9. Farmers in other countries have also resorted to the use of organic fertilizers as an alternative to the chemical-based farm inputs which could not be accessed by the farmers because of travel restrictions (Siddiqui et., 2020; Thang et al., 2020).

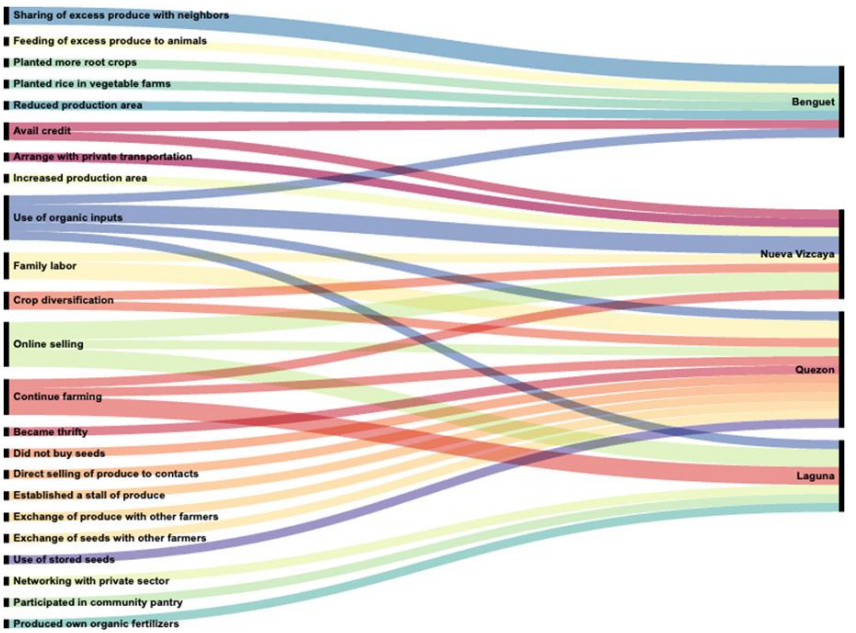

Figure 10. Strategies employed by smallholder farmers to cope with impacts of the COVID-19 pandemic on their agricultural production, as expressed during FGD sessions.

Most farmers, particularly in Laguna, Quezon and Nueva Vizcaya sites have continued their farming systems primarily to address their household food needs. Farmers have also switched to online selling. This strategy was employed because farmers could not transport their produce to the market brought about by the heightened travel restrictions, lack of transportation, and closure of the market outlets. Their financial needs were also addressed by availing loans and credits from service providers within the communities.

3.8 Farmers' realizations from the experiences during the COVID-19 pandemic

Smallholder farmers express that the COVID-19 pandemic has taught them numerous lessons. As shown in Figure 11, smallholder farmers across the four study sites have learned to save money. They have realized the value of prioritizing basic household needs, which is primarily for food. Furthermore, smallholder farmers recognized that being thrifty would enable them to save money, which will serve as their safety net in times of emergency and uncertainty such as the pandemic.

In terms of agricultural production, smallholder farmers have learned the importance of crop diversification. They have diversified their crops to ensure that they would harvest different types of crops throughout the year. This makes food more available in farm households. Besides its ecological contributions (Alletto et al., 2022; Tamburini et al., 2020; Njeru, 2013), crop diversification also ensures food security (Makate et al., 2016; Mango et al., 2018). Thus, crop diversification is considered as a key strategy for climate change adaptation and resilience (Lakhran et al., 2017; Nazir & Das Lohano, 2022) and other uncertainties in small-scale agriculture (Mango et al., 2018).

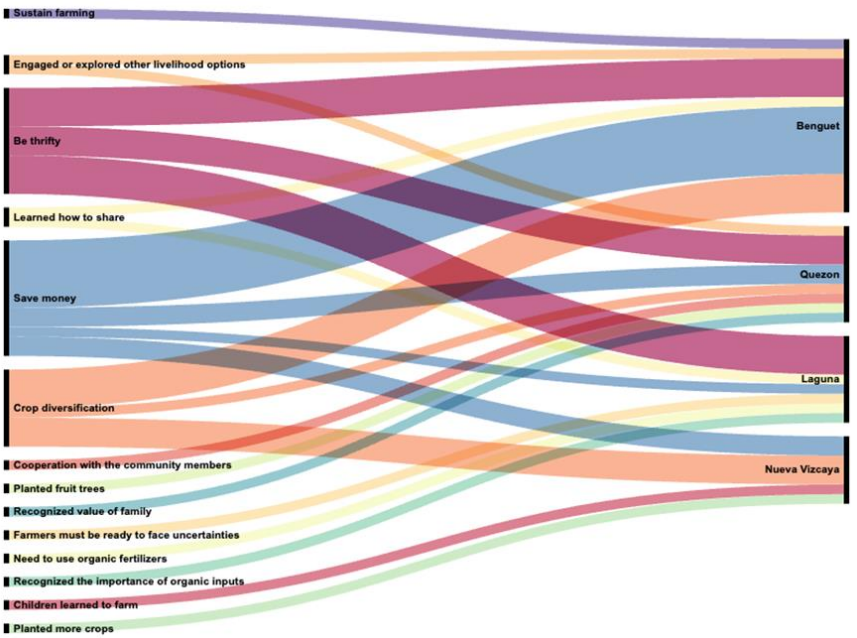

Figure 11. Lessons learned by smallholder farmers engaged in vegetable-based agroforestry systems in selected upland farming communities in the Philippines from impacts of the COVID-19 pandemic.

4. CONCLUSIONS AND RECOMMENDATIONS

Research results highlight how vegetable-based agroforestry systems of smallholders in the Philippines uplands have been affected by the impacts of the COVID-19 pandemic. The lockdowns, quarantine and travel restrictions have affected their access to farm inputs such as seeds, fertilizers and pesticides; transport and marketing of their produce; and, led to the low market price of their produce. In terms of effects on their livelihood assets, the COVID-19 pandemic has affected human capital accumulation due to the lack of training opportunities for the farmers and difficulty of hiring farm laborers during lockdown periods. Financial capital was likewise negatively affected because of declining farm productivity, limiting market opportunities for their produce, and lowering market prices of agricultural produce. On the other hand, the COVID-19 pandemic enhanced the social capital of smallholder farmers. Exchange of planting materials between farmers, sharing of farm inputs, particularly seeds and fertilizers; sharing of harvests and farm produce with neighbors; and, closer bonding among household members were among the positive effects of COVID-19 on social

relationships between and among smallholder farmers. Likewise, natural capital was not negatively affected, and in fact, farmers have observed a greener and more lush environment.

To cope with the impacts of the COVID-19 pandemic on their livelihoods, smallholder farmers maintained their vegetable-based agroforestry farms and increased production for home consumption; reduced production intended for marketing; explored additional sources of income; used organic inputs; shifted to online selling; and, availed loans from formal and informal credit service providers. With the effects of the pandemic, smallholder farmers have realized the value of prioritizing their needs, saving money as part of their safety net, and the relevance of crop diversification. Furthermore, farmers have realized the importance of digital resources as an alternative means of marketing their produce.

These findings suggest the need to further build and enhance the capacity of smallholder farmers to become more self-sustaining by producing their own farm inputs such as seeds, fertilizers and biological pest controls; diversifying markets for their produce using various marketing mechanisms such as online selling, contract buying, and retail; and intensifying partnerships with fellow farmers, local government units and other development organizations. Specifically, this partnership could explore the possibility for the establishment of post-harvest and processing facilities for proper storage and processing of their produce to prevent spoilage of produce, and diversify markets.

Author Contributions: This article is an offshoot of a collaborative research, in which, each collaborator took the lead in the implementation of research in their respective sites, including the preparation of the research results. The authors hereby declare no conflict of interest in the publication of the research results.

Competing Interests: The authors hereby declare no conflict of interest in the publication of the research results

Acknowledgments: The authors hereby acknowledge the University of the Philippines-Enhanced Creative Work and Research Grant (UP-ECWRG) for the funding support to carry out this study. We recognize the research participants in the three study sites, namely: Barangay Cabua-an, Bayombong, Nueva Vizcaya; Barangay Pasdong, Atok, Benguet; Barangay Luquin, Liiw, laguna; and Barangay Concepcion Banahaw, Sariaya, Quezon, for their active engagement throughout the research process Finally, we also thank the local government units for allowing us to conduct this study at the aforementioned sites.

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