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The mitigating role of climate smart villages to the impacts of COVID-19 pandemic in the Myanmar rural communities

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A B S T R A C T

Climate smart village approach is identified as an important strategy laid out in the Myanmar Climate Smart Agriculture Strategy (MCSAS, 2016) Four climate smart villages were established in 2017 to facilitate participatory action research to develop the CSV approach as well as to generate evidence of outcomes. The CSV approach is based on the principle of community-directed research process where community-members collaborate with an external researcher to investigate community challenges and their solutions. Like other countries in 2020, the height of the COVID-19 pandemic, Myanmar implemented wide-scale national and local restrictions on mobility that impacted trade and business resulting to an economic slowdown. Rural communities dominated by smallholder agriculture in Myanmar are not spared from the negative impacts of these restrictions. This paper seeks to assess the impacts of the COVID-19 pandemic to the 4 climate smart villages in Myanmar by analyzing household survey data (N = 527) collected in 2020 during the height of economic disruptions and comparing these data to the household survey conducted during the pre-pandemic period of 2018. Our analysis indicated that overall, the effect of the pandemic to agriculture production in 2020 production season in the 4 CSVs has been minimal as evidenced by the continued agriculture production at the same levels as the pre-pandemic conditions in 2018. The effects to household food security and diet diversity has been varied. Sakta village in Chin state in the highlands have demonstrated that diversified production systems enable them to achieve food security in the pandemic year of 2020.

1. Background

Rural communities make up 44% of the global population according to the World Bank in 2019. A big part of these communities bears a disproportionate burden of poverty, poor health, and poor quality of life (Steiner and Fan, 2019). Southeast Asia has around the same proportion of rural population despite the rapid progress of urbanization within the region (Aranuzzaman and Dahiya, 2019). In 2019, Myanmar has a rural population at 69% making it primarily a rural country (The World Bank Data, 2019a).

The rural economy is crucial to global economic growth. In 2018, agriculture accounted for 4% of global GDP (The World Bank, 2019). In some developing countries, rural production contributes to up to 25% of the national economy (Food and Agriculture Organization (FAO), 2011). In Myanmar agriculture remains an irreplaceable economic pillar as it continues to constitute 21% of Myanmar’s GDP in 2018 (The World Bank Data, 2019b), and employs more than half of the country’s labor force (Myint et al., 2016).

Climate change impacts refer to the effects of extreme weather and climate events, and the effects of climate change on natural and human systems (Inter-governmental Panel on Climate Change (IPCC), 2014). It is commonly believed that the impact of climate change falls disproportionately on the rural and poor populations regardless of countries and regions. In a study on the Greater Mekong Subregion (GMS) showed that rural people in this region are particularly vulnerable to climate change due to their dependence on rainfed agriculture and other

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climate-sensitive natural resources such as nontimber forest products. Increased appropriate investments in climate change adaptation are necessary to protect rural livelihoods and stimulate economic development within GMS (Asian Development Bank (ADB), 2014).

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) developed the Climate-Smart Village (CSV) approach to address knowledge gaps and scaling of climate smart agriculture. Building on the early work of CCAFS, the International Institute of Rural Reconstruction (IIRR) developed its own version of the climate smart village as a location where development interveners can demonstrate context-specific community adaptation processes, not just the development and scaling of climate smart agriculture. The broader consideration for the scope of the IIRR’s CSVs presents itself the potential of not just addressing climate risks and vulnerabilities but also building robust adaptive capacities anchored on development outcomes. A broad-based study of the overall development impact of the CSV approach seems absent. This is probably due, on one hand, to the fact that the CSV is a relatively young model, and on the other hand, to the highly localized characteristic of climate-smart villages with diverse backgrounds and focuses.

Climate smart villages are identified as an important strategy laid out in the Myanmar Climate Smart Agriculture Strategy (Hom et al., 2015). With support from CGIAR-CCAFS and the International Development Research Center-Canada, IIRR established 4 climate smart villages in 2017 to conduct participatory action research directed at developing methods and tools to establishing CSVs in Myanmar as well as generate evidence of development outcomes such as food security and nutrition (Barbon et al., 2021; Hanley et al., 2021).

The climate smart village approach as espoused by IIRR is based on the principles and processes of participatory action research (PAR). The PAR approach is defined as a community-directed research processes where community-members collaborate with an external researcher to investigate community challenges and their solutions. PAR as it progresses enables community participants to build capacities, create ownership and autonomy (Maguire, 1987; St. Denis, V., 1992; Hoare et al., 1993).

A menu of socio-technical methodologies and tools was also developed and implemented to facilitate engagement with members of the four Myanmar CSVs. Consistent with the location-specificity of adaptation to climate change, a “portfolio approach” to adaptation was implemented. This “portfolio” of adaption options include technologies (e.g. new varieties of crops) and practices (e.g. having a home vegetable garden, using green manure, etc.) aimed at reducing the impacts of climate change to agriculture production and livelihoods. By having a portfolio of adaptation options, opportunities for climate change adaptation are created based on each community member’s unique agro-ecological and socio-economic situation. This approach therefore ensures inclusivity, that there is an adaptation option even for the poorest and the most vulnerable members of the CSV.

The World Health Organization (WHO) on March 2020, has declared the spread of COVID-1 as a global pandemic (WHO, 2020). After this declaration, countries have taken a number of steps to control the spread of the disease by mainly restricting mobility in communities including national lockdowns (Lunn et al., 2020; Mishra et al., 2020). These national lockdowns have impacted economic growth nationally and globally (Mishra et al., 2020).

One of the significant impacts of the national lockdowns is the increase in food insecurity in vulnerable communities. This is caused by loss of income from closures of businesses or reduction of work caused by lockdowns. Another driver of food security was the disruption to agriculture production and livelihoods. By having a portfolio of adaptation options, food security was disrupted by lockdowns. Another driver of food security was the disruption of markets that affected the movement of food products to consumers but also the movement of farm inputs required in food production. As a result, there was widespread food wastage in one location but hunger in another location (Stephens et al., 2020).

Myanmar’s economy was growing rapidly prior to COVID-19 (Boughton et al., 2021). However, agricultural livelihoods in Myanmar are a risky business even in normal times due to country’s exposure to climate change and trade volatility (International Food Policy Research Institute and Michigan State University, 2020). Myanmar only registered a few hundred cases until August 2020 (MOHS, 2020). The democratic government of Myanmar in 2020 rapidly responded to the threat of COVID-19, both in terms of its impacts to public health as well as its economic impacts (Minolletti and Hein, 2020).

Like other countries, Myanmar also implemented national and local travel restrictions and closures of businesses. This has affected the agriculture trade resulting to difficulties of farmers selling their produce as well as acquiring farm inputs. Household incomes have dropped in the months of January to June in 2020. There was a stage of recovery in July to August but starting September to October, incomes dropped again, due to a second wave of increased COVID-cases during this period (Boughton et al., 2021).

The government established an Economic Recovery task force to develop a Comprehensive Economic Recovery Plan (CERP). However, the vulnerability of agriculture and rural livelihoods to COVID-19 was not initially well recognized by the Economic Recovery task force (Boughton et al., 2021). Although agriculture plays a major role in rural areas where food prices are a key factor affecting nutrition security for rural households, the share of household expenditure for agriculture production has been far too small which has prevented food and nutrition insecurity of households (Boughton et al., 2021).

This paper seeks to assess the impacts of the COVID-19 pandemic to the 4 climate smart villages in Myanmar by analyzing household survey data collected in 2020 during the height of economic disruptions caused by the pandemic in Myanmar and comparing it household survey data collected in pre-pandemic period of 2018. The impacts are assessed in terms of livelihood activities, subjective assessment of ability to cope, household well-being using household wealth scores, income generation from agriculture and food security.

2. Materials and methods

2.1. Household surveys

As part of the participatory action research conducted by IIRR, a household survey was conducted in 2018 to generate a baseline for the communities. The household survey was conducted in full enumeration, all the households in each of the four CSVs were included in the data collection. The survey questions collected data on demographics of the household, livelihoods including land ownership, list of household items to be used as metric for household wealth. It also included the questions to determine Household Food Insecurity and Access Scores (HFIAS) and Household Diet Diversity Scores (HDDS).

In 2020 at the height of the lockdowns in Myanmar, IIRR conducted the same survey in the 4 CSVs to gather household data during the time of extreme stress from the social and economic impacts of the pandemic. Both surveys in 2018 and 2020 were implemented at around the same time of the year between October to November to ensure that other external conditions are the same except that it’s a pandemic year in 2020. These surveys provided the data to analyze the effects of the pandemic to the CSVs by comparing these with 2018 pre-pandemic data.

The questionnaire was prepared in English and translated to the Myanmar language. It was also pre-tested with farmers from nearby communities. A total 527 households were included in the surveys in 2018 and 2020. Htee Pu Ma Sein, Taung Khamauk (TKM) = 85 HH, Ma Sein = 87 HH and Sakta = 112.

The survey data were then encoded in Microsoft Excel and data analysis was made using Statistical Package for Social Sciences (SPSS).

2.2. Statistical analysis

After encoding the survey into MS Excel, we exported these to SPSS and created a panel data to allow for a one to one, before and after
statistical analysis of the collected household data. The following the statistical analysis measures were deployed in the analysis.

a) **Descriptive statistics**, includes frequency distribution, percentages, mean and median.

b) **Tests for Significant Difference** to test for significant difference between 2018 and 2020 data. As the data in most variables are presented as proportions (percentages), the McNemar test was used. This test is used to analyze pretest-posttest study designs, as well as being commonly employed in analyzing matched pairs in before and after studies. The non-parametric Mann-Whitney U test for independence was also used to determine the difference between 2018 and 2020 data for food consumption.

c) **Principal Component Analysis** to determine wealth index of each household in the CSVs. This method of generating household wealth index is based on the Demographic and Health Surveys (DHS) wealth index construction tools and guidance specific to Myanmar. The DHS wealth index is a measure of a household’s living conditions. It is determined by calculating easy to collect data of household ownership to selected assets that serve as a proxy for wealth and well-being such as owning television sets, motorbikes or the materials used to build the household house. (Rutstein, S no date indicated) (Rutstein, 2022).

d) **Analysis of Variance (ANOVA)** to determine if there is significant difference across the CSVs with regard to the household wealth scores in 2018 and 2020.

### 3. Results and discussion

#### 3.1. Understanding the socio-economic context of the Myanmar climate smart villages

The four CSVs in Myanmar represent 4 major agro-ecologies of the country namely—semi arid dry zone, delta floodplains, uplands and hilly mountainous. These CSVs were selected to demonstrate the differences of agro-ecologies, agriculture systems, climate change impacts as well as socio-economic contexts.

Table 1 presents the unique features of the 4 CSVs and Table 2 presents the demographic profile of the four Myanmar CSVs. (See Fig. 1.)

The proportion of men and women was almost the same in all studied sites. In the CSV program, it was considered important to provide opportunities to women to enhance inclusiveness. With regards to age distribution, the age groups of 19–45 years old dominate the populations in all the four CSVs. This offers an opportunity for finding ways for these target groups in all the CSVs, to contribute to the intensification and expansion of climate resilient agriculture using a range of crop, tree and small livestock-based options.

Land ownership is a key element affecting investment in sustainable and resilient agriculture production and associated livelihoods. With the majority of the households in three CSVs owning farm land (except in Ma Sein CSV where 76% of the total households are landless) many opportunities for resilience-conferring agriculture have surfaced. Domestic work and casual labor is the dominant livelihood activity in Ma Sein. Casual labor in Myanmar is short-term employment in nearby towns and are paid with a daily wage.

Interestingly (in an earlier paper) it was noted that between 2018 and 2020, the size of landholdings has also changed in all 4 CSVs from owning 1 acre or less of farm land, this has increased to 2 acres or more (Barbon et al., 2021).

#### 3.2. Effects of the pandemic to household income from agriculture

To determine the effects of the pandemic to household income in the 4 CSVs, the household-level agriculture production in 2020 was analyzed, during the period of disruptions and compared it to pre-pandemic production trends of the same households in 2018. Fig. 2 suggests that production activities have not been severely affected by the 2020 lockdown in Myanmar. Comparing this to the 2018 pre-pandemic data of the same households in the CSVs, we noted the increase in the number of households raising more chickens and goats, growing vegetables and growing staple crops such as rice and corn. Mentioned in other studies, there was mention of short period of recovery in the months of July to August 2020 in Myanmar (Boughton et al., 2021). This short window of recovery was considered timely as it coincided with the onset of the monsoon months and the initiation of agriculture production activities in all 4 CSVs. This short window of recovery allowed farmers to access important inputs to production allowing them take advantage of the monsoon rains, to grow annual crops, plant fruit trees, and raise animals.

From the survey data in the studied locations of the conditions during the pre-pandemic period and during the 2020 lockdown, we noted that there was no major disruption in the production activities in the 4 CSVs in Myanmar. We examined the gross cash earned from selling the agriculture produce of the households in 2020. Fig. 3 shows comparison between pre-pandemic year of 2018 to 2020 of the total cash received from the agriculture for all households in the 4 CSVs. In the

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**Table 1**

Profile of the Myanmar climate smart villages.

| Name of village | Htee Pu | Taung Khamauk (TKM) | Ma Sein | Sakta |
|-----------------|--------|---------------------|--------|-------|
| **Agro-ecology** | Dry Zone | Upland Delta | Highlands |
| Major crops | Groundnut, pigeon pea, green gram | Rice, millets. Corn | Rice, rice, corn, vegetables |
| Township (Tsp) | Nyaung-Oo | Nyuang. Shwe Bogale | Hakha |
| State/Region | Mandalay | Shan | Ayeayarwaddy | Chin |
| Total households | 275 | 94 | 103 | 200 |
| Total Population | 11,180 | 405 | 453 | 865 |
| Female | 603 | 215 | 249 | 445 |
| Male | 577 | 190 | 214 | 420 |
| Distance from nearest | 35 km | 20 km | 11 km | 32 km |
| Ethnic Group | Burmese | Pa-o | Burmese | Chin |

Source: IIRR Myanmar.

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**Table 2**

Demographic data of the climate smart villages, Myanmar, 2020.

| Demographics | Htee Pu | TKM | Ma Sein | Sakta |
|--------------|--------|-----|--------|-------|
| 1. Sex (%)   |        |     |        |       |
| Male         | 46.63  | 53.39 | 49.37  | 48.43 |
| Female       | 53.37  | 46.61 | 50.63  | 51.57 |
| 2. Age (%)   |        |     |        |       |
| 0-18         | 17.54  | 35.06 | 29.56  | 38.59 |
| 19-30        | 20.70  | 22.13 | 17.92  | 20.96 |
| 31-45        | 25.82  | 19.54 | 24.53  | 15.96 |
| 46-60        | 19.61  | 16.38 | 19.81  | 14.84 |
| 60-above     | 16.34  | 6.90  | 8.18   | 9.65  |
| 5. Land Ownership | Yes | 80.25 | 91.76 | 24.14 |
| No           | 19.75  | 8.24  | 75.86  | 4.46  |
| 6. Livelihood Activities (%) |        |     |        |       |
| Domestic Work | 70.87 | 83.04 | 44.34 | 99.70 |
| Farming      | 62.39  | 83.48 | 11.32 | 99.70 |
| Livestock    | 65.11  | 73.48 | 11.01 | 99.70 |
| Fishing/Hunting | 3.70 | 10.43 | 0.00  | 1.18  |
| Business/GA  | 26.96  | 22.17 | 5.97  | 6.51  |
| Casual Labor | 35.43  | 72.17 | 34.91 | 10.65 |
| Unskilled Formal | 4.13 | 1.30  | 0.00  | 0.89  |
| Skilled Formal | 2.50  | 0.43  | 0.63  | 2.66  |

a) Only adult members were included in the analysis.
Fig. 1. Map of the 4 climate smart villages in Myanmar.
Source: Myanmar Information Management Unit.
survey, the respondents gross cash receipts in the Myanmar Kyat (MMK) currency. We standardized this for comparison with the 2018 gross cash receipts by using the foreign exchange rate in 2018 which is USD1 = MMK 1300. The average rate in 2020 was USD1 = MMK 1600.

Our analysis indicated that the households in all 4 CSVs recorded more cash inflows (in US dollar) from agriculture activities in 2020, compared to the pre-pandemic year of 2018 with Ma Sein CSV making the biggest jump in gross cash received. This increase in cash inflow in Ma Sein is driven largely by the increased floor price of rice set by the Government in 2020 (Food and Agriculture Organization, 2020). Rice is the main agricultural output of Ma Sein village.

In the 4 CSVs, IIRR the implementor of the program has promoted the use of improved varieties of the crops cultivated in the CSVs such as varieties that are short-duration and drought-tolerant upland rice, pigeon pea, peanut, vegetables and corn. IIRR also promoted the diversification into small livestock production, fruit tree production and even, small-scale aquaculture.

All of these interventions featured the strategic use of external inputs, making the options cost effective for farmers and relied on approaches and principles that local farmers were already familiar with. Moreover, a special effort was made to engage women is using homesteads (the space around the residence) as production areas where vegetables are cultivated and small livestock are raised. These homesteads are spaces where women had special control and decision-making authority.

3.3. Effects of the pandemic to household wealth scores in the CSVs

Tables 3 and 4 present the change in the wealth quintiles of the four CSVs and the results of the ANOVA of wealth scores across the CSVs. Taung Khamauk (TKM) CSV exhibited significant decrease in the ultra-poor quintile.

The ANOVA results (Table 4) indicate that the mean wealth index scores among the four CSVs are significantly different from each other. Htee Pu CSV has the highest mean wealth index score for 2018 and 2020 suggesting Htee Pu CSV is better off among the four CSVs. Ma Sein CSV has the lowest wealth index scores across the four CSVs, suggesting Ma Sein as the poorest among the four CSVs.

The wealth quintile tables is useful to determine first whether there is significant change in the wealth ranking in the CSVs between pre-pandemic and pandemic years and secondly, whether the is change in the percentage of ultra-poor households in the village. Our analysis suggests that between pre-pandemic year of 2018 and pandemic year of 2020—in general there are very few statistically significant changes in the wealth ranking in the CSVs except for the category of ultra-poor households. Focusing on this category, it is noted that Htee Pu CSV and TKM CSV (significant with p = 0.012) showed a decline in the percentage of households categorized as ultra-poor. This is considered an improvement as more households have moved up either to poor or middle-class categories. This is opposite for Ma Sein and Sakta CSV where it indicated an increase in the ultra-poor households in 2020.

This trend in the percent of ultra-poor households in 2020 suggest that in Htee Pu and TKM CSVs—the community was able to cope with the negative effects of the pandemic while in Ma Sein and Sakta CSV it is the opposite. Particular to Ma Sein, CSV, we noted earlier the increased percent of household not owning agricultural land yet this village exhibited the highest gross cash received in 2020. This would imply that
agriculture lands have been concentrated to very few rich households in the village. Anecdotal accounts from the field researchers in Ma Sein CSV, also indicated that most households due to lack of cash capital driven by COVID-19 pandemic economic slowdown, sold their farm land and many migrated to towns for casual labor. In the case of Sakta CSV—considering their location in the highlands of Chin state—when mobility was restricted, the CSV experienced difficulties accessing markets to trade their products and access other socio-economic support.

3.4. Effects to perceived ability of the household to meet basic needs

Table 5 presents a subjective measure of how the household feel at the time of the survey of their ability to meet basic needs. Htee Pu and Sakta CSV indicated a significant increase in the percent of households saying they are “doing well”. Taung Khamauk and Ma Sein CSV (highly significant p = 0.004) indicated a decrease in the percent of households saying their “doing well” in 2020. All four CSVs indicated an increase in 2020 in the percentage of households responding to “struggling” and “unable to meet basic needs”. While the earlier analysis indicated huge improvements in the gross cash income of the households in the CSVs, this has not led to better self-confidence to cope with the pandemic in 2020. This is mostly likely driven by increasing food prices in 2020 as well as the uncertainties brought by the pandemic.

3.5. Effects to food security and diet diversification

To assess the effect of the COVID-19 pandemic to food security and nutrition in the 4 CSVs, we collected and analyzed the Household Food Insecurity and Access Scores (HFIAS) and the Household Diet Diversity Scores (HDDS) for 2018 and 2020. HDDS was used as an indirect measure for better nutrition as a diverse diet has been linked to better nutrition outcomes as it makes the diet more balanced or the appropriate distribution of nutrient sources (Kant et al., 1993).

Table 6 is the difference of HFIAS in the 4 CSVs between pre-pandemic and pandemic periods. In HFIAS—the higher the score, the higher is the food insecurity of the household (Coates et al., 2007). Except for Sakta CSVs—3 CSVs have higher food insecurity scores during the pandemic period compared to the pre-pandemic period in 2018. This higher food insecurity scores may have been caused by rising food prices caused by the disruptions in trade and the overall decline of the Myanmar economy in the later part of 2020 when the households surveys were conducted. In the case of Sakta CSV—this CSV is far isolated in the highland region of Chin, the households in this CSV may have been able to address food access by growing and consuming their own produce during this period of isolation and restrictions in trade.

Table 7 is the analysis of the Household Diet Diversity Scores as an indirect measure of better nutrition. The analysis indicated that there is significant increase in the diet diversity of the households during the 2020 pandemic conditions compared to 2018 pre-pandemic conditions. While TKM and Ma Sein villages indicated a decrease in diet diversity in

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Table 3

| Village            | 2018 Baseline | 2020 Endline |
|--------------------|---------------|--------------|
|                    | Minimum | Maximum | Mean | Std. Dev. | F-test | Minimum | Maximum | Mean | Std. Dev. | F-test |
| Htee Pu            | -1.55   | 2.02    | 0.59 | 0.78      | 199.41** | -1.08   | 1.94    | 0.60 | 0.66      | 391.75** |
| Taung Khamauk      | -1.65   | 1.53    | -0.33 | 0.65      | 1.34      | -0.08   | 0.55    | 0.66 |
| Ma Sein            | -2.52   | 0.67    | -1.46 | 0.65      | 2.78      | -0.05   | 0.37    |
| Sakta              | -1.13   | 1.29    | 0.10 | 0.45      | NA        | 1.11    | 1.30    | 0.15 | 0.42      |

* Significant at 1%.
** Significant at 0.1%.

Table 4

| Wealth quintiles | Htee Pu (%) | Taung Khamauk (%) | Ma Sein (%) | Sakta (%) |
|------------------|-------------|-------------------|-------------|-----------|
| Wealthiest       | 39.92       | 39.09             | 0.864       | 3.70      |
| Above middle class| 23.87     | 27.57             | 0.313       | 13.58     |
| Middle Class     | 18.93       | 14.40             | 0.161       | 15.38     |
| Poor             | 13.58       | 16.46             | 0.324       | 0.70      |
| Ultra-poor       | 3.70        | 2.47              | 0.508       | 85.06     |

Table 5

| Responses               | Htee Pu | Taung Khamauk | Ma Sein | Sakta |
|-------------------------|---------|---------------|---------|-------|
|                         | 2018 (%)| 2020 (%)      | p-value |
|                         | 2018 (%)| 2020 (%)      | p-value |
|                         | 2018 (%)| 2020 (%)      | p-value |
|                         | 2018 (%)| 2020 (%)      | p-value |
| Doing well              | 5.35    | 13.99         | 0.002** | 24.14  |
| Doing just OK/breaking even | 85.19  | 62.14         | 0.000** | 58.62  |
| Struggling              | 7.82    | 21.81         | 0.000** | 16.09  |
| Unable to meet household needs | 1.65   | 2.06          | 1.00    | 1.15   |

* McNemar’s test was conducted to determine if there is a significant difference on the proportion (increase or decrease) over time.

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Table 6

| Village            | 2018 2020 (p-value)* | 2018 2020 (p-value) | 2018 2020 (p-value) |
|--------------------|----------------------|----------------------|----------------------|
|                    | 2018 | 2020 | p-value | 2018 | 2020 | p-value | 2018 | 2020 | p-value | 2018 | 2020 | p-value |
| Htee Pu            | -1.55 | 2.02 | 0.59 | 0.78 | 199.41** | -1.08 | 1.94 | 0.60 | 0.66 | 391.75** |
| Taung Khamauk      | -1.65 | 1.53 | -0.33 | 0.65 | 1.34 | -0.08 | 0.55 |
| Ma Sein            | -2.52 | 0.67 | -1.46 | 0.65 | 2.78 | -0.05 | 0.37 |
| Sakta              | -1.13 | 1.29 | 0.10 | 0.45 | NA | 1.11 | 1.30 | 0.15 | 0.42 |

Table 7

|Responses| Htee Pu| Taung Khamauk| Ma Sein| Sakta|
|---------|-------|--------------|--------|------|
|         | 2018  | 2020         | p-value |      | 2018  | 2020     | p-value |
|         | (%)   | (%)          |         |      | (%)   | (%)       |         |
| Doing well| 5.35  | 13.99        | 0.002** |      | 24.14 | 5.81      | 0.004** |
| Doing just OK/breaking even | 85.19 | 62.14        | 0.000** |      | 58.62 | 70.93     | 0.175   |
| Struggling | 7.82  | 21.81        | 0.000** |      | 16.09 | 22.09     | 0.458   |
| Unable to meet household needs | 1.65  | 2.06         | 1.00    |      | 1.15  | 1.16       | 1.00    |

* McNemar’s test was conducted to determine if there is a significant difference on the proportion (increase or decrease) over time.

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Table 8

| Wealth quintiles | Htee Pu (%) | Taung Khamauk (%) | Ma Sein (%) | Sakta (%) |
|------------------|-------------|-------------------|-------------|-----------|
| Wealthiest       | 39.92       | 39.09             | 0.864       | 3.70      |
| Above middle class| 23.87     | 27.57             | 0.313       | 13.58     |
| Middle Class     | 18.93       | 14.40             | 0.161       | 15.38     |
| Poor             | 13.58       | 16.46             | 0.324       | 0.70      |
| Ultra-poor       | 3.70        | 2.47              | 0.508       | 85.06     |

NA - not applicable.

* McNemar’s test was conducted to determine if there is a significant difference on the proportion (increase or decrease) over time.

p-value < 0.05, then the proportion is statistically significant at 5%.

p-value < 0.01, then the proportion is statistically significant at 1%.
Table 6
Mean household food insecurity and access scores (HFIAS), 2018, 2020.

| Village | 2018 (pre-pandemic) | 2020 (pandemic) | Mann-Whitney U value | p value | Interpretation of HH food security in 2020 |
|---------|---------------------|-----------------|----------------------|---------|-------------------------------------------|
| Htee Pu | 0.98                | 3.92            | 21,390               | < 0.001 | Decrease in food security (highly significant) |
| TKM     | 3.17                | 6.13            | 2744                 | < 0.001 | Decrease in food security (highly significant) |
| Ma Sein | 3.55                | 3.69            | 4664                 | 0.733   | Slight decrease to no change in food security (not significant) |
| Sakta   | 6.90                | 1.78            | 4011                 | < 0.001 | Increase in food security (highly significant) |

Table 7
Mean household diet diversity scores (HDDS), 2018, 2020.

| Village | 2018 (pre-pandemic) | 2020 (pandemic) | Mann-Whitney U value | p value | Interpretation of HH diet diversity in 2020 |
|---------|---------------------|-----------------|----------------------|---------|--------------------------------------------|
| Htee Pu | 6.46                | 6.84            | 26,599               | 0.003   | Increase in diet diversity (significant)   |
| TKM     | 6.01                | 5.59            | 3682                 | 0.151   | Decrease in diet diversity (not significant) |
| Ma Sein | 6.89                | 5.93            | 3464                 | < 0.001 | Decrease in diet diversity (highly significant) |
| Sakta   | 4.93                | 5.53            | 8541                 | < 0.001 | Increase in diet diversity (highly significant) |

Possible drivers of this change in HDDS in the pandemic period include the level of diversification of production of crops and animals in 2020. The more diverse the production the more diverse is the available food materials in the community. Another driver is having more cash available to purchase diverse food materials. Finally, the extent of the household consuming their own produce from diversified production systems can also enhance diet diversity of the household.

Fig. 4 is the analysis for households consuming their own produce. Performing the non-parametric test, Mann-Whitney U to determine the statistical significance of the difference between the number of households consuming their own produce in 2018 and 2020. Overall, the number of households responding that they have consumed their produce is higher in 2020 compared to 2018, U = 245,309 p-value < 0.001, suggesting highly significant difference between the pre-pandemic and pandemic years.

Sakta CSV in the highlands has also recorded the highest number of households consuming their own produce compared to other CSVs which likely contributed to the better food security and diet diversity scores indicated earlier. Their location being in the highlands in Chin state, considering the disruptions in trade in 2020, this might have driven households to shift towards subsistence farming (farming for their own consumption) versus the farming to sell produce. This further confirmed the earlier analysis when Sakta CSV also registered the lowest gross cash income from their own produce.

This analysis of HFIAS and HDDS in the CSVs provides insights as to the potential of diversified agriculture production systems at the local level in addressing food insecurity and poor nutrition as a result of the restrictions in trade, mobility and general economic slowdown. This is evident in Sakta CSV which by virtue of their isolated location in the highlands—the households were still able to achieve food security and better diet diversity despite not so significant gross cash income earned from farming.

4. Conclusion

The broader consideration for the scope of the IIRR’s CSVs is its potential of not just addressing climate risks and vulnerabilities, but also building robust adaptive capacities anchored on development outcomes. The role of the CSV’s socio technical interventions in supplementing household and local food needs is being demonstrated during height of the COVID-19 pandemic in Myanmar in 2020. One limitation of this study is sample size of 4 villages which is too small to be representative of the total rural communities of Myanmar. Another limitation is the absence of a study and data as to the specific impacts of the COVID-19 pandemic to the 4 villages studies. The COVID-19 impacts considered are inferred from available studies conducted in Myanmar.

Despite these limitations in the methodology, our analysis indicated that overall, the effect of the pandemic to agriculture production in 2020 production season in the 4 CSVs has been minimal. This is evidenced by the continued agriculture production at the same levels as the pre-pandemic conditions in 2018. There is even an indication of expansion of production as indicated by the increased areas for cultivated land. Eventually, this lead to an increase of cash inflows in the 4 CSVs. A key factor of this reduced impact to production was the short window of respite from restrictions during the start of the monsoon in June–July 2020. This has allowed farmers in the CSVs to access important farm inputs and services to start-off the production season. This situation coupled with new varieties of crops and diversified production as promoted by IIRR in the CSVs—led to a much better performance in the production activities, some are even better than the pre-pandemic period of 2018. The implication of this is in the management of lockdowns and travel restrictions. Managers of the pandemic response should consider identifying strategic periods of production season to which some form of mobility is allowed or offering an alternative mechanism to deliver needed farming support.

While agriculture production has been sustained and potentially expanded in 2020, this has not translated to significant improvements in well-being. The study revealed that there was an increase in the percentage of households in the CSVs categorized as ultra-poor in 2020 compared to pre-pandemic data in 2018. In terms of household food security and diet diversity—some CSVs have fared better than the other CSVs. Sakta village in the highland areas of Chin state fared very well in food security and diet diversity despite of the situation that their cash inflows have not change a lot in the pandemic year of 2020. As trade in Chin state has been disrupted, people in the CSVs have consumed more...
of their produce contributing to better food access and diet diversity. This is evidence that there is a potential for smallholder diversified agriculture production in ensuring a more secure local food system for communities in the event of trade disruption and general economic slowdown. Having own food to consume during crisis has also the potential to ease the burden on women to find food for the household, a task still traditionally assigned to women.

The future scope of this study includes studies on developing quantitative metrics of measuring household level resilience to the impacts of not only climate change but also of other risks such as COVID-19 pandemic and the current economic crisis. This study has provided potential indicators of household resilience such as cashfl wows, wealth scores, food security and diets that can be included in developing a household resilience metric. As a support to the recovery and further protection of the most vulnerable, a systematic assessment of social and economic support mechanisms provided to rural communities in Myanmar since the start of the pandemic in 2020 will valuable to inform future rural development programs in the country.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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