



Cost-Benefit Analysis of Establishing a Climate Smart Village in Southern Shan, Myanmar: The Case of Taungkhamauk Village, Nyaung Shwe Township

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Abstract

This study analyzed the financial sustainability of a Climate-Smart Village (CSV) established in Taungkhamauk, Nyaung Shwe Township, in the southern Shan State of Myanmar. The Climate-Smart Agriculture (CSA) options adopted by participating households and evaluated by this study included yield enhancement for upland rice and corn, planting fruit trees in farms and homesteads, and vegetable gardening as well as livestock and poultry raising in homesteads. The Cost and Return Analysis method was used in determining financial sustainability. Results showed that the majority of the households benefited from implementing the CSA options. Furthermore, the study also noted that the CSV promoted social values about economic empowerment, household food security, and gender inclusiveness. Upscaling of the CSV approach in other villages in the Shan State was recommended.



Keywords

Climate smart agriculture, climate smart villages, cost-benefit analysis, agro-forestry systems

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Acronyms

CCAFS	Climate Change, Agriculture and Food Security
CDA	Canada and the Community Development Association
CSA	Climate Smart Agriculture
CSV	Climate Smart Village
IDRC	International Development Research Centre
IIRR	International Institute for Rural Reconstruction

Introduction

Taungkhamauk is an agricultural village within the Nyaung Shwe Township in the southern part of the Shan State of Myanmar. The people living in the village rely on farming and raising poultry and livestock as their main source of livelihood (Dayo, et al., 2021). They grow upland rice, corn, groundnut, sunflower, and safflower as cash crops and raise chickens, pigs, cows, and buffalo (Dayo, et al.).

Due to climate change, the village experiences extreme climate variability, specifically irregular but intense rainfall and high ambient temperature. As a result, agricultural production has become highly vulnerable leading to “poor seed germination, lower crop yield, and even crop failure. (Barbon, et al., 2020)

International development agencies and local research institutions have initiated cooperative efforts to help ameliorate the economic condition of rural households vulnerable to the impact of climate change. In Myanmar, the International Institute for Rural Reconstruction (IIRR) implemented the Climate Smart Villages (CSV) approach, wherein climate-smart agricultural options (CSA) are introduced in villages. Technologies and/or practices the villagers choose are implemented using donor funds. In the village of Taungkhamauk, the CSAs that were implemented were:

1. Yield enhancement for upland rice and corn,
2. Planting fruit trees on farms and homesteads, and
3. Vegetable gardening and livestock and poultry raising in homesteads.

The projects started in 2018 and were completed in 2020. The CGIAR supported the project through CCAFS Southeast Asia and the International Development Research Centre (IDRC) Canada.

Determining the financial benefits generated by the CSAs for the villagers is a component of the CSV project in Myanmar. This paper presents the Cost-Benefit Analysis of the CSV in the village of Taungkhamauk. The analysis attempts to ascertain whether the selected CSAs are financially advantageous to the households through quantitative data.

Objectives of the study

The general objective of this study was to determine the financial and social benefits generated by the Climate Smart Agriculture (CSA) options adopted by the village of Taungkhamauk, Nyaung Shwe Township, Shan State, Myanmar. Specifically, the study was conducted to:

1. Estimate the net benefits accruing to the households from implemented CSA options;
2. Determine the combined financial benefits of the various CSA options; and
3. Determine social benefits generated by the CSV project.

Methodology

Mode and year of data collection

Primary data for this study were generated through personal interviews of households in the village of Taungkhamauk using a structured questionnaire. Data gathering was done in 2021.

Analysis of the CSA options

Cost and Return Analysis

The financial benefits accruing to the Taungkhamauk households that adopted the CSA options were measured using the Cost and Return Analysis. Estimates of the households' Gross Value (GV) were compared with estimates of the Operating Costs incurred in employing the options. The GV represents the market value of agricultural produce (i.e., rice, corn, vegetables, livestock, poultry) that were sold or consumed at home, including the estimated market value of fruits that can be harvested from trees planted by the households, as well as values of unsold offspring of livestock which can be sold when the need arises. The Net Value (NV) was obtained by taking the difference between the GV and the corresponding operating costs. The NV is the "profit" earned by the households. Similar to the GV, the term Net Value, instead of Profit, was used in most of the Cost and Return Analyses in this study because noncash revenue such as produce consumed at home, unsold live assets, and projected fruit harvests was considered in determining household earnings.

Profitability Analysis

The Profitability Analysis is an essential component of the Cost and Return Analysis. After the Cost and Return Analysis has determined the profit (termed "Net Value" in this study), the former measures how "profitable" the Net Value is in relation to the GV. This study used the Operating Profit Margin Ratio (OPMR) to gauge the profitability of the CSA options. The OPMR reflects the percentage of Net Value (profit) the farmer retains out of the GV. A high percent value is preferred over a lower one. For instance, an OPMR of 70% means that a farmer keeps 70% of the GV as his profit while the remaining 30% pays for his operating/production expenses.

On the other hand, an OPMR of 10% means that the farmer only retains 10% of his GV as profit while 90% goes to expenses. A low OPMR of 10% indicates that the farmer is operating in a disadvantaged position and will continue to do so unless his operating costs are minimized. On the other hand, the farmer with a 70% OPMR is better off because he is getting more than half of the GV as earnings while only 30% goes to his expenses in the farm operation.

Analysis of the CSV approach

Climate-smart village (CSV) is an approach that was developed to mitigate the negative effect of climate change on agriculture and on people who depend on agriculture as a source of livelihood. It is based on adopting a portfolio of climate-smart agriculture options appropriate for the locality. Estimating the financial impact of the CSV approach was achieved by adding up the net financial gains of the households from all the CSA options they adopted.

Economic empowerment

Economic empowerment is defined as “enabling poor people to think beyond immediate daily survival and to exercise greater control over both their resources and life choices” (Combaz and McLoughlin, 2014). In the context of the CSV project, this social benefit may be represented by an improvement in household liquidity due to additional revenue generated from the CSV interventions.

Household food security

Household food security exists “when all the people living in the household have physical, social and economic access to sufficient, safe and nutritious food at all times that meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996). A household becomes food insecure when it is “unable to acquire adequate food for one or more household members because the households had insufficient money and other resources for food” (Life Sciences Research Office, 1990; National Research Council, 2005). This was measured by asking the respondents whether their household experienced food insecurity during a given period and to what degree.

Inclusiveness and women

Social inclusion refers to the “removal of institutional barriers and the enhancement of incentives to increase the access of diverse individuals and groups to development opportunities” (FAO, 2016). Other literature refers to it as women's empowerment (Buvinic and Nichols, 2013). For this study, the indicator of inclusiveness was equal access to IIRR-organized meetings, which aims to increase technical knowledge in agriculture.

Results and Discussion

Description of Respondents

Number of respondents

Eighty households were interviewed for this case study. After finishing the interviews, this number was eventually reduced to 76 by excluding respondents with incomplete responses. Fifty-eight (76%) of the 76 respondents implemented the technology to improve the yield of upland rice, while 41 (54%) applied the process to increase the yield of corn (Table 1). Vegetable gardening and raising livestock in homesteads were adopted by 30% to 46% of the households. Thirty-three (43%) and 18 (24%) planted fruit trees on their homesteads and farms, respectively.

**Table 1. Number of households by types of implemented CSA options
Taungkhamauk Village, Nyaung Shwe Township, Shan State, Myanmar, 2021**

Implemented CSA	Number of HH*	% of 76 HH
Yield improvement for upland rice	58	76%
Yield improvement for corn	41	54%
Planting fruit trees at homesteads	33	43%
Vegetable gardening at homesteads	23	30%
Cattle raising at homesteads	35	46%
Poultry raising at homesteads	23	30%
Pig raising at homesteads	34	45%
Planting fruit trees at the farm	18	24%

* Multiple responses

HH = household

Number of family members per household

More than half (57%) of the households are composed of four to five family members (Table 2). Fourteen percent have more than five members in a household, while 30% have less than three family members. The number of family members in a household ranged from one to nine. The World Bank stated that "poor households have almost two times more children than non-poor households, resulting in a higher child dependency ratio" (World Bank, 2017). Based on the family member distribution, fewer (14%) households have a considerable responsibility to provide food and other basic needs for the family, while the majority (57%) are only moderately burdened with family support. The respondents' demographic profile indicated that most households could not be classified as extremely poor.

**Table 2. Number of family members per household, 76 households
Taungkhamauk Village, Nyaung Shwe Township, Shan State, Myanmar, 2021**

Number of Family Members	Number of Households	Percent
1	1	1%
2	8	11%
3	14	18%
4	18	24%
5	25	33%
6	5	7%
7	1	1%
8	2	3%
9	2	3%
Total	76	100%

Family members by age bracket

The majority of the 76 households in Taungkhamauk have family members that are young adults (17 to 30 years old, 64%) and who are in their middle ages (31 to 50 years old, 66%) (Table 3). The persons under these age brackets represent the economically productive members of the households. In addition, a smaller number of households (26%) have older family members (51 to 65 years old) who can still earn a living. On the other side of the scale are family members aged 0 to 16 years old. They depend on the older productive family members for their basic needs.

Table 3. Number of households showing family members by age bracket, Taungkhamauk Village, Nyaung Shwe Township, Shan State, Myanmar, 2021

Age Bracket	Number of HH*	Percent of 76 HH
0 to 16	58	76%
17 to 30	49	64%
31 to 50	50	66%
51 to 65	20	26%
> 65	6	8%
No data	3	4%

HH = household

Farm area and land ownership

The majority (74%) of the respondents till land that spans from less than 0.5 to 1.5 hectares (Table 4). Of these households, 26% work on less than 0.5 hectares, 22% on 0.5 to 1.0 hectares, and 26% on 1.01 to 1.5 hectares. Twenty percent produce crops on land with an area greater than 1.5 hectares. The majority (92%) of these households own the land that they farm.

Table 4. Farm size and land ownership, 76 households, Taungkhamauk Village Nyaung Shwe Township, Shan State, Myanmar, 2021

Farm Description	Number of households	Percent
Farm size (Ha.)		
< 0.5	20	26%
0.5 to 1.0	17	22%
1.01 to 1.5	20	26%
1.501 to 2.0	6	8%
2.01 to 2.5	8	11%
4.05	1	1%
No data	4	5%
Total	76	100%
Land ownership		
Owned	70	92%
Not owned	6	8%
Total	76	100%

Crops planted and other sources of livelihood

Households planted eleven different types of crops on their farms in 2020. These included rice, corn, groundnuts, sesame, tomato, sunflower, beans, pigeon peas, and chili. The households differed in the choice of the types of crops that they planted, but the more common crops grown were rice, corn, and groundnuts. In addition, some households raised cattle which they mainly sold to be used as draft animals. Table 5 presents the various crops and cattle grown by the households. It also shows that, aside from farming, a few households earned a living by working off-farm as laborers, selling food/farm produce in the public market, or collecting and selling firewood. On the other hand, a few households (8%) also reported that they did not draw income from farming or off-farm sources.

Table 5. Primary sources of livelihood, 76 households, Taungkhamauk Village Nyaung Shwe Township, Shan State, Myanmar, 2021

Primary Sources of Livelihood	No. of HH	Percent
Corn, groundnut	8	11%
Corn	8	11%
Groundnut	8	11%
Rice, corn, groundnut	5	7%
Rice, groundnut	7	9%
Rice	3	4%
Rice, corn, groundnut, tomato, cattle	3	4%
Rice, groundnut, tomato	3	4%
Rice, corn, groundnut, sunflower	2	3%
Corn, groundnut, sunflower	2	3%
Corn, groundnut, tomato	2	3%
Rice, corn, beans	1	1%
Rice, corn, groundnut, turmeric, pigeon pea	1	1%
Corn, groundnut, sunflower, chilli	1	1%
Rice, groundnut, tomato, cattle, casual labor		
firewood	1	1%
Rice, corn, sesame, groundnut	1	1%
Rice, corn, sesame, groundnut, sunflower	1	1%
Rice, corn, sesame, groundnut, tomato	1	1%
Rice, corn, groundnut, tomato, labor	1	1%
Rice, corn, groundnut, beans	1	1%
Rice, corn, groundnut, cattle	1	1%
Rice, corn, sunflower	1	1%
Rice, groundnut, tomato, cattle	1	1%
Rice, corn, tomato, cattle, vending	1	1%
Rice, sesame, groundnut, cattle, labor	1	1%
Corn, labor	1	1%
Groundnut, tomato	1	1%
Groundnut, labor	1	1%
Pigeon pea, groundnut, sunflower	1	1%
Sesame, groundnut	1	1%
No regular farm/off-farm livelihood	6	8%
Total	76	100%

Financial Analysis of the CSA Options Adopted by the Households

Yield improvement for upland rice and corn

Attaining the goal of increasing the yield of upland rice and corn in the village of Taungkhamauk was put into motion through the CSV project on Participatory Varietal Selection (PVS) of high-yielding field crop varieties. Farmers participating in the project chose Yn-3230, Yanlu-31, and Tarpagu, as well as AB-DMT (sweet corn) as the varieties of upland rice and corn, respectively, for the field trials to determine the ones that are most suitable for their environment. The varieties were produced by Myanmar's department of agricultural research.

This study performed a Cost and Return Analysis based on the field trials conducted in 2019 and 2020. Gross Revenue and Production Cost values were averages of the two-year data.

In the case of upland rice, 58 households participated in the field trials. Forty-six (46) of these households could profit from selling the yield produced by the tested rice varieties. The combined Gross Revenue earned by the 46 households was estimated to be MMK 9,977,050.00 (USD 6,028.00), while the total production cost was MMK 3,845,461.00 (USD 2,324.00) (Table 6). The resulting Net Income was MMK 6,131,589.00 (USD 3,705.00). Production costs included the cost of seeds, fertilizer, and pest control materials, farm machinery rental, hired labor for land preparation, planting, maintenance, harvesting, shelling, and drying, and marketing services (transport and handling). Family labor was excluded as a direct cost with the assumption that this is not a cash cost and there is no opportunity cost for family labor. Net Income, on the other hand, was considered as the returns to family labor and management. On a per household basis, the Net Income earned by each household was estimated to be MMK 216,892.00 (USD 131.00). This represents the amount the household received as remuneration for family labor and management that they inputted in the rice production process.

Computing for the Operating Profit Margin Ratio (OPMR), the Net Income generated by the households was estimated to be 61% of the Gross Revenue. In contrast, the portion of the Gross Revenue used to pay for the Production Cost amounted to 39%. The households could keep a larger part of the Gross Income as profit instead of being absorbed as cost, indicating that the field trials using the selected varieties were profitable. The remaining 12 households earned an average Gross Revenue of MMK 124,125.00 (USD 75.00). However, their average Production Cost (MMK 203,029.00 or USD 123.00) exceeded their Gross Revenue resulting in a negative profit. On the other hand, it is worth mentioning that most of the households in Taungkhamauk Village interviewed for this study admitted that they were concerned about food security for the family in 2020. This was the height of the COVID-19 pandemic. It is reasonable to assume that, for this reason, farmers decided to keep a large part of their rice harvest for home consumption instead of disposing everything in the market. Thus, the revenue from the quantity of rice these farmers sold was inadequate to cover the cost incurred in producing their rice crop.

In addition to acceptable financial performance, the field trial also showed that the majority (79%) of the 58 households successfully produced the quantity of yield required to generate a profit. This result suggests that the selected varieties of rice have the potential to be adopted as seed stocks for rice production by the village.

Table 6. Cost and return analysis of upland rice production using new methods to increase yield, 58 households Taungkhamauk, Nyaung Shwe Township, Shan State, Myanmar, 2021

Item	Total		Average		Range		No. of HH
	MMK	USD	MMK	USD	MMK	USD	
Rice							58
HH with + Net Income							46
Gross Revenue	9,977,050	6,028	216,892	131	18,000 to 1,497,000	10.90 to 904.50	
Production Cost	3,845,461	2,324	83,597	51	3,230 to 431,000	1.95 to 260.42	
Net Income	6,131,589	3,705	133,295	81	650 to 1,066,000	0.39 to 644	
OPMR	61%						
HH with (-) Net Income							12
Gross Revenue	1,489,500	900	124,125	75	30,000 to 450,000	18.30 to 272.00	
Production Cost	2,436,350	1,472	203,029	123	31,250 to 885,000	18.88 to 534.74	
Net Income	(946,850)	(572)	(78,904)	(48)	(435,000) to (9,250)	(263) to (6)	

For corn, 41 households conducted field trials in 2019 and 2020 to test the performance of the selected varieties. Similar to the Cost and Return Analysis for upland rice, the data used for corn were averages of the Gross Revenue and Production Cost of the two abovementioned years. Thirty of the 41 households could earn a profit using the new corn varieties. The combined Net Income of these households amounted to MMK 9,150,376.00 (USD 5,529.00), while per household Net Income was MMK 305,012.00 (USD 184.00) (Table 7). The Operating Profit Margin (OPMR) for these gainers was computed to be 70%, indicating that each household retained 70% of their Gross Revenue as profit. This amount represents payment for family labor and management, while the remaining 30% is paid for the farmer's operating cost. With a high OPMR, corn production using the selected varieties can be considered profitable.

Similar to the results of the field trials for upland rice, the majority (73%) of the farmers that tested the new corn varieties earned a profit given the yield generated from the trials. The large number of households that succeeded in generating good financial results suggest that the selected varieties could improve corn production and income of the households in Taungkhamauk.

Table 7. Cost and return analysis of corn production using new varieties to increase yield, 41 households Taungkhamauk, Nyaung Shwe Township, Shan State, Myanmar, 2021

Item	Total		Average		Range		No. of HH
	MMK	USD	MMK	USD	MMK	USD	
Corn							41
HH with + Net Income							30
Gross Revenue	13,068,387	7,896	435,613	263	2,563 to 3,000,000		
Production Cost	3,918,020	2,367	130,601	79	200 to 845,000		
Net Income	9,150,367	5,529	305,012	184	366 to 2,991,500	0.22 to 1,807.60	
OPMR	70%						
HH with (-) Net Income							11
Gross Revenue	1,150,569	695	104,597	63	2,563 to 640,000	1.55 to 386.71	
Production Cost	1,581,948	956	143,813	87	3,100 to 653,000	1.87 to 394.60	
Net Income	(431,379)	(261)	(39,216)	(24)	(187,579) to (538)	(113.34) to (0.33)	

Homestead vegetable gardening

Twenty-three households converted available space in their homesteads to be a productive resource by planting cash crops. Table 8 presents the type(s) of crops grown by the households. Almost three-fourths (74%) of the households preferred planting tomatoes or beans. The rest of the households grew corn (13%) or a combination of beans and corn (13%).

Table 8. Number of households by type of cash crop planted in their homestead Taungkhamauk Village, Nyaung Shwe Township, Shan State, Myanmar, 2021

Cash Crops Planted	No. of Households	Percent
Tomato	9	39%
Beans	8	35%
Corn	3	13%
Beans and Corn	3	13%
Total	23	100%

Twenty-one (91%) of the households could make a profit out of the harvests from the crops they planted. The Gross Revenue generated by these households per production season ranged from MMK 4,000.00 (USD 2.40) to MMK 5,250,000.00 (USD 3,172.00), or an average of MMK 678,198.00 (USD 410.00) per household (Table 8). They spent an average of MMK 80,579.00 (USD 49.00) for production expenses, including fertilizers, pesticides, and hired labor for weeding, cultivation, fertilizer application, and harvesting. The resulting Net Income ranged from MMK 4,000.00 (USD 0.30) to MMK 5,097,000.00 (USD 226.60) or an average of MMK 597,619.00 (USD 361.00). The Net Income represents 88% of Gross Revenue retained as profit by the households.

Two households were not successful in generating a profit from home vegetable gardening. Their Gross Revenue averaged MMK 9,100.00 (USD 5.00) per production season, while the average Production Cost amounted to MMK 45,500.00 (USD 27.00), leading to a negative Net Income.

Table 9. Cost and return analysis of homestead vegetable gardening, 23 households, Taungkhamauk Village Nyaung Shwe Township, Shan State, Myanmar, 2021

Item	Total		Average		Range		No. of HH
	MMK	USD	MMK	USD	MMK	USD	
Tomato, Beans, Corn							
HH with + Net Income							
Gross Revenue	14,242,158	8,606	678,198	410	4,000 to 5,250,000	2.40 to 3,172	21
Production Cost	1,692,150	1,022	80,579	49	500 to 375,000	226.59	21
Net Income	12,550,008	7,583	597,619	361	4,000 to 5,097,000	0.30 to 226.60	21
OPMR	88%						21
HH with (-) Net Income							
Gross Revenue	18,200	11	9,100	5	3,200 to 15,000	2.00 to 9.10	2
Production Cost	91,000	55	45,500	27	20,500 to 70,500	12.40 to 42.60	2
Net Income	(72,800)	(44)	(36,400)	(22)	(55,500) to (17,300)	(34) to (10.45)	2

HH = household

Raising livestock and poultry at the homestead

Small-scale livestock and poultry production at the homestead is a common practice among rural households in Myanmar, significantly contributing to family income and nutrition. The animals commonly raised are cattle, buffalo, pigs, and chicken (Barbon, et al., 2017). Cattle and buffalo are commonly raised to be used as draft animals for “land cultivation, transportation, and producing manure for compost.” Farmers rarely keep cattle and buffalo to be sold for meat. They are fed mainly with a mixture of broken rice, rice straw, and salt (Theingi Myint et al., 2018).

Backyard producers of chicken use native breeds under a low-input, free-range type of feeding (Henning and Pym, 2019). In a few cases, producers provide supplementary feeds such as broken rice, food scraps, corn, or sorghum (Win, 2012). The producers rarely provide housing, vaccination, and disease treatment (Henning, et al., 2009). At night, the birds are kept under their homes, “inside the cowshed, in trees, natural sheds and bird shelters (made of bamboo and palm leaves), all of which are provided with nests for laying and brooding” (Burgos et al., 2009). Female chickens lay 12 eggs per clutch while producing three clutches per year (Henning and Pym). The average hatchability of the eggs is 75 to 85%, and hatched chicks have a survival rate of 40 to 66% (Burgos et al.). The birds are raised mostly for “income generation by selling them live, followed by home consumption and cockfighting” (Win et al., 2019). Backyard producers sell directly to consumers, village traders/assemblers, or the local market. Local consumers prefer native chicken meat and eggs over products from imported breeds.

Raising pigs in homesteads is another source of food and supplementary income for the household. Native breeds are preferred over hybrids because of their low feeding and medication costs (Chan Myae, 2018). Gilts (female pigs) reach their reproductive stage within five to six months and give birth to an average of 12 piglets in one farrowing. The piglets reach their marketable weight about six months after farrowing (National Pork Board, 2016).

A Cost and Return Analysis was performed to determine whether households in Taunkhamauk Village benefit financially by raising livestock and poultry in their homesteads. The data for the analysis were gathered from households that participated in IIRR’s CSA project on homestead livestock and poultry raising.

Cattle Production

Thirty-five of the 80 households were interviewed regarding the results of rearing cattle as a CSA option. These households opted to market their cattle instead of keeping them as draft animals. Households did this to raise cash to pay off loans in acquiring some of the cattle. Results of the financial analysis showed that 29 of these households could profit from selling their livestock by generating an average Gross Revenue of MMK 1.55 Million (USD 935.00) (Table 10). After subtracting the purchase cost of cattle and the production cost, the Net Income per household was computed to be MMK 463,831.00 (USD 280.00). Note that the cost of cattle was deducted from the Gross Revenue instead of the depreciation cost of the cattle because they were not kept as an asset but sold within a short period. Expenses for commercial feeds were minimal since the households utilized rice straw, forages, and homegrown corn (if available) as feed materials. The 29 households sold a total of 46 heads of cattle. The total Net Income generated was MMK 13.45 Million (USD 8,128.00). Converting the Net Income into a per head basis, the households earned MMK 308,890.00 (USD 187.00) from selling one head of cattle.

The Net Income corresponds to 30% of the Gross Sales indicating that the households retained 30% of their gross sales as compensation for their labor and management in rearing the cattle. A larger percentage of the Gross Sales was used to recover the purchase cost of the cattle as well as the expenses for the commercial feeds.

On the other hand, five households were not successful in earning a profit from selling their livestock. The combined cost of cattle and production cost exceeded their Gross Sales. The estimated loss per household was MMK 85,200.00 (USD 51.00).

Native Chicken Production

Twenty-three households served as respondents for the financial analysis of raising native chicken as a CSA option. Sixteen households sold 123 birds for 2020, including seven birds consumed at home. The remaining seven households did not report any number of birds sold or consumed by the family.

It is worth noting that most households did not spend on commercial feeds or veterinary medicines to raise chickens. The few households that reported expenses for feeds estimated significantly minimal amounts. Family labor, being a non-cash cost, was also not considered an operating cost, an assumption that was applied in all the analyses in this study.

Hence, the production cost for raising chicken in this study was considered zero. However, the depreciation of the start-up (breeder) chicken (i.e., the female and/or male chicken that were initially bought to start the coop) was considered a fixed cost and was deducted from the Gross Value. Depreciation cost for one year was estimated based on the reported purchase cost and the three-year economic life of the breeders.

Item	Total		Average		No of HH
	MMK	USD	MMK/HH	USD/HH	
HH with (+) Net Income					29
Gross sales	44,860,000	27,106	1,546,897	935	
less: Cost of cattle	27,746,000	16,765	956,759	578	
Total Gross Revenue	17,114,000	10,341	590,138	357	
less: Production Cost	3,662,900	2,213	126,307	76	
Net Income	13,451,100	8,128	463,831	280	
Gross Revenue per head of cattle	372,043	225	No. heads sold: 46		
Production Cost per head	63,153	38	No. heads raised: 58		
Net Income per head	308,890	187			
OPMR	30%				
HH with (-) Net Income					5
Gross sales	3,850,000	2,326	770,000	465	
less: Cost of cattle	2,945,000	1,779	589,000	356	
Total Gross Revenue	905,000	547	181,000	109	
less: Production Cost	1,331,000	804	266,200	161	
Net Income	(426,000)	(257)	(85,200)	(51)	
Gross Revenue per head of cattle	150,833	91	No. heads sold: 6		
Production Cost per head	221,833	134	No. heads raised: 6		
Net Income per head	(71,000)	(43)			
HH with Zero Net Income					1
Gross sales	800,000	483	800,000	483	
less: Cost of cattle	700,000	423	700,000	423	
Total Gross Revenue	100,000	60	100,000	60	
less: Production Cost	100,000	60	No. heads sold: 1		
Net Income	0	0	No. heads raised: 1		
HH = household			Total households:		35

The households that marketed and consumed their home-raised chicken generated a combined Gross Value of MMK 670,500.00 (USD 405.00) or an average of MMK 41,906.00 (USD 25.00) (Table 11). After deducting the depreciation cost, the total Net Value amounted to MMK 577,167.00 (USD 349.00). This is equivalent to a per household earning of MMK 36,073.00 (USD 22.00). Based on 132 heads of chicken that were sold and consumed at home, the resulting Net Value per bird amounted to MMK 4,372.00 (USD 2.64).

The total Net Value represents 86% of the total Gross Value. In other words, the households that sold and/or consumed chicken could keep 86% of the gross returns they generated. This amount, which is greater than half of the Gross Value, serves as the remuneration for the labor and management performed by the family members in raising the native chicken.

Table 11. Cost and return analysis of raising native chicken, 23 households, Taungkhamauk Village, Nyaung Shwe Townsh Shan State, Myanmar, 2021

Item	Total		Average		No of HH
	MMK	USD	MMK/HH	USD/HH	
Gross Value	670,500	405	41,906	25	
Production Cost	Nil				
Depreciation cost	80,333	49	5,021	3	
Net Value	577,167	349	36,073	22	16
OPMR	86%				
Gross Value per head	5,080	3.07	Number of heads sold: 123		
Depreciation cost per head	609	0.37	Number of heads consumed: 9		
Net Value per head	4,372	2.64	Total number of heads: 132		
Households without sale					7
HH = household					

Thirty-four (34) households were interviewed to generate data for the financial analysis of raising native pigs in their homesteads. Fifteen of these households reported selling a number of their livestock in 2020. Home consumption was not recorded. On the other hand, 19 did not report any market transaction or slaughtering livestock for home consumption. The latter were families that started raising pigs under the IIRR CSV project in 2020 and, therefore, did not have marketable litters to sell when the study was conducted.

The Cost and Return Analysis for the households that generated revenue from selling their livestock revealed that all were able to earn a profit from their transactions. The 15 households made a combined Gross Revenue of MMK 5.87 Million (USD 3,547.00) or an average of MMK 391,333.00 (USD 236.00) gross earnings for every household. A total Production Cost amounting to MMK 713,008.00 (USD 431.00) or an average of MMK 47,534.00 (USD 208.00) was deducted from the Gross Revenue to determine the households' Net Income. The analysis showed that the households generated a combined Net Income of MMK 5.16 Million (USD 3,116.00) or an average of MMK 343,799.00 (USD 208.00). The Net Income is equivalent to 88% of the Gross Revenue the households retained as their profit (OPMR). It refers to the amount of revenue they received as payment for the time and labor the family spent rearing their livestock. This ratio is relatively high in contrast to an OPMR that is way below 50%.

The Production Cost included the cost of commercial feeds, the depreciation cost of housing and/or enclosures, and the depreciation of the start-up animals. Housing and enclosures were depreciated based on an assumed lifespan of three years. On the other hand, the female and male breeders were depreciated based on a reproductive life of five years.

Table 12. Cost and return analysis of pig raising, 15 households, Taungkhamauk Village, Nyaung Shwe Tow: Shan State, Myanmar, 2021

Item	Total		Average		No. of HH
	MMK	USD	MMK/HH	USD/HH	
Gross Revenue	5,870,000	3,547	391,333	236	15
LESS:					
Operating Cost	540,803	327	36,054	22	
Depreciation cost:					
Start-up pigs	132,070	80	8,805	5	
Housing and enclosure	40,135	24	2,676	2	
Total Production Cost	713,008	431	47,534	29	
Net Income	5,156,992	3,116	343,799	208	
OPMR	88%				
Gross Revenue per pig	172,647	104			
Cost per pig	6,541	4			
Net Income per Pig	166,106	100			
Total Pigs Sold: 34	Total pigs raised: 109 heads				

HH = household

Planting fruit trees was one of the Climate Smart Agriculture (CSA) options identified by the International Institute for Rural Reconstruction (IIRR) for the southern Shan State uplands (Barbon, et al., 2017). Fruit trees are a source of supplemental income and food for households. They also mitigate the harsh effects of climate change in the uplands, such as soil degradation due to soil erosion and flooding of lower areas due to water run-off.

Thirty-three households participated in planting fruit trees in their homesteads. The households selected eight varieties of fruit trees, with avocado, lime, and orange emerging as most preferred (Table 13). Planting started from 2018 to 2020, with a total of 1,020 surviving trees recorded by the study in 2021. The table also implies that several households planted a combination of fruit trees in their homesteads.

Table 13. Number and type of live fruit trees by year planted in homesteads, 33 households, Taungkhamauk, Nyaung Shwe Township, Shan State, Myanmar, 2021

Type of Fruit Tree	2018		2019		2020		Total	
	No. of fruit trees	No. of HH recipients*	No. of fruit trees	No. of HH recipients*	No. of fruit trees	No. of HH recipients*	Fruit Trees	Percent
Avocado	38	3	249	15	165	10	452	44%
Lime	10	4	151	17	98	11	259	25%
Orange	0	0	114	7	57	6	171	17%
Mango	38	3	34	3	20	1	92	9%
Longan	0	0	9	5	6	3	15	1%
Sunkist	0	0	5	1	5	1	10	1%
Jackfruit	0	0	10	6	8	5	18	2%
Lychee	1	1	0	0	2	2	3	0.3%
Total	87	11	572	54	361	39	1,020	100%

*Multiple responses

HH = household

Value estimation of fruits to be harvested

Table 14 presents the assumptions used in estimating the Gross Value of fruits expected to be harvested by the households from their homesteads. Included in the assumptions were the number of years it would take for the trees to bear fruits, yield per tree, and farmgate prices.

Table 14. Assumptions used in estimating the Gross Value of fruits, Taungkhamauk Village, Nyaung Shwe Township, Shan State, Myanmar, 2021

Fruit Tree	Years to bear fruits	Ave. yield at growth stage	Ave. yield at mature stage (Yr 10 onwards)	Ave. farm gate price	
		Kg/tree	Kg/tree	MMK	USD
Avocado	3	18	36 (Year 4 onwards)	200	0.12
Lime	3 to 4	50 (Year 3)	100	639	0.39
Orange	3	10	150	1,000	0.60
Mango	5	10	20	843	0.51
Longan	5	8	60	800	0.48
Sunkist	3	10	150	1,500	0.91
Jackfruit	5	750	900	600	0.36
Lychee	5	25	60	2,000	1.21

Financial benefit of growing fruit trees in homesteads

Evaluating the financial benefit of growing fruit trees differed from the process done on the other CSA options discussed earlier because the Gross Values of most of the fruit trees were based on projected data instead of past data. Most of the fruit trees bear fruit on or after the third year after planting, as Table 14 indicated. Thus, minimal information on the harvest volume from these perennials was available when the study was conducted in 2021, thereby compelling the need to project values.

The Gross Values were obtained from the years where the maximum quantities of harvest were projected during the growing and mature stages of the trees (Table 15). The total projected Gross Value from the 1,020 fruit trees planted amounted to MMK 18.95 Million (USD 11,454.00) at the growing stage and MMK 52.08 Million (USD 31,471.00) at the mature stage. Deducting the cost of production[1], the resulting Net Value (“profit”) earned by all households was estimated to be MMK 18.9 Million (USD 11,421.00) per year during the growing stage and MMK 52.03 Million (USD 31,438.00) per year at the mature stage.

Based on value per tree, households with an avocado tree could earn a Net Value of MMK 3,535.00 (USD 2.14) per year during the growth stage and MMK 7,109.00 (USD 4.30) during the mature stage. Households with a lime tree would earn a Net Value of MMK 32,223.00 (USD 19.47) and MMK 64,495.00 (USD 38.97) at the growth and mature stages, respectively. An orange tree would generate a Net Value of MMK 9,880.00 (USD 5.97) at the growth stage and MMK 148,900.00 (USD 89.97) when the tree reaches its mature fruiting age. For mango, households would earn MMK 8,391.00 (USD 5.07) per tree in one year during the growth stage. This amount would increase to MMK 16,831.00 (USD 10.17) upon reaching the mature stage. Households that planted longan could generate a profit of MMK 6,140.00 (USD 3.71) per tree during its growth stage and increase to MMK 47,449.00 (USD 28.67) during the mature stage. The potential annual income from a Sunkist Orange tree could amount to MMK 9,434.00 (USD 5.80) during its growth stage. This would significantly increase to MMK 221,274.00 (USD 133.20) when the tree reaches its mature fruiting age. Households could earn the largest income from a jackfruit tree due to the weight of its fruits. At the growth stage, the average earning per tree was estimated to be MMK 446,574.00 (USD 269.83) per year. Income would increase to MMK 535,944.00 (USD 323.83) upon reaching its mature fruiting age. Lastly, a lychee tree would enable a household to receive MMK 49,678.00 (USD 30.02) and MMK 119,767.00 (USD 72.37) during the growth and mature stages of fruit-bearing.

Table 15. Cost benefit analysis of planting fruit trees in homesteads, Taungkhamauk, Nyaung Shwe Township Shan State, Myanmar, 2021

Fruit Tree	Value of max. annual harvest at Growth Stage		Value of max. annual harvest at Mature Stage		No. of Trees	Value per Tree			
	MMK	USD	MMK	USD		Growth Stage	Mature Stage	MMK	USD
Avocado					452				
Gross value	2,641,777	1,596	3,231,619	1,953		3,575	2.16	7,150	4.32
Production cost	18,205	11	18,205	11		40	0.02	40	0.02
Net value	2,623,175	1,585	3,214,010	1,942		3,535	2.14	7,109	4.30
Lime					259				
Gross value	5,550,870	3,354	11,101,740	6,708		32,273	19.50	64,545	39.00
Production cost	14,895	9	14,895	9		50	0.03	50	0.03
Net value	5,535,975	3,345	11,086,845	6,699		32,223	19.47	64,495	38.97
Orange					171				
Gross value	1,698,030	1,026	25,470,450	15,390		9,930	6.00	148,950	90.00
Production cost	8,275	5	8,275	5		50	0.03	50	0.03
Net value	1,689,755	1,021	25,462,175	15,385		9,880	5.97	148,900	89.97
Mango					92				
Gross value	776,195	469	1,552,390	938		8,441	5.10	16,881	10.20
Production cost	4,965	3	4,965	3		50	0.03	50	0.03
Net value	772,885	467	1,549,080	936		8,391	5.07	16,831	10.17
Longan					15				
Gross value	95,990	58	714,960	432		6,355	3.84	47,664	28.80
Production cost	3,310	2	3,310	2		215	0.13	215	0.13
Net value	92,680	56	711,650	430		6,140	3.71	47,449	28.67
Sunkist					10				
Gross value	150,605	91	2,259,075	1,365		14,895	9.10	226,735	136.50
Production cost	54,615	33	54,615	33		5,462	3.30	5,462	3.30
Net value	97,645	59	2,206,115	1,333		9,434	5.80	221,274	133.20
Jackfruit					18				
Gross value	8,043,300	4,860	9,651,960	5,832		446,850	270	536,220	324
Production cost	4,965	3	4,965	3		276	0.17	276	0.17
Net value	8,038,335	4,857	9,646,995	5,829		446,574	269.83	535,944	323.83
Lychee					3				
Gross value	150,605	91	360,790	218		50,064	30.25	120,153	72.60
Production cost	1,159	0.7	1,159	0.7		386	0.23	386	0.23
Net value	149,447	90.30	359,632	217.30		49,678	30.02	119,767	72.37
TOTAL					1,020				
Gross value	18,956,767	11,454	52,083,909	31,471					
Production cost	55,774	34	55,774	34					
Net value	18,902,252	11,421	52,030,387	31,438					

In addition to planting fruit trees at homesteads, the IIRR CSV project also initiated growing fruit trees on the farms of the village residents. Eighteen (18) households planted 649 trees from 2018 to 2020. The trees planted are similar to the ones raised in the homesteads, with the addition of custard apples (Table 16). The majority (57%) of the selected trees were avocados. This was followed by lime (21%) and orange (15%) trees. Fewer mango, longan, jackfruit, custard apple, and lychee trees were planted. Most of the fruit trees (410 out of 640 surviving perennials) were planted in 2019.

Value estimation of fruits to be harvested

In estimating the value of fruits produced on the farms, the same assumptions used for similar trees planted in homesteads were used with the addition of assumptions for custard apples (see Table 16). The latter would bear fruits within three years after planting and is expected to produce 10kg of fruits per year throughout its economic life. The farmgate price for a kilogram of custard apple is MMK 955.00 (USD 0.58).

Table 16. Number and type of live fruit trees by year planted in farms, households, Taungkhamauk, Nyaung Shwe Township, Shan State, Myanmar, 2021

Type of Fruit Tree	2018		2019		2020		Total	
	No. of fruit trees	No. of HH recipients*	No. of fruit trees	No. of HH recipients*	No. of fruit trees	No. of HH recipients*	Fruit Trees	Percent
Avocado	30	2	240	11	97	6	367	57%
Lime	0	0	85	6	50	2	135	21%
Orange	0	0	65	4	32	2	97	15%
Mango	20	1	0	0	5	1	25	4%
Longan	0	0	16	2	0	0	16	2%
Jackfruit	0	0	3	1	4	2	7	1%
Custard Apple	0	0	1	1	0	0	1	0.2%
Lychee	0	0	0	0	1	1	1	0.2%
Total	50	3	410	25	189	14	649	100%

*Multiple responses

HH = household

The results of the Cost and Return Analysis showed that the total projected Gross Value from the 649 fruit trees planted on the farms amounted to MMK 7.97 Million (USD 4,818.00) per year at the growing stage and MMK 27.32 Million (USD 16,506.00) at the mature stage (Table 17). Deducting the cost of production, the resulting Net Value generated by the 18 households was estimated to be MMK 7.96 Million (USD 4,810.00) per year during the growing stage and MMK 27.30 Million (USD 16,497.00) per year at the mature stage.

Measuring the net returns per tree, households with an avocado tree could earn a Net Value of MMK 3,557.00 (USD 2.15) per year during the growth stage and MMK 7,100.00 (USD 4.29) during the mature stage. Households with a lime tree would earn a Net Value of MMK 32,248.00 (USD 19.49) and MMK 64,520.00 (USD 38.99) at the growth and mature stages, respectively. An orange tree would generate a Net Value of MMK 9,913.00 (USD 5.99) at the growth stage and MMK 148,933.00 (USD 89.99) when it reaches its mature fruiting age. For mango, households would earn MMK 8,421.00 (USD 5.09) per tree in one year during the growth stage.

An orange tree would generate a Net Value of MMK 9,913.00 (USD 5.99) at the growth stage and MMK 148,933.00 (USD 89.99) when it reaches its mature fruiting age. For mango, households would earn MMK 8,421.00 (USD 5.09) per tree in one year during the growth stage. This amount would increase to MMK 16,861.00 (USD 10.19) upon reaching the mature stage. Households that planted longan could generate a profit of MMK 6,252.00 (USD 3.78) per tree during its growth stage and increase to MMK 47,561.00 (USD 28.74) during the mature stage. Households could earn MMK 446,543.00 (USD 269.80) per year from a jackfruit tree at the growth stage. Income would increase to MMK 535,913.00 (USD 323.83) upon reaching its mature fruiting age. The potential annual income from a custard apple tree could amount to MMK 9,318.00 (USD 5.40) throughout its productive life. Lastly, a lychee tree would enable a household to receive MMK 49,683.00 (USD 29.95) and MMK 119,772.00 (USD 72.30) during fruit-bearing growth and mature stages.

Table 17. Cost benefit analysis of planting fruit trees in farmlands, Taungkhamanuk, Nyauung Shwe Township Shan State, Myanmar, 2021

Fruit Tree	Value of max. annual harvest at Growth Stage		Value of max. annual harvest at Mature Stage		No. of Trees	Value per Tree			
						Growth Stage		Mature Stage	
	MMK	USD	MMK	USD		MMK	USD	MMK	USD
Avocado					367				
Gross value	2,277,280	1,376	2,623,175	1,585		3,575	2.16	7,150	4.32
Production cost	6,620	4	18,205	11		18	0.01	50	0.03
Net value	2,270,660	1,372	2,616,555	1,581		3,557	2.15	7,100	4.29
Lime					135				
Gross value	4,357,615	2,633	8,713,575	5,265		32,273	19.50	64,545	39.00
Production cost	3,310	2	3,310	2		25	0.01	25	0.01
Net value	4,354,305	2,631	8,710,265	5,263		32,248	19.49	64,520	38.99
Orange					97				
Gross value	963,210	582	14,448,150	8,730		9,930	6.00	148,950	90.00
Production cost	1,655	1	1,655	1		17	0.01	17	0.01
Net value	961,555	581	14,446,495	8,729		9,913	5.99	148,933	89.99
Mango					25				
Gross value	211,840	128	422,025	255		8,441	5.10	16,881	10.20
Production cost	497	0.3	497	0.3		20	0.01	20	0.01
Net value	211,344	128	421,529	255		8,421	5.09	16,861	10.19
Longan					16				
Gross value	100,955	61	762,955	461		6,355	3.84	47,664	28.80
Production cost	1,655	1	1,655	1		103	0.06	103	0.06
Net value	99,300	60	761,300	460		6,252	3.78	47,561	28.74
Jackfruit					7				
Gross value	3,127,950	1,890	3,753,540	2,268		446,850	270	536,220	324
Production cost	2,152	1.3	2,152	1.3		307	0.2	307	0.2
Net value	3,125,799	1,889	3,751,389	2,267		446,543	269.8	535,913	323.8
Custard Apple					1				
Gross value	14,895	9	226,735	137		9,599	6	9,599	6
Production cost	662	0.4	662	0.4		281	0.4	281	0.4
Net value	14,233	8.6	226,073	136.6		9,318	5.4	9,318	5.4
Lychee					1				
Gross value	49,650	30	120,815	73		50,064	30.25	120,153	72.60
Production cost	497	0.3	497	0.3		381	0.30	381	0.30
Net value	49,154	29.7	120,319	72.7		49,683	29.95	119,772	72.30
TOTAL					649				
Gross value	7,975,445	4,819	27,317,430	16,506					
Production cost	14,895	9	26,480	16					
Net value	7,960,550	4,810	27,302,535	16,497					

Total Financial Benefits Generated by the Climate Smart Village by Implementing Climate Smart Agriculture Options

Taungkhamauk, which was selected to be a Climate Smart Village (CSV), adopted a portfolio of Climate Smart Agriculture (CSA) options. These options included yield improvement for upland rice and corn through the selection of genetically improved varieties, planting fruit trees on farms and homesteads, and vegetable gardening and cattle, pig, and poultry raising in homesteads. The adoption of these options generated financial benefits for the village households. The combined financial gain of Taungkhamauk as a CSV was estimated and summarized in Table 18. Two sets (Total A and Total B) of the estimated Net Value per year (if the produce was either sold and/or consumed at home) or Net Revenue per year (if the produce was totally sold) that was earned by the village from the CSA options are shown in the table. Total A, which amounts to MMK 73.88 Million (USD 44,640.00), is the combined Net Value/Revenue if income from fruit trees is measured during the growth stage of fruit-bearing. Total B, which has a value of MMK 126.35 Million (USD 76,344.00), is the combined financial gain if the Net Value from fruits is considered when the trees have reached the mature age where fruit bearing is at maximum.

Note that the estimated financial gains have benefited most households interviewed for each CSA option. For instance, the benefits from the project on yield improvement for upland rice were earned by 46 households (79%) out of the 58 households that were interviewed for this study. The remaining households did not report a monetary gain from the project. These households decided to keep a large portion of their rice harvest at home for food security instead of selling them in the market. Similarly, only 70% and 44% of the households that raised chickens and pigs, respectively, generated profits from selling their produce. The rest of the households interviewed withheld selling their livestock and poultry for specific reasons such as ensuring household food security or keeping the animals as assets that can be easily liquidated in the future when the need arises.

The financial benefits that the CSV Project generated become significant when perceived in the context of welfare improvement. The national poverty line of Myanmar as of 2017 was MMK 1,590.00 per person per day (World Bank, 2017) or MMK 580,350.00/person/year (USD 351.00/person/year). The average family size of households in the village of Taungkhamauk is five persons/household. Translating the poverty line into a value equivalent to a household with five family members, the poverty threshold per year per household becomes MMK 2.90 Million (USD 1,753.00). Households that are dependent on agriculture for their source of livelihood are highly vulnerable to shocks brought about by climate change. This vulnerability can affect their income and push their economic condition below the poverty line. The Net Value/Revenue from any CSA options functions as additional income or a “safety net” for each household, so they do not fall below the threshold.

Table 18. Financial benefits gained by households from implementing CSA options, Taungthaamauk Nyaung Shwe Township, Shan State, Myanmar, 2021

Implemented CSA	Net Value/Revenue per year		Households Involved	% of HH Interviewed	Households Interviewed
	MMK	USD			
Yield improvement for upland rice	6,131,589	3,705	46	79%	58
Yield improvement for corn	9,150,367	5,529	30	73%	41
Planting fruit trees at homesteads			33	100%	33
Growth stage	18,902,252	11,421			
Mature stage	52,030,387	31,438			
Vegetable gardening at homesteads	12,550,008	7,583	21	91%	23
Cattle raising at homesteads	13,451,100	8,128	29	83%	35
Poultry raising at homesteads	577,167	349	16	70%	23
Pig raising at homesteads	5,156,992	3,116	15	44%	34
Planting fruit trees at the farm			18	100%	18
Growth stage	7,960,550	4,810			
Mature stage	27,302,535	16,497			
TOTAL (A)	73,880,025	44,640			
TOTAL (B)	126,350,145	76,344			

HH = household

Social Benefits Established by the CSV Project

In addition to evaluating the financial performance of the CSV project, this study determined the social benefits arising from its implementation. The social benefits examined were: economic empowerment, household food security, and gender inclusiveness.

Economic empowerment

Economic empowerment was defined earlier as the “enabling [of] poor people to think beyond immediate daily survival and to exercise control over resources and life choices” (Combaz and McLoughlin, 2014). The CSV Project achieved this task by introducing climate-smart agriculture interventions that enable households to increase their income if they choose to market their produce and provide additional food sources for family members. The results of the financial analyses of the CSA options adopted by the village proved that these are economic activities that are effective in attaining economic empowerment. The household beneficiaries can become self-reliant, resilient, and empowered with increased income.

Aside from cash income, the study also revealed that households that raise livestock and poultry obtain satisfaction from the knowledge that they have “live” assets in their backyards that they could liquidate when needed. This pervading perception could be considered as part of the economic empowerment benefit that was generated by the CSV project.

Household food security

Household food security is achieved when households have “physical, social and economic access to sufficient, safe and nutritious food at all times that meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996). In the village of Taungkhamauk, all CSA options adopted under the CSV Project foster food production to improve household food availability. The study noted that during the period between 2020 to 2021, 89% of the 76 respondents reported that they did not worry that their household would not have enough food (Table 19). Furthermore, 88% stated that their household did not experience eating fewer meals within the day because there was not enough food for everyone. However, no correlation was statistically established between households’ perception of food security and adoption of CSA options. The questionnaire used by the study was not designed to draw data for a Correlation Analysis.

On the other hand, eight households (11%) admitted that they did worry about not having enough food supply for the family and nine (12%) reported that their household was not able to have a complete number of meals for the day. It is also worth noting that five of the eight households concerned about not having enough food for the family were also included among the households that reported missing meals for the day.

**Table 19. Village perception of household food security, 76 households
Taungkhamauk Village, Nyaung Shwe Township, Shan State, Myanmar, 2021**

Question	No. of HH	Percent
In the past 12 months did you worry that your household would not have enough food?		
Yes	8	11%
No	68	89%
Total	76	100%
In the past 12 months did you or any household member have to eat fewer meals in a day because there was not enough food?		
Yes	9	12%
No	67	88%
Total	76	100%

HH = household

Inclusiveness and women

Social inclusion was defined in this study as the “removal of institutional barriers and the enhancement of incentive to increase access of individuals and groups to development opportunities” (FAO, 2016). Attendance in meetings initiated by the CSV project as well as membership in village organizations were used as indicators of gender inclusiveness. Participation in these activities was found to be gender neutral based on the perception of 26 interviewees (Table 20). Either the husband, the wife or both were allowed to attend these activities.

Table 20. Village perception of gender inclusiveness in CSV activities, 20 households Taungkhamauk Village, Nyaung Shwe Township, Shan State, Myanmar, 2021

Activity	Husband	Wife	Husband & Wife	Total
Who usually represent the household in meetings organized by the IIRR?	5	13	2	20
	Yes	No		
Are both male and female household members allowed to join groups formed for the CSV?	20	0	-	20



Summary and Conclusion

Yield enhancement for upland rice and corn, planting fruit trees in farms and homesteads, and vegetable gardening, as well as livestock and poultry raising in homesteads, were the Climate-Smart Agriculture (CSA) options adopted by households in Taungkhamauk Village, Nyaung Shwe Township, Shan State.

This report presents the study's results conducted in 2021 to determine the financial and social benefits generated by the CSAs for the households that participated in the CSV project. A cost-benefit analysis using the Cost and Return Analysis method was applied to evaluate each CSA option. The results showed that a large majority of the households benefited financially from adopting the interventions. Collectively, the total net benefit generated by the CSV project ranged from MMK 73.88 Million (USD 44,640.00) to MMK 126.35 Million (USD 76,344.00) per year. Thus, the CSV project can be considered financially sustainable.

The study also determined that the CSV project propagated social benefits for the villagers. The additional cash and non-cash income derived from the CSA options provided increased household liquidity, resulting in economic empowerment. In addition, access to food (household food security) was achieved since all of the adopted CSA options were aimed at food production. Lastly, the CSV project promoted gender inclusiveness by ensuring that all project-related activities are open to both male and female household members.

The positive results of the study further show that the CSV approach can be recommended for upscaling in other villages of the Shan State. Upscaling would merit serious consideration by local and international development agencies for future projects in Myanmar.



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