SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS OF THE CONSERVATION FARMING VILLAGE PROJECT IN UPLAND COMMUNITIES OF LA LIBERTAD, NEGROS ORIENTAL, PHILIPPINES

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(Received: December 26, 2016; Accepted: November 3, 2017)

ABSTRACT

Upland agriculture is a major cause of soil erosion in the Philippines. The clearing of forests for agricultural production and improper farming practices combine together to make the uplands highly susceptible to degradation. While a number of soil conservation interventions for upland agriculture have been identified, adoption by farmers has been marginal. The Conservation Farming Village (CFV) approach is a modality that aims to improve the adoption of soil conservation technologies. This approach was implemented in selected barangays (villages) in La Libertad, Negros Oriental, Philippines from October 2008 to December 2011. This paper analyzed the socio-economic and environmental impacts of CFV on upland farms. Specifically, it estimated changes in soil loss, organic matter and nitrogen, phosphorus and potassium content, and farm income. The CFV project has been effective in transforming the traditional monocropping system into a diversified cropping system. While soil erosion was still noted, the rate of soil loss and the total amount of nutrient loss decreased through time. The conservation farming (CF) technologies adopted by farmers were effective in reducing soil erosion. Moreover, the farmers' net returns generally increased after CF adoption due to the increased returns from crop diversification. The CFV project resulted in positive social impact. It improved the farmers' level of living, self-confidence leading to better leadership capability and decision-making as well as increased their social network.

Key words: Soil erosion, soil conservation, soil nutrient, impact assessment, technology adoption

INTRODUCTION

The land resource of the Philippines is deteriorating because of land use change and erosion. Twenty-one percent of the country's agricultural lands and 36 percent of non-agricultural lands are moderately or severely eroded (ADB 2009). Moreover, large portions of our forest are degraded due to shifting agricultural production. There are more than 20 million people living in upland watershed areas, half of whom are dependent on shifting cultivation for their livelihood (Cruz and Zosa-Feranil 1998 as cited by NEDA 2011). With the rapid growth of population and the apparent lack of livelihood opportunities in the lowlands, migration into the uplands will continue. Unfortunately, the upland farmers either do not take soil conservation seriously or are not fully aware of the effects of soil erosion. Hence, the unsustainable land use and improper farming practices make the upland areas highly susceptible to degradation.

In other parts of the world such as in the ASEAN region and in Australia, conservation activities such as conservation agriculture and landcare programs were implemented for natural resource management. The Conservation Agriculture Network for South East Asia (CANSEA) was created in 2009 to develop conservation agriculture (CA) cropping systems in South East Asia in 2009. The network believes that each country can contribute to advancing conservation agriculture (CA) to counteract negative environmental and economic externalities of crop intensification (Panyasiri et al. 2010). In Australia, the Australian Government is investing A$1 Billion through the National Landcare Programme over four years from 2014-15, including support for the Landcare Networks, with the objective of managing landscapes to sustain long-term economic and social benefits from their environment (NRM 2017).

For the Philippines, the Conservation Farming Village (CFV) is a modality for enhancing the transfer of conservation farming technologies and practices anchored on participatory planning, monitoring, and evaluation processes at the community level. The CFV mechanism adopts a multi-level technology promotion mechanism that capacitates local soil conservation extension units of the local government units (LGUs) and change agents (farmer-volunteers). The farmer-volunteers are used as an arm for the promotion of upland farming technologies and approaches. The farmer-to-farmer linkage strengthens the “multiplier effect” of technology diffusion processes at the local level. The major output in each CFV site are the Science &Technology-based model farms, serving as satellite farms with several farmer-adopters around the core model. The criteria used in the selection of CFV sites included the following: (1) located in the uplands, (2) reliable source of water for raising crops, (3) soil erosion is a problem, (4) located within a critical watershed, (5) agricultural production is actively practiced, (6) accessible to motorized transportation, (7) within UPLB’s operational coverage, (8) the LGU counterparts are supportive of the technological interventions and are willing to assist in the implementation of the CFV project, and (9) no existing or very few national programs on soil conservation implemented. Under the CFV, the upland farmers are provided with choices of the soil conservation technologies that will suit their farming conditions. These technologies are: (1) conservation agriculture technologies utilizing the three principles of no tillage, permanent soil cover and crop rotation; (2) alley cropping/use of hedge rows; (3) sloping agricultural land technologies (SALT 1-4, including livestock component); (4) contour farming; (5) natural vegetative strips; (6) contour composting/vermi-composting; (7) *Jatropha* as hedgerow vegetation; (8) farming systems suitable for sloping lands (multi-species cropping, conservation tillage, ground cover); (9) pole barriers and other physical barriers (bench terraces, contour rock walls); (10) canals and soil traps; (11)water-saving technologies/water management; (12) nitrogen-fixing trees, silviculture, and improved forage planting; and (13) agro forestry technologies.

This paper analyzed the social, economic and environmental impacts of CFV on the upland communities of La Libertad, Negros Oriental. Specifically, it estimated the changes in soil loss, organic matter and nitrogen, phosphorus and potassium content, as well as net farm income.

METHODOLOGY

Selection of Study Sites

The study was conducted in barangays or villages where the Conservation Farming (CF) technologies were introduced: Elecia, Pitogo, Nasunggan and Aya, La Libertad. Farmers from another adjacent village (Talaon) decided to adopt the CF technologies. Talaon and Aya have almost the same topography and crop cover. Large portions of these barangays have slopes of above 18% which are prone to flooding resulting in excessive soil erosion and landslides. The soils in the CFV sites are clay loam to clay and planted with corn, coconut and palay (rainfed and irrigated). These are situated in the upper part of the Pacuan Watershed where conversion of forestlands into agricultural use is rampant, becoming grasslands due to deforestation. Appendix Tables 1 and 2 show the baseline data on soil fertility taken during project implementation and the condition of the study sites before the CFV project implementation. Baseline data on soil fertility showed that phosphate (K) level was high while organic matter (OM) content was at medium level, however, the nitrogen (N) and potassium (P) levels were low while soil pH was strongly acidic. Excessive soil erosion, flooding in low-lying areas and landslides were reported to be very common in the area. There was lack of access to public services such as roads, potable water, and educational facilities. During that time, the LGU allotted funds for the development of the water system to reach the communities with less access. Also, there was no sustainable livelihood in the upland communities. The LGU decided to include the distribution of livestock (hogs and/or goats) and assorted high-value crop planting materials in the CFV program. The objective was to help improve the low level of household income in the area.

A total of 40 model farms (10 model farms per barangay) were established in the four initially selected barangays (Elecia, Pitogo, Nasunggan and Aya) with a combined area of 80.35 hectares. The CF technologies practiced in these farms included the following: hedgerow intercropping or contour hedgerows (100%), multi-storey planting (100%), contour composting (50%), contour rockwalls (13%) and mulching (5%). Hedgerow intercropping and multi-storey cropping became popular to the farmers because these were simple and easy to establish and effective in preventing soil erosion. Contour farming with rock wall and multi-storey cropping were adopted by farmers whose farms were situated in rocky and forested areas, respectively.

Selection of respondents

A total of 40 farmers were interviewed during the survey in the five CF sites in La Libertad. The farmer-respondents were composed of: (1) all of the farmers (n=10) who volunteered the farms that they operate to be used as CFV model/demo farms; and (2) randomly selected farmers (n=30) who adopted the CF technologies during and after the project.

Data collection and soil analysis

Farm visits, soil sampling and ground slope determination were conducted in each model farm as well as in other critical areas of the barangays. Present land use, farming systems and occurrences of soil erosion were also observed during field visits and interviews. A total of 23 soil samples were collected from the CFV sites in La Libertad. These soil samples were analyzed by the Department of Soil Science of the University of the Philippines Los Banos for texture, nutrient content (N, P, K), OM and pH.

Assessment of socio-economic impact

Social impact was measured by determining the changes in the living condition of the farm households as well as the farm communities as a whole when the CFV project was implemented. Effect on leadership capability and decision making were also measured. Data were generated using personal interview. Change in farm income was used as indicator to measure the economic impact of the CFV. This was determined by comparing net farm income before and after the adoption of CF technologies by the farmers. A t-test of paired two sample means was used to determine if the difference between the farmers' income before and after CFV adoption is statistically significant. Spearman's Correlation Analysis was used to determine whether there is a statistically significant relationship between change in farm income and the social impact indicators.

The over-all economic impact of the adoption of CF technologies was measured using the Benefit-Cost Analysis (BCA). The analysis focused on the annual incremental on-site benefits and costs of the soil conservation measures that were implemented in each of the CFV sites. The cash flow covered the years 2009 to 2015 (a 6-year period). The year 2009 represents the start of implementation of the CFV project while 2015 is the year the impact evaluation was conducted. The Internal Rate of Return (IRR), Net Present Value (NPV), and Benefit-Cost Ratio (BCR) were used to measure the project worth. The discount rate used was 6% which is the opportunity cost of money representing the minimum attractive rate of return for development projects (PCAARRD 2013).

Assessment of environmental impact

Environmental impact was gauged in terms of the changes on the biophysical condition of the soil, particularly level of soil fertility and amount of soil loss. The before-after analytical framework was used. Soil erosion was estimated using the modified Universal Soil Loss Equation developed by David (1976) and David and Collado (1977) as cited in David (1988). Change in soil fertility was measured in terms of the amount of N, P, K that were saved due to the adoption of the CF technologies. The value of the soil nutrients saved was estimated using the Replacement Cost valuation method (Shiferaw et al. 2005). This method estimates the cost of replacing the lost soil nutrients with commercially available fertilizers. The amount of N, P and K was translated into monetary value based on the price per 50kg-bag of urea (PhP1300), Solophos (PhP950) and muriate of potash (PhP2100). The resulting costs per kg were PhP 12 for N, PhP3.80 for P and PhP25.20 for K. The cost of nutrient per kg multiplied by the rate of nutrient loss (converted in kg/ha/year) was used as the value of nutrients saved.

RESULTS AND DISCUSSION

Characteristics of the farmer-respondents

The average age of farmer-volunteers was 46 years and 44 years for farmer-adopters. There was an equal number of male and female respondents among the farmer-volunteers while there were more female farmers (53.33%) in the farmer-adopters group. This finding implies that farming is no longer significantly dominated by male farmers. All of the farmer-respondents have formal schooling and a majority have elementary education. Majority of the farmer-respondents were married, and had 4-6 household members. Majority of the farmer-volunteers and farmer-adopters owned residential land where they built their own houses. Majority of the farmer-volunteers, and farmer-adopters' houses were made of wood or a combination of wood and concrete. All the farmer- respondents sourced their drinking water from a mountain spring, used fuel wood for cooking and with manual-flush toilet facility. Most of the farmer-volunteers (60%) and farmer- adopters (50%) used electricity for lighting. These findings imply that although the CFV farmers were relatively "well-off" than the other farmers in terms of their housing material, they appeared to be less financially able in terms of other housing facilities.

Technologies adopted by farmer-volunteers farmer-adopters and their perceptions on effectiveness and ease of adoption

The farmer-volunteers were able to establish demonstration farms and chose the soil conservation technologies based on the physical characteristics of their land. All farmer-volunteers adopted contour hedgerows and composting. Majority adopted boundary planting, organic farming and multi-storey cropping. Likewise, majority of the farmer-adopters practiced contour hedgerows, contour composting, rockwall and boundary planting in order to prevent soil erosion (Table 1). All of the farmer-volunteers tried to convince other farmers to adopt the CF technologies after they found the practices to be effective and easy to adopt. Both male and female farmer-volunteers considered all of the practices to be effective, apart from contour composting which was considered by a few male farmers to be just slightly effective. In terms of ease of adoption, there is a slight difference in the ratings of the males and females. Females rated the following practices as relatively difficult to follow: boundary planting, organic farming, livestock raising, contour composting vermiculture, contour rockwall and pole barriers or contour fences. On the other hand, the males reported that terracing is not easy to implement. Majority of the farmer-adopters practiced contour hedgerows and contour composting in order to prevent soil erosion.

In terms of effectiveness, all CF technologies received higher ratings from farmer-adopters (ranging from 2.78 to 3, with 3 being the highest). These technologies were considered effective in preventing soil erosion and bringing back soil fertility. In terms of ease of adoption, the same technologies were considered as easy to adopt by adopters with a mean rating of 2.48-3. Among the technologies mentioned, the easiest to follow were pole barriers or contour fences and integrated pest management. The relatively difficult practices were establishing terraces and vermiculture.

Table 1. Conservation farming technologies adopted by farmer-volunteers and farmer-adopters, La Libertad, Negros Oriental, Philippines, 2015.

Conservation Farming Technology	Farmer-Volunteers (n=10)		Farmer-Adopters (n=30)	
	Number	Percent	Number	Percent
Contour hedgerows	10	100	20	67
Contour composting	10	100	16	53
Rockwall	4	40	15	50
Boundary planting	9	90	14	47
Organic farming	7	70	12	40
Livestock raising	6	60	12	40
Terracing	6	60	12	40
Multi-storey cropping	7	70	10	33
Vermiculture	5	50	10	33
Mulching	5	50	10	33
Integrated pest management			4	13
Pole barriers/Contour fences			4	13

While there was continuous local government unit (LGU) support to the farmer-adopters, some factors impeded the adoption of the technologies such as lack of planting materials, unavailability of labor to maintain the farm, and non-ownership of the land. Vermiculture had the highest percentage of discontinuance because of the difficulty in rearing the worms (Table 2).

Table 2. Discontinuance of CF technologies adopted by 30 farmer-adopters, La Libertad, Negros Oriental, Philippines, 2015.

CF Technology	Adopted		Discontinued	
	Frequency	*Percentage*	*Frequency*	*Percentage*
Vermiculture	13	43.33	2	15.38
Contour hedgerows	24	80.00	3	12.50
Contour composting	20	66.67	2	10.00
Mulching	12	40.00	1	8.33
Multi-storey cropping	17	56.67	1	5.88
Organic farming	17	56.67	1	5.88
Contour rockwall	20	66.67	1	5.00

Socio-Economic Impact

Change in farmers' income

Incremental incomes of the 22 farmer-adopters and 10 farmer-volunteers before and after adoption of CF technologies are shown in Tables 3 and 4, respectively. Of the 30 farmer-adopters, only 22 were included in the impact evaluation because the remaining eight of these farmers were very recent adopters at the time of the impact assessment and the effect of the CF technologies would not be significantly felt at that time. T-test results showed that there is a statistically significant difference between the farmers' income before and after CFV adoption at 95% confidence level. Also, the percent change in the net income of the farmer-adopters (90%) was found to be higher than the percent change in the net income of the farmer-volunteers (61%). The farmer-adopters' better market access would account for the better performance.

Table 3. Net income before and after CFV, 22 farmer-adopters in 2009-2013, La Libertad, Negros Oriental, Philippines.

Item	Before CFV	After CFV	Difference	% Difference
RETURNS		Pesos per hectare		
Home consumption	5,420.81	7,173.72	1,752.91	32%
Sales from crops and livestock	9,096.02	19,017.33	9,921.31	109%
Total Returns	14,516.83	26,191.05	11,674.22	80%
COSTS				
Production Cost	1,275.00	1,081.39	-193.61	(15.18)
Total Cost	1,275.00	1,081.39	-193.61	(15.18)
NET RETURNS	13,241.83	25,109.66	11,867.83	90%

Table 4. Net income before and after CFV, 10 farmer-volunteers in 2009-2013, La Libertad, Negros Oriental, Philippines.

Item	Before CFV	After CFV	Difference	% Difference
RETURNS		Pesos per hectare		
Home consumption	8,986.92	9,183.85	196.92	2%
Sales from crops and Livestock	7,365.00	16,971.92	9,606.92	130%
Total Returns	16,351.92	26,155.77	9,803.85	60%
COSTS				
Production Cost	796.15	1,111.92,	315.77	40%
Total Cost	796.15	1,111.92,	315.77	40%
NET RETURNS	15,555.77	25,043.85	9,488.08	61%

Impact at the community level

At the community level, a little more than half of farmer-adopters (55%) observed that access to market has improved after the CFV program as the LGU provided trucks to transport farm produce at no cost to the farmers every Wednesday and Thursday. The LGU established trading posts and started improving the access roads to the CFV villages by changing the all-weather roads to concrete pavements. Land use and farming systems were changed by the CFV initiative through the introduction of forest and fruit trees, vegetables and hedges. Vegetables and other short duration crops were planted together with the main crop (commonly corn). Diversified farming was also practiced by the farmers. The use of inorganic fertilizers and the practice of burning crop residues were minimized. After the project implementation, an aggregate area of about 520 hectares was under CFV, or about 11% of the total land area of the five barangays. Majority of the farmer-volunteers perceived that the level of living and level of cooperation in the community improved because of CFV. Farmers supported and helped their fellow farmers as well. In contrast, majority (59%) of farmer-adopters did not observe any change.

Impact at the household and individual levels

Majority of the farmer-volunteers (90%) mentioned that adoption of CF technologies helped attain security for food and children's education. They were able to buy household items and farm implements because of the additional income from increased production. Majority of the farmer-adopters (82%) became food secure while less than half of the respondents (45%) mentioned that their additional income helped in purchasing household assets, such as television sets and furniture while 41% were also able to buy farm implements like shovel, scythe and plow. In addition, 45% of the farmer-adopters attributed house improvement to CFV adoption. Considering both farmer-volunteers and farmer-adopters, 82% mentioned that their level of living improved after the CFV project. This is consistent with Newby and Cramb's (2011) findings that adoption of CF practices increased the farmers' productivity which increased income and helped improve their level of living.

Majority of farmer-volunteers and farmer adopters perceived that their leadership ability, self-confidence and decision-making were enhanced. Moreover, their social network (among members of the community and the LGU) expanded and this helped in addressing farm problems. This confirms Cramb's (2005) findings that adoption of CF systems increased the formation of networks and association within the community that could serve as a form of social capital for the farmers. Social network size plays a role in the adoption of natural resource management practices (Wosen et al. 2013). Social capital plays a significant role in the adoption of soil and water conservation practices among 398 farming households in Ethiopia (Husen et al. 2017). Seventy seven percent of the 22 farmer-adopters enhanced their leadership ability as shown by their being officers of the CFV organization established or 'leading' the non-members to follow the CF technologies. This in turn, led to increased self-confidence, better decision-making and an expanded social network.

Results did not show high correlation values with income (INC) that would support the respondents' perception (Table 5). However, the analysis revealed statistical significance between the variables, purchase of farm implements (PFI) and purchase of household items (PHHI) indicating that farmers who were able to buy new farm implements were among those who bought new household items. Furthermore, the correlation among PFI, PHHI, and increased social network (SOCNET) was found to be statistically significant. Leadership also showed statistically significant values with PHHI (a= 5%) and SOCNET (a=1%) indicating that those who claimed that their leadership improved were among the respondents who reported that their social network improved and that they were able to purchase new items for their households. The correlation between household food security (FOODSEC) and INC was not significant even at a 90% confidence level. A number of the respondents who claimed that their household food security improved were those who were also able to increase farm production but did not sell their additional harvests and were used for home consumption. The difference in the number of soil conservation methods that the respondents adopted (SCA) did not make any significant difference. This indicates that the increase in income among the farmers was due to the additional crops that were planted and sold.

Table 5. Correlation analysis between change in income and selected socio-economic variables, La Libertad, Negros Oriental, Philippines, 2015.

Variable	INC	FOODSEC	PFI	PHHI	SOCNET	LEAD	SCA
INC	1.0000						
FOODSEC	0.2666	1.0000					
	0.1337						
PFI	0.1274	-0.2840	1.0000				
	0.4799	0.1093					
PHHI	0.2171	0.1304	0.4588	1.0000			
	0.2248	0.4693	0.0072				
SOCNET	-0.1458	-0.2364	0.3967	0.3758	1.0000		
	0.4180	0.1853	0.0223	0.0311			
LEAD	-0.1185	-0.0213	0.1754	0.4287	0.5129	1.0000	
	0.5113	0.9064	0.3289	0.0128	0.0023		
SCA	0.1878	0.0832	0.0592	0.1126	0.2938	0.1125	1.0000
	0.2952	0.6454	0.7435	0.5329	0.0971	0.5330	

Key: upper level values - rho, lower level values – sig. level

Farmers' attitude towards conservation

Majority of the farmers will continue the CF practices due to the benefits derived such as improvement in the level of living and additional income. Some farmers mentioned continuation of the CF practices because of the concern for the future generation. From their perspective it will help in the improvement of the environment because it helps prevent soil erosion. Majority of the farmers said they will convince other farmers to try CF practices so they enjoy the same benefits they are getting from the CF technology. Some farmers mentioned that convincing other farmers will benefit the community more because of the prevention of soil erosion through adoption of CF practices.

Environmental impact

The annual rates of soil erosion ranged from 41.1 to 67.6 tons/ha/yr with an average of 54.3 tons/ha/yr (start of the project) and 7.5 to 19.5 tons/ha/yr with an average of 10.2 tons/ha/yr (after the project). In the Philippines, the considered table soil erosion is less than 10/tons/ha/year (PCAARRD 2001). In general, a reduction of 81% in the amount of soil erosion was observed after the project (Table 6).

Table 6. Changes in soil erosion rates (in ton/ha/yr) in La Libertad, Negros Oriental, Philippines, 2015.

Barangay	Average annual erosion rate (ton/ha/yr)				
	Before	**Classification**	**After**	**Classification**	**% decrease**
Nasunggan	67.6	very high	11.9	low	82
Aya	41.1	very high	8.5	low	79
Talaon	no data	-	19.5	moderate	-
Elecia	no data	-	12.7	low	-
Pitogo	no data	-	no data	-	-
Average	**54.3**	**very high**	**10.2**	**low**	**81**

The level of soil fertility in the CFV sites in La Libertad remained the same for a period of seven years (2008-2015). The levels of P, organic matter and pH remained the same while the level of K decreased based on qualitative description. However, numerical values derived from the soil analyses showed a general downward trend in the soil nutrient levels (Table 7). Several reasons can be cited to explain this situation. First, though the erosion rate was reduced, soil erosion still occurred even in the model farms. Also, the practice of organic farming has not significantly increased among the farmers. Instead, majority of the farmers did not apply any form of fertilizer to recharge the soil nutrients. Thus, with increased cropping intensity, nutrients remaining in the soil were continuously "mined" thereby decreasing soil fertility levels further. Moreover, soil acidity was not consciously addressed by the CFV program.

Table 7. Changes in the level of N, P, K, %OM, and pH before and after the CFV project, La Libertad, Philippines.

Period	**N (%)**	**P**		**K**		**% OM**		**pH**	
		(Ppm)	**Level**	**(Me/100g soil)**	**Level**	**Value**	**Level**	**Value**	**Level**
Before	0.13	5.8	low	0.60	high	2.7	medium	5.5	strongly acid
After	0.11	2.0	low	0.33	medium	2.1	medium	5.1	strongly acid
Change	No change	No change		Decrease		No change		No change	

Note: P (before & after) - using Bray method

Projected trends in soil erosion rates, N, P, K and organic matter (%OM) are shown in Table 8. As a result of adopting CF technologies, all the parameters mentioned above showed decreasing rates. From a high of 72 tons/ha/yr, projected soil erosion in 2015 reached the tolerable level at 10.2 tons/ha/yr. The reduced rate of N, P and K loss also translates to a reduced rate when these nutrients are translated to kg/ha/yr (Table 8). A large reduction in the amount of soil erosion is a proof that the conservation farming technologies established in La Libertad were effective in reducing soil erosion. This is the reason why, after the CFV project, 28% of farmers did not experience erosion while 55% of the farmers experienced low to moderate erosion. The farmers also observed that the floodwaters became clearer, not muddy as previously described before adoption of the CF technologies.

Overall Impact of the CFV Project

An incremental net benefit analysis using a cash flow from 2009 to 2015 was applied to determine the worth of the CFV project. The value of nutrient losses were incorporated in the stream of costs in the cash flow table starting in 2010 until 2012 (Table 9). These losses represent the cost of delayed adoption of the CFV technologies. Note that the values were decreasing over time indicating that more farmers were adopting the CFV practices until 2012 when all target farmers have completely joined the CFV. Thus, by 2013, no nutrient losses appeared as a cost item in the cash flow table.

The incremental increase in income of the 32 farm households who initially adopted the soil conservation measures is presented in the cash flow table starting from the year 2010. For the late adopters, increased income was reflected from 2011 onwards. Prior to this year, only the value of harvests from traditional crops (without the additional production triggered by the LGU assistance) was included in the cash flow to account for the opportunity cost of late adoption. Also appearing in the stream of benefits is the value of nutrients saved due to reduced soil erosion. A decreasing trend in erosion was observed from the period 2011 to 2015. This implies that the soil nutrients being lost from erosion was also decreasing. Conversely, the quantity of nutrients being saved from erosion was increasing over time. In addition, the number of farmer-adopters also increased to 343. Thus, the value of nutrients saved exhibited an increasing trend from 2011 to 2015. Using a 6% discount rate resulted in a positive Net Present Value (NPV) and a BCR equal to 1.14. The Internal Rate of Return turned out to be 10% which is greater than the minimum attractive rate of return (6%) for development projects. The results indicate that the annual net benefits generated by the CFV project at La Libertad from 2009 to 2015 were able to recover the investments for mitigating soil erosion in the area.

CONCLUSION AND RECOMMENDATIONS

The CFV project was able to increase farm production and conserve land of upland farmers of La Libertad. The conservation farming technologies that were adopted were effective in reducing soil erosion. Crop diversification increased farmers' income. Net returns generally increased after CF adoption. The CFV project resulted in a positive social impact as it improved the farmers' self-worth leading to better leadership capability and decision-making, as well as increased social network. As a whole, the benefits generated by the CFV project outweighed the costs.

The CF technologies should be introduced in other upland areas that are susceptible to soil erosion. The encouraging results of the impact evaluation indicate that the conservation farming technologies would benefit other upland farms around the municipality of La Libertad. In the same vein, soil erosion in upland farms located in other areas of the country can be effectively addressed through the adoption of CF technologies.

Table 8. Trends in soil erosion, losses in N, P, K and % OM, La Libertad, Negros Oriental, Philippines, 2008-2015.

Year	SE[1] tons/ha/yr	N (%)	P (ppm)	K (me/100g soil)	OM (%)	N		P		K	
						kg/ha/yr	decrease/ yr	kg/ha/ yr	decrease/ yr	kg/ha/ yr	decrease/ yr
2008	72.0	0.14	7.3	0.7	3.0	103.69		0.53		2.01	
2009	63.2	0.14	6.5	0.7	2.8	87.46	16.23	0.41	0.11	1.67	0.34
2010	54.3	0.13	5.8	0.6	2.7	72.21	15.25	0.31	0.10	1.35	0.31
2011	45.5	0.13	5.0	0.5	2.6	57.95	14.27	0.23	0.09	1.07	0.28
2012	36.7	0.12	4.3	0.5	2.5	44.66	13.28	0.16	0.07	0.82	0.25
2013	27.8	0.12	3.5	0.4	2.3	32.36	12.30	0.10	0.06	0.61	0.22
2014	19.0	0.11	2.8	0.4	2.2	21.03	11.32	0.05	0.05	0.42	0.19
2015	10.2	0.11	2.0	0.3	2.1	10.69	10.34	0.02	0.03	0.27	0.16

[1] SE values were computed using MUSLE and showed significant decrease from 2008 to 2015

Table 9. Cash flow for Benefit-Cost Analysis, 343 CFV farmer-adopters, La Libertad, Negros Oriental, Philippines.

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Item	2009	2010	2011	2012	2013	2014	2015
Total Net Returns from Production	0	358,565	2,414,368	2,633,134	2,633,134	7,011,709	7,011,709
Nutrients saved	0	12,309	25,115	28,944	95,345	88,816	82,288
Total benefits	0	370,873	2,439,484	2,662,079	2,728,479	7,100,525	7,093,997
Cost of mitigating soil erosion							
Establishment cost	115,030	20,800	18,390	0	56,255	0	0
Project cost	7,200,000	0	0	0	0	0	0
Support of the LGU (tools, planting materials)	2,000,000	2,000,000	2,000,000	0	2,000,000	0	0
Total cost of mitigation	9,315,030	2,020,800	2,018,390	0	2,056,255	0	0
Nutrient loss	0	93,328	78,775	72,929	0	0	0
Total cost	9,315,030	2,114,038	2,097,165	72,929	0	0	0
NET BENEFIT	-9,315,030	-1,743,165	342,318	2, 589,150	672,224	7,100,525	7,093,997

IRR = 10% **NPV (6%) = 2,224,920** **BCR (6%) = 1.14**

ACKNOWLEDGEMENT

The authors acknowledge the Philippine Council for Agriculture, Aquatic, Forestry and Natural Resources Research and Development for funding this research and thank the directors and staff of the Socio Economic and Research Division and Agricultural Resources Management Research Division, for their valuable inputs to this project.

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APPENDIX TABLES

Appendix Table 1. Soil fertility analysis during CFV project implementation, La Libertad, 2010.

Barangay	N 5% of OM	P		K		OM		pH	
		Ppm (Bray)	Level	Me/100g soil	Level	Percent	Level	Value	Level
Nasunggan	0.13	2.8	Low	0.47	Medium	2.6	Medium	5.6	Moderately acidic
Aya	0.15	2.8	Low	0.48	Medium	2.9	Medium	4.9	Very strongly acidic
Pitogo	0.12	11.8	Medium	0.85	High	2.7	Medium	5.9	Moderately acidic
Average	0.13	5.8	Low	0.6	High	2.7	Medium	5.5	Strongly acidic

Source: Silliman University 2011.

Appendix Table 2. The condition of the study sites before the CFV project implementation.

Item	Condition before the project
Facilities and services	
Roads	Not accessible during rainy season
Schools	Primary level
Livelihood	Not sustainable
Electricity	None
Potable water	Limited
Landslides	Frequent (during typhoon seasons)
Agricultural production	Low level
Environmental hazards	
Landslides	Frequent (during typhoon seasons)
Flooding	Frequent (in low-lying areas)
Soil erosion	Excessive

Source: Survey Data 2015.