Journal of Environmental Science and Management SI-2: 60-75 (2020) ISSN 0119-1144

Development Pathways of Upland Farmers in Selected Sites of Conservation Farming Villages (CFV) Program in the Philippines

ABSTRACT

This study analyzed the livelihoods of upland farmers in the pilot sites of Conservation Farming Villages in Ligao City, Albay and La Libertad, Negros Oriental, Philippines from 2000-2015. It also identified the development pathways based on the livelihood change in the 15-year period, and analyzed the determinants of farmers' choice of development pathways. Development pathway is a pattern of change in the livelihood strategies in response to stimuli. The focus group discussions and farm household survey involving 200 farmer-respondents revealed that from intensified food crops production in 2000-2005, the upland farmers have shifted to crop diversification and conservation farming practices combined with non-farm employment in 2006-2015. Thus, five development pathways were identified, namely: reduction of monocropping; expansion of conservation in monocropping; expansion of conservation in multiple cropping; intensification of agroforestry; and intensification of agroforestry with non-farm employment. Multinomial logistics regression revealed that age, income, and policies determine the farmers' choice of development pathways. The pathway 'intensification of agroforestry and non-farm employment' has the highest likelihood of being chosen with a mean predicted probability of 0.40. There is a need to sustain the promotion of agroforestry and conservation farming practices in the upland communities, highlighting the economic and ecological services of agroforestry systems and conservation farming practices, and with active engagement of local governments.

Keywords: *agroforestry, non-farm employment, multinomial logistics regression, conservation farming, multiple cropping, monocropping*

Leila D. Landicho[1*]
Josefina T. Dizon[2]

[1] Institute of Agroforestry, College of Forestry and Natural Resources, University of the Philippines Los Banos (CFNR-UPLB), College, Laguna, Philippines
[2] Institute for Governance and Rural Development, College of Public Affairs and Development, UPLB

*corresponding author: ldlandicho@up.edu.ph

INTRODUCTION

Smallholder farmers dominate the agriculture worldwide. There are approximately 525 million farms worldwide, and of these, smallholders who operate plots of land of less than 2 ha currently constitute 85% (*Lowder et al. 2014*). Many of these smallholder farmers are poor, food insecure and have limited access to market and basic services (*Rapsomanikis 2015*). Besides the small landholdings, many of these smallholder farmers cultivate marginal lands. The Philippines covers a total land area of 30M ha. Much of the country is hilly and mountainous with 52.6% of the land area officially classified as forestlands (*FMB 2019*). These forestlands have become the homes and sources of livelihoods of many Filipinos, mostly indigenous people and migrants. In year 2000, there were already 20 M Filipinos living in the uplands (*Guiang et al. 2001*). The Philippine uplands have become more vulnerable to land degradation because of inappropriate land uses (*Briones 2012*), and dependence on forest resources for people's livelihoods (*Espiritu et al. 2010*).

The issue on sustainable farming in sloping lands or uplands has become a perennial concern in the past decades until now in the Philippines and in other parts of the world. Because the upland areas are sensitive to agricultural encroachment and have become vulnerable to soil erosion and environmental degradation problems, striking a balance between economic development and environmental protection of these areas is deemed necessary. In Asia, in general, the growing population has shifted the production orientation from subsistence farming to improved productivity and sustainability of upland farming to enhance food security and livelihoods of the upland population (*Partap 2004*).

Lessons from the many upland development programs require the need for sustainable livelihoods that would enable the upland farming communities maintain the ecological stability of the forest ecosystem while at the same time addressing their socio-economic needs. A number of people-oriented and development-focused forestry programs have evolved in the Philippines from the Family Approach to Reforestation (FAR) in 1970s to the Community-Based Forest Management (CBFM) Program in 1995 to address the issue of sustainable upland development in the Philippines. These programs have integrated agroforestry as the main production technology to address the socioeconomic and ecological concerns in the upland communities. Through their corporate social responsibility, the private sector has also joined the government in creating opportunities for the sustainability of development-oriented reforestation programs with the hope that their project initiatives would serve as mechanisms towards ensuring sustainability of the upland communities. However, the problem on deforestation, unstable soil conditions in the uplands, upland poverty, and marginalization of the upland dwellers are among the major concerns and are seen as a vicious cycle in most of the upland communities in the Philippines. Apparently, sustained adoption of sustainable farming technologies and livelihoods remain a challenge in many upland farming communities in the country. *Martin et al.* (*2011*) posit that, in general, the rate of adoption and sustained adoption of agroforestry projects among the farmers, depend on how the technologies and projects would suit their requirements.

The livelihood strategies employed by the upland farmers change over time depending on the internal and external environment that influence the household survival. For instance, the upland communities who used to engage in intensive agricultural production, particularly, coffee plantation, have exited farming/ agriculture when industrialization began to flourish in the province of Cavite. The transition of forest communities from tree farming to agroforestation in the upland communities was also observed in Leyte (*Martin et al. 2011*). The shift from corn monocropping to crop diversification and agroforestry were also noted in the pilot sites of CFV program (*De Luna 2017*), which suggests that upland farmers have been chaging their farming systems and livelihoods. In recent years, non-farm activities have also been added as part of the livelihoods of the smallholder farmers in the many upland farming communities in the Philippines (*Landicho, et al 2015; Baliton et al 2020*; *Baliton et al. 2017*). The changes in the pattern of their livelihood strategies at one point in time are referred to as the development pathway.

A development pathway is defined as A development pathway is defined as a common pattern of change in livelihood strategies (*Pender 2004*) The pattern of change is associated with causal and conditioning factors (*Pender 2004*), as well as the adjustments that farm families usually take in response to stimuli (*Ingram et al. 2013*). These stimuli may either be the external triggers and pressures (*Ondersteijn et al. 2003*) such as changes in the market policies, fluctuating prices of commodities, and changes in the policy and technologies or the characteristics of the farm households. More specifically, the development pathways are routes taken by the households through resource allocation decisions in response to interventions (*Rola 2011*).

A number of studies have pointed out that development pathways have been occurring in many rural farming communities. In the study of *Zeller et al.* (*2000*) three pathways of rural development in the five agroecological zones and 188 communities in Madagascar were identified. These include: agricultural intensification as indicated by the participation in member-based microfinance institutions; migration as indicated by the immigration rate; and agricultural extensification as indicated by the change in the upland areas. *Zeller et al.* (*2000*) revealed that access to member-based financial institutions, such as credit groups, village banks or saving and credit cooperative societies seem to play an important role for enabling an agricultural intensification pathway in Madagascar. Access to financial institutions had significant positive effects on lowland rice yields and on soil fertility of the upland. Migration was seen as a driving force for natural resource degradation while social capital had significant contributions in enhancing soil fertility.

Pender (*2004*) identified six types of development pathways in the hillsides and uplands of Honduras. These include the basic grains expansion, basic grains stagnation, horticultural expansion, coffee expansion, forestry specialization, and nonfarm expansion. *Pender* (*2004*) highlighted that the different pathways are associated with different types of cropping practices and conservation measures. For instance, the grains expansion communities use less burning and more fertilizer and insecticides indicating intensification and expansion of grain production, compared to basic grains stagnation communities. Meanwhile, horticultural communities use less burning and mulching but more of several inputs and practices including fertilizer, herbicides, improved seeds, irrigation and contour planting, which demonstrates the greatest degree of intensification in use of purchased inputs. Coffee communities, on the other hand, use less burning and herbicides but more fertilizer, minimum tillage, and invest more in terraces and live barriers, which indicate the adoption of soil and waterconservation practices compared to the other pathways. Finally, the forestry communities use less burning and more continuous cropping, improved seeds and contour planting, while non-farm employment communities use less mulching but more insecticides probably due to labor constraints and greater availability of cash in this pathway.

Rola (*2011*) reported four major development pathways undertaken by an upland community in Bukidnon, Philippines. These are the corn area reduction, coffee area reduction, commercial crop area expansion, and non-farm employment. Meanwhile, *Martin et al.* (*2011*) noted two pathways for development among the forest communities in Leyte. These findings confirm that different development pathways are suited to areas of different comparative advantages and that these different development pathways have different implications for land management, productivity and resource and welfare outcomes.

This study is anchored on the sustainable livelihoods framework developed by the Department for International Development (DFID) in 2000. The SL framework puts emphasis on vulnerability, role of assets or capital, as well as the policies, institutions at various levels (i.e., household, community, national, international) in shaping the livelihood strategies of people or communities. Livelihood strategies comprise the range and combination of activities and choices that people undertake in order to achieve their goals (*DFID 2000*).

This study is centered on two pilot sites of the CFV program. Conservation Farming Village was launched in 2007 with an overall goal of improving human lives through better livelihoods, agricultural productivity and environmental security of the communities living in the marginal sloping lands. It aimed to help upland farmers improve their economic conditions by strengthening their capacities to manage the natural resources thereby protecting their communities against environmental degradation while sustaining their sources of livelihood (*CFV Project Report 2011*). Specifically, this program aimed to: enhance farmers' adoption of sloping lands management technologies through model S&T–based farming in the sloping lands, thereby, enhancing their productivity and farm efficiency as well as conservation and protection of fragile upland resources; capacitate key groups and stakeholders in the community to better manage fragile upland resources on a sustained basis; conduct sustainability exercises to ensure that upland community development in general, and adoption of model farms, in particular, are on a sustainable basis and incorporated into local planning and implementation processes; and establish linkages among research-extension agencies and organizations for capacity-building and provision of support systems for the conservation farming communities (*CFV Project Report 2011*).

MATERIALS AND METHODS

The study was conducted in the two pilot areas of Conservation Farming Village (CFV) Program from July to December 2015. These pilot sites include Ligao City, Albay and La Libertad, Negros Oriental (**Figure 1**). The data were gathered using focus group discussions (FGDs), farm household survey, key informant interviews (KIIs), direct observation and secondary data gathering. Five FGDs were conducted in the two study sites. Farm household survey was administered to a total of 200 farmer-respondents.

There were a total of 398 CFV adopters from the two study sites. From this sampling universe, a sub-sample of 200 was computed using the Slovin's formula (*Sevilla et al. 1992*) (**Table 1**).

$n= N/(1(Ne^2)$

Where: n = sample size
N = total number of CFV adopters
e = sampling error (5%)

The sample size was distributed proportionately in the seven (7) communities.

Descriptive statistics particularly percentages and frequency counts were used for the socioeconomic characteristics, biophysical conditions and structures and process that prevail in the community. Using SPSS Package, a multinomial logistics regression was employed to identify the determinants of the farmers' choice of development pathways.

Multinomial logistics regression is used to predict a response variable on the basis of continuous or categorical explanatory variables (*El-Habil 2012*). The response variable is composed of more than two categories.

In this study, the dependent variable is the development pathway, which is a categorical variable. Thus, a value was assigned for each of the five development pathways in the three study sites: for expansion of conservation in monocropping; for expansion of conservation in multiple cropping; for intensification of agroforestry; for intensification of agroforestry and non-farm employment; and for reduction of monocropping. Twelve variables

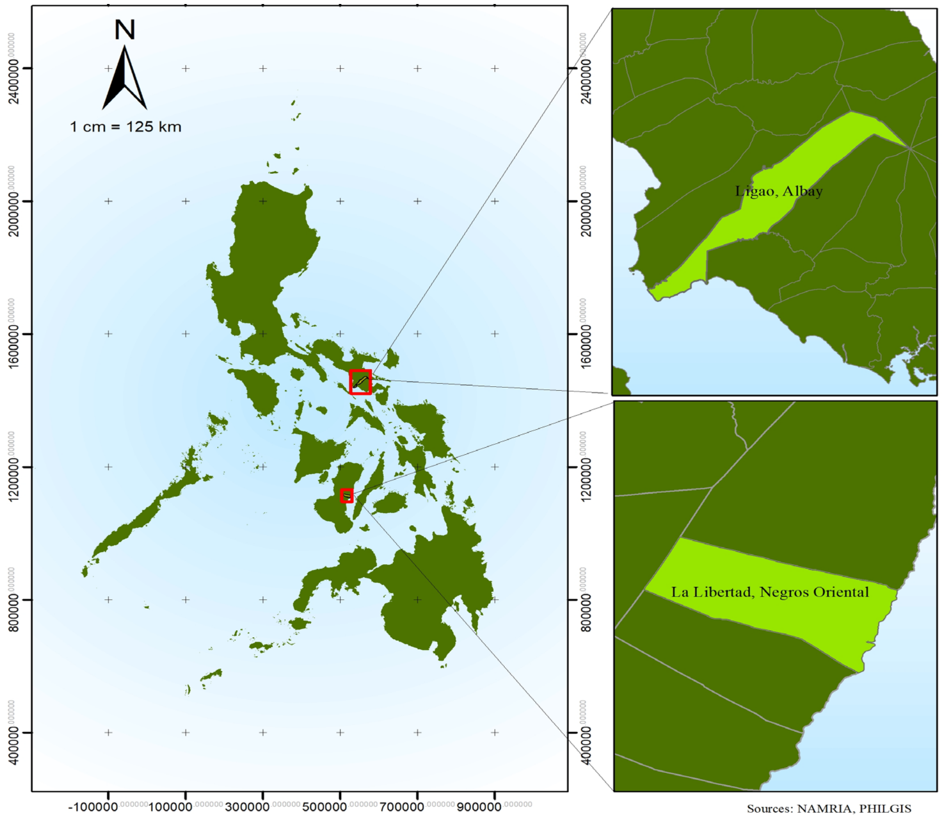


Figure 1. Location map of the two pilot areas of Conservation Farming Villages Program in Ligao City, Albay and La Libertad, Negros Oriental, Philippines.

Table 1. Sampling frame of the study of Conservation Farming Villages (CFV) in Ligao City, Albay and La Libertad, Negros Oriental, Philippines.

CFV Sites	Total Number of CFV Adopters (N)	Number of Samples (n)
Ligao City, Albay		
Barangay Abella	41	21
Barangay Oma-oma	75	38
Barangay Maonon	50	25
Sub-total	166	84
La Libertad, Negros Oriental		
Barangay Aya	46	23
Barangay Elecia	100	50
Barangay Nasunggan	40	20
Barangay Talaon	46	23
Sub-total	232	116
TOTAL	398	200

representing the farmers' characteristics (i.e., age, farm size, household size, land tenure, income, education), farm characteristics (i.e., farm size, water source, farm topography) and structures and processes (i.e., technical support, bayanihan, policies) comprised the predictor variables. The assumptions for the multinomial logistic regression were satisfied. Upon using the backward and forward selection for the best model, the final model to predict the determinants of development pathways consist of seven (7) variables, namely: age, household size, income technical support, bayanihan, policies and farm size. This model was run for all the categories except for the reference category, which is 'intensification of agroforestry and non-farm employment", being the dominant pathway.

RESULTS AND DISCUSSION

Socio-economic and Biophysical Characteristics

Ligao City, Albay and La Libertad, Negros Oriental were among the pilot areas of the CFV program, which was officially launched in 2007. These areas represent the general conditions of the upland farming communities with marginal conditions and in need of rehabilitation; and at the same time, offer the potentials of improving the farming systems for their agriculture-based economic development.

Ligao City is geographically located between 13° and 14° latitude and 123° and 124° longitude at the center of the 3rd district of Albay province (*www.ligaocity.org*). The city is classified as 4th class component city with a total land area of 24, 640 ha of which, 79% is classified as agricultural areas. As such, the local economy is predominantly agriculture-based. Among these barangays include the three sites of CFV, namely: Barangays Oma-oma, Abella and Maonon. On the other hand, La Libertad is a coastal municipality which lies in the northern side of Negros Oriental. It has a total land area of 17,480 ha of which one-third is classified as public forest land where about one-third of the population lives (*La Libertad FLUP 2010*). About 8,400 ha or 48% of the total area are classified as agricultural lands. Among the barangays that served as the CFV pilot areas are Barangays Aya, Talaon, Nasunggan and Elecia.

The mean age of upland farmers is 47 (**Table 2**). This finding suggests that the farmers are still in their productive years. It was noted that farmers were as young as 22 years old and as old as 79 years, which indicates the interest of young generation o engage in farming, and the interest of older farmers to sustain their farm development activities.

Almost all (90%) of the farmers were married with a mean household size of five (5). This suggests the availability of family labor for farm development activities, and the opportunity of members to engage in non-farm related activities as sources of household income. Many (42%) of the farmers have attained elementary education. Similar with previous studies (*Landicho et al. 2015, Gutierrez 2013*), the rural farmers, in general, have limited opportunities to reach higher level of education. This could be brought about by their limited access to education facilities and opportunities, distance of upland communities to education facilities, and personal choice of the farmers. All (100%) of the farmer-respondents were engaged in farming as their main source of livelihood, while there were still some (9%) whose household members are engaged in off-farm

Table 2. Socio-economic characteristics of farmers in Ligao City, Albay and La Libertad, Negros Oriental, Philippines.

Socio-economic Characteristics		Frequency		Total	%
		Ligao City (n=84)	La Libertad (n=116)		
Age	Minimum	27	22	22	
	Maximum	79	70	79	
	Mean	49	44	47	
Education	Elementary graduate	41	54	95	42
	Elementary Undergraduate	5	43	48	23
	Highschool graduate	19	13	32	17
	Highschool undergraduate	14	6	20	12
	College graduate	4	0	4	3
	College undergraduate	1	0	1	1
Household size	1-3	18	27	45	21
	4-6	47	66	113	58
	>6	19	23	42	21
	Mean	5	5	5	
Income sources	Farming	84	116	230	100
	Farming and off-farm	6	11	21	9
	Farming and non-farm employment	10	60	94	40
Estimated annual household income (Php)	<10000	15	2	17	8
	10000-30000	59	52	111	49
	31000-50000	8	22	30	16
	>50000	2	40	42	27
	Mean	24134.00	90,861.00	86,515.00	
Farm size (in hectares)	<one hectare	40	37	77	34
	1-3	42	72	114	61
	3.1-5	1	5	6	3
	>5	1	2	3	2
	Mean	1.15	1.65		
Land tenure status	Owned	9	104	113	53
	Tenant	51	3	54	30
	Rented/Leased	0	3	3	2
	Public Land	0	6	6	5
	Not aware	24	0	24	10

activities and non-farm employment (40%), from which they derived an estimated mean annual household income of PhP 86,515.00, with farmers in Ligao City having a lower mean annual household income of PhP 24,134.00. These upland farmers cultivate farms with a mean size of 1.15-1.65 ha, with the farmers in Ligao City having the least (1.15 ha). Half of the farmers (53%) reportedly owned the farms that they cultivate (by rights). This provides an opportunity of maximizing land use because they can decide about the crop species to be planted and the farming systems that would be employed.

The general topography of the farms in the two study sites is rolling to steep slopes (**Table 3**). This indicates a higher probability of soil erosion in these farmlands if certain soil and water conservation measures are absent. In reality, the upland farms are generally inaccessible to irrigation system because of the geographical location. Except in La Libertad whose irrigation water for crops is sourced from springs, most of the farms being maintained by the farmer-respondents in Ligao City were rainfed as reported by 39% of the respondents This finding suggests the vulnerability of the upland farming communities to climate change, particularly long dry spells. In terms of road conditions, all (100%) of the farmers reported poor road conditions in La Libertad, while good road conditions prevail in Ligao City.

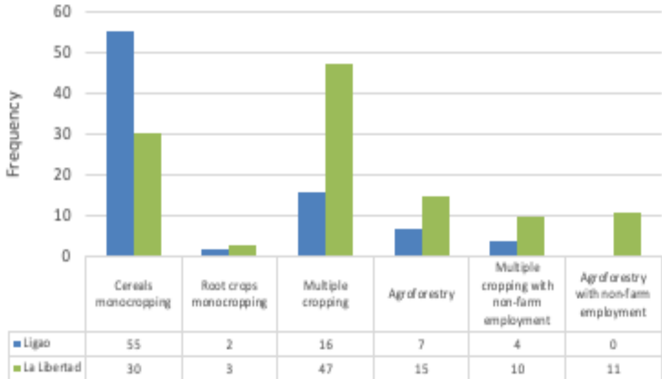
Farming Systems and Livelihoods

Food crops production was the primary livelihood of the upland farmers in the two CFV sites in 2000-2005 (**Figure 2**). Almost half (47%) of the farmer-respondents were engaged in monocropping, with cereal crops such as rice (*Oryza sativa*) and corn (*Zea mays*) as the primary crop component. These two cereal crops are important species being the main staple food of the farm households. Surpluses were sold to the market as source of their cash income. Root crops were also integrated in the farming systems of the farmer-respondents. Multiple cropping was employed by 28% of the farmer-respondents in 2000-2005, with the aim of maximizing land use of their small farms. Multiple cropping is a system which involves the cultivation of two or more agricultural crop species in the same unit of land in the same cropping period. The crops found in multiple cropping system of the farmer-respondents were corn, rice, vegetable crops and root crops. The practice of agroforestry was also prominent during this period as shown by the 32% of the farmer-respondents who were engaged in this practice. In their agroforestry system, vegetable crops, corn, banana, rice and root crops were integrated either with fruit trees such as jackfruit (*Artocarpus heterophyllus*), rambutan (*Nephellium lappaceum*), lanzones (*Lansium domesticum*), mango (*Mangifera indica*), coffee (*Coffea*, sp), and santol (*Sandoricum koetjape*), among others; and, forest trees such as mahogany (*Swietenia macrophylla*), gmelina (*Gmelina arborea*) and native trees. Non-farm employment was also noted as an additional livelihood source of the upland farmers.

In 2006-2010, however, most of these upland farmers in the two CFV sites have changed their farming system from single crop production or monocropping to crop diversification, which is either multiple cropping or agroforestry (**Figure 3**). This period (2006-2010) also marked the integration of conservation farming practices into the farming systems in the two study sites. Conservation farming practices refer to hedgerow planting, contour farming, rockwalls, bench terracing (*Elauria et al. 2017*) which aim to control soil erosion, and conserve and manage soil and water resources in the farm. Among the hedgerow species include: cassava (*Manihot esculenta*), pineapple (*Ananas comosus*), banana (*Musa* sp.), flemingia (*Flemingia macrophylla*), calliandra (*Calliandra calothyrsus*) and *kakawate*

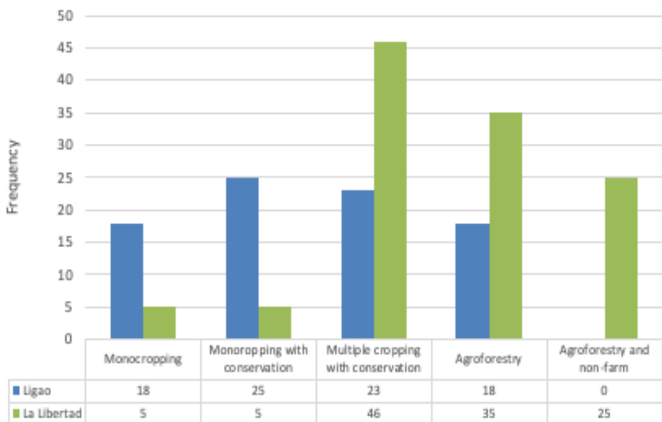
Table 3. Biophysical characteristics of Ligao City, Albay and La Libertad, Negros Oriental, Philippines.

Biophysical Characteristics		Frequency		Total	%
		Ligao City (n=84)	La Libertad (n=116)		
Topography	Flat	20	28	48	24
	Rolling	34	48	82	41
	Steep	30	40	70	35
Water source	Creek/River	22	71	93	47
	Spring	5	5	10	5
	Rainfed	47	28	75	38
	Irrigation	2	4	6	3
	Water pumps	8	8	16	8
Road conditions	Poor and less accessible	0	116	116	100
	Improved (cemented) and accessible	84	0	84	100



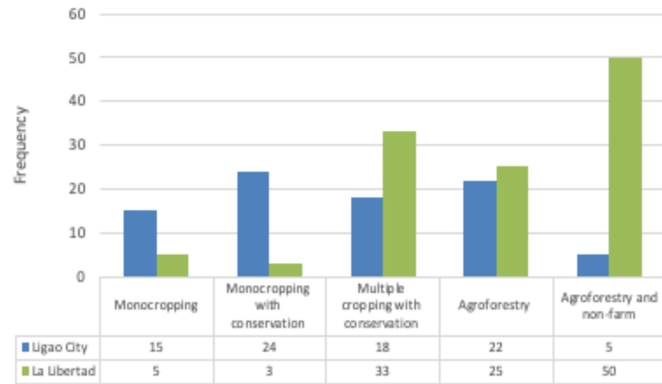
	Cereals monocropping	Root crops monocropping	Multiple cropping	Agroforestry	Multiple cropping with non-farm employment	Agroforestry with non-farm employment
Ligao	55	2	16	7	4	0
La Libertad	30	3	47	15	10	11

Figure 2. Livelihoods of the upland farmers in the conservation farming village sites in Ligao City, Albay and La Libertad, Negros Oriental, Philippines in 2000-2005.



	Monocropping	Monoropping with conservation	Multiple cropping with conservation	Agroforestry	Agroforestry and non-farm
Ligao	18	25	23	18	0
La Libertad	5	5	46	35	25

Figure 3. Livelihoods of the upland farmers in the conservation farming village sites in Ligao City, Albay and La Libertad, Negros Oriental, Philippines in 2006-2010.



	Monocropping	Monocropping with conservation	Multiple cropping with conservation	Agroforestry	Agroforestry and non-farm
Ligao City	15	24	18	22	5
La Libertad	5	3	33	25	50

Figure 4. Livelihoods of the upland farmers in the conservation farming village sites in Ligao City, Albay and La Libertad, Negros Oriental, Philippines in 2011-2015.

(*Gliricidia sepium*). Some farmers whose areas have rich source of rocks have also established rock walls as structures for soil erosion control.

The practice of agroforestry and the integration of conservation farming practices intensified during the period of 2011-2015 across the two study sites with 102 (51%) of the farmers in the two study sites integrated woody perennials (**Figure 4**). The integration of non-farm employment in the livelihoods of the CFV farmer-adoptors was also at its peak during this period.

Development Pathways of the Upland Farmers

Based on the changes on the livelihoods and farming systems in 2000-2015, five development pathways were taken by the CFV farmers in the two study sites. These are: reduction of monocropping; expansion of conservation in monocropping; expansion of conservation in multiple cropping; intensification of agroforestry; and intensification of agroforestry and non-farm employment.

Reduction of monocropping is characterized with at least 50% reduction in the number of farmers who practiced the production of single crops particularly rice and corn. From 90 (45%) farmer-respondents engaged in monocropping in 2000-2005 (**Figure 2**), the number was reduced to 53 (27%) in 2006-2010 (**Figure 3**) and 47 (24%) in 2011-2015 (**Figure 4**). From cereals monocropping, the farmers have practiced either multiple cropping or agroforestry in 2006-2015.

Expansion of conservation in monocropping is characterized with at least 50% of farmers who have integrated conservation farming practices in their monocropping system in 2006-2015. No conservation farming measures were incorporated in the farming systems across the two study sites in 2000-2005 (**Figure 2**). About 56% (30 out of 53 farmers engaged in monocropping) and 57% (27 out of 47 farmers) have incorporated conservation farming practices in 2006-2010 and 2011-2015, respectively (**Figures 3** and **4**).

Expansion of conservation in multiple cropping is characterized with at least 50% increase in the number of farmers who have integrated conservation farming practices (i.e. contour hedgerows, contour canals, rock walls and other soil and water conservation measures) in their multiple cropping system in 2006-2015. It was noted that 100% of the farmers engaged in multiple cropping in 2006-2015 have incorporated conservation farming practices. This indicates the recognition and importance of integrating conservation farming practices into the multiple cropping system of the CFV farmer-adoptors.

Intensification of agroforestry is characterized with an increasing number of farmers who practiced combined production of agricultural crops and woody perennials in the same piece of land with supportive conservation technologies such as hedgerow planting and contour farming in the three five-year periods. An increasing number of farmers who have transformed their farms into agroforestry, with only 14 (7%) farmers in 2000-2005 to 53 (27%) and 47 (23%) in 2006-2015 (**Figures 2-4**).

Intensification of agroforestry with non-farm employment is characterized with an increasing number of farmers engaged in agroforestry combined with non-farm employment in 2000-2015. From 11 (5%) farmers engaged in agroforestry and non-farm employment in 2000-2005, the farmers who have adopted agroforestry as their production system and a conservation farming practice, and integrated non-farm activities as additional livelihood source, grew to 25 (13%) in 2006-2010 and 55 (27%) in 2011-2015 (**Figures 2-4**). Agroforestry offers potentials in enhancing the socioeconomic productivity of the farmers because of the diverse crop components (*Tolentino et al. 2010; Cunningham et al. 2003; Landicho et al. 2015*), while at the same time addresses the ecological dimension (*Casas et al. 2014; Palma and Carandang 2014*). On the other hand, non-farm employment has become part of the livelihoods in most rural people (*Rashidpour 2012*), particularly in developing and transitional economies (*Davis 2003*). In some cases, non-farm employment is seen as a household strategy to finance subsistence agriculture (*Rantso 2016*).

"Intensification of agroforestry with non-farm employment" is the dominant pathway in the CFV pilot sites with about 28% CFV farmer-adoptors taking the pathway (**Table 4**). This finding indicates the shift either from monocropping or multiple cropping to agroforestry, through the integration of woody perennials. In addition, the integration of non-farm activities indicates the intention of the farmers to generate additional household income in addition to their agroforestry farms. On the other hand, only 10% were in the pathway "reduction of monocropping". This finding indicates that the number of farmers engaged in monocropping without conservation practices has declined significantly. It may be noted, however, that still, some (13%) farmers were still engaged in monocropping but, they chose to integrate conservation farming practices. About 25% of the CFV farmer-adoptors were engaged in the pathway "expansion of conservation in multiple cropping", while 23% were into the pathway "intensification of agroforestry". These five development pathways that the CFV farmer-adoptors have taken indicate their recognition on the importance of crop diversification and conservation farming practices.

Determinants of Development Pathways

Generally, the farmers' decision on farm resource allocation, farming systems, adoption of farming technologies, marketing of produce, and other aspects of agricultural production, is shaped by a number of factors. Farmers oftentimes deal with changes in the market policies, fluctuating prices of the commodities, including the changes in the policy and technology and social trends. *Ondersteijn et al.* (*2003*) argued that farmers have always been responding to external triggers and pressures when changing pathways and creating opportunities and scanning for options in the external environment. Development pathways are embedded in the household structures of typical family farms (*Ondersteijn et al. 2003*). Thus, socio-economic, biophysical and institutional factors influence farmers' decision to adopt and uptake agricultural technologies and innovations (*Mwangi and Kariuki 2015; Tran et al. 2019; Meijer et al. 2015*) and development pathways (*Rola 2011*).

Farmers' Characteristics. In general, the socioeconomic characteristics of the farmers influence the adoption of soil conservation measures (*Lapar and Pandey 1999; Cramb et al. 2006*), agricultural technologies (*Jamala et al. 2013*), livelihoods transition (*Fujii 2005*), and choice of development pathways (*Pender 2004; Rola 2011*).

There are varying characteristics of farmers engaged in the different development pathways (**Table 5**). Farmers taking the pathway "expansion of conservation in multiple cropping" had the highest mean age of 54. On the other hand, farmers taking the pathway "expansion of conservation monocropping" had a mean age of 48. Younger farmers are more likely to adopt agroforestry and conservation practices with the view of the long-term

Table 4. Frequency count of the development pathways of the Conservation Farming Villages (CFV) farmer-adoptors in Ligao City, Albay and La Libertad, Negros Oriental, Philippines.

Development Pathways	Frequency (n=200)	%
Intensification of agroforestry and non-farm activities	55	28
Expansion of conservation in multiple cropping	51	25
Intensification of agroforestry	47	23
Expansion of conservation in mono-cropping	27	13
Reduction of monocropping	20	10
TOTAL	200	100

Table 5. Characteristics of farmers in Ligao City, Albay and La Libertad, Negros Oriental, Philippines engaged in the different development pathways, 2000-2015.

Farmers' Characteristics	Frequency Distribution Across Development Pathways				
	Expansion of conservation in monocropping (n=27)	Expansion of conservation in multiple cropping (n=51)	Intensification of agroforestry	Intensification of agroforestry and non-farm employment (n=55)	Reduction of monocropping (n=20)
Mean age*	48	54	44	46	44
Household income range (PhP)					
2000-2005	<10000[a]	<10000[d]	<10000[g]	10000-20000[j]	21000-30000[m]
2006-2010	10000-20000[b]	10000-20000[e]	10000-20000[h]	21000-30000[k]	31000-40000[n]
2011-2015	21000-30000[c]	31000-40000[f]	31000-40000[i]	61000-70000[l]	41000-50000[o]
2015 Mean income	9,142.96	31,018	63,740	89,414.4	61,448.8
In US$ (1$=PhP50)	182.86	620.36	1274.80	1788.28	1228.98
Mean household size*	5	5	5	5	4
Education **					
Elementary graduate	15 (55%)	10 (40%)	16 (34%)	36 (44%)	6 (30%)
Highschool graduate	7 (26%)	9 (36%)	27 (57%)	39 (48%)	11(55%)
College undergraduate/Vocation	5 (19%)	6 (24%)	4 (9%)	6 (8%)	3 (15%)
Land tenure status**					
Owned	7 (6%)	7 (28%)	42 (89%)	78 (96%)	2 (10%)
Tenant	20 (74%)	5 (20%)	5 (11%)	0	18 (90%)
Public land	0	0	0	3 (4%)	0
Rented	0	3 (12)	0	0	0
Not aware	0	10 (40%)	0	0	0

*data from 2015; **data from 2000-2015 period
[a]23/27 farmer-respondents; [b]25/27 farmer-respondents; [c]21/27 farmer-respondents
[d]49/51 farmer-respondents; [e]38/51 farmer-respondents; [f] 42/51 farmer-respondents
[g]40/47 farmer-respondents; [h]38/47 farmer-respondents; [i]41/47 farmer-respondents
[j]45/55 farmer-respondents; [k]48/55 respondents; l47/55 farmer-respondents
[m]17/20 farmer-respondents; [n]15/20 farmer respondents; [o]13/20 farmer-respondents

benefits of trees as future investment (*Obeng and Weber 2014; Lapar and Pandey 1999*). This could be the reason why they preferred continuing their multiple cropping, rather than integrate woody perennials and convert their farms into agroforestry. Instead, they have incorporated conservation farming practices such as terracing, contour hedgerows to control soil erosion and improve farm productivity. On the other hand, the lowest mean age of 44 was recorded both in pathways "intensification of agroforestry' and "reduction of monocropping".

Farmers engaged in pathway 'intensification of agroforestry and non-farm activities" had the highest estimated mean annual household income of PhP 89,414 (US$1788.28). This could be brought about by the contribution of non-farm employment to the household income, and the diverse produce derived from the agroforestry system. This finding also reflects that farmers with higher income are more likely to adopt innovations (*Batz et al. 1999, Sarker et al. 2005*). Thus, the farmers engaged in this pathway could have higher capital for investing on the woody perennials and other crop components. On the other hand, farmers engaged in "expansion of conservation in monocropping" had the lowest mean annual household income of PhP 9142.96 (US$182.86). These could be the farmers whose primary intention of crop production is for household consumption. These farmers produce either corn or rice for home consumption, and when there are surpluses, these are sold to the market.

Farmers engaged in pathways 'intensification of agroforestry', 'intensification of agroforestry and non-farm activities' and 'reduction of monocropping' were mostly high school graduates, while farmers engaged in pathways 'expansion of conservation in monocropping', 'expansion of conservation in multiple cropping' were elementary graduates. Education, being a human capital variable has positive effects on the adoption of technologies (*Mwangui and Kuriaki 2013*) and choice of livelihood strategies adopted by the rural households (*Abimbola and Oluwakemi, 2013, Rahman and Akter 2014*).

The farmers engaged in pathway 'reduction of monocropping' had the smallest mean household size of four (4), while those in the four pathways had mean household size of five (5). This suggests the availability of family labor for the integration of additional crop components, and soil conservation measures. In some cases, the availability of family labor influences the type of farming systems and uptake of agricultural interventions (*Abimbola and Oluwakemi, 2013*). Likewise, bigger household size provides an opportunity for other household members to engage in non-farm employment (*Landicho et al. 2015*).

Land tenure plays a crucial role in the farmers' adoption of agricultural technologies, soil conservation practices (*Lapar and Pandey 1999*), farming systems and timber production (*Martin et al. 2011*). It is apparent that the farmers engaged in "intensification of agroforestry" and "intensification of agroforestry and non-farm activities" owned the lands that they cultivate (either passed onto them by their parents, or acquired by rights), while those engaged in pathways 'expansion of conservation in monocropping' and 'reduction of monocropping' were tenants (**Table 4**). Thus, the production of single crops may have been the decision of their landlords.

Farm Characteristics. The CFV farmer-adoptors were all smallholder farmers having a mean farm size of less than two hectares across the five types of development pathways (**Table 6**). Farmers engaged in the pathway 'expansion of conservation in multiple cropping' had the highest mean farm size of 1.51 ha, while those engaged in the pathway 'intensification of agroforestry and non-farm activities' had a mean farm size of 1.43 ha. This finding indicates that these farmers have higher chance of integrating other crop components, as compared to the farmers engaged in pathway 'expansion of conservation in monocropping' with a mean farm size of 1.04 ha. *Obeng and Weber* (*2014*) noted that despite the economic advantages of integrating annuals with perennials to form an agroforestry system, there are countervailing socioeconomic forces. The small-sized farms of the majority of farmers in developing countries, limited options for integrating trees because of insufficient family labor and the lack of resources enable them to devote their farms to the production of food crops to fulfil their subsistence needs. Farm size also matters in the adoption of soil and water conservation measures (*Cramb et al. 2006*) such that the output that was lost because of the establishment of soil and water conservation measures was offset by increasing the production area. In contrast, however, the farmers taking the pathway 'intensification of agroforestry' with the lowest mean farm size of 0.91 ha were able to diversify crops and integrate woody perennials. Similarly, farmers engaged in 'reduction of monocropping' with a mean farm size of 1.31 ha did not practice crop diversification. There could be other factors that influenced farmers' decision not to practice crop diversification. As discussed earlier, the land tenure status of those engaged in 'reduction of monocropping' could explain this finding. As *Farmar-Bowers and Lane* (*2009*) argued, farm decisions are subject to a changing set of motivations which are unique to the farm family.

All farms in the two study sites were rainfed across the different types of development pathways. The farms had rolling to steep topography (**Table 5**). Thus, the integration of soil and water conservation measures became necessary.

Structures and Processes. *DFID* (*2000*) referred to the structures and processes as legislations, programs, policies and interventions at different levels (i.e. household, community, national, international), which also influence people to transform and change their

Table 6. Characteristics of farmers in Ligao City, Albay and La Libertad, Negros Oriental, Philippines engaged in the different development pathways, 2000-2015.

Farm Characteristics	Frequency Distribution Across Development Pathways				
	Expansion of conservation in monocropping (n=27)	Expansion of conservation in multiple cropping (n=51)	Intensification of agroforestry	Intensification of agroforestry and non-farm employment (n=55)	Reduction of monocropping (n=20)
Mean farm size (ha)	1.04	1.51	0.91	1.43	1.31
Water sources	Rainfed, spring and river	Rainfed, spring and river	Rainfed, spring and river	Rainfed, spring and river	Rainfed, spring and river
Topography					
Flat	5 (19%)	3 (12%)	8 (17%)	25 (31%)	5 (25%)
Rolling	9 (33%)	6 (24%)	28 (60%)	30 (37%)	8 (40%)
Steep	13 (48%)	16 (64%)	11 (23%)	26 (32%)	7 (35%)

livelihood strategies. FGD results highlight that there were existing policies at the community and municipal levels. At the community level, a policy on "no cutting of trees" has been established in the two sites by the village officials. These local policies ensure environmental protection considering that the two study sites are classified as upland communities. Policies and programs influence farmers' adoption of agricultural technologies (*Bowman and Zilberman 2013*), and in exploring the livelihood strategies (*DFID 2000*). Beginning 2007, the CFV program was launched in the two study sites. CFV is a modality for enhancing the transfer of conservation farming technologies and practices to the upland farmers using participatory approaches. To ensure the transfer of the technology, capacity-building activities such as off-site and on-site training, cross-farm visits and technical assistance have been provided by the CFV program, through the agricultural technicians of the local government units, and the technical experts from the partner state colleges and universities.

De Luna (*2017*) highlighted that CFV has trained a total of 5906 farmer-adoptors in its seven pilot sites and organized a total of 13 cross-farm visits. Model farms were likewise established in each of the seven pilot sites to showcase the appropriate conservation farming practices and technologies. In addition, planting materials, farm tools and other farm inputs were provided to the CFV farmers. Farmers' associations were also formed, which served as channels and vehicles in promoting conservation farming practices in the upland communities. Through their collective action or 'bayanihan' system, the farmers were able to establish soil and water conservation measures. According to *Quimo et al.* (*2015*), 'bayanihan' has been observed as an effective strategy for technology adoption.

The FGD and KII revealed that when CFV program officially phased-out in 2011, the local government units took over and mainstreamed the CFV concepts in their local development program to sustain, intensify and expand the practice of conservation farming technologies in the CFV pilot sites and the potential replication sites. Local policies such as the "Food Program" in La Libertad, Negros Oriental and "Adoption of Contour Farming" in Ligao City which began in 2012 paved the way for intensifying conservation farming practices. These local programs sustained the capacity-building activities, improvement of model farms, provision of planting materials and farm tools, and regular technical assistance and monitoring from the LGU technicians.

Multinominal logistic regression was used to estimate the mean probability that a farmer will choose a particular development pathway. This model was run for all the categories except for the reference category which is 'intensification of agroforestry and non-farm employment', being the dominant pathway. Parameter estimates are not computed for the reference category as these are arbitrarily set to zero, because all the parameters in the model are interpreted in reference to it. The obtained log likelihood ratio of the multinomial logistic regression model is 532.24 and the chi-square statistics for the goodness-of-fit is 112.72, significant at 0.05 level. The pseudo R^2 value of the model is 0.416. Thus, the overall model is significant.

The multinomial logistics regression showed that income, age and policies have positive significance on the farmers' choice of development pathways (**Table 7**). Looking at each pathway, results indicate that income (p=0.001) determines the farmers' choice of pathway "expansion of conservation in monocropping' over the reference category. This indicated that farmers with higher income are more likely to choose the pathway "expansion of conservation in monocropping'. If other factors are held constant, the odds-ratio in favor of the probability of the farmers to choose 'expansion of conservation in monocropping' increases by a factor of 1.137 for every unit increase in farmers' income. These findings were similar with those of *Gebru* (*2018*) who studied the determinants in the farmers' choice of livelihoods diversification. In their study, *Obayelu et al.* (*2017*) found out that changes in technology adoption among smallholders are associated with changes in financial status of farm households and the net gain from adopting the technology, among others. Furthermore, policies and programs on conservation farming is also a determinant with a p= 0.011. This suggestsed that with the presence of policies and programs, it is more likely that the farmers would take the pathway "expansion of conservation in monocropping" rather than the reference category, "intensification of agroforestry and non-farm employment'. If other factors are held constant, the odds-ratio in favor of the probability of farmers to choose 'expansion of conservation in monocropping' increases by a factor of 6.446 for every local policy on conservation farming that is instituted in the locality. This finding suggested that farmers do recognize the local policies that are being executed by concerned agencies. Hence, they would rather employ soil and water conservation farming practices, than integrate woody perennials and other crop components in their farms.

On the second pathway, age (p=0.000) and income (p=0.000) were the main determinants in the choice

Table 7. Multinomial logistic regression model for each type of development pathways in the Conservation Farming Village sites in Ligao City, Albay and La Libertad, Negros Oriental, Philippines.

Predictor Variables	Development Pathways[1]			
	Expansion of conservation in monocropping	Expansion of conservation in multiple cropping	Intensification of agroforestry	Reduction of monocropping
AGE				
Coefficient	0.004	0.109	-0.438	0.504
Std Error	0.007	0.006	0.384	0.008
Odds ratio	1.00	1.115	1.29	1.028
Significance (p>z)	0.085	0.000*	0.255	0.412
HHSIZE				
Coefficient	0.752	0.105	0.182	0.105
Std Error	0.155	0.000	0.0001	0.000
Odds ratio	2.944	1.740	1.199	1.527
Significance (p>z)	0.066	0.223	0.095	0.125
INCOME				
Coefficient	1.000	5.046	5.745	1.000
Std Error	0.000	0.000	0.000	0.000
Odds ratio	11.137	1.000	1.000	2.149
Significance (p>z)	0.001**	0.000**	0.013**	0.045*
TECHSUPP				
Coefficient	0.000	0.189	-0.030	0.189
Std Error	0.000	0.000	0.000	0.000
Odds ratio	0.527	0.919	1.280	1.208
Significance (p>z)	0.998	0.998	0.875	0.765
POLICIES				
Coefficient	4.364	0.121	0.363	0.121
Std Error	0.577	0.514	0.768	0.550
Odds ratio	6.446	1.093	0.970	1.129
Significance (p>z)	0.011**	0.366	0.302	0.961
BAYANIHAN				
Coefficient	1.590	-0.005	-0.307	0.110
Std Error	0.583	0.441	0.498	0.518
Odds ratio	0.241	1.438	1.43	1.116
Significance (p>z)	0.427	0.498	0.929	0.958
FARM SIZE				
Coefficient	0.073	0.204	0.041	0.204
Standard Error	0.695	0.0001	0..615	0.363
Odds ratio	0.011	1.010	1.43	1.227
Significance (p>z)	0.916	0.908	0.946	0.744
Mean predicted probability[2]	0.14	0.12	0.24	0.10

[1]Reference category is 'intensification of agroforestry and non-farm employment'
[2]Mean predicted probability of the reference category is 0.40
*significant at 0.05 level; **significant at 0.01
Log Likelihood is 532.24; Chi-Square statistics for goodness-of-fite is 112.72; R2 is 0.42; Sig.0.0000

of pathway "expansion of conservation in multiple cropping' (**Table 7**). These two variables have positive significance on the second pathway. If other factors are held constant, the odds-ratio in favor of the probability of the farmers to choose this pathway increases by a factor of 1.115 as the age of the farmers increases by one year. Hence, older farmers are more likely to choose the pathway 'expansion of conservation in multiple cropping' over the reference category.. Multiple cropping systems consist of growing two or more cultivars or species with a spatial and temporal association (*Gaba et al. 2015*). This cropping system does not necessarily have to integrate woody perennials. As stressed by *Franzel and Scherr* (*2002*), an agroforestry system is likely to take three to six years before benefits begin to be fully realized compared to the few months needed to harvest and evaluate a new annual crop. As the farmers get older, this may not be favorable because of the perception that they would not have immediate economic benefits from these species. *Obeng and Weber*

(*2014*) noted in their study that agroforestry practices are more likely to be adopted by younger farmers who may view the long-term benefits of trees as future investment. Furthermore, Furthermore, farmers with higher income are more likely to choose the pathway "expansion of conservation in multiple cropping' over the pathway 'intensification of agroforestry and non-farm activities'. If other factors are held constant, the odds ratio in favor of the probability of farmers to be in the pathway increases by a factor of 1.00 for every unit increase in farmers' income. This suggests that the farmers who have the financial capital would rather integrate conservation farming practices and more than two types of agricultural crops in the farms, than integrating woody perennials in the farm.

Income has positive significance on the third pathway, "intensification of agroforestry" and on the fourth pathway "reduction of monocropping" with p values of 0.013 and 0.045, respectively (**Table 7**). Thus, upland farmers with higher income are more likely to be in these pathways, respectively, rather than the reference category. respectively, rather than the reference category. Thus, if other factors are held constant, the odds-ratio in favor of the probability of the farmers to be in these pathways increases by a factor of 1.000 and 2.149, respectively for every unit increase in farmers' income. It could be that the farmers in pathway "intensification of agroforestry' have the financial capacity to invest on agroforestry by diversifying crops and integrating woody perennials in their farm. In addition, the farmers would have enough financial capacity to meet the household needs, hence, integration of non-farm employment is no longer necessary. On the other hand, the farmers in the pathway "reduction in monocropping" could have already established their financial capacity, and therefore, no other intervention is necessary in their farms.

.

Based on their mean predicted probabilities, however, results indicate that the pathway "intensification of agroforestry and non-farm activities" is most likely to be chosen by the upland farmers in the CFV sites having the highest mean predicted probability of 40%. This implied that non-farm activities would already become an important part of the livelihoods of the upland farmers. Meanwhile, pathways "intensification of agroforestry' "expansion of conservation in monocropping", "expansion of conservation in multiple cropping", and "reduction of monocropping" have mean predicted probabilities of 24%, 14%, 12% and 10%, respectively. These results suggest that farmers place importance on agroforestry and conservation practices on their livelihoods, particularly those who have intensified their agroforestry practices, and those who have integrated conservation practices in their existing farming systems such as monocropping and multiple cropping.

CONCLUSION AND RECOMMENDATIONS

The upland farmers in the CFV pilot sites have transformed their farming practices and livelihoods in 2000-2015. Beginning with monocropping as the main livelihood, these upland farmers have practiced crop diversification particularly multiple cropping and agroforestry in 2006-2015. Integration of conservation farming practices and non-farm activities also intensified during this period. From these changes, five development pathways have occurred in the three pilot sites. These are reduction in monocropping; expansion of conservation in monocropping; expansion of multiple cropping and conservation; intensification of agroforestry; and, intensification of agroforestry with non-farm employment. The socioeconomic characteristics of the upland farmers, particularly age and income, as well as policies, are among the determinants of these pathways. The pathway "intensification of agroforestry and non-farm activities" has the highest likelihood of being chosen by the upland farmers having a mean predicted probability of 0.40.

This study, therefore urges the development organizations and institutions promoting agroforestry and conservation farming practices to highlight the economic viability and ecological services of the different agroforestry technologies to ensure the sustained adoption of these technologies among the upland farmers. Agroforestry model farm development should highlight technologies, crop components and cropping combination that are not only suitable to the biophysical conditions of the area, but more importantly, would help improve the income of the farmers. Furthermore, these organizations could also initiate the integration of non-farm-based livelihood activities that would enhance synergy with the conservation farming practices of the upland farmers.

This study also showed the importance of local policies and programs towards sustaining the adoption of agroforestry and other conservation farming technologies. Thus, the CFV model, which harnesses the active engagement of the local government units in promoting conservation farming practices, should be scaled-up at the national level. Other national government agencies and development organizations who are engaged in promoting sustainable upland development could consider integrating the CFV model in their programs and approaches.

REFERENCES

Abimbola, A.O. and Oluwakemi, O. 2013. "Livelihood Diversification and Welfare of Rural Households in Ondo State, Nigeria". *Journal of Development and Agricultural Economics* 5(12): 482-489. DOI 10.5897/JDAE2013.0497.

Baliton, R.S., Landicho, L.D., Cabahug, R.E.D., Paelmo, R.F., Rodriguez, R.S., Laruan, K.A., Visco, R.G. and Castillo, A.K.A. 2020. "Ecological Services of Agroforestry Systems in Selected Upland Farming Communities in the Philippines". *BIODIVERSITAS Journal of Biodiversity* 21(2):707-717.

Batz, F.J., Peters, K.J., and W. Jansen. 1999. "The Influence of Technology Characteristics on the Rate and Speed of Adoption". *Agricultural Economics* 21:121-130.

Bowman, M. S. and D. Zilberman. 2013. "Economic Factors Affecting Diversified Farming Systems. *Ecology and Society* 18(1): 33. http://dx.doi.org/10.5751/ES-05574-180133).

Briones, N.D. 2012. "Environmental Sustainability Issues in the Philippine Agriculture". *Asian Journal of Agriculture and Development* 2 (1&2):67-78.

Casas, J.A. Marin, R.A., Bruno, A.G.T., Lacandula, L.F. and Aguinsata, R.G. 2014. "Ecosystem Services of Agroforestry Model Farms in Bukidnon, Philippines". *Philippine Journal of Agroforestry* 1(1): 49-72.

Conservation Farming Villages Project Report. 2011. Environmental Forestry Program, College of Forestry and Natural Resources, University of the Philippines Los Baños, College, Laguna, Philippines.

Cramb, R.A., Catacutan, D., Culasero-Arellao, Z., and Mariano, K. 2006. "The Landcare Approach to Soil Conservation in the Philippines: An Assessment of Farm-Level Impacts". Paper presented at the InternationalAssociation of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006.

Cunningham, P.J., Nicholson, C., Yaou, S. and Rinaudo, T. 2008. "Utilization of Australian Acacias for Improving Food Security and Environmental Sustainability in the Sahel, West Africa". Paper presented at the International Symposium on 'Underutilized Plants for Food, Nutrition, Income and Sustainable Development', March 2008. Arusha, Tanzania Accessed from http://www.icuc-iwmi.org/Symposium2008/ on February 21, 2009.

Davis, J.R. 2003. The Rural Non-Farm Economy, Livelihoods and their Diversification: Issues and Options. Natural Resources Institute (NRI) Report No. 2753. 39 pp.

De Luna, C.C. 2017. "Protecting the Land and Feeding the Poor Through the Conservation Farming Villages (CFV) Approach". Paper presented during the 2nd Biennial Meeting of the Interdisciplinary Association for the Study of the Commons, July 14-17, 2017, Asian Institute of Technology.

Department for International Development. 2000. DFID Guidance Sheets. Retrieved from : http://www.efls.ca/webresources/DFID_Sustainable_livelihoods_guidance_sheet.pdf on date.

Elauria, M.M., Manilay, A.A., Abrigo, G.N.A., Medina, S.M., and delos Reyes, R.B. 2017. "Socio-economic and Environmental Impacts of the Conservation Farming Village Project in Upland Communities of La Libertad, Negros Oriental, Philippines". *Journal of the International Society for Southeast Asian Agricultural Sciences* 23(2):45-56.

El-Habil, A.M. 2012. "An Application on Multinomial Logistics Regression". *Pakistan Journal of Statistics and Operation Research.* VIII(2):271-291..

Espiritu, N.O., Casin, C.S. and Camacho, S.C. 2010. "Development Pathways of Upland Communities in the Philippines". Asian Journal of Agriculture and Development, 7(2):27-47.

Forest Management Bureau (FMB). 2012. Philippine Forestry Statistics 2012. https://drive. google.com/file/d/0B1G5mTNoDPOFUEF0R0FBbU9BRU0/view?usp=drive_open

Farmar-Bowers, Q. and R. Lane. 2009. "Understanding Farmers' Strategic Decision-Making Processes and the Implications for Biodiversity Conservation Policy". *Journal of Environmental Management* 90(2):1135-1144.

Franzel S., and Scherr, S.J. (eds). 2002. Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa. Retrieved from https://www.researchgate.net/publication/305681832_Trees_on_the_Farm_Assessing_the_Adoption_Potential_of_Agroforestry_Practices_in_Africa#fullTextFileContent

Fujii, M. 2005. Livelihood Change in a Philippine Coconut Farming Village: A Case Study in Laguna Province. African Study Monographs, Suppl. 29: 115-124, March 2005.

Franzel, S. and Scherr, S.J. 2002. Introduction. In: Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa (ed. Franzel S., and SJ Scherr). CABI, Wallingford. pp.1

Gaba, S., Lescourret, F., Boudsocq, S., Enjalbert, J., Hinsinger, P., Journet, E.P., Navas, M.L., Wery, J., Louarn, G., Malezieux, E., Pelzer, E., Prundent, M., and Lafontaine, H.O. 2015. “Multiple Cropping Systems As Drivers for Providing Multiple Ecosystem Services: From Concepts to Design”. *Agronomy for Sustainable Development* 35:607–623.

Gebu, G.W., Ichoku, H.E., Phil-eze, P.O. 2018. “Determinants of Livelihood Diversification Strategies in Eastern TigrayRegion of Ethiopia”. *Agriculture and Food Security* 7(62):1-9. https://doi.org/10.1186/s40066-018-0214-0

Guiang, E.S., Borlagdan, S.B., and Pulhin, J.M. 2001. Community-Based Forest Management in the Philippines: A Preliminary Assessment. Institute of Philippine Culture: Ateneo de Manila University. 224 pp.

Gutierrez, J. 2013. Filipino Farmers: A Dying Breed? IRIN. Inside Stories on Emergencies. Retrieved from http:/www.http://www.irinnews.org/report/97550/filipino-farmers-dying-breed on August 28, 2018.

Ingram, J., Gaskell, P., Mills, J. and Short, C. J. 2013. “Incorporating Agri-Environment Schemes into Farm Development Pathways: A Temporal Analysis of Farmer Motivations". *Land Use Policy* 31:267-279.

Jamala, G.Y., Shehu, H.E., Yidau, J.J. and Joel, L. 2013. “Actors Influencing Adoption of Agroforestry among Smallholder Farmers in Toungo, Southeastern, Adamawa State, Nigeria”. *OSR Journal of Environmental Science, Toxicology and Food Technology* 6(6): 66-72.

La Libertad Forest Land Use Plan. 2020. Municipality of La Libertad, Negros Oriental

Landicho, L.D., Visco, R.G., Cabahug, R.D., Paelmo, R.F., Baliton, R.S., Espaldon, M.V.O., and Lasco, R.D. 2015. “Field-Level Evidences of Climate Change and Coping Strategies of Smallholder Farmers in Molawin-Dampalit Sub-Watershed, Makiling Forest Reserve” Laguna, Philippines". *Asian Journal of Agriculture and Development* 12(1):81-94.

Lapar, M.L.A. and Pandey, S. 1999. “Adoption of Soil Conservation: The Case of the Philippine Uplands”. *Agricultural Economics* 21(3):241-256. https://doi.org/10.1016/S0169-5150(99)00028-6.

Lowder, S. K., Skoet, J., and Singh, S. 2014. What do we really know about the number and distribution of farms and family farms worldwide? Background paper for The State of Food and Agriculture 2014. ESA Working Paper No. 14-02. Rome: FAO. Accessed from https://www.researchgate.net/publication/261727193_What_do_we_really_know_about_the_number_and_distribution_of_farms_and_family_farms_in_the_world_Background_paper_for_the_State_of_Food_and_Agriculture_2014 on date.

Martin, F.S., Bertomeu, M., Noordwijk, M.V., and Navarro, R. 2011. ‘Understanding Forest Transition in the Philippines: Main Farm-level Factors Influencing Smallholder's Capacity and Intention to Plant Native Timber Trees’. *Small-scale Forestry* 11:47-60. DOI: 10.1007/s11842-011-9166-y.

Mwangi, M. and Kariuki, S. 2015. “Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries”. *Journal of Economics and Sustainable Development* 6 (5):208-216.

Meijer, S.S., Catacutan, D., Ajayia, O.C., Sileshia, G.W., and Nieuwenhuis, M. 2015. “The Role of Knowledge, Attitudes and Perceptions in the Uptake of Agricultural and Agroforestry Innovations Among Smallholder Farmers in Sub-Saharan Africa”. *International Journal of Agricultural Sustainability* 13(1):40–54. http://dx.doi.org/10.1080/14735903.2014.912493.

Obayelu, A., Ajayi, O., Oluwalana, E., and Ogunmola, O. 2017. “What Does Literature Say About the Determinants of Adoption of Agricultural Technologies by Smallholders Farmers?”. *Agricultural Research and Technology:* Open Access Journal 6(1):001-005. DOI: 10.19080/ARTOAJ.2017.06.555676.

Obeng, E.A. and Weber, M. 2014. “Socioeconomic Factors Affecting Agroforestry Adoption by Smallholder Farmers in Ghana”. *Ghana J. Forestry* 30(1):43-60.

Ondersteijn, C.J.M., Giesen, G.W.J., Huirnes, R.B.M. 2003. "Identification of Farmer Characteristics and Farm Strategies Explaining Changes in Environmental Management and Environmental and Economic Performance of Dairy Farms". *Agricultural Systems* 78 (2003) 31–55.

Palma, R.A. and Carandang, W. M. 2014. “Carbon Density of Bagras (Eucalyptus deglupta Blume) in Smallholder Tree–Based Agroforestry Systems in Northern Mindanao, Philippines”. *Philippine Journal of Agroforestry* 1(1):73-80.

Partap, T. 2004. Sustainable Farming Systems in Upland Areas. Asian Productivity Organization. ISBN 92-833-7031-7. Retrieved from http://www.apo-tokyo.org/00e-books/AG-02_SustFarming/AG-02_SustFarming.pdf on August 31, 2018.

Pender, J. 2004. “Development Pathways for Hillsides and Highlights: Some Lessons from Central America and East Africa". *Food Policy* 29(4):339-367 DOI: 10.1016/j.foodpol.2004.07.005

Quimno, V., Ahmed, I., and Turner, T. 2015. “The Significance of Bayanihan Culture on Technology Adoption: A Case of Virtual Learning Environment Adoption in a Regional

Public University in the Philippines.” Paper 155 in the PACIS 2015 Proceedings. Accessed 14 May 2019, https://www.researchgate.net/publication/299409955_

Rahman S. and Akter, S. 2014. “Determinants of Livelihood Choices: An Empirical Analysis from Rural Bangladesh”. *Journal of South Asian Development* 9(3):287-308.

Rantso, T.A. 2016. “The Role of the Non-Farm Sector in Rural Development in Lesotho”. *Journal of Modern African Studies* 54(2):317-338.

Rapsomanikis, G. 2015. The Economic Lives of Smallholder Farmers: An Analysis Based on Household Data from Nine Countries. Rome: Food and Agriculture Organization of the United Nations. Accessed from http://www.fao.org/3/a-i5251e.pdf on date.

Rashidpour, L. 2012. “A Study on the Role of Non-Farm Activities on Rural Sustainable Development in West Azarbaijan Province of Iran”. *African Journal of Agricultural Research* 7(3):475-481. DOI: 10.5897/AJAR11.1439.

Rola, A.C. 2011. An Upland Community in Transition: Institutional Innovations for Sustainable Development in Rural Philippines. ISEAS Publishing, Singapore.

Sarker, M.A., Itohara, Y., and Hoque, M. 2005. “Determinants of Adoption Decision: The Case of Organic Farming in Bangladesh”. *Extension Farming Systems Journal* 5(2):39-46.

Sevilla, C. G., Ochave, J. A., Punzalan, T. G.; Regalla, B. P., and Uriarte, G. G. 1992. Research Methods (Revised Edition). Quezon City, Philippines: Rex Printing Company Inc. How many pages?

Tran, N.L.D., Rañola, R.F., Ole Sander, B., Reiner, W., Nguyen, D.T. and Nong, N.K.N. 2019. "Determinants of Adoption of Climate-Smart Agriculture Technologies in Rice Production in Vietnam", *International Journal of Climate Change Strategies and Management* 12(2):238-256. https://doi.org/10.1108/IJCCSM-01-2019-0003.

Tolentino, L.L., Landicho, L.D., de Luna, C.C., and Cabahug, R.D. 2010. “Case Study: Agroforestry in the Philippines”. 317-331. In Handbook on Climate Change and Society, Constance Lever Tracy (ed), Routledge: USA and Canada. pp 317-331.

www.ligaocity.org. Profile of Ligao City, Albay. Accessed on February 29, 2016

Zeller, M., Lapenu, C., Minten, B., Desire Randrianaivo, E.R., and Randrianarisoa, C. 2000. “Pathways of Rural Development in Madagascar: An Empirical Investigation of the Critical Triangle of Environmental Sustainability, Economic Growth and Poverty Alleviation”. Discussion Paper No. 82. International Food Policy Research Institute. Retrieved from https://www.researchgate.net/publication/5056508_Pathways_of_rural_development_in_Madagascar on December 20, year?

ACKNOWLEDGMENT

The authors acknowledge the CFV farmer-adoptors in Ligao City, Albay and La Libertad, Negros Oriental who served as the research participants. The authors also thank the Office of the Municipal Agriculturist of La Libertad and City Environment and Natural Office of Ligao City for serving as key informants and for coordinating the data gathering activities. The Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) is also acknowledged for the funding support in carrying out this study.