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Sustainable Livelihoods-Based Assessment of Adaptive Capacity to Climate Change: The Case of Organic and Conventional Vegetable Farmers in La Trinidad, Benguet, Philippines

ABSTRACT

Climate change adaptation is vital for farmers in developing countries due to the high vulnerability of agricultural livelihoods. Scientific literature proposed that organic farming is a promising adaptation strategy, but micro-level studies are lacking. This study compared the adaptive capacity to climate risks of organic and conventional vegetable farmers in La Trinidad, Benguet in the Philippines. Guided by the Sustainable Livelihoods framework, thirty variables under the five livelihood capitals were used to compute Household Adaptive Capacity Index (HACI). Organic farming households have higher adaptive capacity than the conventional group, and have higher natural, financial, human, and social capital. The higher adaptive capacity of organic farmers was due to farm practices related to organic agriculture such as crop diversification, sustainable land management, and participation in organizations. This indicated that organic farming potentially enhances adaptive capacity of vegetable farming households. Findings support literature on the contribution of organic farming to the resilience of agricultural systems. Increased support toward higher adoption of organic farming in areas with similar context is recommended for adaptive management to climate change.

Key words: *adaptive capacity, climate change, farmers, sustainable livelihoods framework*

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INTRODUCTION

The irrevocable evidence of climate change underscores the need to understand adaptation, especially in the extremely vulnerable agriculture sector. Climate change largely affects food production systems, agriculture-based livelihoods, food security, and nutrition (*FAO 2012; IPCC 2014a; Rosegrant et al. 2015; WB 2013*). It endangers agricultural livelihoods through direct, indirect and cumulative impacts on crop yield and income, soil quality, water availability, impacts on farmers such as increased risk of heat exhaustion during agricultural activities, and others (*Lamboll et al. 2017*).

Without adaptation, the agriculture sector in developing countries stands to suffer significant losses from climate risks (*ADB 2017, OECD 2017, WB 2013*). However, successful adaptation remains difficult because of its context-specificity, temporal and scale issues (*Dasgupta et al. 2014*), and the need to consider varying dimensions (social, political, institutional, etc.) (*Moser and Boykoff 2013*). The heterogenous nature of farming systems and livelihood strategies and the uncertainty in the direction and magnitude of climate change impacts on agriculture add to this complexity (*Lamboll et al. 2017*).

Studies recommend increasing adaptive capacity through mainstreaming adaptation in development planning since these have similar determinants and goals (*McGray et al. 2007, UNDP 2010*). Adaptive capacity is defined as the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (*IPCC 2014b*). Increasing adaptive capacity improves resilience and flexibility of systems in adapting autonomously to climate change (*FAO 2015, FAO 2012, IPCC 2014a*).

One promising strategy to increase adaptive capacity while also enhancing the ability of agriculture to contribute to environmental goals is organic farming (*Lasco et al. 2011, Scialabba and Muller-Lindenlauf 2010*). Organic agriculture is considered a sustainable livelihood strategy with decades of use in different climate zones and under a wide range of specific local conditions (*Muller 2009*). Founded on ecological principles, it relies on the management of the agro-ecosystem largely through agronomic, biological, and mechanical methods rather than relying on external and synthetic materials to maintain long-term soil fertility and to prevent pest and diseases (Codex Alimentarius Commission). This is in contrast to conventional agriculture which is predominantly based on mono-cropping schemes and relies on synthetic inputs for soil management and pest control.

The discourse on the climate change adaptation potential of organic agriculture comes at a juncture where there is increasing evidence of adverse impacts of modern farming practices on both human and natural systems. Such evidences have fostered concerns on whether traditional (organic) or modern (conventional) agriculture lead to improved livelihoods while sustainably meeting the needs of the growing population.

A developing country, the Philippines is a backdrop of the agricultural livelihood sustainability discussion. Agriculture and fisheries comprise 27% of employment (*PSA 2016*). The World Risk Index of the Integrated Research on Disaster Risk in 2016 ranks the Philippines as the 3rd most vulnerable country to climate change due to its high exposure. From 1990 to 2006, majority of the Php12.43 B (USD 229.75 B) average annual value of damages to agriculture was due to climate-related hazards (*Philippine National Climate Change Action Plan 2011 to 2028*). Similarly, *FAO* (*2015*) reports that between 2006 and 2013, typhoons/storms caused most of the production losses in the country amounting to USD 3.8 B. Among the impacts of climate change on agriculture and fisheries in the country are losses in crop production increased labor costs, and low farm income (*Cruz et al. 2017*).

The Philippine government promotes the adoption of organic agriculture by virtue of the Organic Agriculture Act of 2010 and also considers organic agriculture, among others, as an adaptation option. The Agri-Pinoy framework of the Department of Agriculture (DA) supports organic agriculture in its goal to ensure food security and self-sufficiency. In 2013, the DA launched the Adaptation and Mitigation Initiative in Agriculture (AMIA) which mainly aims to promote climate change-resilient livelihoods and communities in the agriculture and forestry sector. This program recognizes organic farming as a strategy with high potential for climate smartness (*Rudinas et al. 2013*). Moreover, organic agriculture is considered as a climate-resilient agriculture practice implemented by small-scale farmers in vegetable production in the country (*Dikitanan et al. 2017*).

The promotion of organic agriculture occur amid existing research gaps in adaptation literature. Most studies on adaptive capacity and adaptation focus on the biophysical aspect, technical interventions, and macro-level analysis (*Asante et al. 2012, Lamboll et al. 2017*). Moreover, studies investigating how organic agriculture affects adaptive capacity of farmers (micro-level) are still lacking.

The local government in La Trinidad, Benguet was among the first in the country to incorporate organic farming in its development plans. Years of conventional farming led to soil degradation and consequently, the decline of the vegetable farming industry in the town. Promotion of organic farming primarily aimed to revive this industry. While the percentage of organic farmers compared to conventional farmers in the area is still small (around 17% in the areas covered in this study), the local government aims to increase this significantly. The initiative has the potential to advance two goals at the same time if organic agriculture is a climate change adaptation strategy.

This study aimed to compare the adaptive capacity of organic and conventional farmers in La Trinidad, Benguet, Philippines. Specifically, the objectives of the study were to assess the adaptive capacity of the organic and conventional vegetable farmers using the Sustainable Livelihoods Approach (SLA); compare the adaptive capacity of organic and conventional farmers; and provide policy recommendations for increasing adaptive capacity of vegetable farmers. The SLA was utilized since it allows the evaluation of the capability of households to adapt to changing conditions by analyzing their capitals or assets. This approach assumes that livelihoods are sustainable (i.e. resilient to external stresses and shocks such as climate change) if people have access to a range of capitals/resources/assets (natural, economic, human, and social capital) which are combined in pursuit of different livelihood strategies (*DFID 1999, Scoones 1998*).

Results can provide empirical data on how organic agriculture affects the adaptive capacity of vegetable farmers. It can also contribute to literature on the viability of organic farming as a strategy to promote agricultural livelihood sustainability amid climate change.

The Study Area

The municipality of La Trinidad is the capital of Benguet province in the northern part of the Philippines. It is located 256 km north of the Philippine capital (Metro Manila) at geographical coordinates 16’21’’N and 120’35’’E. The town is composed of sixteen barangays with a total land area of 8,079.50 ha (**Figure 1**).

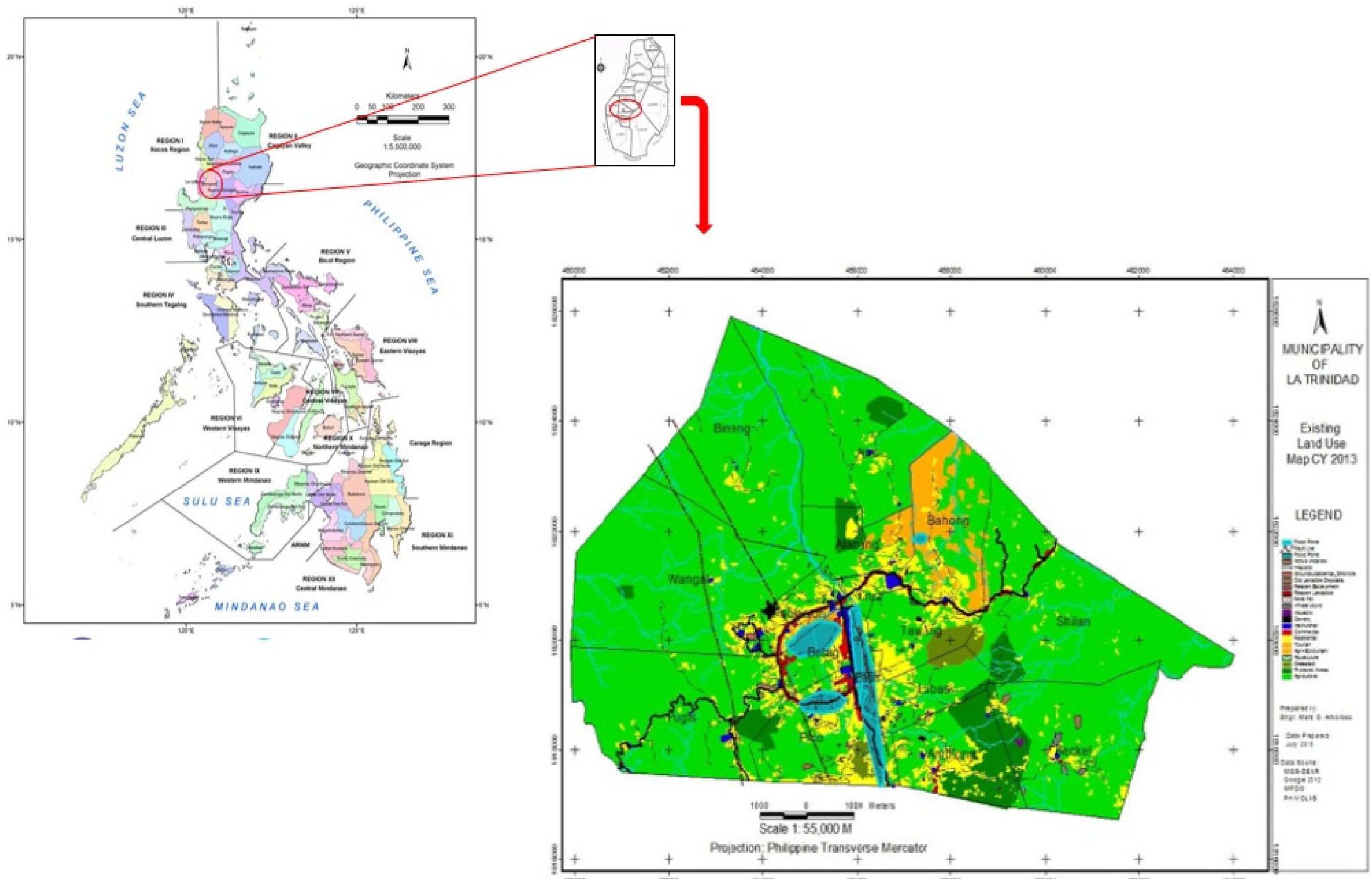

Figure 1. Location map of the study area (sources: DENR and Manila Observatory: Amoroso 2013).

The population in 2015 was 129,133 (*Municipal Ecological Profile 2017*).

La Trinidad is a first-class municipality (with average total revenue of Php 1.5M or more per annum). Despite this, 54.48% of its land area is rural and 44.2% is being utilized for agriculture (*Municipal Ecological Profile 2017*). Thus, agriculture, which largely supports tourism, trade, and manufacturing industries in the municipality, is still considered as the driving force of the town's economy. The major crops grown in the municipality are vegetables, cut-flowers, and strawberries (*Municipal Ecological Profile 2017*).

The topography of La Trinidad is characterized by steep mountains and high terrain (slope percentage mostly moderately steep to very steep), with a valley occupying around 350 hectares of land. It has Type I climate under the Modified Corona System of Classification (*BSU 2011*) characterized by two pronounced seasons, wet season from May to October and dry season for the rest of the year. The town is frequented by the northeast and southwest monsoons and typhoons. Based on data from PAGASA (Station 328: Baguio-Benguet) on the climatological normals from 1971 to 2000, mean temperature is at 19.6°C, slightly cooler than the rest of the country (*Municipal Ecological Profile 2017*). The average annual rainfall during the same period was 3,879 mm (*Municipal Ecological Profile 2017*). Benguet province, where La Trinidad is located, receives one of the highest annual rainfall in the country. An average of 2 to 3 strong typhoons makes landfall in the province annually. In addition, from 2000 to 2010, the province was affected by six out of the seven strongest tropical storms that hit the country (*BSU 2011*).

Climate-related events and hazards are among the main sources of risk to farmers in the municipality. The town is highly vulnerable to geologic hazards due to regular occurrence of extreme rainfall events, its mountainous topography, and the presence of active fault lines. Many farms are located on cliffs and mountainsides or along waterways making these prone to landslides, soil erosion, and flooding during rainy season (*Municipal Ecological Profile 2017*). In a study assessing climate change vulnerability of farmers in La Trinidad (*Pablo et al. 2012*), farmers identified typhoon, landslide, intense rainfall, flooding, La Nina, and El Nino as climate-related hazards experienced in the area.

While the prevailing climate in Benguet is generally "normal", some manifestations of climate change were observed upon comparison of monthly average temperatures and average daily rainfall within a ten-year period (1999-2009) versus the 30-year climatological normal from 1979-2009 (*BSU 2011*). For the ten-year period, there was an increase of about 0.4°C from the 30-year data in terms of average daily temperature throughout the year. The difference between the maximum and minimum daily temperatures also increased during the cold months (8.1°C) of the ten-year period which indicates that maximum daily temperature increased while minimum daily temperature decreased. With regards to rainfall, deviation from the average daily rainfall in some months were also observed. These changes are relevant to the agriculture sector since it can lead to crop failures (*BSU 2011*).

MATERIALS AND METHODS

The study utilized both qualitative and quantitative methods to allow validation of data. Key informant interviews (KII) and focus group discussions (FGD) were used to gather qualitative data. Quantitative data was collected using an interview schedule. Direct observation and desk review of secondary data (socio-economic profile, agricultural data, etc.) were also done to capture community-level information that do not need to be asked through interviews.

The study focused on vegetable farmers since vegetables are the major crops produced by organic farmers in La Trinidad, Benguet. The unit of analysis was the farming household system where the dynamics of livelihood capitals can be clearly studied.

Data Collection

The KIIs with academic experts, local government officials, and farmer leaders were conducted to gather insights on the dynamics of vegetable farming in the municipality, climate variability and extremes, relevant adaptive capacity indicators, and information on the agriculture sector in the study area. In addition, two FGDs (one for each group of farmers) were conducted to gain in-depth insight into the perceptions and dynamics of adaptive capacity from the farmer's perspective.

To assess adaptive capacity, face-to-face interviews with household heads of organic and conventional vegetable farming households were conducted. A semi-structured interview schedule was used to gatherdata on the indicators of household adaptive capacity. Since organic farming households were not located in all the barangays in the municipality, three barangays with the largest number of organic farmers who had previously received group certification from the Organic Certification Center of the Philippines (OCCP) were purposively selected. For the organic group, a census was conducted because there was only a small number of organic farming households. For the conventional group, stratified random sampling was done; sample size was computed and proportionally allocated in the three barangays. A total of 143 conventional farming households (out of 223 total households as of 2014) and 38 organic farming households were interviewed.

Household Adaptive Capacity Index (HACI) Construction

The indicator approach was used to assess adaptive capacity. Indicators of the Household Adaptive Capacity Index (HACI) were identified using the Sustainable Livelihoods Framework (SLF) of the DFID. The SLF is based on the SLA which considers livelihoods to be sustainable "if these maintain or enhance local and global assets on which livelihoods depend", and if these "can cope with and recover from stress and shocks" (*Chambers and Conway 1992*). Adaptive capacity is thus conceptualized as an emergent property of five capitals or assets (natural, physical, financial, social, and human capitals) that are considered to influence livelihood sustainability. This approach has been used in several vulnerability and adaptive capacity studies (*Defiesta and Rapera 2014, Eakin and Bojorquez-Tapia 2008, Nelson et al. 2010, Peñalba and Elazegui 2013*).

The *DFID* (*1999*) defines the five capitals as follows: Human capital refers to the "skills, knowledge, ability to labor and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives"; Social capital refers to the "social resources upon which people draw in pursuit of their livelihood objectives developed through networks and connectedness, membership of more formalized groups, and relationships of trust, reciprocity and exchanges that facilitate cooperation providing basis for informal safety nets among the poor"; Natural capital refers to the "natural resource stocks from which resource flows and services such as nutrient cycling and erosion protection useful for livelihoods are derived (may be intangible such as biodiversity or tangible such as assets used directly for production, e.g. land)"; Physical capital refers to the "basic infrastructure and producer goods needed to support livelihoods including transportation, shelter and buildings, water supply and sanitation, energy, and communication"; and Financial capital refers to "financial resources used to achieve livelihood objectives, especially in terms of the availability of cash or equivalent that enables people to adopt different livelihood strategies."

The five SLF capitals served as sub-indices of the HACI (**Table 1**). Indicators for each sub-index wereinitially identified and elaborated based on a desk review of related studies (*Baca et al. 2014; Below et al. 2012;Defiesta and Rapera 2014; Eakin and Bojorquez-Tapia 2008; Eakin et al. 2014; Hayati et al. 2010; Pieri et al. 2005; Rigby et al. 2001; Swanson et al. 2007; Waney et al. 2014; World Bank 2005*). These were contextualized to the study area and finalized based onthe KIIs. The final list was composed of thirty indicators, distributed as follows: Natural capital: six indicators; Physical capital: six indicators; Financial capital: seven indicators; Human capital: six indicators; and Social capital: five indicators. It is assumed that having higher capitals increases adaptive capacity.

The procedure for HACI construction followed the works of *Nelson et al.* (*2010*) and *Deressa et al.* (*2008*). The indicators and sub-indices were normalized using the Min-Max Approach applied for the Human Development Index of the United Nations Development Programme (UNDP). This was done to transform the values from zero to one to be comparable.

Table 1. Definition of variables used to elicit information in the study area.

Sub-index/Capital	Indicators	Assumptions
Natural Capital	• Farm size[a] • Crop diversity[a] (species and genetic level) • Self-assessment of land productivity[b] • Adoption of sustainable land management practices[c] • Water availability for irrigation[a]	Higher natural capital increases AC. Better conditions of land productivity, farm size, water availability, and higher crop diversity allows higher and more sustainable farm production amid climate variability and extremes. Sustainable land management practices help maintain the land quality for higher production.
Physical Capital	• Type of Irrigation[a] • Ownership of useful farm machines[a] • Access to roads[b] • Access to markets[b] • Technology: Adoption of protected agriculture[c] • Water collection/ management system[b]	Higher physical capital increases AC. Access to roads provides access to services while access to markets reduces transportation costs. Availability of technology such as farm machines, irrigation, water collection, and protected agriculture helps protect farm protection from stresses and shocks related to climate.
Financial Capital	• Diversity of income[a] • Income and income stability[b] • Wealth: Farm land ownership[a] • Availability of financial instruments[a]	Higher financial capital increases AC since it can be used for implementation of adaptation strategies and in order for households to meet the household's needs amid climate risks. Stable income, income diversity, and financial instruments help ensure this.
Human Capital	• Access to technical assistance[a] • Farming experience[a] • Perception of climate risk[b] • Education level of HH[a] • Available labor[a]	Higher human capital increases AC. Technical assistance, farming experience, and education level provide farmers with additional knowledge on a wider range of adaptation options and their implementation. Climate risk must also be perceived in order to respond or adapt to climate change.
Social Capital	• Participation in organizations[a] • Local coping networks[b] • Communication networks/source of climate information[a]	Higher social capital increases AC. Social networks facilitate innovation, development and sharing of knowledge, and risk spreading. Participation in organizations and local coping networks give households access to financial, material, or other forms of support needed. More sources of climate information allow households to prepare and act promptly.

[a]based on *Eakin and Bojorquez-Tapia 2008 and Defiesta and Rapera 2014*
[b]elaborated from *Below et al. 2012, Eakin and Lemos 2006, and Baca et al. 2014*
[c]based on *Swanson et al. 2007, Hayati et al. 2010, Rigby et al. 2001, Pieri et al. 2005, and Waney et al. 2014*

Adaptive capacity was assumed to be a function of the sub-indices and indicators identified under the SLF. Weights were assigned to the sub-indices and indicators using Principal Components Analysis (PCA). PCA addresses concerns on the arbitrary use of numeric equality in equal weighting and the subjectivity of assigning weights through expert judgement. The loadings for each run of PCA (principal component) describe the contribution or relative importance (taken as weights) of each indicator to the sub-index and each sub-index to the HACI. Only the first principal components (loadings of the first run of PCA) were used since this explained majority of the variation in the data set.

First, PCA was run for the indicators under each sub-index to determine the relative importance (weights) of each indicator. The normalized indicator values were multiplied by the generated weights to calculate the sub-indices. Second-step PCA was then run to generate the weights of the five sub-indices in relation to the HACI. The normalized sub-indices were multiplied by the weights. Finally, HACI was calculated by adding the values of the five sub-indices. In this approach, a higher HACI indicates higher adaptive capacity of the farming household. While the HACI is not an absolute measurement of adaptive capacity, it allows comparability among the households included in the study. PCA was run at the Institute of Statistics of the University of the Philippines Los Banos using the SAS 9.1 software.

Data Analysis

Descriptive statistics (frequency count, percentage, mean) were used to analyze the socio-economic and demographic profile of respondents and farm characteristics.

Since there were no standard thresholds for classification, the HACI values were classified into low, medium and high following *Eakin and Bojorquez-Tapia* (*2008*) and *Defiesta and Rapera* (*2014*) for purposes of comparison. Cut-off points for low, moderate, and high adaptive capacity were set using three intervals (between 0 to 1).

The scores of organic and conventional farming households in the sub-indices (capitals) and the HACI were compared using the t-test. The scores were also presented in a radar chart to further visualize the differences between the two groups.

Potential points of intervention for enhancing adaptive capacity of farming households were identified by analyzing the capitals (sub-indices) and indicators where the farming households had lower scores or were weak in.

RESULTS AND DISCUSSION

Key Socio-Demographic and Farm Characteristics of Respondents

Many of the respondents from the organic (81.58%) and conventional group (79.02%) belonged to the prime working age group (25-54 years old). This indicated that farming remains a source of livelihood for the current generation. A majority of the respondents were male (68.42% for the organic group and 60.84% for the conventional group) and many were married (71.05% for the organic group and 87.41% for the conventional group). The dominant household size ranged from 2 to 7, with each group having an average household size of 5. Moreover, many of the respondents (86.84% for the organic group and 88.81% for the conventional group) were originally from Benguet province or were natives in the area.

The farms of all the organic and conventional farming households in the study were small (less than 2 ha). During wet season, the farms of both groups are largely rainfed. During dry season, the farms are irrigated, usually through manual means (water can, hose/pipes) or mechanical sprinklers for those with larger farm size. Water sources are springs, deep wells, or water pumps.

Multiple cropping is practiced by both groups of farmers, with most planting only vegetables throughout the year. The farmers also do not practice a distinct fallow period, although some do not cultivate their farm during the dry season or during periods of strong typhoons to avoid losses. In both group of farmers, half of the respondents said they did not hire additional laborers and enlisted the help of family members for farm operations. Despite being small-scale, farming operations (based on the interviews) is highly commercialized (more than 75% of output sold).

Comparison of Sub-Indices/Capitals

Organic farming households had higher capacity than conventional farming households in four of the five sub-indices or capitals: natural, financial, human, and social capital. The conventional group only had a higher score in terms of physical capital (**Figure 2**). Based on the t-test, the differences in the five capitals were found to be significant (**Table 2**).

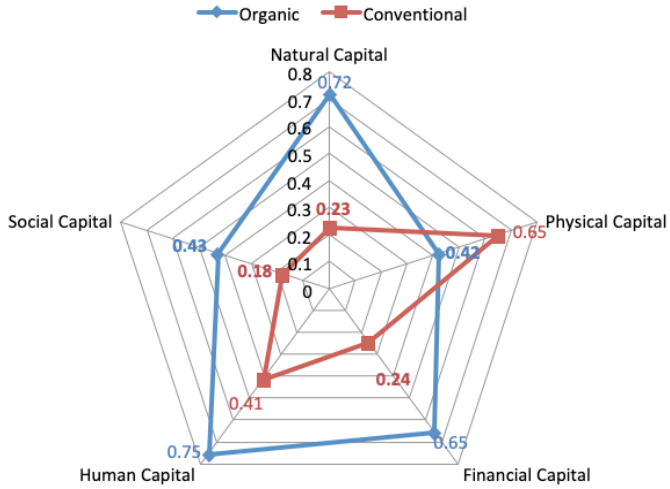

Figure 2. Sub-indices of organic and conventional farming households included in the study.

Table 2. Comparison of the sub-indices of organic and conventional farming households and t-test interpretation on the significance of differences.

Sub-index	Organic	Conventional	T-test interpretation
Natural capital	0.7177	0.2311	Significant
Physical capital	0.4246	0.6499	Significant
Financial capital	0.6499	0.2357	Significant
Human capital	0.7515	0.4119	Significant
Social capital	0.4256	0.1834	Significant

Natural Capital

Natural capital, generally refers to the quantity andand quality (e.g. fertility, suitability to crop production, etc.) of environmental resources accessible to the farmers. High natural capital is important in ensuring continued productivity and thus sustainability of agriculture-based livelihoods.

The higher natural capital of the organic group can be attributed to their higher crop diversity. Organic farmers planted as much as 13 types of crops per year and utilized up to 22 varieties compared to conventional farmers who used 9 crop types and eleven varieties annually. Based on the PCA, crop diversity contributed the highest weight to natural capital. In addition, the organic group also implemented more sustainable land management (SLM) practices relevant to soil quality and biodiversity: use of cover crops, use of organic amendments, agroforestry, crop rotation, intercropping. Organic farmers implemented from three to five SLM practices compared to conventional farmers who mostlyimplemented only one (use of organic amendments).

Crop diversification and sustainable land management practices were among the main components of organic farming since these contribute to land productivity, pest management, and efficient nutrient use. Cover cropping, use of organic amendments, intercropping, and crop rotation have been found to increase soil organic matter content, soil water-holding capacity, and soil fertility as well as helps reduce sensitivity to soil erosion. These practices also reduce the use of chemical inputs such as fertilizers which could lead to soil acidification, thereby limiting the availability of many elements to the plants. Long-term comparisons between conventional and organic farms have found that organic methods indeed improve the fertility and overall health of the soil, with organically managed soils demonstrating better water-retention capacity (*Morgera et al. 2012*). Crop diversity serves as a risk spreading mechanism in the context of climate change due to the different responses of plants to climate-related factors. On the other hand, soil quality in terms of pH, water retention, and others are also important in the context of climate change due to potential impacts on water availability (*Lamboll et al. 2017*).

Physical Capital

Physical capital relevant to agriculture include irrigation and water collection, infrastructure and technology such as roads and protected agriculture (e.g. greenhouse). Irrigation and water collection are important if farmers are to adapt to potentially drier dry months or more droughts due to climate change. Road and market access are also crucial in sustaining agricultural livelihoods. Distance impedes fast or easy delivery of supplies or access to services from external sources (e.g technical assistance, aid, etc.). Roads also facilitate economic activity by providing easier access to markets (*Deressa et al. 2008*). Farming households with farms nearer the main road and their main market for produce spend less for transportation of produce to the market or to access commercial farm inputs.

Physical capital was the only capital where the conventional farming households had higher scores than the organic group. Although the mathematical difference between the scores of the two groups was small, the difference was still significant based on the t-test.

The two groups slightly differed in the source of irrigation and access to roads. Both groups practiced farm irrigation during dry season to ensure production throughout the year. However, more conventional farmers used less labor-intensive irrigation methods (hose, pipe, sprinkler) compared to organic farmers who more commonly used watering cans. It is assumed that non-manual irrigation methods are more efficient thus contributing to production efficiency. In addition, organic farmers scored lower in terms of access to roads.

This difference, however, was more a result of geographical difference in the location of the farms included in the study rather than an attribute specifically distinguishing organic and conventional farming practice.

Financial Capital

Greater economic resource is expected to increase adaptive capacity since farmers can implement various adaptation options (*Defiesta and Rapera 2014, Smit and Wandel 2006*). It facilitates the implementation of a new technology and ensures access to training opportunities (*Smit and Wandel 2006*). In many Asian countries, successful implementation of technical adaptation options in many rural communities has been found to be constrained by very low economic development (e.g. lack of money) (*Acosta-Michlik et al. 2008 as cited in Acosta-Michlik and Espaldon 2008, Ngilangil et al. 2013*).

In most of the indicators, both groups had similar capacity. Almost half of the organic and conventional farming households relied on a combination of on-farm and non-farm sources of livelihood. This allows farmers to have a source of funds when agricultural income is affected by climate-related or other hazards. Despite this, a relatively substantial percentage of both groups of farmers still relied solely on on-farm livelihood sources. Both groups of farmers also largely practiced multiple cropping as a form of diversification of farm revenues (i.e. planting a variety of crops to offset the lower price of or higher damage incurred by one crop due to higher sensitivity to climatic variability or extremes). In terms of access to financial instruments, most of the farmers in both groups had access to one to four sources of credit, insurance, or subsidy. These financial instruments offer safety nets for the farming households during disasters.

The organic farming households had a significantly higher financial capital owing largely to the group's more stable agricultural income. In the PCA, this had the second highest weight among the indicators of financial capital. The organic farmers benefited from the fixed price of organic produce, providing relative stability to their income in a year. Crop price is very important to Benguet farmers because when the price is low, it often does not cover the cost of production thus leading to bankruptcy and incurrence of debt (*BSU 2011*). Nevertheless, organic farmers also noted that the fluctuating price of conventional produce has a slight effect on their sales. The farmers observed that the consumption pattern of their consumers is still affected by price, such that when the price of conventional produce is very low, more consumers choose these. As elaborated in study by *Batt et al.* (*2007*) in the Philippines, the seasonal nature of vegetable production are climate-related and causes large fluctuations in supply and thus in the spot market price (*Batt et al. 2007*). In addition, imports from countries such as China have lower prices setting a new floor price often below the cost of production (*Batt et al. 2007*). This situation was also mentioned by conventional farmers and the municipal agriculturist during the interviews and FGD. In this situation, organic farmers have a relative advantage due to the fixed pricing mechanism for organic produce.

Human Capital

Human capital is necessary to adaptive capacity because it contributes to the ability of the households to utilize or maximize other capitals. It refers to the know-how, skills, and ability (e.g. good health) of households to pursue different livelihood strategies. High human capital allows farming households to be flexible and adapt their farming practices to stresses and shocks because they have appropriate knowledge (from formal or non-formal education, training, etc.), and physical ability to do so.

Again, organic farming households had higher human capital than the conventional group. The two groups did not have considerable difference in farming experience, education, and available labor. However, organic farmers had higher capacity in the indicators of human capital with the highest weights based on PCA: number of sources of technical assistance, and attendance to relevant trainings.

All organic farmers reported having availed technical assistance related to farming from at least one source to as much as three sources. On the other hand, several conventional farmers said they have not availed of any technical assistance in the past five years. All the organic farmers have also undergone several trainings and seminars compared to only half of the conventional farmers having done so. For the organic group, the capacity building activities were part of their transition or start-up to organic farming. In addition, the Department of Agriculture has also actively implemented such activities, including training related to climate change adaptation, in its program for organic agriculture.

Technical assistance helps equip farmers with new or additional science-based and practical knowledge in farming including a wider array of possible responses to climate variability and extremes. Already, organic farmers interviewed mentioned the introduction of crop varieties or crops that are more resistant to higher temperature or stronger rains as one of the measures that they believed could help increase their adaptive capacity. Organic farmers have also incorporated more varieties of crops compared to previous practice. This contributes to increasing agricultural biodiversity.

The findings were similar to other studies conducted among farmers. In a study of farmers in the Limpopo River Basin, *Gbetibouo* (*2009*) found that access to extension was one of the main factors that enhance adaptive capacity. Farmers with access to extension were found to have increased probability of portfolio diversification and were more likely to be aware of changing climatic conditions and various management options for adaptation. Agricultural extension was also found to be of factor that needs to be increased among farmers from six villages in Tanzania to improve adaptation (*Below et al. 2012*).

Social Capital

Related literature highlighted the importance of strengthening social capital of farmers to improve adaptation and for risk-spreading (*Below et al. 2012, Cuesta and Rañola 2009, Kansiime 2012, Piya et al. 2012*). Participation in organizations provides households with greater access to information as well as other resources (financial assistance, etc.) that may be utilized for spreading climate risks. Organizations can also serve as a lobby group to seek resolution to their concerns and needs from concerned agencies. As mentioned by a key informant, organizations give farmers higher bargaining power with regards to market price.

Among the indicators under social capital, the two groups of farmers differed largely in terms of participation in organizations. This had the highest influence on social capital based on the PCA. All the organic farming households were members of at least one organization as compared to conventional farming households wherein more than half (64.35%) were not members of any organization. This is again related to the nature of organic farming. As explained in the study of organic agriculture by *Morgera et al.* (*2012*), to remain competitive, organic farmers need to adapt to local conditions by constantly experimenting on the ways to manage labor, land and resources in a way that maximizes production and remains sensitive to the environment. To achieve this, organic farmers need to pool local knowledge and learn from best practices of other farmers, emphasizing the need to form organized groups among them. Organized groups to which organic farmers belong can pool their resources, allow them to enjoy greater access to markets, and gain leverage in trade negotiations (*Morgera et al. 2012*).

Household Adaptive Capacity Index (HACI)

The constructed HACI revealed that in general, organic farming households had higher adaptive capacity than the conventional farming households. More than half (65.8%) of the organic farming households had high HACI and none had low HACI (**Table 3**). In contrast, none of the conventional farming households had high HACI and many (82.5%) had a low HACI. Moreover, the mean HACI of organic farming households (0.6911) was also significantly higher than that of the conventional farming households (0.2303) based on the t-test (**Table 4**).

The higher HACI scores of the organic farming households can be attributed to the higher score of the group in four of the five capitals: natural capital, financial capital, human capital, and social capital. The difference in HACI can mainly be attributed to the higher scores of organic farmers in terms of crop diversity for natural capital, agricultural income stability for financial capital, access to technical assistance for human capital, and participation in organizations for social capital. The higher scores of organic farmers in these aspects are related to the nature of organic agriculture that encourages crop diversification and the nature of organic produce as a specialty product reflected in the more stable pricing mechanism of the produce. Increased social networks are also important in organic agriculture which promotes

Table 3. Number of organic and conventional farming households with low, moderate, and high HACI.

HACI level	Organic		Conventional	
	Frequency	%	Frequency	%
Low	0	0	118	82.5
Moderate	13	34.2	25	17.5
High	25	65.8	0	0
Total	38	100	143	100

Table 4. Mean HACI of organic and conventional farming households.

HACI level	Mean HACI	
	Organic	Conventional
Low	--	0.1894
Moderate	0.5753	0.4232
High	0.7512	--
Overall Mean	0.6911	0.2303

sustainable livelihoods by encouraging self-reliance of communities and the sharing of local knowledge.

The result lends support to several scientific literature that consider organic agriculture as a strategy to increase the adaptive capacity of farmers (*Borron 2006, Lasco et al. 2011, Muller 2009*). In a study that analyzed climate change adaptation of smallholder farmers in Southeast Asia, organic agriculture as a form of change in current farm management practices was identified as an appropriate strategy for farmers in the region (*Lasco et al. 2011*). A study by *Scialabba and Muller-Lindenlauf* (*2010*) concluded that organic agriculture systems have strong potential for building resilient food systems in the face of uncertainties through farm diversification, building of soil fertility through organic matter, as well as offering alternatives to energy-intensive production inputs which are likely to be further limited to poor rural populations by rising energy prices.

This result is encouraging in the light of the local and national government's promotion of organic agriculture in the country. However, while organic farmers exhibited higher adaptive capacity compared to conventional farmers, there are some aspects that need to be strengthened or addressed. Under natural capital and physical capital, organic farmers encountered problems with water availability for irrigation. There is a need to improve their access to irrigation technology since many still relied on simple water collection techniques (minimal storage in barrels and small water impounding) and manual irrigation. This is crucial to adapt to potentially dryer dry months or prolonged/increased incidence of droughts due to climate change. In addition, despite benefiting from a fixed pricing mechanism and a premium price for their produce, organic farmers noted that the price of conventional produce also affect their sales. Thus, safety nets to improve the stability of income of farmers in general need to be put in place. As emphasized by the farmers, this is crucial not only in the context of climate change but also in the context of changing market policies (e.g. competition with lower-priced imported agricultural produce).

Local and national government programs as well as other support toward the increased adoption of organic agriculture in suitable areas can contribute to climate change adaptation efforts in the country.

CONCLUSION AND RECOMMENDATIONS

In the specific context of the study area, organic farming can thus be considered as a strategy to increase adaptive capacity to climate risk. The higher adaptive capacity of organic farming households is mainly due to the farm management practices followed in this type of agriculture. These practices contributed to the improvement of capitals considered under the Sustainable Livelihoods approach to influence livelihood sustainability. Assuming that the indicators of the five capitals are possessed and accessed by the farming households, it can be concluded that organic farming is a more sustainable livelihood than conventional farming with regard to climate change. This is based on the concept of sustainable livelihood as one that maintains or enhances capitals/assets and has the ability to cope with and recover from stress and shocks such as climate variability and extremes. In the context of the study, this lends justification to the promotion of organic agriculture in the study area to increase the adaptive capacity to climate risk of farmers in addition to the local government's primary objective to revive the vegetable farming industry. To some extent, it also offers scientific support to the national policy promoting organic agriculture in the Philippines. Applicability of results to other localities with similar context can also be considered.

Researchers recommend that studies be conducted in other areas to add to the empirical evidence from location-specific data. In addition, studies exploring the influence of scale on the adaptive capacity of farmers are recommended.

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