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Analyzing Opinions on Sustainable Agriculture: Toward Increasing Farmer Knowledge of Organic Practices in Taiwan-Yuanli Township

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Abstract: Local farmer knowledge is key to sustainable agriculture when organic farming promotes biodiversity conservation. Yet, farmers may not recognize ecosystem service (ES) benefits within their agricultural landscape. Surveys were administered to 113 farmers, and the opinions of 58 respondents toward organic farming were analyzed to identify influential variables when deciding to farm organically. We classified responses by geographic category within a socio-economic production landscape (SEPL), and by social influence categories. With principal component analysis (PCA), a two-scale, four-phased analysis was conducted. Coastal farmers (n = 22) were the most positive towards organic farming trends due to consumer demand. Plains farmers (n = 18) were highly interested in future opportunities for achieving consumer health and food safety objectives. Mountain farmers (n = 18) perceived the most organic transitioning barriers overall, namely irrigation. In all three geographic categories, farming decisions were not primarily related to biodiversity conservation or ES management, but rather to farming community patterns, consumer feedback, and a lack of barriers. Further, farmer opinions toward organic practices were more influenced by their life experiences than by school-taught concepts. Since no previous studies have assessed the knowledge, values, and opinions on organic farming of Taiwan's west coast farmers from an ES perspective, the proposed approach both identifies farmers' knowledge and opinions, and verifies a satoyama landscape with PCA results for informed decision making.

Keywords: sustainable agriculture; organic farming; farmer knowledge; farmer opinions; ecosystem services; satoyama

1. Introduction

Organic farming is an important means to achieve sustainable agriculture [1]. When compared with conventional farming systems, the most frequently recognized advantage of organic farming is its positive impact on biodiversity [1–3]. Organic farming as a conservation practice that sustains and restores natural resource use and ecosystem services (ESs) is a 'win-win', since it generates measurable ecological, social, and economic benefits [4]. As agricultural research and developmental focus shift from maximizing yield and increasing specialization to maximizing agro-ecosystems' environmental and social benefits [3,5], public opinion also reflects the belief that organic food is healthier than conventionally grown food [6]. Yet, local farmers' knowledge that is key to sustainable and resilient agriculture is often neglected by agricultural policy makers and rural development planners [7]. While local farmers' knowledge is tied to a farmer's ethical, environmental, and social values, and reflected in their farming practices [7], recent studies indicate a need to increase farmer knowledge of organic production in order to facilitate the organic farming transition process [8]. Although natural resource management and environmental policy literature indicates that values are learned in childhood [9] and are relatively stable throughout an individual's life stages [10] (the basis for school taught environmental education), it may also be necessary to first demonstrate to local stakeholders the benefits of ESs within their agricultural landscape [11].

Organic farming practices utilize ecosystem approaches to integrate agricultural biodiversity conservation and sustainable land use, and also include a concept of fairness related to the reciprocal relationships between the environment and 'life opportunities' [12]. While conventional agricultural systems disrupt the heterogeneity of natural habitats resulting in less biodiversity [3,13], organic farming minimizes this disruption with natural approaches to maintain biodiversity and reverse local species decline due to conventional agriculture practices [3,13,14]. Generally reported in ES research, agricultural ESs (i.e., provisioning ES) result in negative tradeoffs with other ESs (e.g., decreases in runoff water quality as a result of increased crop densities, which necessitates increased pesticide applications [2]), whereas synergies are often reported between regulating and cultural ESs such as increased aesthetic appeal as a result of increased pollination from flower planting [15]. However, synergies can also be found between agricultural ESs and other ESs when organic practices promote biodiversity [16].

The ES relationships within a landscape are complex and vary as a result of spatio-temporal land-use differences and the heterogeneity and stochasticity of bio-geophysical processes [2]. Though the ESs embedded within agricultural landscapes do in fact provide public benefits, the publicly perceived and subjective valuation of any landscape's ESs is context specific [17]. Similarly, as agriculture is subject to its environment, an individual farmer's agricultural adaptive capacity (and hence, a landscape's collective agricultural sustainability and resilience) depends on the intimate knowledge of local conditions and resources and a keen understanding of the specific set of natural and cultural resources local to their ecosystems [7]. While farmers' knowledge often contains highly localized solutions to their specific challenges, few studies have quantified farmers' knowledge, values and opinions from an ES perspective [2]. As a result, local crop resilience and sustainability expertise are often overlooked or inaccessible beyond rural farming communities [7]. Although Taiwan is an 'advanced economy' [18], farmers are largely underrepresented in society [19] due in part to post-WWII value shifts in Taiwan rural farmers themselves, as well as the persistent public sentiment that industrial development is preferred to farming for modernization [20]. As a result, historical patterns of urban-based industrial centers using rural areas for sources of cheap raw materials and labor endure [20]. Research on farmer opinions towards organic farming in Taiwan is limited. Yet, understanding the conditions within which local values are created is necessary, since the behaviors we exhibit are shaped by our 'past histories, our group memberships, and by our context-dependent experiences' [21], and reflect the degree to which we define ourselves as part of nature [22]. Likewise, farmer opinions toward organic farming can be interpreted as a cross-section of what farmers have internalized thus far as a result of their life's worth of value-creation.

Technically foreign to Taiwan, 'satoyama' is a Japanese concept that encompasses rural livelihoods dependent on the rural socio-economic production landscape (SEPL) focusing on mutuality, ecological balance, and human dignity within a framework of biodiversity conservation and sustainable resource use. The satoyama concept is embraced by the international community as an approach that contributes to 2020 Aichi Biodiversity Targets and the Sustainable Development Goals, and currently resonates with Taiwan rural farmer values while also appealing to urban intellectuals and policy makers for use as a common language of communication [20]. Doshita [23] details the evolution of the satoyama concept, providing more insight. Further, using the satoyama unit (or SEPL) as a study scale allows nations to link even their local rural value systems and practices with the larger international environmental movement for broader, multi-scaled global participation in achieving sustainable agriculture [20]. Since the satoyama approach ensures the preservation of traditional knowledge systems and local knowledge, the important role of SEPLs in providing cultural ESs has also been specifically highlighted [24]. Taiwan case studies that apply concepts promoted by the International Partnership for the Satoyama Initiative

(IPSI) are largely rural village studies, but also include small town rice-paddy landscapes and peri-urban areas, though all are mostly located on the island's east coast [25,26].

Relative to Europe and North America, public support for organic agriculture in Asia is comparatively recent [27]. However, since first promoting organic agriculture in 1996 [28], Taiwan now ranks among the top 10 Asian countries with the largest shares of organic agricultural land (0.8%), according to a 2019 FiBL-IFOAM report [27]. Taiwan's organic agricultural sector has experienced significant progress towards its goals of promoting local organic consumption and production with a target of increasing certified organic land from <1% of all agricultural land (6784 hectares) to 22% by 2020 (15,000 hectares) [29]. Most organic products in Taiwan are for domestic consumption and, in general, local consumers associate organic products with food safety, sustainable farming practices, and as morally aligned with their religious beliefs [29]. Organic agriculture is also increasingly important to Taiwan's overall agricultural production because of four uniquely specific reasons: (1) the public concern for food safety; (2) the domestic market potential; (3) the high product price stability that is less affected by weather; and (4) the higher-quality food produced with potential for international competitiveness [28]. Rice, the main organic crop in Taiwan (comprising more than 50% of all organic crops currently produced), is grown mainly on the east coast of the island. Hualien county, on the east coast, is where half of all Taiwan's organic farms are located [28], and where a considerable amount of state-sponsored organic farming research is conducted [30]. The west coast, on the other hand, has had a history of negative environmental impact due the predominance of industrial areas, and has been shown to have heavy metal concentrations present in agricultural soils near these industrial areas [31].

In this context, we analyze the opinions of rice farmers from Taiwan's western coast toward organic farming within a SEPL. To our knowledge, there are no previous studies that assess Taiwan west coast farmer opinions on organic farming from an ES perspective, nor studies that compare farmer opinions within the same SEPL. In response, we elicited the opinions of farmers within a SEPL located in Miaoli, Taiwan. We quantified their opinions toward organic farming and further quantified how participants perceived factors influencing their decision to farm organically based on different farmer groups classified by social influence categories. Our objectives were to investigate farmer opinions in order to: (1) describe the key issues affecting organic farm transition decisions of specific groups within the study SEPL; (2) determine if shared opinions were prominent across the SEPL by geographic and socio-demographic considerations; (3) quantify how opinions varied in different farmer groups within the SEPL; and (4) assess the practical relevance of our findings to inform future decision-making processes. The primary purpose of this study is to investigate, using an exploratory data analysis approach, the extent to which current farmer opinions toward organic farming reveal a 'recognition of values' of the SEPL's ES benefits when organic farming is taken to be an innovative agricultural and conservation practice [11]. A secondary purpose is descriptive, in that revealing farmer concerns when deciding to transform to organic farms facilitates policy decision-making objectives of increasing organic land in Taiwan when organic farming is a means to directly support local community livelihoods, sustain ESs within the landscape, alleviate consumer food safety fears, and ensure food security in Taiwan.

2. Materials and Methods

2.1. Study Area

Miaoli county is located on the west coast of Taiwan (Figure 1) and has a total area of 1820 km^2 with two cities and 16 townships (5 'urban', 10 'rural', and 1 'mountain Indigenous') [32], spanning approximately 64 km from its eastern to western boundaries, and 50 km from north to south. Unlike its two neighboring counties, Hsinchu county to the north (whose local economy is linked to its large science park) and Taichung county to the south (with its robust industrial zone), Miaoli county relies on agricultural and food production. Although Miaoli county aims to attract residents with its close proximity to its neighboring industrial hubs as a suburbia of sorts, it also intends to protect its natural environment [33]. To this end, Miaoli county also includes conservation areas to promote leopard cat conservation and sustainable land-use awareness [34], and is a tourist destination for hiking the surrounding mountains. Further, recent changes to the Organic Regulations for Irrigation and Water Conservancy Associations law may have expanded total irrigation systems coverage from 310,000 hectares of agricultural land to 680,000 hectares in areas including Miaoli. The study area is located within one of the urban townships at the southwestern corner of Miaoli county, Yuanli township, locally known as 'Miaoli's granary' (Figure 1). While Yuanli itself is considered an urban township, with a total area of 68 km^2 and population of 46,939 in January 2017 [32], township classification in Taiwan is largely based on population size and total commercial businesses, rather than on the geographical characteristics of the township's location, which in Yuanli's case is relatively rural and includes the Snow Mountain range foothills (referred to as 'Miaoli Hills'), the Da-An River, and coastline. In this study, Yuanli township is considered a satoyama-like landscape in that it is a 'dynamic mosaic of managed socio-ecological systems producing a bundle of ecosystem services for human well-being' [35]. Even if dissimilar to the traditional rural Japanese landscape, the inclusivity of the Satoyama Initiative's [36] SEPL concept allows for application of the Initiative's approach to landscapes with 'similar spirit in terms of function and significance' [37].

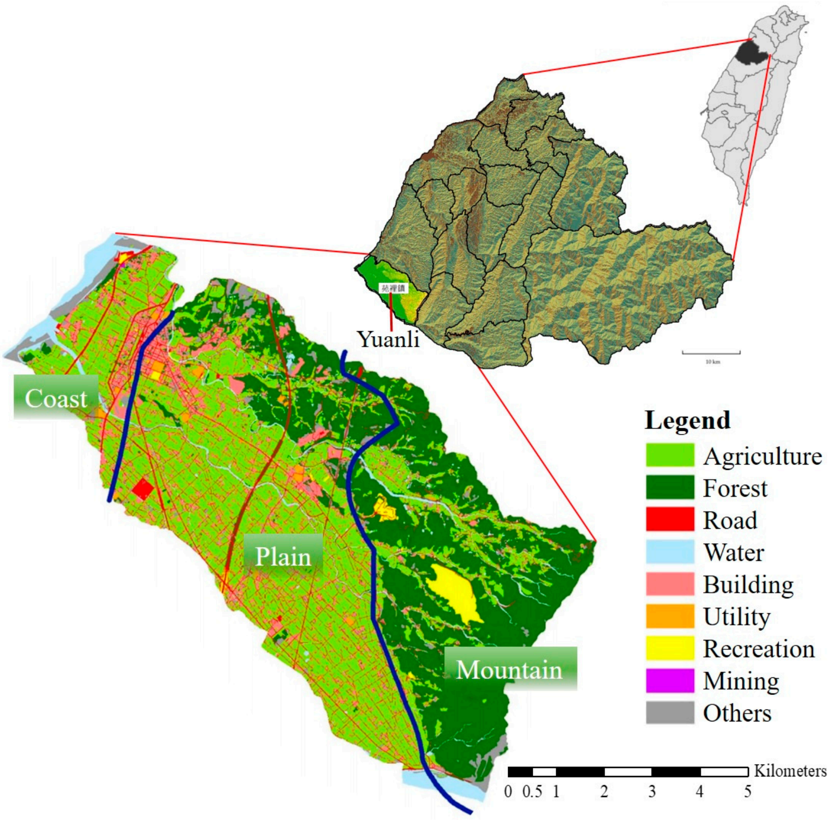


Figure 1. Map of study area of Yuanli township in Miaoli county, Taiwan. Map of Miaoli county with Yuanli township in color [38] and land use map of Taiwan [39].

The Yuanli township study area, a rectangular-shaped SEPL, consists of a mosaic of agricultural land and residential villages throughout, with the Snow Mountain foothills and its forest cutting across the township along a southeast to northwest diagonal, the Da-An River on its south, and the coast along its western edge.

2.2. Data

The source data used in this study was obtained using a structured questionnaire (see Supplementary Materials) with 113 participants in a group setting. The questionnaire was designed and administered by the study area's local Agricultural Production and Marketing Group (APMG), a sub-organization of the Miaoli District Agricultural Research and Extension Station, Council of Agriculture, Executive Yuan. APMGs are specific to Taiwan, and are the way that the national-level Council of Agriculture, Executive Yuan is able to exercise administrative functions at the local level. APMGs are further subdivided by crop. For example, rice farmers in Miaoli county will typically (and voluntarily) belong to a specific APMG, while taro farmers will belong to the taro-specific APMG in their area. In general, APMGs within Taiwan have the common aim of increasing agricultural product value and developing advanced processing techniques [28]. Prior to collecting farmer responses, the questionnaire purpose and questions were first introduced to the group of farmers by agency representatives. Farmers voluntarily participated, gave their informed consent, and were further made aware that the results they provided would be used for academic and government agency research about Taiwan farmer opinions toward organic farming. For this study, results were anonymized, though farm addresses were used to obtain geocoded data for classification. Following data cleaning, results from 58 farmers were retained for further analysis. Table 1 is a snapshot of the socio-demographic characteristics of these farmers.

Table 1. Socio-demographic characteristics of Yuanli township farmers in Miaoli, Taiwan.

Variable	Frequency	%	Variable	Frequency	%
Current-Future Method			**Gender**		
Conventional-Conventional	17	29	Male	53	91
Conventional-Organic	7	12	Female	5	9
Organic-Organic	32	55			
Organic-Conventional	2	3			
AGE			**Education**		
20 s and under	6	10	None	1	2
30 s	6	10	Elementary	18	31
40 s	9	16	Junior High	13	22
50 s	16	28	High School/Polytechnic	14	24
60 s	9	16	Undergraduate	11	19
70 s and above	12	21	Graduate	1	2
Government Training			**Experience Farming**		
1–2 times	40	69	1–10 years	16	28
3–4 times	5	9	11–20 years	10	17
5–6 times	7	12	21–20 years	14	24
7–8 times	1	2	31–40 years	3	5
9–10 times	1	2	≥41 years	15	26
≥11 times	4	7			

Note: 'Current-Future Method' refers to farming methods reported as currently used and that will be used in the future. Responses are considered as 'conventional' or 'organic' even if survey responses indicated either very or partly conventional or organic rather than full. 'Government Training' refers to government-sponsored organic agricultural training received throughout the farmer's career. 'Experience Farming' refers to experience growing rice whether conventionally or organically. N = 58.

The opinions toward adoption of organic farming practices and future farming objectives were collected to determine factors that influence the farmer's behavior toward organic farming adoption [40]. The survey was conducted in Mandarin Chinese with questions and results later translated into English. The survey consisted of three groups of questions. The first group of questions (23 total) collected background information related to a farmer's socio-demographic profile, land ownership status, trust relationship with consumers, local observed levels of irrigation pollution, and farm operations and management. Farmer responses were coded so that rather than requiring the farmer to input his/her actual age, for example, farmers selected an age category. Select responses used for the 'social influence' category classification (see Section 2.2.3 below) were then manually standardized by converting their original 'score' into a 0–5 scale (see Table S1 in the Supplementary Materials). In a second set of survey questions, farmers scored the importance of variables (34 total) on influencing their decision to organically farm or not, regardless of whether they currently farmed organically or conventionally. For these questions, farmers expressed their opinions using a six-point Likert-type scale without a midpoint, ranging from 'very unimportant' to 'very important'. The internal consistency of the survey questions was measured with Cronbach's alpha for an estimate of the reliability of survey scores ($\alpha = 0.9508447$). Cronbach's alpha was computed using R-package 'psych' [41]. Survey scores were then manually standardized by converting the original −3 to 3 scale to a 0–5 scale (see Table S2 in the Supplementary Materials). The third group of questions consisted of four questions that asked farmers to indicate their current and future farming methods ranging from 'fully conventional' to 'fully organic', as well as their current and future methods of selling farm products, ranging from completely traditional methods that include using government channels (such as the national Farmer's Association) to completely independent methods that includes self-promoting their own brand using alternative channels such as e-commerce.

2.2.1. Clustering Analysis

To assess the clustering tendency of the opinion portion of the data, we computed and evaluated the results of hierarchical clustering using R-package 'pvclust' [42] to classify farmer responses according to their response similarities. We assessed, however, that there was no significant clustering tendency seen in the results when a hierarchical cluster analysis was performed, computing the *p*-value calculation of clusters via the package's multi-scale bootstrap analysis for all clusters contained in the original data using the average cluster method and a Euclidean-based dissimilarity matrix. For this reason, and for further insight, we manually classified the data into 'geographic' categories by farm location elevation, and 'social influence' categories by social influence variables, as follows.

2.2.2. Classification of Farmer Responses by Geographic Category

Based on the concept of satoyama [11], we classified farms by elevation to create three geographic categories of farm as 'coast', 'plain', and 'mountain'. Using Google's Elevation API, which returns elevation data 'for all locations on the surface of the earth, including depth locations on the ocean floor', data from the farmers' background information taken in the first group of survey questions was geocoded to obtain farm elevation for each farm so that individual responses corresponded to a geographic category. Farm elevation was not evenly distributed, however, and farms with elevations of 9–91 m were classified as 'coast'; farms with elevations of 92–122 m were classified as 'plain'; and farms with elevations of 123–151 m were classified as 'mountain' (Table 2). While there was no official feature classification standard for 'hill' versus 'mountain' [43], it should be noted that within Miaoli county are the Miaoli Hills, foothills of the Snow Mountain range, which has an elevation of more than 3000 m at its apex; and some villages in other Miaoli townships are located at 500 m elevation.

Table 2. Geographic categories of farmer responses by farm elevation classification.

Farm Elevation (m)	Geographic Category	Sample Size
9–91	Coast	22
92–122	Plain	18
123–151	Mountain	18

2.2.3. Classification of Farmer Responses by Social Influence Category

While urban residence, age, education, and political ideology, have been consistently (and statistically significantly) associated with environmental attitudes since 1979 [44], in this study, data were classified into four social influence categories that were scored according to combinations of personal and social variables influencing an individual's environmental concern and pro-environmental behavior as reported in Gifford [45]. They were also based on the responses of farmers in the first group of survey questions that captured socio-demographic information and other details (see Supplementary

Materials). Social-influence variables in this study were 'farmer age', 'academic level achieved', 'farming experience', and 'organic training' received. While age was a personal factor, age also reflected any cohort- or era-effects in which farmers from similar age groups may have experienced impactful events shaping behavior common to their cohort [45,46]. In this way, an age cohort is more similar to a social group. For example, farmers older than 70 years will have shared experiences from Taiwan's Japanese Occupation period, which lasted till 1945, while farmers aged 30 years and younger will have had many experiences influenced by the social-media age. Years of 'farming experience' was chosen as a social influence variable because it is representative of both social class and urban/rural residence, both of which have been identified as influential factors [45]. A report of more farming experience indicated more time spent in rural areas, and, in general, in a relatively lower social class. Historical research reported by Gifford [45] suggests the tendency for environmentalists to be middle- or upper-class individuals. The 'organic training' variable in this study represented both current societal norms and the transmission of subjective norms [45,47] so that farmers with more organic training not only had received state-sponsored technical training, but also a sense of the current social expectations and patterns of behavior for agricultural producers.

Social influence category names were defined as follows. Four categories reflected combinations of more or less 'academic achievement' and more or less 'life experiences', written as hyphenated acronyms. 'Academic achievement' was highlighted as a category naming convention to reflect the amount of exposure a farmer has had to school-taught environmental education concepts assumed to be included in the local education system. 'Life experiences' are taken to mean the combination of three influential variables: farmer age, farming experience, and organic training. The 'more academic achievement-more life experience' (MA–ML) category was first designated as those farmers with a college- or graduate school-level education, aged 40 years or older, that had 11 years of farming experience or more and had participated in three or more government organic agricultural training programs. The MA–ML group scores ranged from 9–20 (Table 3). Second, we defined the LA–ML category as those farmers with less academic achievement but more life experience, referring to individuals with a zero- to high school-level education, and an age of 40 years or more, who had 11 years of farming experience or more and had participated in three or more government organic agricultural training programs. The LA–ML category differs from the MA–ML category only in academic achievement. LA–ML category scores ranged from 5–18. Third, we defined the LA–LL category as those farmers with more academic achievement and less life experience, referring to individuals with a college- or graduate school-level education, and an age of 39 years or less, who had 10 years of farming experience or less and had participated in two or fewer government organic agricultural training programs. The LA–LL category scores ranged from 4–7. Lastly, the LA–LL category was defined as those farmers with less academic achievement and less life experience, specifically those with zero- to high school-level education, an aged of 39 years or less; 10 years of farming experience or less, and participation in two or fewer government organic agricultural training programs. The LA–LL category was the opposite of the MA–ML category in both academic achievement and life experience. The LA–LL category scores ranged from 0–5. Since score ranges for each category overlapped, and because farmers did not always fall clearly within the defined categories, classification judgements were made on a case-by-case basis and relative to the MA–ML category. This was not problematic due to the small sample size. For example, one respondent reported that he was a high school graduate (score = 3), in his 50 s (score = 3), with less than 10 years of farming experience (score = 1), and had never participated in any government organic agricultural training (score = 0). His total score was 7 which can be categorized as either LA–ML or LA–LL. In this case, the farmer was classified as LA–ML only by virtue of their age, since the farmer did not have much farming experience or government agricultural training. That is, the trade-off between a farmer's age and their farming experience plus government agricultural training was taken into account so that respondents with a higher age score (even when combined with lower farming experience) plus government agricultural training scores were considered to have 'more life experience'.

Table 3. Social influence variable standardized score frequencies.

Standard Scale	0	1	2	3	4	5
	None	Elementary	Junior High	High/Poly	College	Master's+
Academic Level Achieved	1	18	13	14	11	1
	20 s below	30 s	40 s	50 s	60 s	70 s above
Age	6	6	9	16	9	12
	<1 year	1–10 years	11–20 years	21–20 years	31–40 years	41+ years
Farming Experience	0	16	10	14	3	15
	1–2 times	3–4 times	5–6 times	7–8 times	9–10 times	11+ times
Organic Training	40	5	7	1	1	4

Note: N = 58. Shaded gray indicates the 'more academic and more life experience' (MA–ML) category frequencies and score range.

2.3. Principal Component Analysis

The principal component analysis (PCA) method was used to extract components with R-package 'FactoMineR' [48] function 'PCA' to conduct a two-scale PCA in four phases. Descriptive interpretations of the principal components based on significant variable correlations and the percentage of variable contribution to principal components have been reported as per established procedures [49], and were limited to the first three PCs for each geographic category. By default, the function 'PCA' in the 'FactoMineR' package scales the data prior to the PCA to have (i) a standard deviation equal to one, and (ii) a mean equal to zero, so that a transformation step is not necessary. In phase one, the opinion portion of survey questions (34 total) were treated as PCA variables, and responses were analyzed to identify both principal components and the top contributing variables for the principal components that contained the most variation in the dataset. Component descriptions were determined with 'FactoMineR' [48] function 'dimdesc', which identified those variables most characteristic of each component. The 'dimdesc' function calculates the correlation coefficient between a variable and component and performs a significance test, returning an ordered list of the most correlated variables with a significance threshold of $\alpha = 0.05$ [48]. The most significantly correlated variable for each of the seven principal components are taken to be the characterization of the component though additional variables can be included for a more complete characterization. These characterizing variables are also the variables with the highest squared factor loading values which relate the percent of variance in the variable, explained by the component [48]. In the case of components where the characterizing variable is the same as that of another component, the second most characterizing variable is used. To determine the top 'contributing variables' for a component, R-package 'factoextra' [50] function 'contrib' takes the variable's squared factor loading ('cos2') to compute: ('variable.cos2' * 100)/(total cos2 of the component). Expressed in percentage, larger values indicate more contribution a variable makes to the component. Variable contributions to the principal axes are computed with 'factoextra' which outputs results as a ggplot2-based visualization [51] for a readable and standardized interpretation [50].

In phase two, the same procedure was conducted on those farmers' responses with farms categorized as 'coast' farms. Phases three and four corresponded to the 'plain' and 'mountain' farmer responses, respectively. Principal component analysis scores for phases two through four were computed with R-package 'pcaMethods' [52], which uses a singular value decomposition similar to the standard method in base R using function 'prcomp' for PCA with function 'scores'. We used a method similar to that reported in Nandi et al. [40] who used factor scores to measure the propensities of farmer opinions toward their respective PCs, and also assumed that positive scores reflect PC importance as a result of a current need in farmers' experiences to address aspects related to positively scored PCs, and that negative scores reflect a PC's relative unimportance because the PC-related aspects are currently not problematic, nor related to issues of concern. While Nandi et al. [40] analyzed category scores determined by a two-step cluster analysis, we analyzed geographic group scores by social influence categories influential to an individual's environmental concern and pro-environmental behavior [45]. Scores were visualized with ggplot2 [51] and used to interpret collective opinions [40]. While phase one of the PCA allowed us to gain an overview of the entire SEPL's farmer opinions taken as a whole, phases two through four allowed us to determine if there were specific variables that were more important to farmers relative to their respective geographic location within the SEPL. Components that yielded unambiguous results are discussed in terms of contributing variables (i.e., where no variable appears in multiple PCs as a significant contribution). For additional insight, PCA results for each geographic category were subdivided by social influence categories. R-package 'factoextra' computed the PCA, then output a ggplot2-based visualization [51] of these results for a readable and standardized interpretation [50]. The correlation between a variable's score and a PC is used as the coordinate of the variable on the PC [53]. However, for the biplot visualization, the coordinate of individual scores and variables is not constructed on the same space, so that the variable's direction should be noted rather than their absolute positions on the plot [50,54]. While it is beyond the scope of this study to predict the influence of the individual socio-demographic variables reported by each farmer on their opinions toward organic farming transitioning, we assume that the combined influence of the socio-demographic variables result in observable scoring differences. Figure 2 is a flowchart of the study methodology.

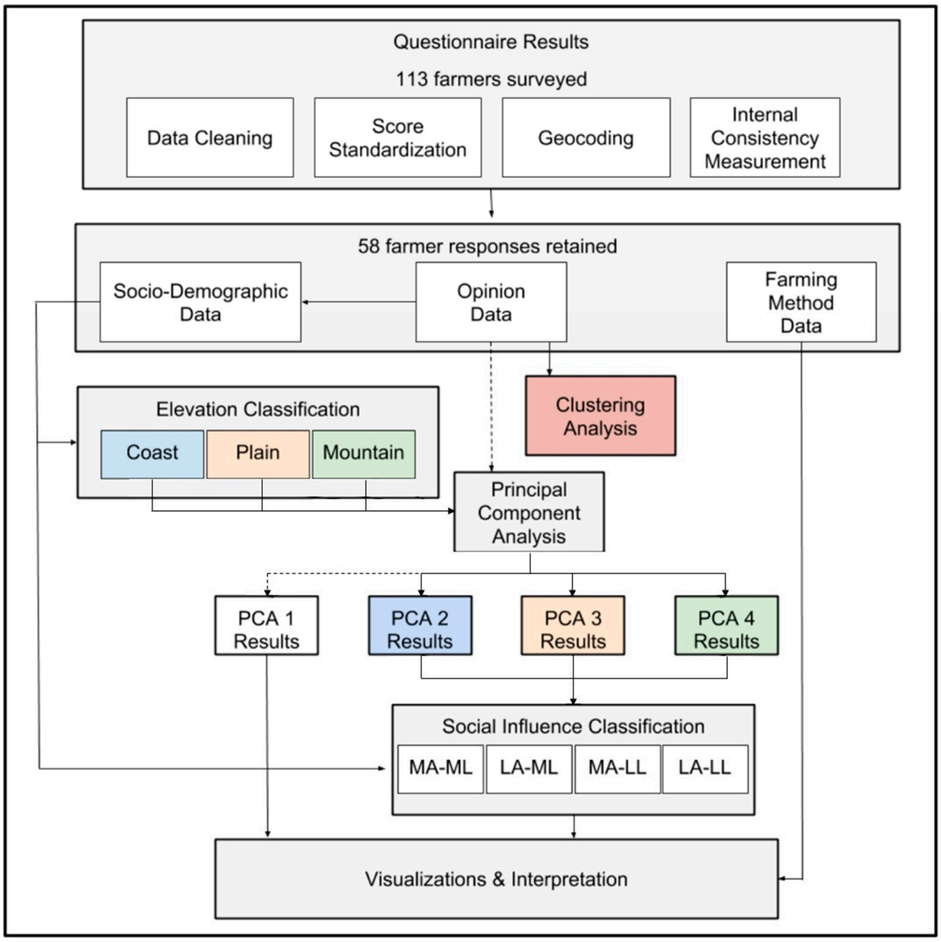


Figure 2. Flowchart of study methodology. MA–ML: more academic achievement and more life experience. LA–ML: less academic achievement and more life experience. MA–LL: more academic achievement and less life experience. LA–LL: less academic achievement and less life experience. Red indicates unsuccessful results. Blue, yellow, and green represent coast, plain, and mountain geographic categories, respectively.

3. Results

3.1. Total SEPL

The dataset contains 58 individual responses to 34 questions (variables). The majority of respondents were male (91%), while only 9% were female (Table 1). Their ages ranged between under 19 and over 70 years old. A higher number of Miaoli organic farmers in the SEPL were older (40+ years old) and had up to a high school education (45% vs. 28% of conventional farmers). These results are similar to previous studies that report an average Taiwan rice farmer age of 56 years old [28], and relatively high levels of education among organic farmers when compared to conventional farmers [40,55]. The 34 variables were reduced to a resultant seven components that retained 75% of the total variance within the original data. Analysis of the graphs did not detect any outlier. The first two components of PCA expressed 39.49% of the total dataset inertia, meaning that 39.49% of the variables within the total variability is explained by this first plane. Because this value is much greater than the reference value of 17.85%, the variability explained by this component is thus highly significant (when using a reference value that is the 0.95-quantile of the inertia percentages distribution obtained by simulating 1036 data tables of equivalent sizes on the basis of a normal distribution). From these observations, it may be interesting to consider the next components that also express a high percentage of the total inertia. While there is no standardized method for determining the appropriate number of principal components to use, studies have recommended that determination is at the point which the remaining eigenvalues are relatively similar [56,57]. While the first seven principal components retained 75% of the total variance when estimating the number of components to interpret with R-package 'FactoInvestigate' [58], observations suggest that only the first three components had real information, as these axes presented an amount of inertia greater than those obtained by the 0.95-quantile of random distributions (56.71% vs. 25.2%). Nevertheless, the top five original variables that contributed most to these seven components are: (1) consumer health and food safety; (2) social approval of organic farming; (3) the spread of organic farming notion; (4) ownership of farmland; and (5) a stable irrigation source. Looking at each component in greater detail, and identifying the most strongly correlated variables for a given component, yields further insight (Figure S1 in the Supplementary Materials).

Total SEPL Analysis: Transformation Cost, Family Background, and Consumer Behavior are Key

The first principal component was strongly correlated with five of the original variables and increased with their increasing scores, suggesting that these variables varied together (Table S3 in the Supplementary Materials). Further, the first principal component correlated most strongly with the costs associated with conventional to organic farming transformations (which was taken to be the characterizing variable describing this component), followed by access to farming tools and machines. It should be noted that this cost-variable was different from the variable that specifically addresses the material cost of organic farming. The second component correlated most strongly with the farmer's family background with regard to organic farming, and was a measure of the importance of aspects associated with farming practices passed down and the livelihood that their way of life brought about (if, for example, the farmer came from a farming background), including material resources and knowledge that had moved from one generation to the next. The third principal component was characterized by the variable 'synratio29', or the synergistic ratio of organic purchase (Table 4); we use the term 'consumer behavior' to describe this component. For example, when a consumer purchases agricultural food products, they may not purchase solely organic products, but rather some organic products alongside other farm products, thereby creating a 'synergistic ratio'. The amount of organic to non-organic product ratio when making purchases is thus determined by the consumer. The third principal component increased with 'synratio29', suggesting that the third principal component would also increase with 'costorg25', the material cost of organic farming, and that the material cost of organic farming is greater than conventional farming in Miaoli. Yet, the third principal component also increased with decreasing 'irrsrc9' (stable irrigation source); 'waterpoll15' (degree of water being polluted); and 'enviss7' (concerning environmental issues).

Table 4. List of 34 study variables.

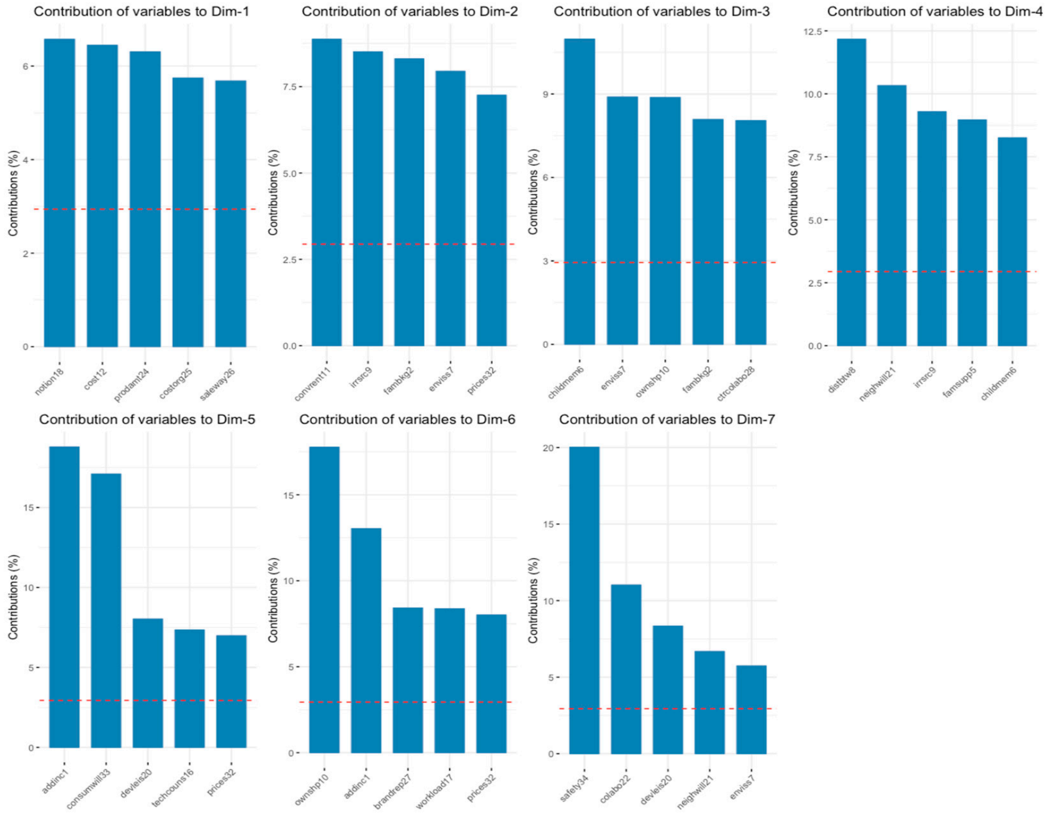
Abbreviation	Variable	Abbreviation	Variable
addinc1	Additional income	notion18	Spread of organic farming notion
fambkg2	Farming family background	mach19	Access to farming tools and machines
humres3	Quantity of human resources	devleis20	Possibility of developing leisurely agricultural farming experiences
inher4	Inheritance of rice farming	neighwill21	Willingness of neighbor farmers
famsupp5	Support from family	colabo22	Collaboration network of organic farming
childmem6	Childhood memories of paddies	socappv23	Social approval of organic farming
enviss7	Concerning environmental issues	prodamt24	Amount produced by organic farming
distbtw8	Distance between farmlands and home	costorg25	Material cost of organic farming
irrgsrc9	Stable irrigation source	saleway26	Ways of sales for organic farming
ownshp10	Ownership of farmland	brandrep27	Reputation of local brand
converent11	Convenience of rented farmland	ctrcolabo28	Chance of contractual collaboration
cost12	Cost of conventional farmland transforming to organic one	synratio29	Synergistic ratio of organic purchase
threeyr13	Legal limit of 'three-year transformation period'	orgqual30	Quality of organic rice
rateorg14	Rate of organic farmland in the neighborhood	ownbrand31	Possibility of establishing self-own brand
waterpoll15	Degree of water being polluted	prices32	Prices of self-produced rice
techcouns16	Assistance of professional technical counseling	consumwill33	Willingness of purchase from consumers
labwork17	Workload of labor	safety34	Consumers' health and food safety

3.2. SEPL—Coast

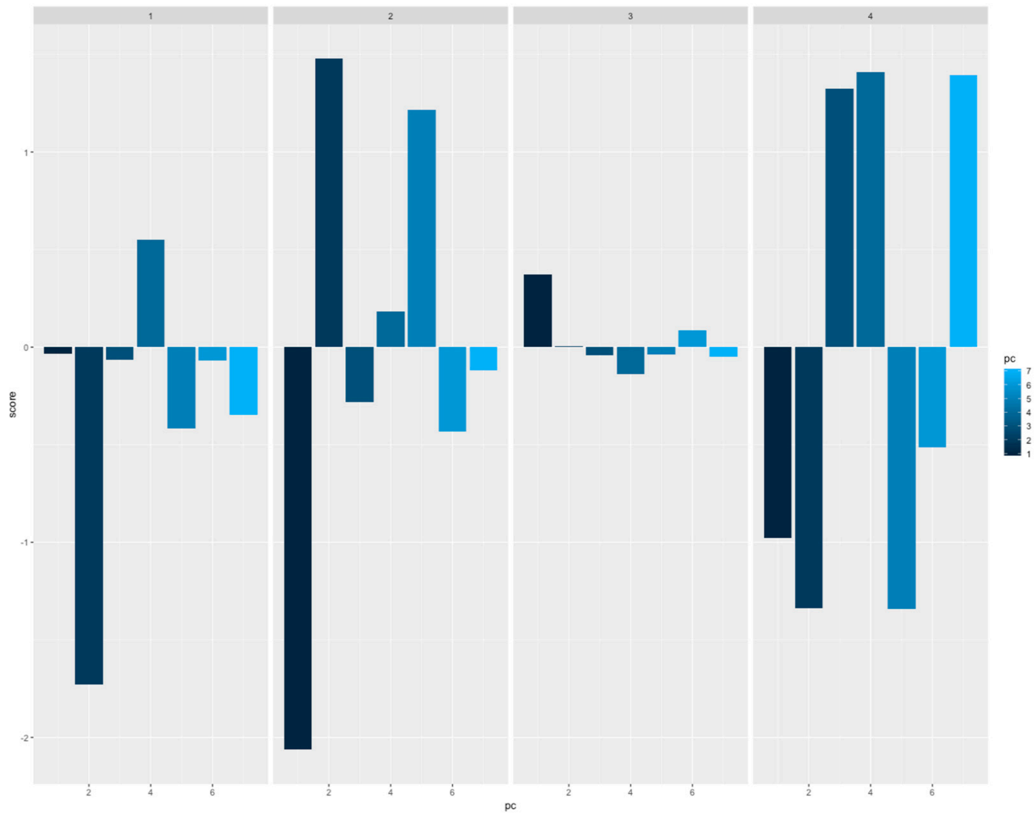
PCA was computed for farmer responses with farms categorized as 'coast' farms, a dataset of 22 individuals and 34 variables. For this dataset, 64.643% of the total variation was retained by the first three principal components and 84.467% by the first seven.

3.2.1. Coast Analysis: The Organic Trend and Renting Farmland are Key

The first principal component was strongly correlated with the following five original variables in descending order of contribution: 'notion18', spread of organic farming notion; 'cost12', or the cost of transforming conventional farmland to organic farmland; 'prodamt24', the amount produced by organic farming; 'costorg25', material cost of organic farming; and 'saleway26', the ways of sales for organic farming (Figure 3). The variable 'notion18' was taken to be the characterizing variable for this component, though the data suggest that these five criteria varied together, so this component could be understood primarily as a measure of the importance of the spread of organic farming notion when farmers are deciding whether or not to farm organically. The spread of organic farming notion can be understood as the popularity of the organic concept, or rather the farming and purchasing 'trend'. The second principal component increased with three original variables ('converent11', convenience of rented farmland; 'fambkg2', farming family background; and 'prices32', prices of self-produced rice), and with two decreasing variables ('irrg9', stable irrigation source, and 'enviss7', concerning environmental issues). While the third principal component increased with increasing 'childmem6', childhood memories of paddies; 'enviss7', concerning environmental issues; 'ownshp10', ownership of farmland; 'fambkg', farming family background; and 'ctrcolabo28', chance of contractual collaboration, this component is excluded from the analysis, as it yielded ambiguous results, with its contributing variables also found in the previous components (Supplementary Table S3). Supplementary Tables S4–S10 further delineate which variables were significantly associated with each of the seven PCs (p-value < 0.05), though only the top five variables for the first three PCs are discussed.



Contribution of variables to Dim-1
Contribution of variables to Dim-2
Contribution of variables to Dim-3
Contribution of variables to Dim-4
Contribution of variables to Dim-5
Contribution of variables to Dim-6
Contribution of variables to Dim-7
Contributions (%)



score
pc

Figure 3. Contributing variables and principal component (PC) analysis scores for the 'coast' sample. Top: top five variables that contribute to components (dimensions) 1–7 for the 'coast' sample. Red dashed line indicates the expected average contribution, if variable contributions were uniform. Bottom: coast farmers' social influence category propensities towards respective factors based on PC scores. Along each of the four top x-axes, social influence category 1 is less academic–less life experience (LA–LL); category 2 is more academic–less life experience (LA–LL); category 3 is less academic–more life experience (LA–ML); category 4 is more academic–more life experience (MA–ML). Along each of the four bottom x-axes, 1 is PC1 'notion'; 2 is PC2 'land rent'; 3 is P3 'childhood memories of paddies'; 4 is PC4 'farm proximity'; 5 is PC5 'additional income'; 6 is PC6 'land ownership'; and 7 is PC7 'consumer health and food safety'.

3.2.2. Coast Farmer Opinions Toward Organic Farming by Social Influence Category

The majority of farmers within the coast areas of the study SEPL (17–22 total) fell within the LA–ML social influence category, with less academic and more life experiences, and could be considered representative of farmers of this area within the study SEPL. Nine of these farmers farmed organically and expected to continue organic farming practices in the future. Eight of the 17 farmers used conventional farming practices, but three expected to farm organically in the future, though it was unknown when in the future (i.e., near or distant). For the farmers who were organic farmers, of the seven PCs that contained 76% of the total variability within the coast farmer dataset, this group was the only social influence category within the coast area farmers that had positive scores for PC1, which is characterized by the spread of organic farming notion. This group also had positive scores for PC2, characterized by the convenience of rented farmland, and PC6, representing ownership of farmland (Figure 3).

3.3. SEPL—Plain

PCA was computed for farmer responses with farms categorized as 'plain' farms, a dataset of 18 individuals and 34 variables. For this dataset, 59.782% of the total variation was retained by the first three principal components, and 85.459% by the first seven.

3.3.1. Plain Analysis: Family Support, Contracts, and Quality are Key

The first principal component was strongly correlated with the following five original variables in descending order of contribution: 'famsupp5', support from family; 'mach19', or access to farming tools and machines; 'ownshp10', ownership of farmland; 'inher4', inheritance of rice farming; and 'socappv23', social approval of organic farming (Figure 4). The variable 'famsupp5' was taken to be the characterizing variable for this component and could be understood as a measure of the importance of the support a farmer received from his/her family when deciding whether or not to farm organically. The second principal component increased with two original variables ('ctrcolabo28', chance of contractual collaboration; and 'irrsrc9', stable irrigation source), and with three decreasing variables ('devleis20', possibility of developing leisurely agricultural farming experiences; and 'neighwill21', willingness of neighbor farmers; and 'addinc1', additional income). The third principal component increased with 'orgqual30', quality of organic rice; 'waterpoll15', degree of water being polluted; and 'rateorg14', rate of organic farmland in the neighborhood. It decreased with 'consumwill33', willingness of purchase from consumers; and 'threeyr13', the legal limit of Taiwan's 'three-year transformation period' (Supplementary Table S11). Supplementary Tables S12–S18 further delineate which variables are significantly associated with each of the seven PCs (p-value < 0.05), though only the top five variables for the first three PCs are discussed.

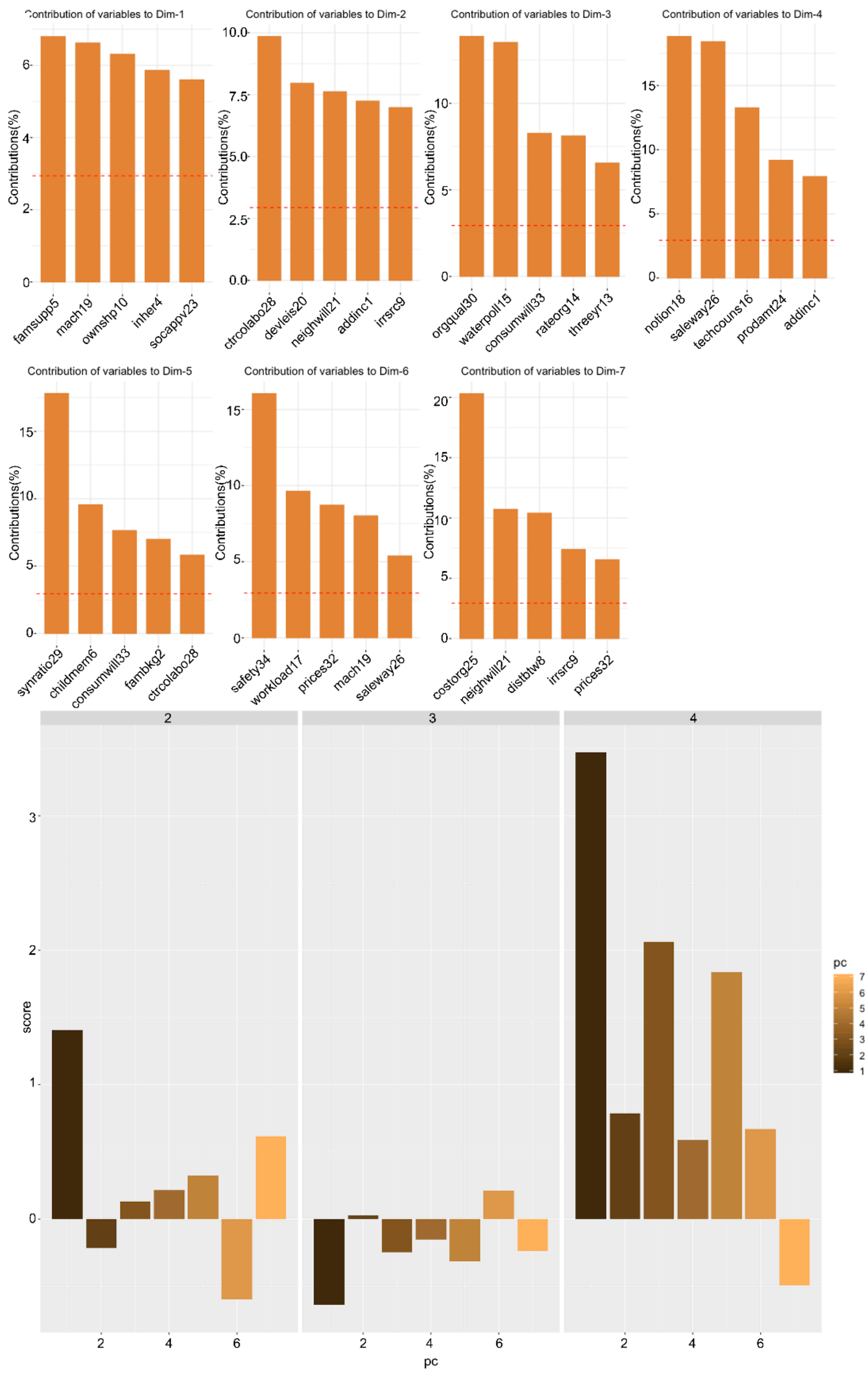


Figure 4. Contributing variables and principal component (PC) analysis scores for the 'plain' sample. Top: top five variables that contribute to components (dimensions) 1–7 for the 'plain' sample. Red dashed line indicates the expected average contribution, if variable contributions were uniform. Bottom: plain farmers' social influence category propensities towards respective factors based on PC scores. Along each of the four top x-axes, social influence category 2 is more academic–less life experience (LA–LL), category 3 is less academic–more life experience (LA–ML), category 4 is more academic–more life experience (MA–ML). Along each of the four bottom x-axes, 1 is PC1 'support from family'; 2 is PC2 'chance of contractual collaboration'; 3 is P3 'quality of organic rice'; 4 is PC4 'spread of organic farming notion'; 5 is PC5 'synergistic ratio of organic purchase'; 6 is PC6 is 'consumer health and food safety'; and 7 is PC7 'material cost of organic farming'.

3.3.2. Plain Farmer Opinions toward Organic Farming by Social Influence Category

The majority of farmers within the plain areas of the study SEPL (12–18 total) fell within the LA–ML social influence category, with less academic and more life experiences. LA–ML can be considered representative of plain farmers within the SEPL, and no farmers were considered as having less academic and less life experiences (LA–LL). Of this representative LA–ML social influence category, eight farmers farmed organically and expected to continue organic farming practices in the future. One farmer farmed organically and expected to farm using conventional practices in the future, while three farmers used conventional farming practices and will continue to do so in the future. Of the seven PCs that contained 85% of the total variability within the plain farmer dataset, the LA–ML group was the only social influence category of plain area farmers that had negative scores for PC1, which is characterized by family support.

Further, the plain farmer LA–ML group had the most negative scores of all the social influence categories and only had positive scores for PC2, characterized by chance of contractual collaboration, and PC6, representing consumers' health and food safety (Figure 4).

3.4. SEPL—Mountain

PCA was computed for farmer responses with farms categorized as 'mountain' farms, a dataset of 18 individuals and 34 variables. For this dataset, 68.180% of the total variation was retained by the first three principal components, and 88.212% by the first seven.

3.4.1. Mountain Analysis: Irrigation, Childhood Memories, and Neighborhood Farms are Key

The first principal component was strongly correlated with the following five original variables in descending order of contribution: 'irrsrc9', stable irrigation source; 'waterpoll15', or degree of water being polluted; 'cost12', cost of conventional farmland transforming to an organic one; 'techcouns16', assistance of professional technical counseling; and 'safety34', consumers' health and food safety (Figure 5). The variable 'irrsrc9' was taken to be the characterizing variable for this component. The second principal component increased with four original variables ('childmem6', childhood memories of paddies; and 'convrent11', convenience of rented farmland; 'humres3', quantity of human resources; 'distbtw8', distance between farmland and home), and with one decreasing variable ('costorg25', material cost of organic farming). The variable 'rateorg14', or rate of organic farmland in the neighborhood, was taken to be the characterizing variable for the third principal component. However, this component increased with one original variable ('brandrep27', reputation of local brand), and with four decreasing variables ('rateorg14'; 'inher4', inheritance of rice farming; 'consumwill33', willingness of purchase from consumers; and 'famsupp5', support from family) (Supplementary Table S19). Supplementary Tables S20–S26 further delineate which variables are significantly associated with each of the seven PCs (p-value < 0.05), though only the top five variables for the first three PCs are discussed.

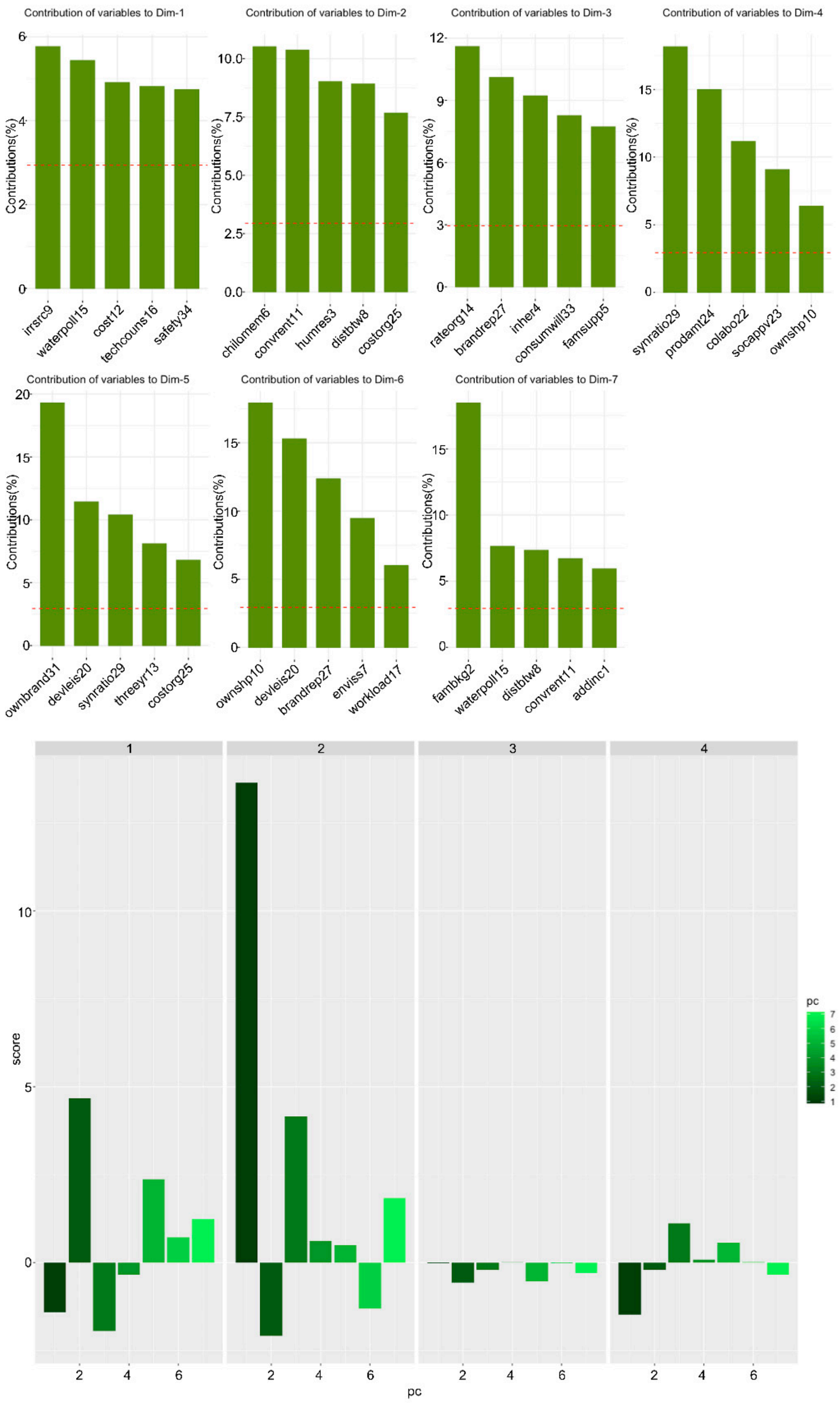


Figure 5. Contributing variables and principal component (PC) analysis scores for the 'mountain' sample. Top: top five variables that contribute to components (dimensions) 1–7 for the 'mountain' sample. Red dashed line indicates the expected average contribution, if variable contributions were uniform. Bottom: plain farmers' social influence category propensities towards respective factors based on PC scores. Along each of the four top x-axes, social influence category 1 is less academic–less life experience (LA–LL), category 2 is more academic–less life experience (LA–LL), category 3 is less academic-more life experience (LA–ML), category 4 is more academic–more life experience (MA–ML). Along each of the four bottom x-axes, 1 is PC1 'stable irrigation source'; 2 is PC2 'childhood memories of paddies'; 3 is P3 'rate of organic farmland in the neighborhood'; 4 is PC4 'synergistic ratio of organic purchase'; 5 is PC5 'possibility of establishing self-own brand'; 6 is PC6 'land ownership'; and 7 is PC7 'family background'.

3.4.2. Mountain Farmer Opinions toward Organic Farming by Social Influence Category

The majority of mountain farmers within the SEPL (13–18 total) were classified by the LA–ML social influence category, with less academic and more life experiences, the representative group for this geographic category (Figure 5). Eight of the representative LA–ML social influence group farmers farmed organically and expected to continue organic farming practices in the future. Five farmers used conventional farming practices. Of these conventional farmers, four will continue to do so in the future, while one will farm organically in the future, though it is unknown at what time. For the seven PCs, which contained 88% of the total variability within the mountain farmer dataset, this group had the most negative scores, with PC4 having a score closest to 0 (−0.011), characterized by synergistic ratio of organic purchase. This group had an overall negative opinion and could be taken to be the most pessimistic of all groups within this area in the SEPL. Though not representative of the area, three of the other social influence groups (consisting of five farmers) all had positive scores for PC5, which is characterized by the variable 'possibility of establishing self-own brand'. Other variables related to livelihood were strongly correlated with PC5, such as: possibility of developing leisurely agricultural farming experiences; synergistic ratio of organic purchase; legal limit of 'three-year transformation period'; and material cost of organic farming.

4. Discussion

Farmers share many common interests and concerns with conservationists such that a farm's success and an ecosystem's sustainability are codependent [59]. Yet, policy decision making is complicated precisely because different stakeholder groups require specific attention to their issues and needs [60]. For this reason, past studies have accounted for ES valuation by investigating social values [61], environmental worldviews [62], knowledge levels [63], and farmer behavior [1] and attitudes that denote organic farming potential [5,40,53]. Previous studies have not, however, compared farmer opinions within a SEPL from an ES approach. In this study, farmer opinions in all of the three geographic categories suggest that decisions to farm organically are not primarily related to biodiversity conservation or sustainable resource use for ES management-related issues at all, but rather are related to farming community patterns, consumer feedback, and a lack of perceived barriers in the transition process. This suggests that biodiversity conservation and ES management concerns will move to the forefront of farmers' decision making over time via channels such as national farming trends, specific consumer demands, and social pressure. For the coast, plain, and mountain areas within the study SEPL, the mountain farmers perceived more barriers to transitioning to organic farming. Furthermore, among the three geographic categories within the study SEPL (i.e., coast, plain, and mountain), farmers in the LA–ML (i.e., less academic but more life experiences) social influence group were representative of each geographic category. This suggests that life experiences versus formal education are more influential social variables in a farmers' decision-making process to transition to organic farming. This is consistent with studies that have shown organic farming adoption to be positively or negatively influenced by the social environment of farmers and the spatial distribution of organic farmers due to neighborhood effects [64]. Though life experiences include state-sponsored technical training in this study, farmer opinions toward organic farming are influenced by long term (e.g., age-dependent cohort effects or social class) yet volatile (e.g., trends or changing local norms) social variables [45] rather than academia-based environmental education curricula.

Our results are similar to previous studies. For example, Marsh et al. [8] reported that among their small sample of farmers, 90% cited that a lack of time, and 75% cited the length of time required to certify for organic farming were the two most common reasons for not transitioning, followed by farmers not knowing how to begin the transition, the perceived high production costs of transitioning, and the doubt that many consumers will be willing to pay higher prices for organic crops. Other studies report barriers to transitioning that are mainly economic reasons, or due to limited understanding and information about organic farming systems, lack of farm management skills, marketing challenges, and a need for more organic education [8,65–68]. Issa and Hamm [5] concluded that transitioning determinants are different for developed countries versus developing countries such that important factors in developing countries focus on individual farmers and farm characteristics, although economic aspects are the most relevant factors; on the other hand, developed countries focus on the socio-economic characteristics of farmers, government subsidies for transitioning, and national agricultural policies [5] as determinants of transitioning. While our results are consistent with each, our study, however, combines the smaller and larger scale analytical lenses for greater insight.

4.1. Total SEPL

Figure 6 is a visualized summary of the top five contributing variables to principal components one through seven, and individuals by geographic category, for the total SEPL. Figure 6 also verifies that our selection of Yuanli as a SEPL for this study does in fact represent a satoyama landscape, in which biodiversity conservation for sustainable agriculture and human well-being [69] is found within the dynamic agricultural mosaic landscape (as seen in the overlapping PCA results from each geographic category); and results from the interaction between human activities and nature [24]. Looking further into each component, results suggest that procuring farming machinery and tools is costly, since the first principal component can be understood as a measure of farmer opinions regarding the importance of costs associated with transforming from conventional to organic farming, access to material resources, social approval (and possibly social pressure), whether or not organic farming as a concept is widely understood, and potential stable income sources such as contractual collaborations. As such, there is a need for attention to these factors when making decisions. These factors are either needs that have not been addressed by current or past programs, or that have been met and should be sustained and applied on a broader scale. It follows that in Miaoli county, farmers are of the opinion that they tend to face relatively high costs when transforming their farmland from conventional to organic. These results are similar to Tsvetkov et al. [3], who reported that due to the yield gap between organic and conventional farming, cost effectiveness differences between the two methods are substantial, even though evidence shows that the reduced yield in organic systems is not as prominent beyond five years [3]. Our results also suggest that the receptivity of farmers to transition to organic farming is based on their experiences farming thus far when examining the second principal component. The second principal component can be understood as a measure of importance for the farmers regarding family background in the farming business and way of life, farmland rental processes, the importance of the rice farming values or resources passed down from their predecessors, living proximity to farmland, and market access. Noteworthy is that this component also increases with decreasing methods of sales for organic farming which reflects an opinion that the method of selling organic products in terms of farmer-utilized sales channels or channels the farmers are aware of is not a barrier (and therefore also not important) in the farmer's decision-making process to farm organically. Yet, increased agricultural food product purchases, in general, may result in more organic food product purchases, which is important to farmers who are considering organic farming. It is unclear, however, if the farmers believe that organic food products may boost their current sales of non-organic products or vice versa. The third component can be understood as a measure that further reflects either: (1) that the farmer is unaware or has not experienced issues with irrigation sources, water pollution, or environmental issues; or (2) the farmer does not consider these aspects as important as others, perhaps due to a lesser frequency of dealing with problems related to these variables since these problems are resolved sufficiently enough to not warrant any further concern. If we deem correlations above 0.5 as important, however, these variables are dismissed. Since organic farming practices—specifically using organic fertilizers—lead to less nitrogen and phosphorus leaching into the groundwater and surrounding ecosystems [70–73], it may still be beneficial, however, to ensure that mechanisms are in place that prevent unstable irrigation sources, high water pollution and related environmental issues, as well as to ensure that Miaoli farmers are able to communicate with local regulatory agencies, and hold them accountable in the event that problems related to these variables do arise that would create barriers to transitioning to organic farming.

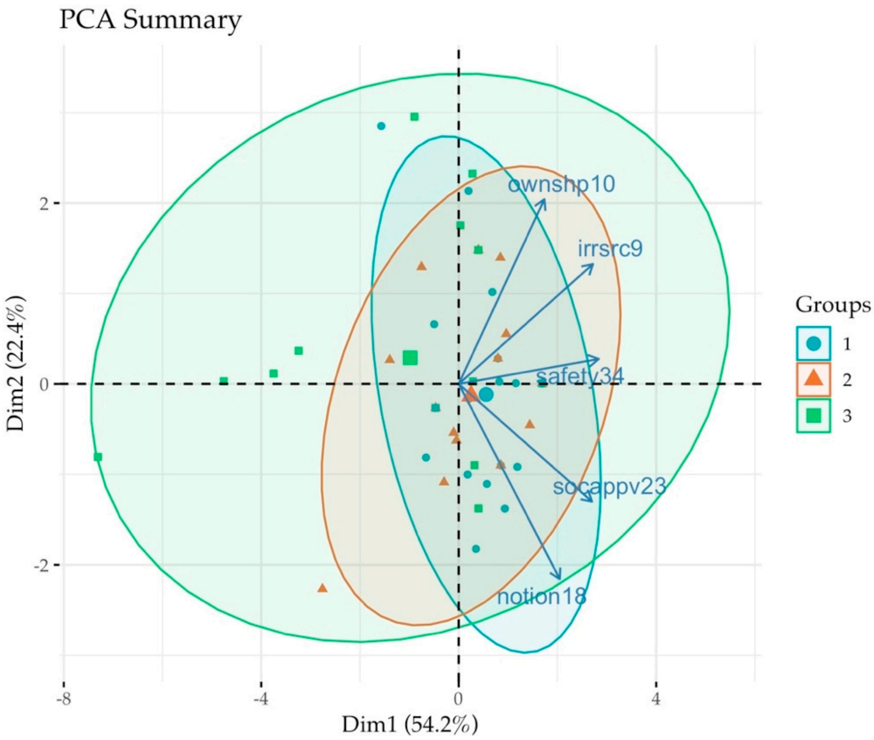


Figure 6. Biplot summary of individuals and the top five original variables that contribute most to principal components 1–7 for the total study area. Group 1 in blue is coast; group 2 in brown is plain; group 3 in green is mountain.

4.2. SEPL—Coast

Results suggest that in the coastal area of the study SEPL, farmers will consider foremost if organic farming is sufficiently prevalent and apparent such that nearby farms are also organically farming. This is similar to results from Sumane et al. [7], who concluded that 'multi-actor knowledge networks' are necessary for advancing sustainable agriculture and the requisite knowledge. These farmers will then also consider the relevant aspects of running an organic farm to include the transformation costs of transitioning, their potential production levels, additional costs incurred associated with the materials needed for organic farming, and feasible means of selling their new products. That is to say, for coast farmers, the data suggests that when the concept of organic farming is within their personal 'sphere of transformation' [74,75] (e.g., when there is a density of nearby organic farms or often-heard talk of organic product demand), they are more likely to consider farming organically. This may also suggest that for those farmers who are currently farming with conventional practices, organic farming as a concept, or notion, has not presented itself and therefore when it does, the farmers will take this as a socio-economic cue to transition to organic farming. In other words, deciding to transition to organic farming will happen when everyone else is farming organically too or when consumer demand is sufficiently high to warrant transitioning. The amount of state-sponsored organic training will also act as a cue since, as previously discussed, organic training in this study is a means of relaying current societal norms and the transmitting of subjective norms [45]. Results also suggest that the convenience of renting farmland in the coast areas of the SEPL is not stable and may fluctuate further, suggesting that any inconveniences in this form of land use may be a hindrance to transitioning to organic farming practices. The results also show that in coastal areas, access to a stable irrigation source and environmental issues are not problems that farmers regularly face, so that these variables are not relatively important aspects of their decision-making process when considering transforming to organic farming, and so are negatively correlated. Rather, what is of more concern to these farmers is the convenience of renting their farmland. Also, contributing to the second principal component is the farmer's family background, which may justify why the convenience of renting farmland remains important. For example, if farmers are new to farming and are landless, the convenience of renting farmland is of high importance when compared to landholding farmers who prioritize costs associated with transforming their own farms. These results may indicate that in the coast areas of the SEPL, farmer socio-demographics are composed of a relatively high number of landless farmers or farmers with less farming experience. Further analysis into the coast area farmers' socio-demographic profile is needed for more insight. Yet, it follows that selling prices of a farmer's organic rice is of concern if farmers are to generate enough income to also pay their land rent. This is in line with studies that report farmers holding less land first look for higher economic benefits rather than other advantages, since their farmland is the source of their livelihood [40]. Yet, Wei [20] points out how farmers in northeast Taiwan successfully raised the price of their local rice because of their organic production methods and the embedded local environmental values. However, although local farmer confidence was also boosted, Wei [20] also notes that prices still failed to reflect how organic farming contributed to preserving the area's biological balance and water resources. When looking at coast scores though, the propensities toward respective factors, either positive or negative, reveal opinions towards the importance of these factors [40].

For coast farmers, keeping up with farming trends as a reflection of consumer demand, and land ownership issues such as the affordability of renting land while still producing and selling enough to maintain their livelihoods, suggests that profit motives are stronger than environmental in deciding to farm organically, a conclusion that seems to have remained consistent since reported in earlier studies [40].

4.3. SEPL—Plain

Results suggest that for farmers in the plain area of the SEPL, family support may represent additional aspects not directly related to physically provided support (i.e., helping with farming activities) since the first component is neither correlated with those original variables that address quantity of human resources available to farmers, nor to labor workload. Family support in this sense may be a reflection of a family's cultivated environmental consciousness and emotional ties with the locality [20]. While the first component is not strongly correlated with variables related to farming family background in terms of identity or cultural tradition, it is described in terms of access to farming resources, land ownership, and an inherited material legacy. Further, social approval can be understood in a similar vein as non-material family support (presumably if the other material aspects are ensured), and as important to farmers' decision-making processes to transition to organic farming. Results also suggest that in the plain areas, neither developing farms into leisure farms, neighbors' willingness to farm organically, nor additional income are relatively important aspects of farmers' decision-making processes when considering transforming to organic farming, whether in the past or in the future. Rather, what is of more concern to these farmers is the chance to obtain a contractual collaboration as well as access to a stable irrigation source. This may suggest that contractual collaborations for organic farmers in the plain areas of the study SEPL are hard to come by, and irrigation sources are not stable and may be a hindrance to transitioning to organic farming practices. It also follows that relative to these two variables, those decreasing variables may be perceived as irrelevant or unattainable. That is, without firstly securing a stable irrigation source and contractual collaboration, developing their farm into a leisure farm and earning additional income are impossibilities regardless of whether neighboring farms are willing to farm organically or not. Further, plain farmers perceived that consumer willingness to purchase organic products, and the three-year transformation period legally required before a farmer's land can be certified as organic, are both affected by the farmer's organic rice quality, the local water pollution, and the organic farmland in the neighborhood. It also follows that there is a lower rate of organic farmland in plain farmers' immediate areas, a higher degree of water pollution, and a lower quality of rice. Because of this, consumer willingness to purchase organic products is not as important to plain farmers as first addressing the issue of rice quality, water pollution, and conventional farming practices that are prevalent in the neighborhood. Likewise, if these issues are not addressed, the mandatory three-year period is relatively unimportant, since post-transformation farms would still face these issues.

The positive opinions towards PC2 and PC6 reveal that plain farmers may be interested in establishing contractual collaborations potentially as a means to achieve objectives related to consumer health and food safety. That they showed relatively greater negative scores for PC1 indicates that for farmers within the plain area of the SEPL, family support (in both the material legacy sense that grants farmers access to farming resources, and the non-material sense of the term 'support') is not an important aspect in their decision-making processes potentially because it is not lacking or problematic but instead is a given. This may reflect a lower tendency toward risk aversion for farmers in this group who have an established support system, which is also in line with previous studies that report that relatively younger farmers (when the average age of organic farmers is younger than conventional farmers) were more willing to adopt new production techniques and to take on the associated risks of organic farming when perceived capital gain is high [40,76,77]. This of course assumes that high-risk-taking younger farmers are free to act so boldly because they have a support system to fall back on. Wei [20], however, reports that younger generations of farmers in northeast Taiwan are risk-averse, raising concerns of the lack of commercial vision and financial return in commercialization strategies that emphasize slow-paced organic production development in order to preserve local biodiversity and way of life.

4.4. SEPL—Mountain

Results suggest that a stable source of irrigation is important to mountain farmers when deciding whether or not to farm organically, and poses more challenges than for areas with lower elevation or that are near to water sources. However, the first principal component is also correlated with degree of water pollution, transformation costs, and technical counseling, suggesting that irrigation infrastructure, associated costs, and technical expertise are also important to a farmer's decision-making process when choosing to transform their farm. Consumer health and food safety also increase with this principal component, further suggesting that suitable non-polluted water irrigation is related to addressing consumer demands for healthy and safe food. This is interesting, since the variable 'quality of organic rice' is not correlated with this component. It follows that while mountain farmers are aware of consumer health-related concerns, their water source is identified as an impediment to addressing consumer concerns since, once the issue is addressed, the expected result is quality farm products that meet consumer demands. Results also suggest that the material cost of organic farming in mountain areas is not a relatively important aspect of the decision-making process when considering transforming to organic farming. Rather, what is of more concern to these farmers are variables that may or may not align with their childhood memories of rice farming, suggesting that for these farmers there is an impression or ideal of farming that strongly influences their current decisions. Childhood memories may also hold valuable farming skills and techniques. Mountain farmers in northeast Taiwan revived indigenous pest-control methods using a local pest-repellent that a single farmer within the community was able to make based on his childhood memory [20]. This may reveal a tendency of farmers in this geographic category to be 'set in their ways' so that achieving their ideals of farming trump overcoming any practical barriers to organic farming. Additionally, their ability to continue to conveniently rent farmland, the number of workers they have on their farms, and the distance of their farms from their home residences potentially all play into creating an idealized farming experience based on their childhood memories. Furthermore, mountain farmers already have the support of their families and even perhaps have inherited material legacies associated with farming such that these aspects are relatively unimportant (i.e., not needed for transition); or that mountain farmers have neither family support nor an inherited legacy, and so these aspects remain unimportant. The latter is more unlikely, however, since these variables are correlated with brand reputation, suggesting that both inheritance and family support contribute to creating or maintaining a farm's reputation. Further, how fast neighborhood farms convert to organic farms, and consumer willingness to purchase organic products, are irrelevant or unimportant to mountain farmers until they has establish reputable farm products on the market.

4.5. Summary

For this study, when highlighting the differences between the specific geographic categories within the SEPL, the key takeaways are as follows:

- coast farmers have the most positive opinions towards the importance of keeping up with organic farming trends as a reflection of consumer demand, though their profit motives may be stronger than environmental in deciding to farm organically;
- coast farmers have the most negative scores towards farm proximity to farmer's residence, suggesting that farmers in this area live relatively close to their farms;
- plain farmers have positive opinions towards establishing contractual collaborations as a potential means to also achieve objectives related to consumer health and food safety, denoting a high interest in future opportunities;
- plain farmers have the most negative scores for family support (in both the material legacy sense that grants farmers access to farming resources, and the non-material sense of the term 'support'), suggesting that family support is not lacking or problematic and may reflect a lower propensity toward risk aversion for farmers in this area with an established support system;
- mountain farmers had the most negative opinions overall, suggesting either that they perceive more barriers to transitioning to organic farming, namely, irrigation source issues, or general apathy towards influential aspects of transitioning to organic farming that were not at all addressed in the survey.

James and Brown [75] discussed farmers' agricultural knowledge and land management in terms of personal, practical, and political scales of 'spheres of transformation' from a resilience approach, revealing constraints to widespread transformation in the political realm. Eighty case studies have focused on agricultural socio-economic activities at a local scale within forest, agricultural, and inland water ecosystems, using IPSI as a knowledge-sharing platform to share SEPL experiences, and to include a case study from Taiwan's east coast discussing Indigenous knowledge and farming practices in the Amis cultural landscape [11]. We, however, specifically considered organic farming practices as a landscape conservation approach to ES management with sustainable agriculture when we compared farmer opinions from different geographic and social influence categories within a single SEPL. Further, our study touched on a less-investigated theme, namely, addressing emerging and relevant issues in order to identify the study SEPL's perceived value for increasing farmer knowledge. Although a relatively small sample, a necessity exists to assess this area's farmer knowledge of organic farming from an ES perspective in order to make actionable projections of the region's contribution to meet the local growing organic demands [8]. That is, as antecedents to ES valuation and ultimately conservation behavior [10], this study's analysis of farmer opinions toward organic farming revealed a 'recognition of values' [11] (or lack) of the SEPL's ES benefits. Moreover, this study contributes to the current field of research by investigating the lesser-studied opinions of Taiwan's west coast farmers from an ES perspective.

5. Limitations

This study is not without limitations. For example, this study uses a six-point Likert-type scale without a midpoint, and Chyung et al. [78] have reported that studies using six-point scales without a midpoint do not affect PCA factor loadings as a validity measure, nor Cronbach's alpha as a reliability measure, indicating that these studies did produce results that met the normality assumption when compared to studies using four- and five-point scales. However, there may be a possibility that respondents use the scale categories interchangeably [78], so that scales with more response categories are more reliable [63]. Also, obtaining unique farm elevations based on geocoded addresses was problematic, since some farmers did not report unique farm addresses, but rather reported similar farm locations. As a result, these farmers were classified into the same geographic category, which ultimately did not alter results but instead expedited classification. Some survey questions that were used for the PCA were very similar, so that nuances could possibly have been lost in translation from Mandarin Chinese to English. For example, the variable 'spread of organic notion' is seemingly very similar to 'willingness of neighbor farmers', but actually connotes a different aspect of a farmer's decision-making process. Reproducing this study using the same opinion questions, then, must take into account culturally based language issues arising from translation. Additionally, many survey questions were related to concerns prevalent to the SEPL's national context, as opposed to those related to general concepts of sustainable resource use or biodiversity conservation. Due to this, opinions towards specific ideas of interest in this study, such as the importance of ES provisioning in transitioning decisions, were not addressed directly but rather, indirectly. Lastly, manual classification for this study was manageable due to the relatively small sample size, but with larger sample sizes an 'automated' algorithmic classification method may prove advantageous for larger-scale studies, in addition to increasing the number of social-influence categories.

6. Conclusions

This study investigates farmer opinions within a satoyama SEPL in a relatively rural area—the Yuanli township on Taiwan's western coast. Similar to the reported disconnect between the scientific interpretation of the concept and the traditional symbolic idea of satoyama, which parallels the disconnect between global sustainable agricultural decision makers and the rural farmers who manage their agricultural resources and engage in conservation practices [23], this study addresses an analogous disconnect to understand farmers' opinions about transitioning to organic farming for better-informed policies. From an ES approach, we looked at farmer opinions toward organic farming as the antecedents to ES benefit valuation and ultimately conservation behavior [10] when organic farming is considered a means to sustain ESs and conserve biodiversity within a SEPL. Furthermore, this study looked into the variation in opinions of rural farmers when accounting for categories of social influence and geographic location within a lesser-studied region of Taiwan. Furthermore, our PCA results verify that Yuanli, selected as a SEPL for this study, is a characteristic satoyama landscape. Farmer opinions toward organic practices are more influenced by their life experiences than by school-taught concepts. Our proposed approach successfully analyzed and identified the knowledge and opinions of farmers. While we cannot yet conclude that addressing the positively identified opinions in this study will ultimately result in more decisions to transition to organic farming, we have determined which aspects of farm transitioning require attention for farmers within the SEPL. We can conclude, however, that our proposed approach can be utilized in the growing body of international satoyama and SEPL research. Finally, when this study's results are representative of larger socially marginalized farmer populations, insights are gained to aid in achieving national goals of increasing organic land within a sustainable agricultural landscape.

Supplementary Materials: The following are available online at http://www.mdpi.com/2071-1050/11/14/3843/s1, Survey: Farmers' willingness to conduct organic and conventional farming in Yuanli, Miaoli County; Table S1: Survey score conversion for select responses used for social influence group classification; Table S2: Survey score conversion for organic farming opinion questions (II, 1-34); Figure S1: Top five contributing variables to each principal components (dimensions) 1-7 for Miaoli total sample; Table S3: Correlations between principal components (PC) 1-3 and original variables for Miaoli total SEPL farmers; Table S4a: Correlations between principal components (PC) 1-3 and top 5 original variables for SEPL Coast farmers; Table S4 through Table S10: Correlation coefficient and p-value of variables significantly correlated to Principal Components 1 through 7 for SEPL Coast farmers; Table S11: Correlations between principal components (PC) 1-3 and top 5 original variables for Miaoli Plain farmers; Table S12 through Table S18: Correlation coefficient and p-value of variables significantly correlated to Principal Components 1-7 for SEPL Plain farmers. Table S19: Correlations between principal components (PC) 1-3 and top 5 original variables for Miaoli Mountain farmers; Table S20 through Table S26: Correlation coefficient and p-value of variables significantly correlated to Principal Components 1-7 for SEPL Mountain farmers.

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References

1. Asadollahpour, A.; Najafabadi, M.O.; Hosseini, S.J. Modeling behavior pattern of Iranian organic paddy farmers. *Paddy Water Environ.* **2016**, *14*, 221–229. [CrossRef]
2. Stosch, K.C.; Quilliam, R.S.; Bunnefeld, N.; Oliver, D.M. Quantifying stakeholder understanding of an ecosystem service trade-off. *Sci. Total Environ.* **2019**, *651*, 2524–2534. [CrossRef] [PubMed]
3. Tsvetkov, I.; Atanassov, A.; Vlahova, M.; Carlier, L.; Christov, N.; Lefort, F.; Tamm, L.; Iantcheva, A.; Herforth Rahmé, J.; Rakleova, G.; et al. Plant organic farming research–current status and opportunities for future development. *Biotechnol. Biotechnol. Equip.* **2018**, *32*, 241–260. [CrossRef]
4. De Groot, R.; Alkemade, R.; Braat, L.; Hein, L.; Willemen, L. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecol. Complex.* **2010**, *7*, 260–272. [CrossRef]
5. Issa, I.; Hamm, U. Adoption of organic farming as an opportunity for Syrian farmers of fresh fruit and vegetables: An application of the theory of planned behaviour and structural equation modelling. *Sustainability* **2017**, *9*, 2024. [CrossRef]
6. Pacifico, D.; Onofri, C.; Parisi, B.; Ostano, P.; Mandolino, G. Influence of Organic Farming on the Potato Transcriptome. *Sustainability* **2017**, *9*, 779. [CrossRef]
7. Šūmane, S.; Kunda, I.; Knickel, K.; Strauss, A.; Tisenkopfs, T.; des Ios Rios, I.; Rivera, M.; Chebach, T.; Ashkenazy, A. Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture. *J. Rural Stud.* **2018**, *59*, 232–241. [CrossRef]
8. Marsh, L.; Zoumenou, V.; Cotton, C.; Hashem, F. Organic farming: knowledge, practices, and views of limited resource farmers and non-farmers on the Delmarva Peninsula. *Organ. Agric.* **2017**, *7*, 125–132. [CrossRef]
9. Vaske, J.; Donnelly, M.; Williams, D.; Jonker, S. Demographic influences on environmental value orientations and normative beliefs about national forest management. *Soc. Nat. Resour.* **2001**, *14*, 761–776.
10. Van Riper, C.; Lum, C.; Kyle, G.; Wallen, K.; JAbsher, J.; Landon, A. Values, Motivations, and Intentions to Engage in Proenvironmental Behavior. *Environ. Behav.* **2018**. [CrossRef]
11. UNU-IAS and IGES. *IPSI Case Study Review—A Review of 80 Case Studies under the International Partnership for the Satoyama Initiative (IPSI)*; United Nations University Institute for the Advanced Study of Sustainability: Tokyo, Japan, 2015.
12. Morgera, E.; Caro, C.; Duran, G. Organic Agriculture and the Law, Food and Agriculture Organization of the United Nations Legislative Study 107. 2012. Available online: http://www.fao.org/docrep/016/i2718e/i2718e.pdf (accessed on 22 May 2019).
13. Postma-Blaauw, M.; de Goede, R.; Bloem, J. Agricultural identification and de-intensification differentially after taxonomic diversity of predatory mites, earthworms, enchytraeids, nematodes and bacteria. *Appl. Soil Ecol.* **2012**, *57*, 39–49. [CrossRef]
14. Holzschuh, A.; Steffan-Dewenter, I.; Tscharntke, T. Agricultural landscapes with organic crops support higher pollinator diversity. *Oikos* **2008**, *117*, 354–361. [CrossRef]
15. Kehinde, T.; Samways, M. Endemic pollinator response to organic vs. conventional farming and landscape context in the Cape Floristic Region biodiversity hotspot. *Agric. Ecosyst. Environ.* **2012**, *146*, 162–167. [CrossRef]
16. Lin, S.; Wu, R.; Yang, F.; Wang, J.; Wu, W. Spatial trade-offs and synergies among ecosystem services within a global biodiversity hotspot. *Ecol. Indic.* **2018**, *84*, 371–381. [CrossRef]

17. Andersson, E.; Nykvist, B.; Malinga, R.; Jaramillo, F.; Lindborg, R. A social–ecological analysis of ecosystem services in two different farming systems. *Ambio* **2015**, *44*, 102–112. [CrossRef] [PubMed]
18. International Monetary Fund. Available online: www.imf.org (accessed on 15 November 2018).
19. Hsu, J.A. Globalization, land expropriation, and community resistance: A case study in Wanbao community, Miaoli County, Taiwan. M.U.P. Thesis, University of Illinois at Urbana-Champaign, Champaign, IL, USA, April 2017.
20. Wei, S. The Dilemmas of Peach Blossom Valley: The Resurgence of Rice-Terrace Farming in Gongliao District, Taiwan. In *The Living Politics of Self-Help Movements in East Asia*; Palgrave Macmillan: Singapore, 2018; pp. 163–187.
21. Bergman, M.M. A theoretical note on the differences between attitudes, opinions, and values. *Swiss Political Sci. Rev.* **1998**, *4*, 81–93. [CrossRef]
22. Schultz, P.W.; Zelezny, L. Values as predictors of environmental attitudes: Evidence for consistency across 14 countries. *J. Environ. Psychol.* **1999**, *19*, 255–265. [CrossRef]
23. Doshita, M. *The Globalisation of Symbolic Concepts of Nature A Case Study of Satoyama*; TAMA University: Tama, Japan, 2015. Available online: https://tama.repo.nii.ac.jp/?action=repository_uri&item_id=259&file_id=22&file_no=1 (accessed on 10 January 2019).
24. Takeuchi, K. Rebuilding the relationship between people and nature: The Satoyama Initiative. *Ecol. Res.* **2010**, *25*, 891–897. [CrossRef]
25. Chang, S.E. Blue Magpie TEAgriculture: Eco-tea Cultivation and Participatory Farming in Pinglin Satoyama, Taiwan. *Procedia Soc. Behav. Sci.* **2013**, *101*, 14–22. [CrossRef]
26. Shiu, Y.S.; Lui, L.W. Crowdsourcing as a participative tool in a landscape conservation initiative at the urban rural buffer zone: A case study of the Waipu District in Taichung, Taiwan. *PLERUS* **2016**, *[Etapa I]*, 157–172. Available online: https://pdfs.semanticscholar.org/7166/dc3aa3da78de8dc6bc18a0559d7b990575ec.pdf (accessed on 18 January 2019).
27. Willer, H.; Lernoud, J. (Eds.) *The World of Organic Agriculture. Statistics and Emerging Trends 2019*; Research Institute of Organic Agriculture (FiBL), Frick, and IFOAM—Organics International: Bonn, Germany, 2019. Available online: https://shop.fibl.org/CHen/mwdownloads/download/link/id/1202/?ref=1 (accessed on 2 May 2019).
28. Jiang, W.J.; Yir-Hueih, L.U.H. Does higher food safety assurance bring higher returns? Evidence from Taiwan. *Agric. Econ.* **2018**, *64*, 477–488. [CrossRef]
29. Anderson-Sprecher, A.; Wu, P. *Growing Demand for Organics in Taiwan Stifled by Unique Regulatory Barriers*; GAIN Report Number TW17006, Global Agricultural Information Network Report; United States Department of Agriculture Foreign Agricultural Service: Washington, DC, USA, 2017.
30. Sun, C.H.; Lin, L.; Hsu, C.Y.; Fan, M.L. Promotion of Organic Agriculture in Eastern Taiwan. *J. World Herit. Stud.* **2017**, 11–16. Available online: http://doi.org/10.15068/00148443 (accessed on 5 June 2019).
31. Lin, Y.-P.; Cheng, B.-Y.; Chu, H.-J.; Chang, T.-K. Assessing how heavy metal pollution and human activity are related by using logistic regressions and kriging methods. *Geoderma* **2011**, *163*, 275–282. [CrossRef]
32. Miaoli County Government Household Registration Service. Available online: https://mlhr.miaoli.gov.tw/ (accessed on 1 December 2018).
33. Miaoli Government. Available online: https://www.miaoli.gov.tw/eng/1-1.php (accessed on 15 November 2018).
34. Miaoli Government News. The Wizard of the Green: Leopard Cat Conservation. Available online: http://www.sanyi.gov.tw/eng/8-1-1.php?forewordID=258944&print=1 (accessed on 15 November 2018).
35. UNU-IAS; IGES. *Socio-Economic Production Landscapes in Asia*; University Institute for the Advanced Study of Sustainability: Tokyo, Japan, 2018.
36. International Partnership for the Satoyama. Available online: https://satoyama-initiative.org (accessed on 15 January 2019).
37. IPSI Secretariat. *The International Partnership for the Satoyama Initiative (IPSI): Information Booklet and 2016 Annual Report*; United Nations University Institute for the Advanced Study of Sustainability: Tokyo, Japan, 2017.
38. National Development Council, Map of Taiwan Cities & Counties. Available online: https://data.gov.tw/dataset/7442 (accessed on 30 June 2019).

39. National Land Surveying and Mapping Center. Land Use Map. Available online: http://www.nlsc.gov.tw/Land (accessed on 30 June 2019).
40. Nandi, R.; Gowdru, N.V.; Bokelmann, W.; Dias, G. Smallholder organic farmer's attitudes, objectives and barriers towards production of organic fruits and vegetables in India: A multivariate analysis. *Emir. J. Food Agric.* **2015**, *27*, 396–406. Available online: https://doi.org/10.9755/ejfa.2015.04.038 (accessed on 30 June 2019). [CrossRef]
41. Revelle, W. *R-Package 'Psych': Procedures for Personality and Psychological Research*; Northwestern University: Evanston, IL, USA, 2018.
42. Suzuki, R.; Shimodaira, H. R-Package 'pvclust'. Hierarchical Clustering with P-Values via Multiscale Bootstrap Resampling. 2015. Available online: http://stat.sys.i.kyoto-u.ac.jp/prog/pvclust/ (accessed on 6 November 2018).
43. United States Geological Survey Website. "What Is the Difference between 'Mountain', 'Hill', 'Peak'; 'Lake' and 'Pond'; or 'River' and 'Creek'?". Available online: https://www.usgs.gov/faqs/what-difference-between-mountain-hill-and-peak-lake-and-pond-or-river-and-creek (accessed on 11 February 2019).
44. Arcury, T.; Christianson, E. Rural-Urban Differences in Environmental Knowledge and Actions. *J. Environ. Educ.* **1993**, *25*, 19–25. [CrossRef]
45. Gifford, R.; Nilsson, A. Personal and social factors that influence pro-environmental concern and behaviour: A review. *Int. J. Psychol.* **2014**, *49*, 141–157. [CrossRef] [PubMed]
46. Ang, S. Life course social connectedness: Age-cohort trends in social participation. *Adv. Life Course Res.* **2019**, *39*, 13–22. [CrossRef]
47. Vesely, S.; Klöckner, C.A. Global social norms and environmental behavior. *Environ. Behav.* **2018**, *50*, 247–272. [CrossRef]
48. Le, S.; Josse, J.; Husson, F. FactoMineR: An R Package for Multivariate Analysis. *J. Stat. Softw.* **2008**, *25*, 1–18. [CrossRef]
49. The Pennsylvania State University Eberly College of Science Department of Statistics. (n.d.). "Interpretation of the Principal Components". Available online: https://newonlinecourses.science.psu.edu/stat505/lesson/11/11.4 (accessed on 18 January 2019).
50. Kassambara, A.; Mundt, F. R-Package 'Factoextra'. Extract and Visualize the Results of Multivariate Data Analyses. 2017. Available online: https://CRAN.R-project.org/package=factoextra (accessed on 11 December 2018).
51. Wickham, H. *ggplot2: Elegant Graphics for Data Analysis*; Springer: New York, NY, USA, 2009.
52. Stacklies, W.; Redestig, H.; Wright, K. R-Package 'pcaMethods'. A Collection of PCA Methods. 2018. Available online: https://github.com/hredestig/pcamethods (accessed on 6 November 2018).
53. Abdi, H.; Williams, L. Principal Component Analysis. In *Wiley Interdisciplinary Reviews: Computational Statistics*; Wiley Periodicals, Inc.: Hoboken, NJ, USA, 2010; Volume 2, pp. 433–459.
54. Husson, F.; Le, S.; Pages, J. *Exploratory Multivariate Analysis by Example Using R, Chapman and Hall*; CRC Press Book: Boca Raton, FL, USA, 2010.
55. Chouichom, S.; Yamao, M. Organic Fertilizer Use in Northeastern Thailand: An Analysis of Some Factors Affecting Farmers' Attitudes. In *Sustainable Agricultural Development*; Springer: Dordrecht, The Netherlands, 2011; pp. 185–196.
56. Jollife, I.T. *Principal Component Analysis*, 2nd ed.; Springer: New York, NY, USA, 2002.
57. Peres-Neto, P.R.; Jackson, D.A.; Somers, K.M. How Many Principal Components? Stopping Rules for Determining the Number of Non-Trivial Axes Revisited. *Br. J. Stat. Psychol.* **2005**, *49*, 974–997. [CrossRef]
58. Thuleau, S.; Francois Husson, F. R-Package 'FactoInvestigate'. Automatic Description of Factorial Analysis. 2018. Available online: https://cran.r-project.org/web/packages/FactoInvestigate/index.html (accessed on 9 January 2019).
59. Plieninger, T.; van der Horst, D.; Schleyer, C.; Bieling, C. Sustaining ecosystem services in cultural landscapes. *Ecol. Soc.* **2014**, *19*. [CrossRef]
60. Kyttä, M.; Broberg, A.; Tzoulas, T.; Snabb, K. Towards contextually sensitive urban densification: Location-based softGIS knowledge revealing perceived residential environmental quality. *Landsc. Urban Plan.* **2013**, *113*, 30–46. [CrossRef]
61. Sherrouse, B.C.; Clement, J.M.; Semmens, D.J. A GIS application for assessing, mapping, and quantifying the social values of ecosystem services. *Appl. Geogr.* **2011**, *31*, 748–760. [CrossRef]

62. Van Riper, C.J.; Kyle, G.T. Capturing multiple values of ecosystem services shaped by environmental worldview: a spatial analysis. *J. Environ. Manag.* **2014**, *145*, 374–384. [CrossRef] [PubMed]
63. Van Riper, C.J.; Kyle, G.T.; Sherrouse, B.C.; Bagstad, K.J.; Sutton, S.G. Toward an integrated understanding of perceived biodiversity values and environmental conditions in a national park. *Ecol. Indic.* **2017**, *72*, 278–287. [CrossRef]
64. Alwin, D.F.; Krosnick, J.A. The reliability of survey attitude measurement. In *Sociological Methods & Research*; Alwin, D.F., Ed.; Sage: Thousand Oaks, CA, USA, 1991; Volume 20, pp. 139–181.
65. Agunga, R.; Igodan, C. Organic farmers need and attitude towards extension. *J. Ext.* **2007**, *45*. Available online: https://www.joe.org/joe/2007december/a6.php (accessed on 5 June 2019).
66. Middendorf, G. Challenges and information needs of organic growers and retailers. *J. Ext.* **2007**, *45*. Available online: https://www.joe.org/joe/2007august/a7.php (accessed on 5 June 2019).
67. Suvedi, M.; Jeong, E.; Coombs, J. Education needs of Michigan farmers. *J. Ext.* **2010**, *48*. Available online: https://www.joe.org/joe/2010june/rb7.php (accessed on 5 June 2019).
68. Farmer, J.; Epstein, G.; Watkins, S.; Mincey, S. Organic farming in West Virginia: A behavioral approach. *J. Agric. Food Syst. Commun.* **2014**, *4*, 155–171. [CrossRef]
69. Uetake, T.; Kabaya, K.; Ichikawa, K.; Moriwake, N.; Hashimoto, S. Quantitative analysis of national biodiversity strategy and action plans about incorporating integrated approaches in production landscapes. *J. Environ. Plan. Manag.* **2019**, 1–25. [CrossRef]
70. Gattinger, A.; Muller, A.; Haeni, M.; Skinner, C.; Fliessbach, A.; Buchmann, N.; Mäder, P.; Stolze, M.; Smith, P.; Niggli, U.; et al. Enhanced top soil carbon stocks under organic farming. *Proc. Natl. Acad. Sci. USA* **2012**, *109*, 18226–18231. [CrossRef] [PubMed]
71. Mader, P.; Fliebbach, A.; Dubois, D. Soil fertility and biodiversity in organic farming. *Science* **2002**, *296*, 1696–1697. [CrossRef] [PubMed]
72. Corsi, S.; Friedrich, T.; Kassam, A. *Soil Organic Carbon Accumulation and Greenhouse Gas Emission Reductions from Conservation Agriculture: A Literature Review*; FAO: Rome, Italy, 2012.
73. Jarosch, K.; Oberson, A.; Emmanuel, F.; Gunst, L.; Dubois, D.; Mäder, P.; Mayer, J. Phosphorus (P) balances and P availability in a field trial comparing organic and conventional farming systems since 35 years. In Proceedings of the 19th EGU General Assembly (EGU2017), Vienna, Austria, 23–28 April 2017; European Geosciences Union: Munich, Germany, 2017; p. 15377.
74. O'Brien, K.; Sygna, L. Responding to climate change: The three spheres of transformation. In Proceedings of the Transformation in a Changing Climate, Oslo, Norway, 19–21 June 2013; pp. 16–23.
75. James, T.; Brown, K. Muck and Magic: A Resilience Lens on Organic Conversions as Transformation. *Soc. Nat. Resour.* **2019**, *32*, 133–149. [CrossRef]
76. Hansson, H. How can farmer managerial capacity contribute to improved farm performance? A study of dairy farms in Sweden. *Acta Agric. Scand. Sect. C* **2008**, *5*, 44–61. [CrossRef]
77. Kafle, B. Factors affecting adoption of organic vegetable farming in Chitwan District, Nepal. *World J. Agric. Sci.* **2011**, *7*, 604–606.
78. Chyung, S.Y.; Roberts, K.; Swanson, I.; Hankinson, A. Evidence-based survey design: The use of a midpoint on the Likert scale. *Perform. Improv.* **2017**, *56*, 15–23. [CrossRef]