sustainability

MDPI

Article

Determinants of Pro-Environmental Behavior among Young and Older Farmers in Taiwan

Wei-Ta Fang [1,*], Eric Ng [2] and Yong-Shen Zhan [1]

[1] Graduate Institute of Environmental Education, National Taiwan Normal University, Taipei 11677, Taiwan; 60346020s@ntnu.edu.tw

[2] School of Management and Enterprise, University of Southern Queensland, Toowoomba, QLD 4350, Australia; eric.ng@usq.edu.au

* Correspondence: wtfang@ntnu.edu.tw; Tel.: +886-2-7734-6558

Received: 22 May 2018; Accepted: 25 June 2018; Published: 27 June 2018

Abstract: The aim of this study was to explore the determinants of farmers' pro-environmental behaviors in Taiwan. A total of 526 valid questionnaires were received from a randomly stratified sample of young (below 40 years old) and older (above 40 years old) farmers located in Central Taiwan. The findings revealed that young farmers' pro-environmental behaviors were directly affected by personal norms, and also indirectly from personal and social norms through perceived behavioral control. In contrast, older farmers' pro-environmental behaviors were directly affected by social norms, whereas personal norms also had an indirect impact via perceived behavioral control. Results from this study could contribute towards the development of appropriate strategies for the two age groups of farmers who respond to the different determinants of their pro-environmental behaviors.

Keywords: Social Attribution Theory; pro-environmental behaviors; sustainable agriculture; farmers; Taiwan

1. Introduction

Agriculture has traditionally focused on maximizing production yields and profitability, which has been further supported by modern technologies in farming nowadays [1]. This conventional agriculture approach was developed with limited consideration of the long-term consequences on the ecological systems and biodiversity [2], and as a result, has contributed to numerous environmental and health related issues (e.g., air pollution, greenhouse gas emissions, pesticide contamination). With the increasing awareness of environmental issues and the growing number of environmental-related regulations [3], the demand for 'greener' and more ecologically friendly farming produce is increasingly evident [3,4]. However, this has given rise to farmers' dilemmas between short-term maximal profitability and the long-term need for preservation of the environment that they depend on for their living. Although farmers play a critical role in contributing towards a 'greener' agriculture, little is known about their personal motives to engage and exhibit pro-environmental behavior. This lack of understanding is also supported by prior studies [5] that revealed the need to explore farmers' attitudes towards the natural environment, which is the key aim of this study.

Sustainable agriculture refers to the maintenance of biodiversity management and the use of agricultural systems that do not damage the ecosystem [6]. Sustainable agriculture is seen as an important alternative farming system which in recent years has generated substantial attention around the world and seeks to ensure profitability as well as food quality and safety [7,8]. The concept of sustainable agriculture is also expanding through the need to meet consumers' expectations as well as for agribusinesses to gain a competitive advantage in the marketplace. Although the extant literature review indicates that farmers are generally receptive of the changes required for sustainable

agriculture and are willing to be proactively engaging in the process [9,10], further insights into understand their intentions are essential. Other studies have also investigated several different aspects of sustainable agriculture, such as the relationship between farmers' quality of life and their attitude towards sustainable agriculture [11]; key factors affecting sustainable agriculture adoption [12]; regulations to sustainable agriculture [13]; and costs and benefits related to implementing sustainable agriculture [14,15].

In 2015, Taiwan's total agricultural production value accounted for an estimated US $14.98 billion; this equates to about 1.7 percent of the nation's gross domestic product [16]. There were approximately 555,000 people involved in agricultural production in the year 2016, and this represented about 2% of the total population. Of these 555,000 farmers, 90% of them are over the age of 40, whereas the remaining 10% are younger than 40 years old, with an average age of 62 years old. Given the changing food consumption patterns and increasing competition, the focus of the country's agriculture has shifted from traditional farming of staple crops to production of higher value commodities targeted at specific markets. In addition, there has been an increasing number of farmers willing to engage in sustainable agriculture and this is particularly evident in young farmers who are under 40 years old and have been adopting environmentally friendly practices to manage their agricultural production [17]. Such a phenomenon is supported by previous studies [18–21], which reveal that young people are more concerned about the environment than older people. Thus, this research seeks to investigate the determinants of the pro-environmental behavior among young and older farmers in Taiwan.

This paper will begin with a discussion on the conceptual framework and the hypotheses proposed for this research study. Next, the materials and methods will be outlined, including the participants involved and measures used in this study. Then, the analysis of data is described, and the findings are presented. These are followed by the discussions and implications of the results, and finally, suggestions for further research and conclusions are drawn.

2. Conceptual Framework and Hypotheses

Social Attribution Theory has been used by researchers to explain the reasons of human behavior and this theory suggests that a behavior can be affected by situations that arise from internal and/or external attributions [22,23]. Accordingly, internal attributions are causes of behavior associated with some internal characteristic, and the two key elements involve are: (1) Perceived behavioral control; and (2) personal norms. Perceived behavioral control refers to an individual's perceived ease or difficulty to perform personal capabilities in order to control external challenges [24]. Personal norms refer to the self-concept and are experienced as feelings of a moral obligation to perform a certain behavior; it is regarded as a type of environmental self-awareness and self-discipline that can be related to the generation of environmental behaviors [25]. In contrast, external attributions refer to causes of behavior that have resulted from some situations or events outside a person's control. Social norm is considered as a major component of external attributions that goes beyond attitudes and shape people's behaviors [26]. Social norms can be further categorized into subjective norms, and descriptive norms. Subjective norms are "the perceived social pressure to perform or not to perform the behavior" in a particular situation, in which the greater the pressure to support or oppose a norm, the stronger the effect of the behaviors [27]. Whereas, descriptive norms refer to individuals' perceived practices of most people and their influence on human behavior is often unconscious [28]. Figure 1 below shows the proposed research framework for this study.

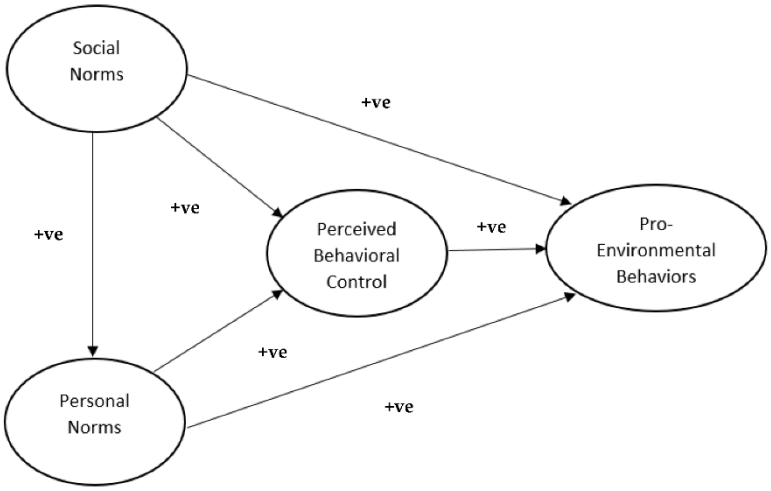

Figure 1. Proposed research framework.

This research has used the Social Attribution Theory to investigate the pro-environmental behaviors of young and older farmers in Taiwan, specifically the impact of perceived behavioral control, personal norms (internal attributions), and social norms (external attributions) on their pro-environmental behaviors. Therefore, this study proposes the following research hypotheses to be investigated.

Hypothesis 1 (H1). *Social norms affect pro-environmental behaviors of young farmers [29–32].*

Hypothesis 2 (H2). *Social norms affect perceived behavioral control of young farmers [29–32].*

Hypothesis 3 (H3). *Social norms affect personal norms of young farmers [29–32].*

Hypothesis 4 (H4). *Personal norms affect perceived behavioral control of young farmers [33–35].*

Hypothesis 5 (H5). *Personal norms affect pro-environmental behaviors of young farmers [33–35].*

Hypothesis 6 (H6). *Perceived behavioral control affects pro-environmental behaviors of young farmers [35–39].*

Hypothesis 7 (H7). *Social norms affect pro-environmental behaviors of older farmers [29–32].*

Hypothesis 8 (H8). *Social norms affect perceived behavioral control of older farmers [29–32].*

Hypothesis 9 (H9). *Social norms affect personal norms of older farmers [29–32].*

Hypothesis 10 (H10). *Personal norms affect perceived behavioral control of older farmers [33–35].*

Hypothesis 11 (H11). *Personal norms affect pro-environmental behaviors of older farmers [33–35].*

Hypothesis 12 (H12). *Perceived behavioral control affects pro-environmental behaviors of older farmers [35–39].*

3. Materials and Methods

3.1. Research Areas

This study was conducted in Central Taiwan, a vital agricultural output area in Asia. Central Taiwan is one of Taiwan Island's major agricultural production regions. It has hilly and plain features, with temperate and subtropical climate characteristics, and is suitable for the cultivation of various crops, such as vegetables and fruits. The products in this area are diverse and rich in features. From the low-altitude area to the high-altitude mountainous area of 3000 m, the agricultural area in Central Taiwan (as shown in Figure 2) cultivates tropical fruits as well as temperate crops, vegetables, fruits, tea, and flowers.

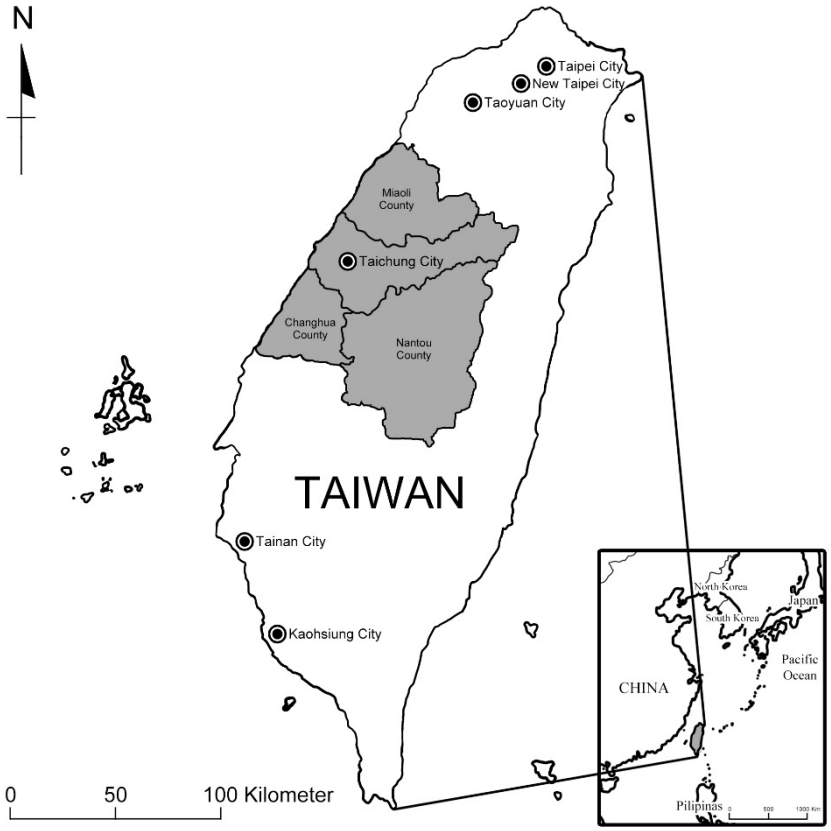

Figure 2. A map of Central Taiwan where the research was conducted.

3.2. Participants

In this study, a sampling survey was conducted with members of the production and marketing groups of the farmers' associations at the four administrative regions in Central Taiwan, namely Taichung City, Miaoli County, Changhua County, and Nantou County. In Taiwan, farmers are obligated to join local farmers' associations, which provide insurance, information regarding farming techniques, and bank loan functions, forming a grassroots agricultural organization [40,41]. The participants selected for this study were stratified into two age groups (i.e., under 40 years old, and above 40 years old). The rationale for this stratification was based on the East Asian Confucian culture where it is a belief that when a person is over 40 years old, his/her life is fixed and it is difficult to process and attain new information, whereas a person who is under 40 years old is more likely to go through changes and able to accept new information and ideas. This was supported by Confucius (551–479 B.C.) who said, "At 40, I had no doubts".

According to the literature, collection of at least 384 sample questionnaires is required to achieve a confidence interval of over 95% [42]. Therefore, the number of samples collected in the present study was set at over 384. We conducted the questionnaire from August 2016 to February 2017. The farmers' population size in the four administrative regions were 215,196. An initial random sampling resulted in the selection of 1200 farmers who were then contacted via telephone to seek their participation in the research study. However, only 650 of them agreed to participate in the questionnaire survey. Of the 650 questionnaires issued, there were 615 returned which equates to a response rate of approximately 94.61%. Among those questionnaires returned, 89 were invalid. Thus, only the remaining 526 valid questionnaires were analyzed.

3.3. Measures

Social attribution theory regards three key dimensions as related to influencing pro-environmental behaviors: (1) social norms, (2) personal norms, and (3) perceived behavioral control. To improve the rigorousness and validity of the questionnaire, three experts were invited to examine the construct validity of the questionnaire and review the suitability, semantics, and fluency of the questions. The content of the questionnaire was subsequently revised and organized according to their opinions. Finally, the questionnaire for this study was drafted and used in the actual survey.

A five-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = normal; 4 = agree; 5 = strongly agree) was used for measurement in this study. The overall Cronbach's α of the questionnaire was 0.735, which proved the internal reliability because the value was greater than the required 0.6. In addition, the Kaiser–Meyer–Olkin value was recorded as 0.751, belonging to a middle grade greater than 0.7 [43], and a spherical Bartlett test value of 1124.249, $p < 0.001$ was recorded.

Statistical Package for the Social Sciences sv. 23 was used for analysis in this study. Frequency analysis was used to determine the key dimensions (social norms, personal norms, perceived behavioral control, and pro-environmental behaviors) and calculate the total number of occurrences, means, and standard deviation (SD) scores for demographic issues and items. The Pearson correlation technique measured the strength and direction of the relationships among these key dimensions.

Finally, SmartPLS 2.0 statistical software was used to conduct the path and statistical analyses for this study and to predict the influence of the Taichung farmers' social norms, personal norms, and perceived behavioral control on their pro-environmental behaviors. Partial least squares structural equation modeling (PLS-SEM) is an exploratory multivariate research method used to establish SEM in small sample studies.

4. Results

4.1. Descriptive Statistics

As shown in Table 1, the overall results of the questionnaire revealed that there were more males (66.7%) than females (33.3%) that participated in this study, which indicated that the agricultural sector in the Central Taiwan region was mainly dominated by males. Of the total 526 participants, 453 (151 females, 302 males) of them were older than 40 years old while the remaining 73 (24 females, 49 males) were younger than 40 years old. The participants' education attainments were as follows: junior high school and below (42.6%), senior high school (37.1%), bachelor's degree (18.6%), and graduate school (1.7%). The proportion of those with a high school education level or above was approximately 50%, which was in line with the result of a survey of farmer households released by the Agriculture and Food Agency in 2014. Most of these farmers specialized in agricultural farming and more than 50% had been engaged in farming for more than several decades, indicating that they had extensive experience in agricultural farming.

Table 1. Descriptive statistics related to the gender among young and older farmers for social norms, personal norms, perceived behavioral control, and pro-environmental behaviors to farming.

Variables	Frequency	Percent	Social Norms				Personal Norms				Perceived Behavioral Control				Pro-Environmental Behaviors			
			Mean	SD	*t*	*p*	Mean	SD	*t*	*p*	Mean	SD	*t*	*p*	Mean	SD	*t*	*p*
All																		
Female	175	33.3	2.80	0.67	3.931	0.000	3.21	0.74	4.431	0.000	3.45	0.78	3.015	0.003	3.75	0.68	3.219	0.001
Male	351	66.7	2.55	0.69			2.90	0.76			3.20	0.94			3.50	0.90		
Farmers older than 40																		
Female	151	33.3	2.83	0.68	3.921	0.000	3.17	0.75	4.057	0.000	3.43	0.79	3.228	0.001	3.73	0.68	2.924	0.004
Male	302	66.7	2.56	0.68			2.87	0.75			3.16	0.94			3.48	0.94		
Farmers younger than 40																		
Female	24	32.9	2.58	0.55	0.746	0.459	3.43	0.68	1.873	0.067	3.60	0.71	0.546	0.587	3.88	0.73	1.473	0.146
Male	49	67.1	2.47	0.73			3.10	0.80			3.50	0.87			3.58	0.93		

Results revealed significant differences between females and males in terms of their social norms (df = 524, two-tailed, $t = 3.931 > 1.967$, $p = 0.000$), personal norms (df = 524, two-tailed, $t = 4.431 > 1.967$, $p = 0.000$), perceived behavioral control (df = 524, two-tailed, $t = 3.015 > 1.967$, $p = 0.003$), and pro-environmental behaviors friendly to farming (df = 524, two-tailed, $t = 3.219 > 1.967$, $p = 0.001$). When comparing between females and males in the age group of older than 40 years old, findings showed significant differences in their social norms (df = 451, two-tailed, $t = 3.921 > 1.967$, $p = 0.000$), personal norms (df = 451, two-tailed, $t = 4.057 > 1.967$, $p = 0.000$), perceived behavioral control (df = 451, two-tailed, $t = 3.228 > 1.967$, $p = 0.001$), and pro-environmental behaviors to farming (df = 451, two-tailed, $t = 2.924 > 1.967$, $p = 0.004$). However, there were no significant differences (p-value greater than 0.05) found between females and males in the under 40 years old age group for their social norms, personal norms, perceived behavioral control, and pro-environmental behaviors to farming.

When comparing the two age groups (i.e., farmers older than 40 years old, and farmers younger than 40 years old), significant differences were found in their personal norms (degree of freedom, df = 524, two-tailed, $t = -2.403 > 1.96$, $p = 0.018$), and perceived behavioral control (df = 524, two-tailed, $t = -2.753 > 1.96$, $p = 0.011$). Table 2 summarizes the results of the analysis of differences between the two age groups' social norms, personal norms, perceived behavioral control, and pro-environmental behaviors.

Table 2. Results of analysis of differences between young farmers and older farmers. (SN: social norms; PN: personal norms; PBC: perceived behavioral control; PEBs: pro-environmental behaviors).

	Farmers Younger than 40 (n = 73)		**Farmers Older than 40 (n = 453)**				
	Mean	**SD**	**Mean**	**SD**	**df**	***t***	***p***
SN	2.51	0.67	2.65	0.69	524	1.71	0.09
PN	3.21	0.77	2.97	0.77	524	−2.40	0.02 *
PBC	3.53	0.82	3.25	0.90	524	−2.75	0.01 *
PEB	3.68	0.88	3.56	0.84	524	−1.07	0.28

* At the significant level of 0.05 (two-tailed).

In terms of social norms, the older farmers had consistently attained a higher mean score value than the young farmers for all the question items "My friends would recommend that I use pesticides and herbicides to prevent damage caused by pests and weeds." "My friends around me spray pesticides and herbicides regularly." and "Many farmers spray pesticides and herbicides." This indicated that older farmers in Central Taiwan were more sensitive to the social impact of using pesticides and herbicides than young farmers. Results of the social norms items are presented in Table 3.

Table 3. Results of social norms items.

Social Norms	**Farmers Younger than 40**		**Farmers Older than 40**	
	Mean	**SD**	**Mean**	**SD**
SN1. Many farmers spray pesticides and herbicides. (R)	2.04	0.84	2.21	0.92
SN2. My friends around me spray pesticides and herbicides regularly. (R)	2.21	0.73	2.28	0.82
SN3. My friends would recommend that I use pesticides and herbicides to prevent damage caused by pests and weeds. (R)	3.27	1.05	3.47	1.04
SN Score	2.51	0.67	2.65	0.69

On the other hand, young farmers achieved a higher mean score than the older farmers in all the question items ("I know that the use of pesticides and herbicides will have a negative impact on crops and soil." "I know that crops with residual pesticides and herbicides will cause human injury and illness." and "I know that spraying pesticides and herbicides is not the best way to maintain agricultural quality.") related to personal norms. The results suggested that young farmers in Central Taiwan had a better understanding of the consequences of using pesticides and herbicides than the older farmers. Table 4 presents summary results of the personal norms items.

Table 4. Results of personal norms items.

Personal Norms	Farmers Younger than 40		Farmers Older than 40	
	Mean	SD	Mean	SD
PN1. I know that spraying pesticides and herbicides is not the best way to maintain agricultural quality.	2.53	1.08	2.33	0.93
PN2. I know that the use of pesticides and herbicides will have a negative impact on crops and soil.	4.14	0.99	3.68	1.16
PN3. I know that crops with residual pesticides and herbicides will cause human injury and illness.	2.95	1.21	2.91	1.25
PN Score	3.21	0.77	2.97	0.76

With regards to perceived behavioral control, young farmers had a higher mean score in all question items, "I can restrain myself from using pesticides and herbicides even if there are many weeds in the farmland." and "I will not kill them even if wild animals damage the crops." than the older farmers. The outcome revealed that young farmers in Central Taiwan were more aware of the need to control the use of pesticides and herbicides, and were more willing to protect wildlife than the older farmers. Results of the perceived behavioral control items are presented in Table 5.

Table 5. Results of perceived behavioral control items.

Perceived Behavioral Control	Farmers Younger than 40		Farmers Older than 40	
	Mean	SD	Mean	SD
PBC1. I can restrain myself from using pesticides and herbicides even if there are many weeds in the farmland.	3.75	0.89	3.63	1.00
PBC2. I will not kill them even if wild animals damage the crops.	3.32	1.07	2.86	1.23
PBC Score	3.53	0.82	3.25	0.90

When considering the pro-environmental behaviors, older farmers were lacking behind the young farmers in all the question items, "I use pro-environmental farming methods and try not to spray pesticides and herbicides." and "I do not use pesticides but instead use energy and pro-environmental efficient techniques for farming." The findings indicated that young farmers in Central Taiwan were more willing to control the use of pesticides and herbicides, and less likely to use them to kill pests or weeds in the farmlands than the older farmers. Table 6 presents the results associated with the pro-environmental behaviors items.

Table 6. Results of pro-environmental behaviors items.

Pro-Environmental Behaviors	Farmers Younger than 40		Farmers Older than 40	
	Mean	SD	Mean	SD
PEB1. I use pro-environmental farming methods and try not to spray pesticides and herbicides.	3.88	0.96	3.82	0.92
PEB2. I do not use pesticides but instead use energy and pro-environmental efficient techniques for farming.	3.48	1.80	3.31	1.19
PEB Score	3.68	0.88	3.56	0.84

4.2. Correlation Analysis

As shown in Table 7, the results of the correlation analysis suggested a moderate level of correlation between social norms and pro-environmental behaviors (0.488), personal norms and perceived behavioral control (0.416), social norms and pro-environmental behaviors (0.414), perceived behavioral control and pro-environmental behaviors (0.398), and social norms and personal norms (0.305). However, the relationship between social norms and perceived behavioral control was not evident.

Table 7. Correlation coefficient in the model.

Dimension	Social Norms	Personal Norms	Perceived Behavioral Control	Pro-Environmental Behaviors
Social Norms	1.000			
Personal Norms	0.305	1.000		
Perceived Behavioral Control	0.204	0.416	1.000	
Pro-environmental Behaviors	0.414	0.488	0.398	1.000

All < 0.001 two-tailed.

4.3. Path Analysis and Structural Equation Model

The dimensions of the young farmers' pro-environmental behaviors were analyzed using SmartPLS 2.0, and the results are presented in Table 8. The PLS results revealed that young farmers had different paths of pro-environmental behaviors from older farmers. The average variance extracted (AVE) values on the three dimensions (social norms, perceived behavioral control, and pro-environmental behaviors) for young farmers were greater than 0.5, indicating that each dimension had achieved a convergent validity level. Although the AVE value of the personal norms dimension was 0.484, it was still greater than the acceptable value of 0.4 [44]. The composite reliability (CR) of each dimension was greater than 0.7, indicating that the internal consistency of each dimension met the standard. The Cronbach's α of social norms, perceived behavioral control, and pro-environmental behaviors all reached a credible standard of 0.5 or more, and the Cronbach's α of personal norms reached 0.4. The R^2 of personal norms, perceived behavioral control, and pro-environmental behaviors were 0.112, 0.202, and 0.329, respectively.

Table 8. Analysis of indicators for AVE and CR from young farmers aged under 40 years.

	AVE	CR	R^2	Cronbach's α
SN	0.561	0.791		0.649
PN	0.489	0.74	0.112	0.484
PBC	0.68	0.807	0.202	0.56
PEB	0.664	0.797	0.329	0.503

Figure 3 presents the model structure of pro-environmental farming behaviors among young farmers. The bootstrapping method was used to obtain the *t*-value of the path and test its significance level. According to the path analysis, social norms ($\beta = -0.009$, $t = 0.060$) were not directly impacting on pro-environmental behaviors, but instead had a direct and predictive impact on perceived behavioral control ($\beta = 0.319$, $t = 3.097$) and personal norms ($\beta = 0.335$, $t = 2.552$). Therefore, H1 was not supported since there was no evidence of a direct influence of social norms on pro-environmental behaviors of young farmers. However, H2 and H3 were supported since the findings revealed a direct positive influence of social norms on perceived behavioral control, and personal norms, which were intervening variables of pro-environmental behaviors. Results also showed that personal norms had a direct effect on perceived behavioral control ($\beta = 0.228$, $t = 2.053$), and pro-environmental behaviors ($\beta = 0.311$, $t = 2.457$). Hence, H4 and H5 were supported since personal norms had direct positive effects on perceived behavioral control and pro-environmental behaviors. H6 was also supported because there was clear evidence on the direct positive influence of perceived behavioral control ($\beta = 0.394$, $t = 3.478$) on pro-environmental behaviors.

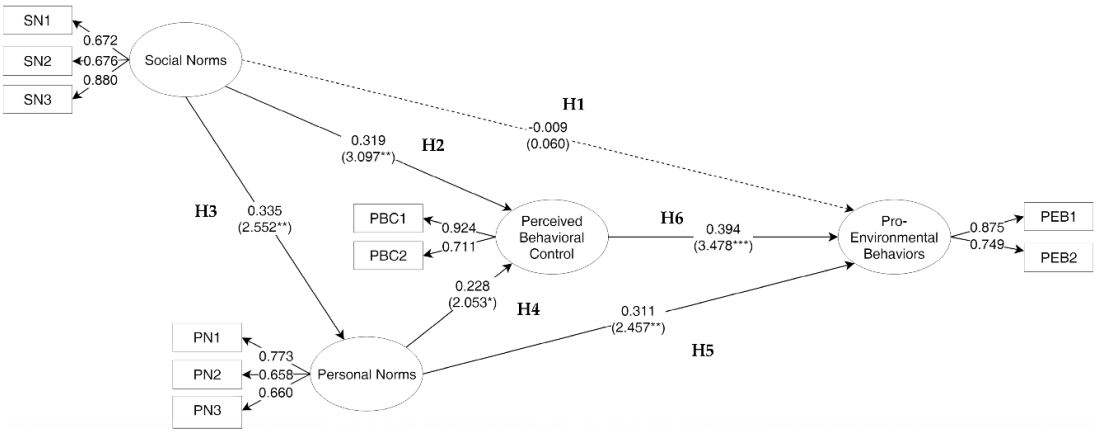

Figure 3. Path coefficients of young farmers aged under 40 years in SNs, PNs, PBC, and PEBs in the model. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The dimensions of pro-environmental farming behaviors of older farmers were also analyzed using SmartPLS 2.0. As shown in Table 9, results indicated that the AVE values for social norms, perceived behavioral control, and pro-environmental behaviors were greater than 0.5, indicating that each dimension had achieved a convergent validity level. While the AVE value of personal norms was 0.469, it was still within the acceptable value of greater than 0.4 [44]. The CR of each dimension was greater than 0.7, indicating that the internal consistency of each dimension met the standard. The Cronbach's α of social norms met the credible standard of 0.6 or more, whereas the Cronbach's α of personal norms and perceived behavioral control reached 0.4, and the Cronbach's α of the pro-environmental behaviors was 0.35. The R^2 of personal norms, perceived behavioral control, and pro-environmental behaviors was 0.190, 0.1513, and 0.431 respectively.

Table 9. Analysis of indicators for AVE and CR for older farmers aged over 40 years.

	AVE	CR	R^2	Cronbach's α
SN	0.55	0.786		0.618
PN	0.469	0.715	0.190	0.454
PBC	0.630	0.767	0.151	0.460
PEB	0.621	0.764	0.431	0.399

The model structure of the pro-environmental farming behaviors among older farmers is presented in Figure 4. The bootstrapping method was used to obtain the *t*-value of the path and test its significance level. Analysis results showed that social norms of the older farmers had a direct predictive impact on pro-environmental behaviors ($\beta = 0.254$, $t = 2.898$) and personal norms ($\beta = 0.436$, $t = 4.695$) but had no direct impact on their perceived behavioral control ($\beta = 0.107$, $t = 0.874$). Therefore, H7 and H9 were supported since a direct influence of social norms on pro-environmental behaviors and personal norms was established. However, H8 was not supported as there was no evidence of social norms affecting perceived behavioral control. Findings also suggested that there was direct influence of personal norms on perceived behavioral control ($\beta = 0.330$, $t = 2.163$) and pro-environmental behaviors ($\beta = 0.330$, $t = 3.263$), and perceived behavioral control ($\beta = 0.280$, $t = 2.406$) on pro-environmental behaviors. Thus, H7, H8 and H9 were supported confirming the positive direct influence of personal norms on pro-environmental behaviors, and perceived behavioral control, which also had an indirect impact on pro-environmental behaviors.

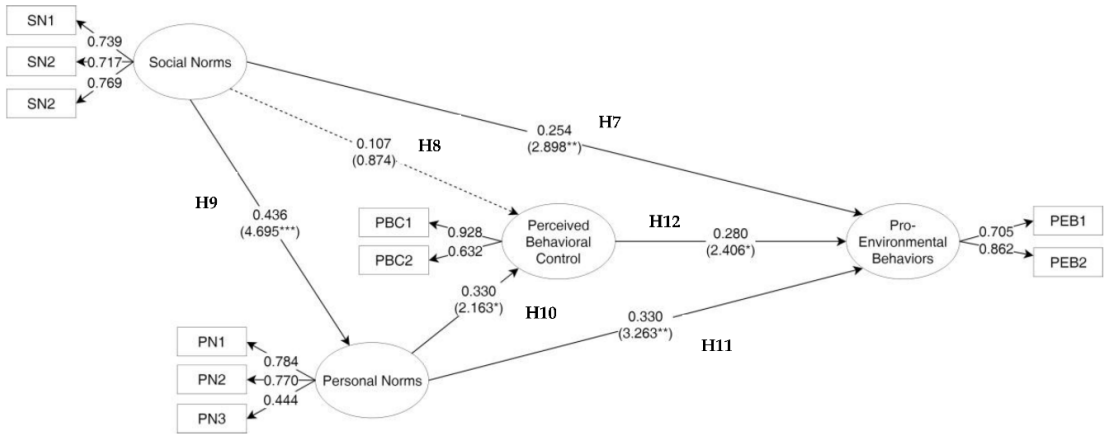

Figure 4. Path coefficients of older farmers aged over 40 years in SNs, PNs, PBC, and PEBs in the model. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5. Discussion

This study used the Social Attribution Theory to investigate the influence of social norms, personal norms, and perceived behavioral control on pro-environmental behaviors by two age groups (i.e., under 40 years old, and above 40 years old) of farmers in Central Taiwan. Literature review indicated that there was a need to further understand farmers' attitudes towards the natural environment and gain insights to determine if young farmers were more concerned about the environment than older farmers. This study has attempted to fill this gap by testing social norms, personal norms, and perceived behavioral control to determine their specific path and level of influence on pro-environmental behaviors. The findings revealed support and accepted 10 (i.e., H2, H3, H4, H5, H6, H7, H9, H10, H11, and H12) of the 12 hypotheses, indicating a positive direct relationship. Overall, young farmers were demonstrating a greater level of pro-environmental behaviors than the older farmers. This finding supported other previous studies [45,46] that found younger people to be more concerned about the environment than older adults.

5.1. Influence of Social Norms

The results indicated that social norms not only had a direct impact on the pro-environmental behaviors of older farmers but also played an indirect role in influencing pro-environmental behaviors through personal norms. This could be explained with the social learning model facilitated by industrial cooperation organizations (such as agriculture production and marketing groups). These social learning networks enable farmers to get together to share, support, observe and learn from one another in order to enhance their cultivation, management and other agriculture knowledge, techniques and skills. Thus, social norms shaped by the older farmers could have a greater impact on their pro-environmental behaviors [47].

In contrast, social norms did not have a direct effect on the pro-environmental behaviors of young farmers. Instead, social norms could indirectly influence pro-environmental behaviors through personal norms and perceived behavioral control. An explanation to this could be that young farmers acquire messages transmitted by social norms, then process them through internalized personal norms and perceived behavioral control, which subsequently change their behaviors. This might suggest that young farmers have a higher level of self-awareness and inner-directed behaviors, and were not primarily affected by the social norms through the social learning networks. This aligned with some previous studies [48,49] that found close associations between young people with self-awareness and inner-directed behaviors.

5.2. Influence of Personal Norms

Findings indicated that for both young and older farmers, personal norms not only had a direct influence on pro-environmental behaviors, but could also have an effect on pro-environmental behaviors through perceived behavioral control. This could be explained by young farmers being more receptive to new information and innovative ideas about the environment and thus developing their own sense of knowledge and feelings towards environmental behaviors. The findings supported earlier studies about young people being more open to change [50,51], and accepting new and innovative idea [52,53] than older people on pro-environmental products.

On the other hand, older farmers might be deeply ingrained in conventional agricultural practices and values, which guides their environmental behaviors. For example, it was a common practice in the past to use pesticides to increase the yield of agricultural products, and this behavior has continued to be in place by many older farmers. In order to change the misconception about the use of pesticides to increase product yield, it would be an imperative to convey to the older farmers the consequences of such behaviors so that they can better engage in pro-environmental behaviors. Several studies in the past also suggested that older farmers tended to be more conservative in their farming practice and thinking [54,55], as well as less receptive to new environmental initiatives and policies [56].

5.3. Influence of Perceived Behavioral Control

Results showed that pro-environmental behaviors among young and older farmers were affected by perceived behavioral control. However, the perceived behavioral control of older farmers was only affected by personal norms and was not directly affected by social norms. This suggested that older farmers must first have developed their personal norms before they could establish perceived behavioral control. For example, many older farmers had been using conventional farming techniques, including spraying herbicides and pesticides, and this long-established practice could be a major barrier for them to develop self-control towards pro-environmental behaviors. In contrast, young farmers whose pro-environmental behaviors were affected by perceived behavioral control tended to derive from both their social norms and personal norms. The results supported prior studies about the barriers to adoption of sustainable agriculture practices in which older farmers tend to keep up with their traditional beliefs and values, and resist new changes and practices [57,58]. Other studies [54,59] also supported young people demonstrating conservation behaviors through the effects of social norms and/or personal norms that could have contributed to their ease of perceived behavioral control to exhibit pro-environmental behaviors.

5.4. Implications, Limitations, and Future Research

The findings have extended the existing literature about the key determinants of pro-environmental behaviors, specifically on young and older farmers in the context of the Taiwan agricultural sector. Through further understanding of the gaps between two age groups (i.e., below 40 years old, and over 40 years old), appropriate strategies can be developed to encourage pro-environmental behaviors. For example, with older farmers being more responsive to social norms, farmers' associations can organize more social learning networks and opportunities to facilitate the sharing and mutual learning of pro-environmental farming techniques, knowledge and skills. As for young farmers who regard personal norms to be more influential to their pro-environmental behaviors, the focus can be on ensuring the availability of new and updated environmental information and ideas so that they are equipped with the necessary knowledge that can help advance their environmentally friendly behaviors.

This study was empirical in nature, and therefore has constrained the applicability of the findings to other parts of the country and sectors. A more representative sampling population is needed for testing in order to generalize the findings. Furthermore, additional studies are required to provide comparisons with other countries and determine similarities or differences in this situation. In addition,

future research can also be conducted to explore the impact of generational differences on sustainable development, such as environmental knowledge and attitudes, which may affect pro-environmental behaviors. As this study has relied on the self-reporting questionnaire survey, evidence of validity on the findings could be limited. Thus, it is suggested that observation techniques be used to help verify the responses provided in the questionnaire survey.

6. Conclusions

In conclusion, this study has investigated the influence of social norms, personal norms, and perceived behavioral control on farmers' pro-environmental behaviors in Taiwan. The findings indicated a different influencing path for young farmers and older farmers with respect to their pro-environmental behaviors. Young farmers' pro-environmental farming behaviors were directly affected by personal norms, and indirectly from personal and social norms through perceived behavioral control. As for older farmers, social norms played a major role in influencing their pro-environmental behaviors, while personal norms might have an indirect impact via perceived behavioral control.

Author Contributions: W.-T.F. coordinated this research project, designed and conducted the questionnaire and survey. Y.-S.Z. helped to carry out field survey. W.-T.F. analyzed the data and wrote the paper. E.N. contributed in editing this manuscript.

Funding: This research received funding from the Ministry of Science and Technology (105-2511-S-003-021-MY3 to Wei-Ta Fang).

Acknowledgments: We thank members of the Graduate Institute of Environmental Education, National Taiwan Normal University (NTNU) for their contributions to the manuscript. This work was supported by grants from the Ministry of Science and Technology. This article was also subsidized by the NTNU, Taiwan. Useful suggestions from anonymous reviewers were incorporated into the manuscript.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Bohlen, P.J.; House, G. (Eds.) *Sustainable Agroecosystem Management: Integrating Ecology, Economics, and Society*; CRC Press: Boca Raton, FL, USA, 2009.
2. Nielsen, R. *The Little Green Handbook: Seven Trends Shaping the Future of our Planet*; Picador: New York, NY, USA, 2007.
3. Rosin, C. The conventions of agri-environmental practice in New Zealand: Farmers, retail driven audit schemes and a new spirit of farming. *GeoJournal* **2008**, *73*, 45–54. [CrossRef]
4. Dodd, M.B.; Thorrold, B.S.; Quinn, J.M.; Parminter, T.G.; Wedderburn, M.E. Improving the economic and environmental performance of a New Zealand hill country farm catchment: 1. Goal development and assessment of current performance. *N. Z. J. Agric. Res.* **2008**, *51*, 127–141. [CrossRef]
5. Wilson, G.A. From productivism to post-productivism ... and back again? Exploring the (un)changed natural and mental landscapes of European agriculture. *Trans. Inst. Br. Geogr.* **2001**, *26*, 77–102. [CrossRef]
6. Lewandowski, I.; Härdtlein, M.; Kaltschmitt, M. Sustainable crop production: Definition and methodological approach for assessing and implementing sustainability. *Crop Sci.* **1999**, *39*, 184–193. [CrossRef]
7. Rigby, D.; Caceres, D. Organic farming and the sustainability of agricultural systems. *Agric. Syst.* **2001**, *68*, 21–40. [CrossRef]
8. Feher, I.; Beke, J. Rationale of sustainable agriculture. *Iustum Aequum Salut.* **2013**, *9*, 73–87.
9. Casabona, C.M.R.; Epifanio, L.E.S.; Cirion, A.E. *Global Food Security Ethical and Legal Challenges*; Wageningen Academic Pub.: Wageningen, The Netherlands, 2010; p. 532.
10. Herath, C.S. Eliciting salient beliefs are critical to predict behavioural change in theory of planned behaviour. *e-Psychologie* **2010**, *4*, 24–36.
11. Lichtfouse, E. Society issues, painkiller solutions, dependence and sustainable agriculture. In *Sociology, Organic Farming, Climate Change and Soil Science*; Springer: Dordrecht, The Netherlands, 2010; pp. 1–17.
12. Wright, J. *Sustainable Agriculture and Food Security in an Era of Oil Scarcity: Lessons from Cuba*; Routledge: London, UK, 2012.

13. Hseu, Z.Y.; Su, S.W.; Lai, H.Y.; Guo, H.Y.; Chen, T.C.; Chen, Z.S. Remediation techniques and heavy metal uptake by different rice varieties in metal-contaminated soils of Taiwan: New aspects for food safety regulation and sustainable agriculture. *Soil Sci. Plant Nutr.* **2010**, *56*, 31–52. [CrossRef]
14. Tilman, D.; Cassman, K.G.; Matson, P.A.; Naylor, R.; Polasky, S. Agricultural sustainability and intensive production practices. *Nature* **2002**, *418*, 671. [CrossRef] [PubMed]
15. Branca, G.; Lipper, L.; McCarthy, N.; Jolejole, M.C. Food security, climate change, and sustainable land management. A review. *Agron. Sustain. Dev.* **2013**, *33*, 635–650. [CrossRef]
16. ROC Yearbook—Agriculture. Available online: https://english.ey.gov.tw/cp.aspx?n=D558EBF449B7C570 (accessed on 15 June 2018).
17. Wu, T.C.; Chiu, W.T.F. Development of sustainable agriculture in Taiwan. *J. Agric. Assoc. China* **2000**, *1*, 218–228.
18. Arcury, T.A.; Christianson, E.H. Rural-urban differences in environmental knowledge and actions. *J. Environ. Educ.* **1993**, *25*, 19–25. [CrossRef]
19. Honnold, J.A. Age and environmental concern some specification of effects. *J. Environ. Educ.* **1984**, *16*, 4–9. [CrossRef]
20. Zhang, J. Environmental hazards in the chinese public's eyes. *Risk Anal.* **1993**, *13*, 509–513.
21. Klineberg, S.L.; McKeever, M.; Rothenbach, B. Demographic predictors of environmental concern: It does make a difference how it's measured. *Soc. Sci. Q.* **1998**, *79*, 734–753.
22. Heider, F. *The Psychology of Interpersonal Relations*; Psychology Press: Princeton, NJ, USA, 2013.
23. Kahneman, D.; Miller, D.T. Norm theory: Comparing reality to its alternatives. *Psychol. Rev.* **1986**, *93*, 136–153. [CrossRef]
24. Ajzen, I. From Intentions to Actions: A Theory of Planned Behavior. In *Action Control*; Kuhl, J., Beckmann, J., Eds.; Springer: Berlin/Heidelberg, Germany, 1985; pp. 11–39.
25. Thøgersen, J. Norms for environmentally responsible behaviour: An extended taxonomy. *J. Environ. Psychol.* **2006**, *26*, 247–261. [CrossRef]
26. Liao, Y.; Ho, S.; Yang, X. Motivators of pro-environmental behavior: Examining the underlying processes in the influence of presumed media influence model. *Sci. Commun.* **2015**, *38*, 51–73. [CrossRef]
27. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [CrossRef]
28. Cialdini, R.B.; Demaine, L.J.; Sagarin, B.J.; Barrett, D.W.; Rhoads, K.; Winter, P.L. Managing social norms for persuasive impact. *Soc. Influ.* **2006**, *1*, 3–15. [CrossRef]
29. Cialdini, R.B.; Reno, R.R.; Kallgren, C.A. A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *J. Personal. Soc. Psychol.* **1990**, *58*, 1015–1026. [CrossRef]
30. Fang, W.-T.; Ng, E.; Chang, M.-C. Physical outdoor activity versus indoor activity: Their influence on environmental behaviors. *Int. J. Environ. Res. Public Health* **2017**, *14*, 797. [CrossRef] [PubMed]
31. Ferdinando, F.; Giuseppe, C.; Paola, P.; Mirilia, B. Distinguishing the sources of normative influence on proenvironmental behaviors: The role of local norms in household waste recycling. *Group Process. Intergroup Relat.* **2011**, *14*, 623–635.
32. Matthies, E.; Selge, S.; Klöckner, C.A. The role of parental behaviour for the development of behaviour specific environmental norms—The example of recycling and re-use behaviour. *J. Environ. Psychol.* **2012**, *32*, 277–284. [CrossRef]
33. Stern, P.C.; Dietz, T.; Abel, T.D.; Guagnano, G.A.; Kalof, L. A value-belief-norm theory of support for social movements: The case of environmentalism. *Hum. Ecol. Rev.* **1999**, *6*, 81–97.
34. Schwartz, S.H. Normative influences on altruism. In *Advances in Experimental Social Psychology*; Leonard, B., Ed.; Academic Press: Cambridge, MA, USA, 1977; Volume 10, pp. 221–279.
35. Hansla, A.; Gamble, A.; Juliusson, A.; Gärling, T. The relationships between awareness of consequences, environmental concern, and value orientations. *J. Environ. Psychol.* **2008**, *28*, 1–9. [CrossRef]
36. Bamberg, S.; Möser, G. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *J. Environ. Psychol.* **2007**, *27*, 14–25. [CrossRef]
37. Bortoleto, A.P.; Kurisu, K.H.; Hanaki, K. Model development for household waste prevention behaviour. *Waste Manag.* **2012**, *32*, 2195–2207. [CrossRef] [PubMed]
38. Han, H. Travelers' pro-environmental behavior in a green lodging context: Converging value-belief-norm theory and the theory of planned behavior. *Tour. Manag.* **2015**, *47*, 164–177. [CrossRef]

39. Lin, S.-P. The gap between global issues and personal behaviors: Pro-environmental behaviors of citizens toward climate change in Kaohsiung, Taiwan. *Mitig. Adapt. Strateg. Glob. Chang.* **2013**, *18*, 773–783. [CrossRef]
40. Benziger, V. Small fields, big money: Two successful programs in helping small farmers make the transition to high value-added crops. *World Dev.* **1996**, *24*, 1681–1693. [CrossRef]
41. Chou, S.-Y.; Liu, J.-T.; Hammitt, J.K. National health insurance and precautionary saving: Evidence from Taiwan. *J. Public Econ.* **2003**, *87*, 1873–1894. [CrossRef]
42. Krejcie, R.V.; Morgan, D.W. Determining sample size for research activities. *Educ. Psychol. Meas.* **1970**, *30*, 607–610. [CrossRef]
43. Kaiser, H.F.; Rice, J. Little Jiffy, Mark IV. *Educ. Psychol. Meas.* **1974**, *34*, 111–117. [CrossRef]
44. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [CrossRef]
45. Cottrell, S.P. Influence of sociodemographics and environmental attitudes on general responsible environmental behavior among recreational boaters. *Environ. Behav.* **2003**, *35*, 347–375. [CrossRef]
46. Dietz, T.; Stern, P.C.; Guagnano, G.A. Social structural and social psychological bases of environmental concern. *Environ. Behav.* **1998**, *30*, 450–471. [CrossRef]
47. Willuweit, L. Promoting Pro-Environmental Behavior. An Investigation of the Cross-Cultural Environmental Behavior Patterns. The Case of Abu Dhabi. Master's Thesis, Department of Human Geography, Stockholm University, Stockholm, Sweden, 2009.
48. Carruthers, P. The cognitive functions of language. *Behav. Brain Sci.* **2002**, *25*, 657–674. [CrossRef] [PubMed]
49. Carver, C.S. 'Self-awareness'. In *Handbook of Self and Identity*; Leary, M.R., Tangney, J.P., Eds.; Guilford Press: New York, NY, USA, 2002.
50. Lee, K. Opportunities for green marketing: Young consumers. *Mark. Intell. Plan.* **2008**, *26*, 573–586. [CrossRef]
51. Pickett-Baker, J.; Ozaki, R. Pro-environmental products: Marketing influence on consumer purchase decision. *J. Consum. Mark.* **2008**, *25*, 281–293. [CrossRef]
52. Lee, K. Gender differences in Hong Kong adolescent consumers' green purchasing behavior. *J. Consum. Mark.* **2009**, *26*, 87–96. [CrossRef]
53. Ottman, J.A.; Stafford, E.R.; Hartman, C.L. Avoiding green marketing myopia: Ways to improve consumer appeal for environmentally preferable products. *Environment* **2006**, *48*, 22–36. [CrossRef]
54. Urban, M.A. Values and ethical beliefs regarding agricultural drainage in central Illinois, USA. *Soc. Nat. Resour.* **2005**, *18*, 173–189. [CrossRef]
55. Ulluwishewa, R. Indigenous knowledge systems for sustainable development: The case of pest control by traditional paddy farmers in Sri Lanka. *J. Sustain. Agric.* **1993**, *3*, 51–63. [CrossRef]
56. Battershill, M.R.J.; Gilg, A.W. Socio-economic constraints and environmentally friendly farming in the Southwest of England. *J. Rural Stud.* **1997**, *13*, 213–228. [CrossRef]
57. Wadud, S.E.; Kreuter, M.W.; Clarkson, S. Risk perception, beliefs about prevention, and preventive behaviors of farmers. *J. Agric. Saf. Health* **1998**, *4*, 15. [CrossRef]
58. Drost, D.; Long, G.; Wilson, D.; Miller, B.; Campbell, W. Barriers to adopting sustainable agricultural practices. *J. Ext.* **1996**, *34*, 1–6.
59. Dolisca, F.; McDaniel, J.M.; Shannon, D.A.; Jolly, C.M. A multilevel analysis of the determinants of forest conservation behavior among farmers in Haiti. *Soc. Nat. Resour.* **2009**, *22*, 433–447. [CrossRef]

© 2018 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).