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MODELING THE FACTORS OF IMPLEMENTATION AND ADOPTION OF RICE TECHNOLOGY AMONG 4-H CLUB YOUTH

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Abstract

The study aimed to pave an argument that exposes the causal factors of rice technology implementation and adoption among the members of 4-H club youth in Southern Leyte, Philippines. Primary data were gathered from 118 4-H club youth members selected at complete enumeration. Descriptive statistical measures were used to summarize the collected data and ordered regression models were constructed to determine the predictors of implementation and adoption of rice technology. Results portrayed that there are still more members who do not implement and adopt the rice technologies introduced by the 4-H club in their respective places. And very few of them have fully implemented and adopted the rice technologies. The first regression model revealed that the significant causal factors of implementation of rice technologies are attended training (at a 5% level), economically viable characteristics of rice innovative and new technology (at a 10% level), and minimal risk characteristics of rice technology (at a 10% level). Plus, the second-ordered logistic model represented that the only significant causal determinant of the adoption of rice innovative and new technologies among 4-H club youth is the training attended (at a 5% level). In conclusion, the youth members of the 4-H club must be trained and educated concerning the different functions, features, and benefits of adopting innovative rice technology. Furthermore, proper training will give them sufficient knowledge and information in implementing and adopting rice technology to improve their productivity as well as increase their economic profitability.

Key words**:** *rice technology, youth members of the 4-H club, implementation and adoption, regression analysis*

INTRODUCTION

It is worth noting that youth is the stage in life where it begins to formulate ideas and meaning of life and question different aspects of daily happenings. According to Lee et al. [13], youth are expressing an ability to envision and think about the progress of the future. In that case, youth is the suitable stage to educate and impart the importance of sustainability in the aspect of agriculture which is vital in the economy [6], [10], [19].

One of the innovative programs in agriculture that provide educational perspective and training for youth is the 4-H club. The said program originatedin the United States (US) where it centered on educating and guiding the youth on how to make grow crops and care for livestock as well as skillful in various food production processes [11], [12]. The abbreviation name 4-H pertains to the following: 1-head, 2-heart, 3-hands, and 4-health [11]. Whence, the 4-H club program represents the four personal parts of the association that needs to focus on sustainable development. In the country of the Philippines, the 4-H club program is encouraging the youth members to adopt new and innovative rice technologies which improve productivity in the country. In fact, rice production must be economically improved since rice is the main staple food on every Filipino's table and is considered the main source of income for local farmers in the country, especially, for poor farmers in rural areas [4], [5], [7]. The primary content of the 4-H club is to educate the youth to implement innovative and new technologies in rice production. Also, to inform and train them that every effort of rice farmers in the country is valuable and that it is the life of the Philippine economy. According to Botangen et al. [3], it is necessary to conduct training and educational seminars to introduce the

importance of new technologies in progressing food production in the country. This is to impart knowledge of the different characteristics of the technologies and innovations so that the 4-H members will be convinced to implement and adopt them. Plus, the program has provided financial and technical support to Filipino youth in establishing livelihood projects [22].

In addition, 4-H attempts to progress the youth's, leadership, responsibility, citizenship, and life skills through cognitive content learning programs and an optimistic youth modification strategy [8]. Hence, with the implementation of the 4-H club livelihood inaugural, the Department of Agriculture (DA) and Agricultural Training Institute (ATI) in the Philippines, in conjunction with local government units (LGUs), hoped to strengthen the extension delivery system in selected municipalities in Southern Leyte, developing the lives of the youth regarding food production.

The investigation of the factors affecting the implementation and adoption of rice innovative technologies among 4-H youth club associates is very few in the body of literature. Henceforth, the article initiated to do a research survey that looks at the causal factors that governed the rate at which 4-H youth club membersare implementing and adopting rice technologies in Southern Leyte, Philippines. In particular, the study identifies the causal determinants that could serve as a groundwork for conceptualizing the extension delivery projects in rice production. The main purpose of this survey study was to infer the experiences of the youth members of the 4-H clubin the discourse of the implementation and adoption of the variousrice innovative technologies in the 4-H Club initiatives in the province. Plus, the findings of the survey may serve as a basis for collaborating agencies in agriculture to develop and improve the 4-HClub program components and promote them to other municipalities. Furthermore, this study may help other researchers in agriculture to improve the well-being of rice farmers and youth members of the 4-H club, and results may impart to the body of knowledge as a global contribution.

MATERIALS AND METHODS

Research Design

This research study utilized a descriptive-correlation survey design that seeks the significant factors affecting the implementation and adoption of rice innovative technologies among the members 4-H club members. The study used standard descriptive measures and regression modeling in analyzing the gathered cross-sectional data.

Locale of the Survey and Participants

The research survey took place in the selected municipalities in Southern Leyte, Philippines which include Tomas Oppus, Macrohon, Saint Bernard, Hinunangan, and Maasin City where 4-H club programs are active and well-organized to influence the youth. Since there are only a few members of the 4-H club youth, this study considered a complete enumeration process to choose respondents for the said survey.

It is worth noting that complete enumeration as a sampling procedure will give a holistic view of the information needed for the survey. In that case, all active 4-H club youth members were included in the survey where they have a recipient role in the government's livelihood programs. Hence, a total of 118 members participated in the said survey which there are 20 members in Tomas Oppus, 25 members in Macrohon, 25 members in Saint Bernard, 23 members in Hinunangan, and 25 members in Maasin City.

Research Instrument, Data Collection, and Ethics

The research instrument of this study was a developed semi-structured questionnaire that consists of four parts such as socio-demographic profile, 4-H Club influence, rice technology characteristics, and implementation and adoption of rice technology. For the respondents' socio-demographic profile, they were asked about the following: age, sex, educational status, and family income. As for the second part, they were asked about who influences them which includes the 4-H coordinator (yes or no), and family (yes or no).

In addition, they were also asked if they attended training (yes or no) concerning rice

technology and they were requested to rate the 4-H club coordinator's effectiveness with the following categories: highly ineffective - 1, ineffective - 2, uncertain - 3, effective - 4, and highly effective - 5). Plus, the youth members were also asked to rate (1 to 5 scaling: 1 is the lowest and 5 is the highest)the following characteristics of new rice technology introduced by the 4-H Club organizer: (1) complexity; (2) economically viable ; (3) compatibility; (4) environmentally safe; and (5) minimal risk. Table 1 portrayed the range of perception scores for rice technology characteristics and their linguistic description.

Table 1. Members' perception scores for the various rice technology characteristics

Interval of scores	Response
4.21 – 5.00	Strongly agree
3.41 – 4.20	Agree
2.61 – 3.40	Neutral
1.81 – 2.60	disagree
1.00 – 1.80	Strongly disagree

Source: Authors' guidelines (2023).

Lastly, participants were asked how the implement (0-not implemented, 1-implemented but not continued, 3-continued but modified some processes, 4-fully continued) and adopt (0-not adopted, 2-adopted in average time and scale, 3-fully adopted in larger scale and shared to others to adopt) the rice technologies introduced by the 4-H club.

A formal letter of permission was sent to the head of the Southern Leyte before the conduct of the said survey. In addition, permits to execute the survey research were also obtained from the agencies of 4-H Clubs in the places where the study is conducted. After that, respondents were informed that participation in the data collection is voluntary and they are also told that the data gathered were solely used for the research article only. Primary data were gathered from the respondents with the aid of a developed questionnaire in the form of a face-to-face interview. Moreover, the information gathered from interviews was validated via focus group discussion (FGD).

Data Management and Analysis

In summarizing the gathered survey data, statistical measures include mean average (M), standard deviation (SD), frequency counts (n), and percentages (%). To determine the factors affecting the implementation and adoption of rice technologies, an ordered logistic regression analysis was employed. To perform the post-estimation technique for the regression model, the ordinary least square (OLS) regression was generated first followed by the diagnostic tests using the STATA command. After that, necessary adjustments in the ordered logistic model were employed to obtain statistically reliable results [15]. Furthermore, all calculations were accomplished with the aid of Microsoft Excel and STATA version 14.0.

RESULTS AND DISCUSSIONS

Members' Profile and Influence

As seen in Table 2, the mean average age of the youth members of the 4-H club in Southern Leyte, Philippines is close to 20.77 (SD=6.07). About 53% of them are male members and 47% are female members. On average, dominant of them (63%) are in-school youth, which indicates that they have attended school at the average age interval of 15-24 years old or at least they have attended college level. And about 37% of them are out-of-school youth, which means they have not finished any college degree or post-high school degree. Approximately, their mean average monthly income is close to PHP 6,370.34 (SD=PHP 3,812.49). Their monthly income is relatively low since most of them do not have a higher-income job. About 94% of the respondents said that the 4-H coordinator is influencing them to implement and adopt the current rice technology.

The remaining 6% said that they are not influenced by the 4-H coordinator. Most (84%) of the respondents said that their family members are the ones who influence them to join the 4-H club and to implement and adopt the rice technology. And about 16% of them said that their family does not influence them in regard to 4-H activities. About 78% of the members are having attended training programs in rice technology implementation and adoption and 22% of them do not have experience in training. From 1 to 5 rating, the

4-H coordinator is rated at 4.55 (SD=0.64), which can be interpreted as highly effective in terms of influencing the members to adopt the rice technology in their respective areas.

Table 2. 4-H club members' profile and influence

Variables	M	SD
Age (in years)	20.77	6.07
Male[a]	0.53	0.55
Education status[a]	0.63	0.50
Monthly family income[b]	6,370.34	3,812.49
4-H coordinator influence[a]	0.94	0.24
Family influence[a]	0.84	0.36
Attended training[a]	0.78	0.42
Effectiveness of 4-H Coordinator[c]	4.55	0.64

Note: a - dummy variable; b - Philippine Peso (PHP); c-scale from 1 to 5.
Source: Own calculation (2022).

Rice Technology Characteristics

Table 3 portrays that the members of the 4-H club are "neutral" (M=3.39, SD=0.88) in the "complexity" characteristics of rice technology. This implies that the youth perceived that the innovations of rice technology are moderately difficult to implement and adopt in their respective areas. In fact, innovative technology in agriculture is challenging to apply in an actual scenario if it involves complex structures and procedures which is difficult to follow [16]. In addition, rice technology as "economically viable" is rated as "neutral" (M=3.38, SD=1.34) by 4-H club members. This means that they perceived that the economic benefits of rice technology moderately exceed its economic expense. It is vital in rice production that a long-term economically viable technology must be integrated into rice farming to maximize profit and attain the expected sustainability [1], [18]. The 4-H club members "agree" (M=3.94, SD=0.87) that the rice technology introduced to them is "compatible". This goes to infer that the new innovative rice technology is consistent and does not conflict with the existing technologies and needs of adopters. The compatibility of rice technology is vital in further enhancement and productivity as well as improving the income and well-being of farmers [20]. Rice technology as "environmentally safe" is rated as "neutral" (M=3.10, SD=1.16). This means that the 4-H club members perceived that the new rice technologies are moderately safe for the environment. In fact, it is important that the application of technologies is eco-friendly and safe to preserve other helpful microorganisms in the paddy field while improving its productivity [17]. Moreover, rice technology as a "minimal risk" is also rated as "neutral" (M=3.36, SD=0.94) by the youth members. In that case, it is perceived that rice technology is moderately a minimal risk where its likelihood of harm or discomfort is lesser compared to the usual harm of existing technologies. Farmers are more likely to adopt a rice technology that is safe and does not harm their health, and does not contaminate the paddy soil which may cause a decrease in yield [14][16].

Table 3. The 4-H club members' rating of rice technology characteristics

Characteristics	M	SD	Description[e]
Complexity[d]	3.39	0.88	Neutral
Economically viable[d]	3.38	1.34	Neutral
Compatibility[d]	3.94	0.87	Agree
Environmentally safe[d]	3.10	1.16	Neutral
Minimal risk[d]	3.36	0.94	Neutral

Note: d - Scale from 1 to 5; e - See Table 1 for details.
Source: Own calculation (2023).

Rice Technology Implementation and Adoption

Table 4 depicts that the dominant (55.08%) of the youth 4-H club members have not implemented the rice technologies introduced to them. About 36.44% of them had implemented but not continued and 5.93% of them had modified some processes of it. Only 2.54% of the members have full and continually implemented the rice technologies in their places.

Table 4. Level of implementation of rice technology

Level of Implementation	n	%
Not implemented	65	55.08
Implemented but not continued	43	36.44
Continued but modified some processes	7	5.93
Fully continued	3	2.54

Source: Own calculation (2023).

Likewise, Table 5 shows that the dominant (68.64%) of the youth members do not adopt the new rice technologies introduced to them. About 25.42% of them have adopted in

average time and scale in their respective places. And only 5.93% of them have fully adopted them on a larger scale and shared the said technologies with other farmers in their places.

Table 5. Level of adoption of rice technology

Level of Implementation	N	%
Not adopted	81	68.64
Adopted in average time and scale	30	25.42
Fully adopted on a larger scale and shared with others to adopt	7	5.93

Source: Own calculation (2023).

Ordered Logistic Models

Table 6 presents the post-estimation (diagnostic tests) for the regression model to ensure the credibility of devising a statistical inference and interpretation of the parameter results. So, the two models are found heteroscedastic (*p*-value=0.001) based on the Breusch-Pagan test and an adjustment of the models was done using a robust command in STATA [15]. In addition, the two models were found to have no omitted variable (*p*-value>0.05) bias based on the Ramsey RESET test which indicates that the variables incorporated into the models were befitting [9].

Table 6. Post-estimation (diagnostics) for the models

Model	Test Statistic		p-value	Interpretation
I	The Breusch-Pagan	χ^2=10.60	0.001	Heteroscedasticity
	The Ramsey RESET	F=0.95	0.417	Absence of omitted variables bias
	Variance inflation factor (VIF)	VIF=1.39	-	Safe from Multicollinearity
	The Shapiro-Wilk	Z=4.46	<0.01	Residuals are not normally distributed
II	The Breusch-Pagan	χ^2=11.93	0.001	Heteroscedasticity
	The Ramsey RESET	F=0.62	0.606	Absence of variables bias
	Variance inflation factor (VIF)	VIF=1.39	-	Safe from Multicollinearity
	The Shapiro-Wilk	Z=5.22	<0.01	Residuals are not normally distributed

Source: Own calculation (2023).

Moreover, the models are found to have no problem concerning multicollinearity between independent variables since the mean average variance inflation factor (VIF) is lesser than 10 [2]. Furthermore, the two models found that their residuals are not normally distributed (p-value<0.01) based on the Shapiro-Wilk test, however, the k-density estimate graphs are close to normality [15]. Hence, the two ordered logistic models are valid and statistically reliable for extracting inferential information.

Table 7. Ordered logistic regression models for 4-H youths' implementation (Model I) and adoption (Model II) of rice technology and its factors

FACTORS	Ordered Logit Models	
	Implementation	*Adoption*
Profile and Influence		
Age (in years)	-0.064^{ns} (0.042)	-0.041^{ns} (0.044)
Male[a]	0.237^{ns} (0.375)	0.383^{ns} (0.396)
Education status[a]	-0.208^{ns} (0.444)	-0.462^{ns} (0.351)
log (Monthly family income[b]+1)	0.768^{ns} (0.767)	-0.229^{ns} (0.939)
4-H coordinator influence[a]	-0.238^{ns} (1.210)	-0.109^{ns} (1.314)
Family influence[a]	-0.309^{ns} (0.613)	-0.520^{ns} (0.627)
Attended training[a]	1.205** (0.013)	1.228** (0.593)
Effectiveness of 4-H Coordinator[c]	-0.151^{ns} (0.429)	-0.073^{ns} (0.408)
Rice technology Characteristics		
Complexity[c]	-0.203^{ns} (0.254)	-0.216^{ns} (0.270)
Economically viable[c]	0.353* (0.186)	0.317^{ns} (0.216)
Compatibility[c]	-0.257^{ns} (0.286)	-0.162^{ns} (0.305)
Environmentally safe[c]	-0.105^{ns} (0.162)	-0.007^{ns} (0.209)
Minimal risk[c]	-0.415* (0.245)	-0.153^{ns} (0.254)
Participants	118	118
χ^2	32.70***	20.84*
p-value	0.002	0.076
Pseudo R²	0.120	0.089

Note: a - dummy (indicator) variable; b - Philippine Peso (PHP); c - 1 to 5 scaling; standard errors are enclosed with parenthesis; ns- not significant; *p<0.10;**p<0.05; ***p<0.01.
Source: Own calculation (2023).

As seen in Table 7, Model I (X^2=32.70, *p*-value=0.002) is highly significant at a 1% level. This goes to infer that there are statistically significant predictors that governed the level of implementation of new rice technologies among the youth members of the 4-H Club. In addition to that, the coefficient of determination (Model fit: R^2=0.120) also shows that there are independent variables that explain the variation in the level of implementation.

In that case, Table 7 reveals that the significant influencing predictors of implementation of rice technology include attended training (at a 5% level), economically viable characteristic of new rice technology (at a 10% level), and minimal risk feature of new rice technology (at a 10% level). At the same time, the second regression model (II) (X^2=20.84, *p*-value=0.076) is statistically significant at a 10% level that has a coefficient of determination (goodness-of-fit) of 0.089 (R^2). Further, the only statistically significant factor in the adoption of new rice technologiesis the attended training (at a 10% level). It is worth noting that training and development in farming are educational activities that involve innovation and new technologies designed to improve the efficiency of farmers and the productivity of economic income.

Training in agriculture is vital in knowledge development concerning farm technologies and new techniques which are necessary for production growth and sustainability [3], [5], [21], [23]. On the face of it, youth members of the 4-H club are more likely to implement and adopt rice technologies if they are rigorously educated about the functions, features, and benefits. In addition, if rice technology is perceived to be economically viable, then youth members are encouraged to implement the technology in their respective places to maximize its profitability [17]. In fact, farmers are more satisfied if they can take advantage of the technology and exceed their economic profitability over the economic cost of rice production [7]. However, the negative sign of the coefficient of minimal risk characteristics indicates that if the youth members perceived that the rice technology is riskier, they are more convinced to implement it. This result is not parallel to the findings in the literature that farmers are more encouraged to adopt the technology if no risk is involved [14], [17].

CONCLUSIONS

The study's main aim is to model the factors influencing the implementation and adoption of rice technologies among 4-H club youth members. Results showed that youth members are influenced by the 4-H coordinator and their families. In addition, it is revealed that most of the youth members in the 4-H club have attended training concerning innovative rice technologies. Moreover, the youth members perceived that 4-H coordinators are doing their job well. However, it is found that most of the members do not implement and adopt the rice technologies and that there are only a few youth members who fully implement (2.54%) and adopt (5.93%) the rice technologies in their respective places.

The statistical model revealed that the significant factors of implementation of rice technologies are the following attended training, economically viable characteristics of rice technology, and minimal risk characteristics of rice technology. Moreover, the second statistical model portrayed that the significant determinant of the adoption of rice technologies among 4-H club youth is the training attended. Conclusively, it is necessary that the youth members of the 4-H club must be trained and oriented in regard to the different functions, features, and benefits of implementing and adopting the newly introduce innovative rice technologies in their respective areas. In fact, proper training and seminars will give them sufficient knowledge and information in implementing and adopting rice technologies to amend their productivity and increase their economic profitability.

In that case, the Philippine government must provide enough budget for supporting the 4-H club program to conduct rigorous training and seminars for their members. Plus, the government must provide subsidies for agricultural inputs in relation to rice technologies to support the youth members and farmers' production process. As for further studies, a similar study must be conducted in other areas in the Philippines where there are 4-H club programs exists to gather richer details and arguments to improve the current program. It is also suggested that one may incorporate variables of well-being (happiness level) or satisfaction of being a member of the 4-H club as possible limitations of the current article.

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