Volume: 3, Issue: 2, (December, 2021), pp -112-129
www.rjt.ac.lk/agri/sljae

SRI LANKAN JOURNAL OF AGRICULTURE AND ECOSYSTEMS eISSN: 2673-1401

SLJAE

ORIGINAL ARTICLE

Impact of Adoption of Sustainable Agricultural Practices on Household Food Security in Small-scale Paddy-Cattle Farming Systems in Anuradhapura District, Sri Lanka

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DOI: http://doi.org/10.4038/sljae.v3i2.80

Abstract

The Paddy-Cattle Integrated Farming System (PCIFS) is one of the dominant farming systems in the dry zone, Sri Lanka which contributes to the well-being of small-scale farmers. These systems are subjected to high risk and uncertainty uttered by poor productivity and food insecurity related issues. Hence, the study aimed at investigating the impacts of adoption for sustainable agricultural practices on household food security in PCIFS in *Anuradhapura* district. A survey was employed to gather data from 300 randomly selected paddy-cattle integrated farmers. Descriptive and regression analysis were used to analyze the data. Farming experience, age of respondents, income from milk, awareness on sustainable agricultural practices, training participation and gender were identified as the factors affecting the adoption of sustainable agricultural practices. Further, household income (p<0.1), age, farming experience, and adoption for sustainable agricultural practices significantly (p<0.05) affected on the Food Consumption Score while household size (p<0.1), access to credits, and adoption for sustainable agricultural practices significantly (p<0.05) influenced the Household Food Insecurity Access Score. The study concludes that the adoption for sustainable agricultural practices ensure sustainable and food secured farming systems in the *Anuradhapura* district. The results suggest the importance of promoting sustainable agricultural practices among the paddy-cattle integrated farmers.

***Keywords**: Adoption, Food security, Paddy-cattle integrated system, Sustainability*

Date of Submission: 19-07-2021 Date of Acceptance: 09-12-2021

1. Introduction

The dry zone is characterized by different food production systems including monoculture, integrated, and mixed farming systems which immeasurably contributed to the national economy. Nevertheless, 80% of those food production systems are practiced by the small-scale farmers who face many constraints in agriculture such as low income from paddy monoculture due to unexpected weather changes, high market price volatility, high cost of production, and low productivity (Vithanage et al. 2013). The productivity is low mainly due to underutilization of on-farm resources, inappropriate and inefficient national-level policies for production, processing, and marketing of diversified agricultural produce, disparity of agricultural extension and research, which usually adopts the top-down approach without considering the socioeconomic and ecological environment of farmers (Vithanage et al. 2013). Therefore, current agricultural systems are unable to provide enough evidence to prove the sustainability of the existing food production systems. Furthermore, dry farmers are resource-poor people living and working in harsh or less productive environments. Farmers in these rural regions also have little access to major decision-making processes and new technologies, although most have secured tenure through different laws implemented by the successive governments over the years since independence (Kelegama and Chandra 2005).

Drastic changes in climate and their impact such as drought, flood, high temperature, etc. have influenced the small-scale food production systems in Sri Lanka directly or indirectly (Vithanage et al. 2013). These conditions caused lowering the productivity of the farming systems compared to national averages. As a result, many of the small-scale farming systems in Sri Lanka including small-scale paddy-livestock integrated systems are unsustainable due to a high degree of risks and uncertainty. Simultaneously, this resulted food security issues such as poor access to food, lack of nutritive foods, poor affordability for food, and consumption of low-quality foods in these vulnerable farming systems. Therefore, it is very difficult to enhance the well-being of these farmers without addressing the prevailing issues.

In this scenario, sustainable agricultural development offers a successful option to eradicate poverty and hunger improving the environmental performance of agriculture, but it requires a transformative intervention to whole food production and consumption (Sustainable Development Solutions

Network 2015). In agricultural sustainability a holistic approach in the management and conservation of natural resource base, and orientation of technological and institutional changes in such manner as to ensure the attainment and continued satisfaction of human needs for present and future generations is considered.

According to Mukhlis et al. (2018) there are four models of agricultural systems. Namely, 1) organic farming system, 2) integrated farming system, 3) low-external-input farming system, and 4) integrated pest management that ensure sustainable agricultural development. The Integrated farming system of crop and livestock is one of the models currently being practiced in the sustainability of production system and increase farmer income. Crop/livestock integrated farming in dry zone refers to the complementary use of crop and livestock farming to maximize the returns from a unit area of land. Crop residues and fodder resources provide animal feed such as rice straw, maize straw, pasture, and tree fodder. Other hand animals provide products like milk, meat, draught power, and animal waste (dung and urine). Manure is an excellent source of organic fertilizer to provide the fertility of the soil. Most exceptional livestock provide a regular supplementary income to meet daily cash needs and hence helps the farmer to avoid falling object to agricultural debt. Therefore, livestock is an important component in all smallholder agricultural businesses in all agro-ecological zones of the country. This condition is observed more in the dry and intermediate zones, where income-generating opportunities are less (Abyegunawardena et al. 1998).

Furthermore, sustainable agricultural practices provide quite several merits such as building soil health, enhancing water quality, preventing soil erosion, delivering tasty nutritious foods, treating animals humanely, pay workers fairly and all of which make for a healthier, more prosperous, higher quality of life for farmers, society as a whole (Food and Agriculture Organization 2018). Nevertheless, the sustainability concepts and theories are novel for the Sri Lankan farmers. Therefore, they are not adequately aware of these concepts and practices. Moreover, the adoption level of sustainable agricultural practices is poor, although they can offer many opportunities for these marginalized farmers in risk coping, farm diversification, and intensification as well as providing livelihood benefits. Hence, the present study aimed at assessing the impact of adoption for sustainable agricultural practices on household food security in a small-scale paddy-cattle integrated farming system in Anuradhapura district, Sri Lanka.

2. Methodology

Study Area

Anuradhapura district was selected for the study on accounts of the higher extent of crop cultivation and livestock rearing among the dry zone districts. Anuradhapura is the largest administrative district, which covers 11% of the total land area in Sri Lanka. The land extent of the district is around 717,900 hectares and the population is around 856,232. Anuradhapura district was the second-highest district where cattle population was recorded (Department of Census and Statistics 2017). According to the Ministry of Livestock Insurance and Development, the second-highest number of dairy farming villages was also reported from the Anuradhapura district. The highest paddy sowing area and production were reported as 109,627 hectares and 467,298 kg ('000) during the 2018/2019 *Maha* season in Anuradhapura district respectively (Department of Census and Statistics 2020). Also, the Anuradhapura district represented a greater number of small-scale paddy-cattle integrated farmers.

Sampling Technique and Sample Size

The cluster sampling method was utilized to select 300 paddy-cattle integrated farmers from the registered paddy-cattle farmers' list under the Agrarian Service Centers which ensures the fair distribution of sample among the whole farmer population. In the first stage, *Kekirawa, Talawa, Nochchiyagama, Padaviya,* and *Palagala* Agrarian Service Centers were selected purposely which represent 40% of the total paddy-cattle farmers' population in Anuradhapura district. At the second stage, pre-determined numbers of respondents were selected randomly from selected *Grama Niladhari* divisions for each Agrarian Service Center selected to obtain large proportionate sample from large populations.

Data and Methods of Data Collection

A questionnaire survey was used mainly in the study for the primary data collection. The questions aimed at finding out the parameters such as demographic, economic, environmental particulars, and adoption level for sustainable agricultural practices that are applicable to the paddy-cattle integrated farming systems. The practices given in the table 1 were assumed as the practices that ensure the sustainability of the paddy-cattle farming system. Discussion with key informants and personal observations optimized the qualitative interpretation of the results of the study. Relevant secondary data were obtained from the Department of Agriculture (2017), and Department of Census and Statistics (2020).

Table 1: Practices that ensure the sustainability of Paddy-Cattle Integrated Farming Systems

No.	Practice
01	Make sure the farm has well-maintained toilets and handwashing facilities with portable water hand soap for handwashing
02	Apply adequate plant nutrients for paddy and pasture lands
03	Supply the required amount of water for saving and care of the crops and also for the livestock
04	Maintain accurate record of agrochemical use, fertilizer use (organic and inorganic), harvest, storage, and processing. Also, all sickness, medical treatments, and mortality
05	Promote cattle welfare such as adequate space, adequate feeding, fresh water, healthy animal, etc.
06	Make sure employees are washing their hands before harvesting, handling, and milking
07	Cleaning and disinfecting the shed by a dilute solution of lime or turmeric water and fumigated with neem
08	Using the right crop protection chemicals, fertilizers, and compost according to their labeled directions and recording every use
09	For all the farming activities consult with the technician/extension agent/agricultural instructor/ veterinary officer that you trust
10	Purchase, store, and use only approved veterinary products following directions and regulations
11	Store harvested products (raw milk and paddy) under hygienic and appropriate environmental condition
12	Feeding crop byproducts such as rice bran to livestock to increase recycling of nutrients within the farm
13	Adding livestock waste to the paddy field to improve soil quality and soil fertility
14	Rotate livestock on pastures to allow for healthy re-growth of pasture plants
15	Keeping cattle and their fresh manures away from active paddy field
16	Maintain the field free of trash, papers, plastics, and empty containers
17	Analyze water of the field at least once a year to see if it is contaminated
18	Use integrated pest management practices in paddy cultivation
19	Prepare organic manure in places far away from the paddy field and water sources

Sources: Andrés et al. 2017; David et al. 2018; Kassie et al. 2009; Zainalabidin 2016

Data Analysis

Both qualitative and quantitative methods were used in data analysis. Descriptive statistics were used to analyze the socio-economic data and the level of adoption for sustainable agricultural practices listed in table 1, among farmers in paddy-cattle integrated systems. Likert scale including five scales (1. Never, 2. Not adopted, 3. Moderate, 4. Adopted, 5. Highly adopted) was used to assess the level of adoption for sustainable agricultural practices. A composite score was used to measure the level of adoption for sustainable agricultural practices listed in table 1 for each farmer. The respondents which the score value ranged between 19-56 were considered as not adopters (Yi*=0) while the score value ranged between 58-95 were considered as adopters (Yi*=1) for sustainable agricultural practices. Boddy Mass Index (BMI) was calculated by dividing the weight in kilograms of a respondent from square of height in meters. Since the surveys group was comprised of adults 20 years old or older, the standard values of BMI; moderate<18.5; normal weight 18.5 - 24.9; pre-obesity 25-29.9; obesity >30, were compared (CDC 2020).

Logistic regression was used to identify the factors that influence the adoption for sustainable agricultural practices where the dependent variable was (Y_i*) representing the adoption or non-adoption for sustainable agricultural practices. Independent variables (X_i) were considered as factors that affect adoption (Table 2).

Table 2: Definition of Independent Variables Used in Logistic Regression

Variable	Description
X_1	Age of the respondents (number of years)
X_2	Gender of the respondents (male or female)
X_3	Household size (number of members)
X_4	Farming experience (number of years)
X_5	Educational level (number of years in education)
X_6	Primary occupation
X_7	Income from farming (LKR/month)
X_8	Access to extension service (1=Yes, and 0 if otherwise)
X_9	Access to credit (1=Yes, and 0 if otherwise)
X_{10}	Training participation (1=Yes, and 0 if otherwise)
X_{11}	Awareness of sustainable agricultural practices (1=Yes, and 0 if otherwise)
X_{12}	Use family labor (1=Yes, and 0 if otherwise)
X_{13}	Use hired labor (1=Yes, and 0 if otherwise)
X_{14}	Produce marketable surplus (1=Yes, and 0 if otherwise)

$$Yi* = \beta1\,X1 + \beta2\,X2 + \cdots + \varepsilon i \qquad \text{(Eq. 1)}$$

Where: Yi = 1 if Yi* > 0 and Yi = 0 if otherwise

Y =1 if the farmer adopted the sustainable agricultural practices and Y=0 if the farmer decided otherwise.

The formula used for computation of FCS can be expressed as follows:

$$FCS = a \times f\,(\text{cereal and or tubers}) + a \times f\,(\text{pulse}) + a \times f\,(\text{milk}) + a \times f\,(\text{fruit}) + a \times f\,(\text{meat and or fish}) + a \times f\,(\text{sugar}) + a \times f\,(\text{vegetables}) + a \times f\,(\text{oil}) + a \times f\text{-}(\text{condiments}) \quad \text{(Eq. 2)}$$

Where,

FCS = Food Consumption Score

f = frequency of food consumption (number of days for which each food group was consumed during the recall period)

a = weighted value representing the nutritional value of food categories

Based on the FCS respondents were categorized into poor food consumption (0–21), borderline food consumption ($21 < FCS \leq 35$), and acceptable food consumption ($FCS > 35$) (EFSA,2009).

HFIAS reflects the three universal domains of household food insecurity namely anxiety about household food insecurity, insufficient quality, and insufficient quantity of food supplies in the past 30 days (Deitchler et al. 2011). In HFIAS calculation, individuals' responses and experiences regarding food insecurity were captured and summarized into a score. For that purpose, the following occurrence questions regarding the food insecurity experiences during the past 30 days were questioned during the survey.

1. Worrying about food adequacy?
2. Eating the kinds of less preferred foods?
3. Eating limited variety?
4. Inability to eat less preferred foods?
5. Eating a smaller meal than needed?
6. Eating fewer meals in a day?
7. Failing to get food of any kind?
8. Sleeping at night hungry?
9. Going the whole day or night without eating anything?

During the survey respondents were asked to either say yes (= 1) if experience occurred or no (= 0) if the experience did not occur. Three response options (1 = rarely, 2 = sometimes, and 3 = often) were used to check the frequency of each occurrence question during the last 30 days. The HFIAS score ranged between 0-27 where zero occurs when a respondent respond ‘no’ to all questions. Otherwise, 27 is the maximum HFIAS when a household responds ‘yes’ to the occurrence question and 'often' as the frequency of occurrence to all questions.

According to Coates et al. (2007), the HFIAS is computed using the following equation.

$$HFIAS\ (0 - 27) = Q1a * F1 + Q2a * F2 + Q3a * F3 + Q4a * F4 + Q5a * F5 + Q6a * F6 + Q7a * F7 + Q8a * F8 + Q9a * F9 \quad \text{(Eq. 3)}$$

Where, "Q" represented the particular food insecurity occurrence questions and "F" represented the frequency of the occurrence questions.

Interpretation of the HFIAS scores can be expressed as; a high HFIAS explained that a household is very food insecure while a low score revealed that a household is less food insecure (Nyikahadzoi et al. 2012).

In addition, Ordinary Least Squares (OLS) regression was used in measuring the influence of adoption for sustainable agricultural practices on food security in low input paddy-livestock integration farming systems in Anuradhapura district.

3. Results and discussion

Socio-economic Characteristics of Respondents

According to the results, of all respondents 83% were males and 17% of respondents were females. Results revealed that many of the respondent farmers (49%) belonged to the 51-75 age category followed by the 26-50 (46%) age category. The mean age of the respondents was 49 years. Most of the families (46%) consisted of 4 family members. Moreover, many of the farmers (46%) of the total population attended secondary education (Grade 6-11) and but all respondents did not face G.C.E (O/L). They had abilities in problem-solving, reading, and writing skills. Moreover, 80% of the total population engaged in paddy farming as their main income source. Only 12% were rearing cattle as their main income source. Further, respondent farmers were engaged in non-agricultural labour (5%) and government sector (3%) as their primary occupation. Cattle management was the prominent (89%) secondary occupation as it provides daily income to the households. The average BMI was 23.44 and results showed that 53.1% of the respondents belonged to normal weight group while 30.5% of the respondents belonged to the pre-obesity group. A considerable percentage (13.3%) of respondents were underweight in paddy-cattle integrated farming systems.

The average paddy production per season per hectare was 3,287kg and paddy production ranges between 1,778kg to 6,856kg per hectare respectively. Similarly, the average milk production per month was 392 liters and it ranges from 60 liters to 750 liters. Selected respondents for this study have earned their agricultural income by selling paddy and raw milk as main produce. The mean seasonal income from paddy per hectare was LKR. 108,717, and seasonal paddy income ranged between LKR. 48,415.00 – LKR. 260,545.00 in paddy-cattle integrated farming systems. Furthermore, the average monthly income from milk was LKR. 27,433.00 and it varied from LKR. 4,200.00 to LKR. 52,500.00 respectively. These results revealed that the integration of paddy with cattle ensured continuous income flows to this household. According to Sariubang (2010), the technology introduced into the integration of paddy and cattle can increase farmers' income. This integration increased the income by IDR (Indonesian Rupiah) 34,488,800.00 that was higher than traditional monoculture farming (IDR 22,903,200.00). The integration of paddy and cattle could increase farmers' income, had a positive impact on development in farming areas. This could be seen from the increase in rice production and the increase in the use of labor in the family (Tarmizi 2012).

The mean seasonal cost of production for paddy (per hectare) was LKR. 72,998.00, and the seasonal cost of paddy production ranged within LKR. 25,451.00 – LKR. 194,665.00 in paddy-cattle integration farming systems. Furthermore, the average monthly cost of milk production was LKR. 4,484.00 and it varied from LKR. 2,000.00 to LKR. 9,000.00 respectively.

Factors Affecting Adoption for Sustainable Agricultural Practices

Logistic regression analysis was used to determine the factors affecting adoption for sustainable agricultural practices among paddy-cattle integrated farming systems. The binomial logistic analysis of measured variations in the outcome explained by predictors was significant ($P < 0.001$).

Table 3 summarizes the main result of the estimates of binary logistic regression. According to the results, variables such as the age of the respondent, gender, farming experience, awareness of sustainable agricultural practices, income from milk, and training participants significantly ($p < 0.05$ or $p < 0.10$) affected the adoption of sustainable agricultural practices.

The farming experience was the most likely (OR=1.44) factor to adoption for sustainable agricultural practices. Moreover, it was positively affected for adoption of sustainable agricultural practices. The age of the respondents influenced the adoptions for sustainable agricultural practices with a positive sign (OR=1.209). Training participation is also positively associated with adoptions.

Table 3: Maximum Likelihood Estimates of the Factors Affecting Adoption for Sustainable Agricultural Practices

Parameter	Estimate	Standard error	*p* > ChiSq	***Odds Ratio***
Intercept	-13.9680	4.1899	0.0009	
Age of the respondent	0.1895	0.0621	0.0023**	1.209
Gender	-1.6490	0.8536	0.0534**	0.037
Household size	-0.1127	0.4323	0.7943	0.893
Farming experience	0.3649	0.1050	0.0005**	1.440
Land size	0.7370	0.5734	0.1987	2.090
Income from paddy	-1.73E-6	5.414E-6	0.7497	1.000
Income from milk	5.123E-6	5.681E-6	0.0672*	1.000
Access to credit	-0.6105	0.5112	0.2323	0.295
Training participation	1.5391	0.6139	0.0122*	0.046
Awareness on sustainable agricultural practices	0.3729	0.4668	0.0243*	0.474

**Significant at 10%, **Significant at 5%*

When the participation in training increased adoption for sustainable agricultural practices have increased (OR=0.046). Furthermore, awareness of sustainable agricultural practices (OR=0.474) and gender (OR=0.037) of the respondents positively influenced to adapt to sustainable agricultural practices. Males are more likely to be adopted when they were aware more of sustainable agricultural practices as opposed to females. Moreover, increasing income from milk was associated with increased adoption (OR=1.00) for sustainable agricultural practices. But the study identified that absence of well-defined location specific sustainable agricultural practices for paddy-cattle integration as a major limitation of the research area.

Farmers who have high technical knowledge significantly use farm practices related to sustainability such as crop rotation, land rotation, using green and organic manures, IPM, rotational grazing, tillage for seedbed preparation, and cultivation for weed control (Hosseini et al. 2005). Apart from age and education, some studies also tested the impact of farmers' marital status, gender, and household size on adoption decisions. Burton et al. (2003) and Tiffin and Balcombe (2011) found that female farm operators have better chances of adopting organic farming compared to their male fellows, while Mzoughi (2011) did not find the effect of gender significant. Marital status was analyzed and its effect turned out to be insignificant (Koesling et al. (2009). Additionally, Läpple and Van (2011) reported the presence of off-farm income or an off-farm activity as adoption contributors, but only one study revealed a significant impact of such activity on adoption, limiting possible broader generalizations.

Vine et al. (2018) investigated the key factors influencing the uptake of sustainable agricultural practices by smallholder farmers in Ethiopian highlands. The majority of the farmers' revealed that access to farming knowledge and advice (38.5%), access to agricultural credit (20%), availability of land (23.2%), availability of labor (8.4%), and access to farm equipment and tools (3.1%), as well as security of farm tenure (2%), would influence their decisions to implement sustainable agricultural practices on their farm. Further, an ordered probit econometric model was identified the number of farmers adapted for sustainable agricultural practices increased with access to agricultural loans. Having access to agricultural loans increases the probability of adopting more than two sustainable agricultural practices. Access to off-farm income was also found to have a significant positive impact on the number of sustainable agricultural practices adopted by farmers, although the marginal effects were quite small. One of the critical barriers to successful adoption and scaling up of sustainable agricultural practices and technologies is the fact that they often require significant initial investments while benefits could be realized in a few seasons (Giller et al. 2009). The availability of household labor resources positively influenced the number of sustainable agricultural practices adopted by farmers. The results showed that each additional unit of family labor increases the probability of adopting two or more sustainable agricultural practices by 2.4% (Vine et al. 2018). This result is consistent with studies that have shown how labor constraints impede the adoption of sustainable agricultural technologies, a typical example being the case of System of Rice Intensification in Madagascar (Moser and Barrett 2003).

Contribution of Adoption for Sustainable Agricultural Practices on Household Food Security

The Food and Agriculture Organization (FAO) defines food security as "a situation when all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996). Hence, the agriculture system must become more productive and less wasteful worldwide by adopting sustainable agricultural practices including both production and consumption integrated approaches (Umesha 2018). Increasing food production in the country may not automatically ensure food security if the poor people do not have the power to buy. Therefore, the participation of small holder farmers in food production through adoption for sustainable practices is required to achieve food security in the country.

Table 4: FCS and HFIAS Values

Food Consumption Score (FCS)	
Acceptable food consumption (FCS > 35)	21%
Borderline food consumption (21 < FCS ≤ 35)	49%
Poor food consumption (FCS < 20)	30%
Household Food Insecurity Access Score (HFIAS)	
Less food in-secured	32%
Very food in-secured	68%

Statistics revealed that the average household Food Consumption Score (FCS) was 28.9 indicating borderline food consumption. Minimum and maximum FCS were found to be 17 and 61.5 respectively. Moreover, near to half (49%) of the respondents identified FCS values as borderline food consumption. According to table 4, a considerable percentage (21%) of the respondents mentioned FCS values as acceptable food consumption. Only 30% of the respondents recorded FCS values as poor food consumption. In terms of Household Food Insecurity Access Score (HFIAS), more than half of the respondents (68%) identified that HFIAS was very food in-secured while 32% of the respondents recorded HFIAS as less food in-secured (Table 4).

The two measures of food security portray almost a similar trend regarding the food security status. The two measures showed that more than 50% of the respondents are food in-secured.

Multiple regression analysis has identified the effects of adoption for sustainable agricultural practices on household food security using different indices. Variability of FCS was described by 65% ($R^2 = 0.65$) from the statistically significant four variables (Table 5); adoption for sustainable agricultural practices ($p < 0.05$), age ($p < 0.05$), farming experience ($p < 0.05$), and income ($p < 0.10$). The increasing farming experience was influenced by decreasing

FCS. Adoption for sustainable agricultural practices was affected with a positive sign to FCS. Farmer income also positively affect the FCS while farmer age was negatively influenced the FCS. Furthermore, variability of HFIAS described by 45% ($R^2 = 0.45$) from the statistically significant ($p < 0.01$, $p < 0.05$ or $p < 0.10$) variables; adoption for sustainable agricultural practices ($p < 0.05$), access to credit ($p < 0.05$) and household size ($p < 0.10$). Increasing adoption for sustainable agricultural practices was influenced to decrease the HFIAS. Moreover, access to credit and household size were positively affected by the HFIAS.

Adoption for sustainable agricultural practices was found to have a positive influence on FCS and a negative influence on HFIAS. Households with a higher rate of adoption for sustainable agricultural practices are more likely to sustain within the farming and ensure the continued income flows to the household from paddy as well as milk thus justifying the positive relationship. This implies the adoption for sustainable agricultural practices improves the food consumption among the farmers in paddy-cattle integration farming systems. In addition, the coefficient of adoption for sustainable agricultural practices was significant and showed a negative influence on HFIAS. This implies that households with highly adapted for sustainable agricultural practices are less food in-secured as compared to those with less adapted for sustainable agricultural practices.

The age of the respondent and farming experience was found to influence the FCS with negative signs. It implies that with the aging of farmers they were reluctant to practice sustainable agricultural practices and it caused to reduce the food security of the household. Iddrisu et al. (2018) found out that younger household heads are likely to have more food access compared to their older households. This result confirms the findings that younger households' heads will practice more sustainable agricultural practices compared to older ones. The results indicate that experience has a positive and significant impact on the household food insecurity access scale.

Household income positively influenced the FCS which implies access to good quality, nutritive and affordable food for the household. Food access increases with increasing income (Yahaya et al. 2018). The coefficient of access to credit was significant at a 5% significant level and negatively related to HFIAS. The result revealed that households that have access to credit had less HFIAS compared to those who did not have access to credit.

Table 5: Effect of Adoption for Sustainable Agricultural Practices on Household Food Security

Parameter	FCS		HFIAS	
	Estimate	*p* > t	Estimate	*p* > t
Intercept	37.1838	0.0091	11.793	0.053
Adoption for sustainable agricultural practices	13.5932	0.0543**	-6.4598	0.011**
Age of the respondent	-0.0276	0.0309**	-0.0369	0.509
Household size	0.44791	0.7052	-0.1512	0.068*
Education level	0.1009	0.9449	0.4245	0.536
Farming experience	-0.0790	0.0109**	0.0510	0.448
Household Income	0.00001	0.0596*	0.000006	0.166
Access to extension	1.0928	0.7119	1.500	0.243
Access to credit	2.247	0.4203	-1.128	0.050**

**Significant at 10%, **Significant at 5%*

The households that had access to credit had additional capital to invest in sustainable agricultural practices and obtain sustainable income from paddy and cattle farming. Access to credit can also enhance the access to productivity-enhancing inputs to paddy-cattle integrated farming. Thus, farmers can improve their income and improve food security within the household. Households with access to credit are more likely to have the capital to invest in on-farm and off-farm activities which generate more income for the household which is then used to improve the food consumption patterns (Akaakohol and Aye 2014).

4. Conclusion and Recommendations

This study concluded that farming experience, age of respondents, income from milk, awareness of sustainable agricultural practices, training participation, and gender are the driving factors of adoption for sustainable agricultural practices among the farmers in the paddy-cattle integrated farming system. Household income, age, farming experience, and adoption for sustainable agricultural practices are significantly affecting the Food Consumption Score while household size, access to credits, and adoption for sustainable agricultural practices influenced the Household Food Insecurity Access Score. Adoption for sustainable agricultural practices positively correlated with Food Consumption Score and negatively correlated with Household Food Insecurity Access Score. In terms of policy directions, the results suggested that the enhance the awareness about sustainable agricultural practices among paddy-cattle integrated farmers especially currently those less adopted is timely needed. As well as policies to augment these farmers' access to training, information, and access credit are also recommended. Government attention is needed to find solutions for the problems in Artificial Insemination (AI), and improving AI facilities, well-distributed veterinary and extension facilities to improve the livestock production in paddy-cattle integrated farming systems in Anuradhapura district.

Conflicts of Interest: The authors have no conflicts of interest regarding this publication.

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