Implementation of Srp (Sustainable Rice Platform) Standards: A Case Study in the Mekong Delta of Vietnam

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Abstract

Rice production holds a main role not only in ensuring national food security but also in sustaining the livelihoods of over 70% of the population in the Mekong Delta region. Embracing the Sustainable Rice Platform (SRP) standards emerges as a promising long-term solution, aligning with the overarching strategy for rice production development in Vietnam and, more specifically, the Mekong Delta. To scrutinize the viability of implementing SRP standards in Mekong Delta rice production, a structured interview approach was employed, gathering data from 200 farmers in the key rice-producing provinces of An Giang and Dong Thap. Descriptive statistics were employed to delineate household characteristics and farmers' scores, with multiple linear regression models utilized to discern the factors influencing the application level of SRP standards, quantified by SRP scores ranging from 1 to 100. The findings reveal a mean SRP score of 84.7, with no farmer falling below a score of 33, indicating universal compliance with SRP standards. This underscores the suitability of SRP standards for seamless integration into the agricultural practices of the Mekong Delta region. The study identifies five thematic areas where farmers fall short of sustainable standards and pinpoints nine specific requirements that remain below the prescribed thresholds. Multiple linear regression analysis further unveils six influential factors shaping the decision to adopt SRP standards: education level, rice farm size, cooperative membership, diary record-keeping, cooperative irrigation utilization, and engagement in consumption contracts. In response to these revelations, the study proposes eight strategic solutions aimed at amplifying the adoption of SRP standards in the Mekong Delta. These encompass intensified training initiatives, the establishment and fortification of cooperatives, support mechanisms for comprehensive diary record-keeping, infrastructural enhancements for cooperative and group irrigation, bolstered linkages between businesses and farmers, branding initiatives, and targeted financial and technical support for small-scale farmers. Grounded in the research's empirical insights, these proposed solutions are envisioned to propel the widespread adoption of SRP standards, fostering sustainable rice production practices in the dynamic agricultural landscape of the Mekong Delta.

Keywords: *Rice production, SRP, Threshold, Influence factors*

1. Introduction

In the realm of global rice exportation, Vietnam stands prominently among the top three exporters, with the Mekong Delta serving as the epicenter of rice production, yielding an impressive annual output of approximately 25 million tons. This constitutes over 50% of the nation's total rice production, contributing significantly to more than 90% of its rice exports. The Mekong Delta's rice sector assumes a pivotal role, supporting the livelihoods of over 70%

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of the local population in this region (GSO, 2020; The Anh, Van Tinh, & Ngoc Vang, 2020). Despite its paramount importance, the Vietnamese rice industry is confronted with a myriad of challenges. Extensive studies underscore the detrimental impacts of prolonged intensification and excessive use of fertilizers and agro-chemicals, posing risks to both the environment and human health, thereby jeopardizing food safety (Chau, Sebesvari, Amelung, & Renaud, 2015; Dasgupta, Meisner, Wheeler, Xuyen, & Lam, 2007; Phung, Connell, Miller, & Chu, 2012; Sankoh, Whittle, Semple, Jones, & Sweetman, 2016). Furthermore, rice production contributes significantly to greenhouse gas emissions, accounting for up to 44% of total emissions within the agricultural sector (OECD, 2015).

To ensure a robust, sustainable, and internationally marketable rice production that adheres to both quality and quantity standards, the imperative lies in the effective implementation of sustainable rice farming technologies. Merely focusing on productivity and economic gains within the rice industry is considered a facet of "weak sustainability" (Bell & Morse, 2012). The primary objective should be to enhance rice productivity while safeguarding the natural resource base, achieved through methods that minimize adverse impacts on the environment (FAO, 2018).

A promising solution to these challenges is presented by the Sustainable Rice Platform (SRP), a global alliance comprising over 100 institutional members from diverse sectors, such as public, private, research, civil society, and finance. The SRP Standard for Sustainable Rice Cultivation stands as the world's pioneering voluntary sustainability standard for rice. This comprehensive standard serves as a toolkit for assessing the sustainability of rice production across economic, social, and environmental dimensions. Notably, it introduces an environmentally conscientious approach to rice production, resulting in a remarkable reduction of up to 50% in greenhouse gas emissions (SRP, 2020, 2021).

In 2015, the SRP standard was introduced to Mekong Delta rice farmers to enhance their capacity in addressing industry challenges. Subsequently, in the following year, the Ministry of Agriculture and Rural Development of Vietnam established an SRP working group, comprising the Department of Cooperative Economy, Olam Group, Loc Troi Group, Hieu Nhan Food Processing company, and other members. Their objective was to promote the application of SRP standards. Despite various projects supporting SRP implementation, limited literature is available on this subject.

Research findings by Huy and Quang (2019) demonstrate an improvement in the sustainable production scores of farmers after implementing the SRP standards. The average score achieved by farmers following SRP standards is 66.9 points, reflecting an increase of 12.4 points compared to the pre-implementation phase. Notably, 100% of the farmers attained the "Working towards sustainable rice cultivation" according to SRP standards, indicating the feasibility of implementing these standards in the Mekong Delta region. However, the study also highlights that no farmer reached the 90% score, the threshold for publicly declared sustainable rice production, underscoring the need for further research and improvement within the SRP standards.

This study endeavors to identify the factors influencing SRP scores, uncover challenges hindering farmers from meeting the required thresholds, and propose solutions to enhance farmers' SRP scores. The ultimate goal is to advance the application of SRP standards for sustainable rice production in the Mekong Delta.

2. Methodlogy

2.1. Study Sites

The choice of An Giang and Dong Thap provinces as the focal points for this study is grounded in their significant contribution to rice production, collectively representing 30% of both rice cultivation areas and production in the Mekong Delta, Vietnam, as documented by the General Statistics Office (GSO, 2022). Furthermore, these provinces have been designated as priority areas by the Ministry of Agriculture and Rural Development (MARD), actively implementing various innovative rice farming techniques and standards, as highlighted in studies by (Flor et al., 2021; Tin & Cuc, 2021) (Fig. 1).
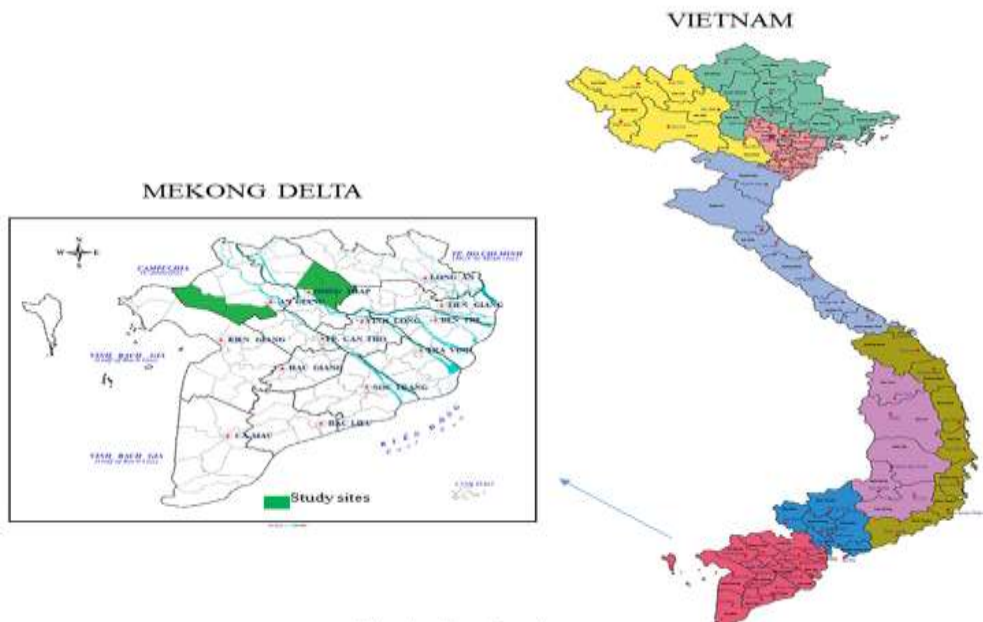

Figure 1. Study Sites. We Chose Two Districts in an Giang (Thoai Son and Tri Ton) and Two Districts in Dong Thap (Cao Lanh and Thap Muoi) For the Survey.

The study's first phase involved the selection of two districts in An Giang and two districts in Dong Thap, guided by recommendations from the Department of Agriculture and Rural Development (DARD). In the subsequent stage, a total of 210 farmers, previously engaged in the adoption of Sustainable Rice Platform (SRP) standards, were directly interviewed. After the exclusion of households with insufficient information, data from a final cohort of 200 farmers were included in the analytical framework of this study. This sample comprises 101 farmers from An Giang province, constituting 50.5% of the total, and 99 farmers from Dong Thap province, representing the remaining 49.5%.

2.2. Data Collection

The socio-economic information pertaining to farming households was procured via interviews employing a semi-structured questionnaire (Supplementary 1). The assessment of Sustainable Rice Platform (SRP) scores adhered to the guidelines outlined in The SRP Standard for Sustainable Rice Cultivation (Version 2.1) (Supplementary 2). The procedural framework for both farmer interviews and SRP scoring is visually delineated in Figure 2.

Figure 2. Face to Face Interview. The Phd. Student Gathered Data on Rice Production from Farmers in an Giang Province.

2.3. Data Analysis

The survey questionnaire data, encompassing socio-economic information, underwent importation into Excel, where raw data exports were merged by farmer ID and subsequently imported into the statistical software SPSS for comprehensive data analyses. Descriptive statistics were employed to furnish sample descriptions inclusive of demographic details and the extent of adoption. Employing a linear regression model, we scrutinized factors influencing the cumulative number of points acquired by farmers, expressed as Equation 1:

$$Y(0-100) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n + e$$

Here,

Y denotes the intensity of farmers' adoption of Sustainable Rice Platform (SRP) standards, quantified by SRP scores on a 1-100 scale, while X represents the independent variables, β signifies scalar parameters, and e represents a random error term. This equation illustrates the mathematical representation of the relationship between the independent variables and SRP scores, with Y representing the predicted SRP score and e signifying the error term. The model yields valuable insights into the potential influences of these variables on sustainable farming practices, aiding in the formulation of strategies to enhance SRP scores and promote

sustainable agriculture among smallholder farmers.

The linear regression model is applied to investigate factors influencing the adherence level to SRP standards, measured by SRP scores ranging from 1 to 100. This analytical approach aligns with the utilization of multivariate linear regression models in diverse studies, including the assessment of the intensity of 1P5G technique application (Connor, Tuan, DeGuia, & Wehmeyer, 2021), intermittent application of smart irrigation techniques (Le, 2021), and the level of input material application (Thanh & Duong, 2021).

The literature review underscores various internal and external dynamics, such as socio-economic characteristics, personal preferences, and promotional activities (Bopp, Engler, Poortvliet, & Jara-Rojas, 2019), alongside farmers' perceived benefits (Connor et al., 2020; Ekane, Mertz, Slovic, Kjellén, & Westlund, 2016), perceived ease of practice, and satisfaction and expectations arising from the introduction process (Wehmeyer, de Guia, & Connor, 2020), all influencing the implementation of sustainable agricultural practices.

The age of the household head emerges as a determinant affecting the adoption of new techniques. Older farmers exhibit less inclination to embrace new techniques (Hoang, 2021), reflecting concerns about risks, resistance to change, and reduced willingness to invest in the long term compared to their younger counterparts (D. D. Tran et al., 2023). However, divergent views exist, with some studies reporting no impact of farmers' age on the decision to adopt new techniques (Kim Dang, Do, Le, Le, & Pham, 2021; Nhân, 2016; Tien Thanh & Bao Duong, 2020; N. L. D. Tran et al., 2020a; Tu, Can, Takahashi, Kopp, & Yabe, 2018).

Educational attainment emerges as a crucial factor influencing the acceptance of new techniques, with farmers possessing higher levels of education exhibiting greater inclination towards adopting innovative farming techniques (Connor et al., 2021; Ha & Bac, 2021; Hoang, 2021; Umetsu, 2021).

Gender also plays a role in the decision to adopt new techniques, with several studies indicating that females exhibit a greater proclivity for adopting new farming techniques compared to males (Hoang, 2021; N. L. D. Tran et al., 2020b; Trinh, Rañola Jr, Camacho, & Simelton, 2018).

Participation in organizations such as the Farmer's Union, cooperatives, farmer groups, or agricultural clubs exerts a positive influence on the decision to adopt new techniques (Pham & Napasintuwong, 2020; Tu, 2017; Tu et al., 2018; Umetsu, 2021). Government initiatives supporting the development of such farmer organizations contribute to the adoption of advanced techniques.

The total number of family members recorded has been observed to have both positive (Hoang, 2021) and negative effects (Hà & Trí, 2018) on the decision to adopt new techniques.

Farm size emerges as a positive influencer of the decision to adopt new techniques, with larger-scale farmers exhibiting a greater likelihood of adopting innovative practices (Connor et al., 2020; Dung, Ho, Hiep, & Hoi, 2018; Ho & Shimada, 2021; Kim Dang et al., 2021; Tien Thanh & Bao Duong, 2021). The financial resources of larger-scale farmers make it easier for them to afford the requirements of new techniques, and their larger land holdings allow for experimentation, reducing exposure to risks compared to smaller-scale farmers (Trang & Napasintuwong, 2016).

In areas with substantial infrastructure supporting rice production, farmers are more inclined to adopt new techniques (Bang, Pham Tiet Tung, & Thanh, 2022; Le, 2021). Specifically,

farmers within concentrated irrigation zones tend to favor advanced farming techniques compared to those outside these areas (Le, 2021; Thanh & Duong, 2021), perceiving sound infrastructure as facilitating the implementation of demanding cultivation techniques (Bang et al., 2022).

Access to credit activities is noted to influence the ability to practice advanced agricultural techniques (Hoang, 2021; Ngo, 2016; Thanh & Duong, 2021; N. L. D. Tran et al., 2020b; Trinh et al., 2018). Farming contracts emerge as significant motivators encouraging farmers to implement new advanced techniques (Pham & Napasintuwong, 2020; Trang & Napasintuwong, 2016). In the Mekong Delta, the adoption of advanced techniques often forms a prerequisite in partnerships with enterprises. The regression analysis incorporates the 11 independent variables described in Table 1 to explore their linear correlation with the dependent variable.

Table 1. Outlines the Characteristics of the Hypothesized Dependent and Explanatory Variables in SRP Adoption.

Variable	Definition
Dependent variable	Continuous, SRP score (1-100)
Independent variables	
Age	Continuous, age of household head (years)
Education	Continuous, the number of formal education year of the household head
Gender	Dummy, the gender of household head: 1 = male, 0 = female
Cooperative	Dummy, member of a cooperative: 1 = member, 0 = Non-memeber
Farm diary	Dummy, Used to record farm diary: 1 = yes, 0 = no
Household size	Continuous, number of family's member
Farm size	Continuous, total rice farmland, ha
Non-rice income	Dummy, 1 = yes, 0 = no
Farming contract	Dummy, Farmers sign contract with a company, 1 = yes, 0 = no
Credit access	Dummy, access to credit of household, 1 = yes, 0 = no
Collective pump	Dummy, 1 = supply by Farmer organization (Cooperative, farmer's group) supply, 0 = supply by other or self - irrigation

There are seven dummy variables and 4 continuous variables.

3. Results

3.1 Farmers' Characteristics and Household Information

Table 2 provides an overview of the demographic characteristics of farmers participating in the study. A total of 200 farmers engaged in the survey questionnaire, with an Giang and Dong Thap contributing 50.5% and 49.5%, respectively. The average age of farmers was 53 years, accompanied by an average farming experience of 28 years. Remarkable consistency in age and experience was observed between farmers in both provinces. The gender distribution skewed heavily towards males, constituting over 90% in both an Giang and Dong Thap. Educational attainment was prevalent, with nearly 98% of farmers having received some level of formal education. This educational background comprised 34% attending primary school, 46.5%

attending secondary school, 15% attending high school, and 2.5% having graduated. Household size averaged around 4 to 5 members, with close to half (49%) having young children within the same residence. The average farm size per household was approximately 3.0 hectares, with an Giang farmers possessing larger farms at an average of 4.0 hectares per household, double the size of those owned by Dong Thap farmers. Approximately one-third of participants were members of cooperatives, with a higher participation rate observed among an Giang farmers in comparison to their counterparts in Dong Thap.

Table 2. Socio-Demographic and Farm Information.

Information		An Giang	Dong Thap	Mean
Household size (persons)		4.5	4.7	4.6
Farm size (ha)		4.0	2.0	3.0
Farming experience (years)		25.6	30.7	28.1
Age (years)		50.7	55.4	53.0
Retire (>60 years) (%)		19.8	33.3	26.5
Female		9.9	6.5	3.0
Education	No school at (%)	2.0	2.0	2.0
	Primary school (%)	37.6	34.0	30.3
	Secondary school (%)	43.6	46.5	49.5
	High school (%)	13.9	15.0	16.2
	Bachelor degree (%)	3.0	2.5	2.0
Cooperative member (%)		38.6	26.3	32.5
Children (%)		52.5	49.0	45.4

A total of 200 farmers (101 from an Giang province and 99 from Dong Thap province)

3.2. Compliance Level of Farmers

Table 3 elucidates the adherence levels to the 41 Sustainable Rice Platform (SRP) standard requirements. Farmers exhibit an average score of 84.7%, with 12% of participants achieving 90 or more points, while the remaining 88% of households fall within the range of 33 to 89 points. Farmers in Dong Thap attained a significantly higher SRP score, registering 85.8 points, as opposed to farmers in an Giang province who scored 83.6 points.

Table 3. Score Level of SRP Achieved by Province.

Score level of SRP (%)	Total (n=200)	Provinces		Sig.
		An Giang (n=101)	Đong Thap (n=99)	
33 – 89	88	90.9	85.1	ns
90 – 100	12	9.1	14.9	ns
Total (%)	100	100	100	
Mean	84.7	83.6b	85.8a	**

ns: not significant different at level of 0.05
**: significant different at level of 0.01

In terms of compliance with SRP standards across various themes, Figure 3 illustrates the distribution of SRP scores within each theme. Among the 8 themes, "Replanting," "Water use," and "Labor rights" nearly attain the highest possible scores. In contrast, the remaining themes, encompassing "Farm management," "Nutrient management," "Pest management," "Harvest & post-harvest," and "Health & safety," achieve scores ranging from just over 71% to under 83%.
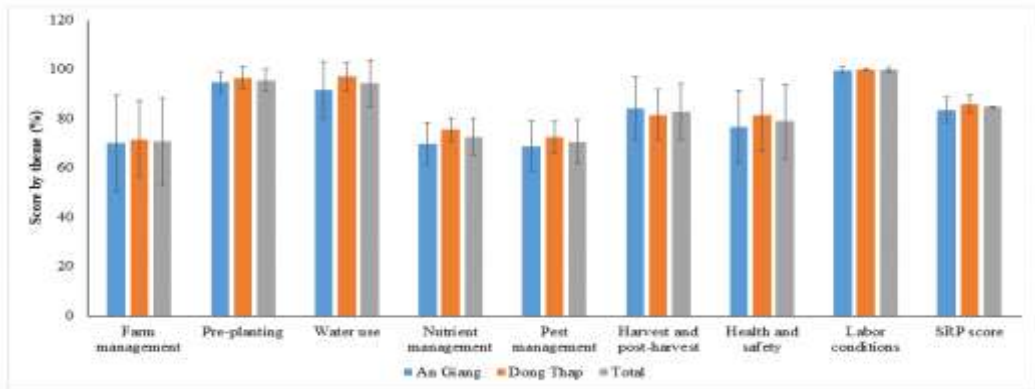
Figure 3. The Level Score of Provinces by Theme. A Total Of 200 Farmers (101 From an Giang Province and 99 from Dong Thap Province) were Assessed to Obtain SRP Scores and Determine the Percentage Achieving Proficiency in Each Theme.

3.3. Missing Threshold

Concerning mandatory compliance levels, nine requirements prove challenging for farmers to meet the established thresholds. Figure 4 delineates the percentages of farmers falling below the thresholds for specific requirements, shedding light on the proportion grappling with adherence challenges. Notably, challenges are pronounced in requirements such as rice stubble (30.5%), rice straw (30.0%), organic fertilizer choice (20.5%), and disease management (20.0%),. Additionally, notable percentages associated with insect management (14.5%), record keeping (10.5%), re-entry time (9.0%), harvest equipment (8.0%), and personal protective equipment (7.0%) underscore areas necessitating improvement to align with the benchmarks set by the Sustainable Rice Platform (SRP) standards.
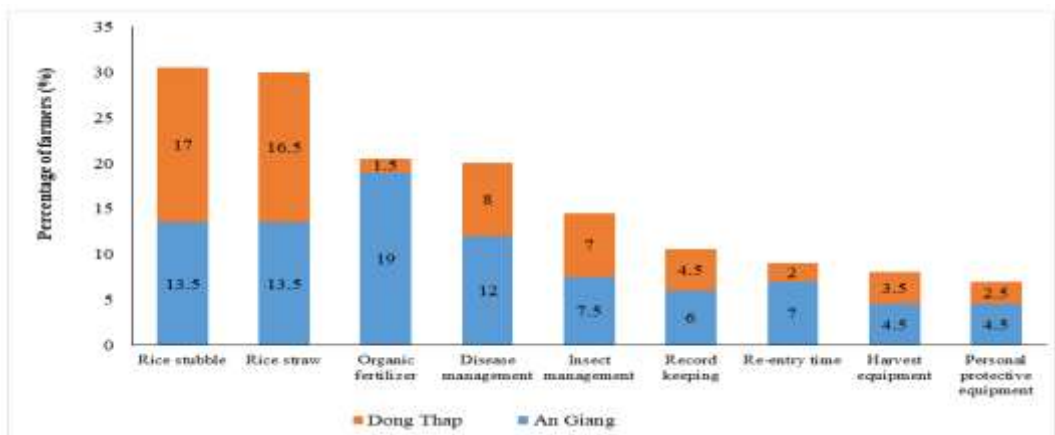

Figure 4. Requirements Missing Thresholds. Nine Requirements Impede Farmers in the Studied Sites from Achieving Sustainable Rice Production Standard, Including Aspects Such as Rice Stubble, Rice Straw, Organic Fertilizer, Disease Management, Record-Keeping, Re-Entry Time, Harvest Equipment, And Personal Protective Equipment.

3.4. Determinants of SRP Score

A multiple linear regression analysis was conducted to discern the factors influencing the SRP

scores of smallholder farmers in this study. The results underscore a linear relationship between various demographic, socio-economic, and institutional factors and the SRP scores achieved by farmers (see Table 4). The model elucidates 31.8% of the total variance. Among the 11 variables scrutinized, the analysis pinpoints six variables with statistically significant impacts on SRP scores. Specifically, farm size, cooperative membership, farm diary usage, and collective pump utilization exhibit significant influence at the 0.01 significance level, while education and farming contract participation exert effects at the 0.05 significance level.

Table 4. Estimation of Linear Regression Model for Smallholders' SRP Score.

Variebles	Coefficient	Std. Err	p value	VIF
Age	-0.029ns	0.029	0.324	1,131
Education	0.190*	0.092	0.042	1,077
Gender	0.811ns	1,215	0.505	1,085
Cooperative	2.655**	0.649	0.000	1,108
Farm diary	1.972**	0.647	0.003	1,073
Household size	0.206 ns	0.168	0.222	1,105
Farm size	0.394**	0.100	0.000	1,082
Non-rice income	-0.340ns	0.615	0.581	1,091
Farming contract	1.473*	0.631	0.021	1,070
Credit access	0.038ns	0.647	0.953	1,102
Collective pump	2.526**	0.635	0.000	1,040
(Constant)	77.083**	2,218	0.000	

Number of observations: 200; R²: 31,8%
ns: insignificant *: significant at ≤ 0.05, **: significant at ≤ 0.01

These findings robustly advocate for the development of a predictive model utilizing a linear regression approach. This model incorporates the six significant variables—education, cooperative membership, farm diary usage, farm size, farming contract participation, and collective pump usage—to forecast SRP scores. The equation is presented as follows:

$$Y=77.083+0.19(\text{education})+2.655(\text{cooperative})+1.972(\text{farm diary})+0.394(\text{farm size})+1.473(\text{farming contract})+2.526(\text{collective pump})+e$$

This formula underscores the positive influence of these six variables on SRP scores. Specifically, higher education levels correspond to a predicted SRP score increase of 0.19 points for each educational level, assuming other factors remain constant. Smallholder farmers in cooperatives are projected to have a 2.655-point higher predicted SRP score compared to non-cooperative counterparts, controlling for other factors. Similarly, maintaining farm records corresponds to an expected 1.972-point SRP score increase, with other variables held constant. Furthermore, every additional hectare in farm size leads to a 0.394-point predicted SRP score increase under constant variables. Involvement in farming contracts is linked to a predicted SRP score rise of 1.473 points, with consistent variables. Additionally, rice farms situated in areas where collective pumps are utilized for irrigation are projected to achieve a predicted SRP score that is 2.526 points higher compared to those not using collective pumps.

4. Discussion

4.1 Limiting Factors in Achieving Thresholds and SRP Scores for Sustainable Rice Production

Sustainable rice production has gained prominence due to its safety, environmental friendliness, and traceability (Dung, Van Hai, & Hiep, 2018; Maraseni, Deo, Qu, Gentle, &

Neupane, 2018). Analysis of 200 farmer households engaged in rice production based on SRP standards in an Giang and Dong Thap provinces reveals that all farmers achieved scores indicative of a sustainable rice production trend, with 12% meeting the standard for sustainable rice production. These findings underscore the feasibility of applying SRP standards in the Mekong Delta, aligning with the strategic goals of the Ministry of Agriculture and Rural Development of Vietnam (MARD & D., 2021). Government support and technology transfer initiatives further contribute to enhancing SRP standards' implementation (R. Paris & Chi, 2005; Thanh & Duong, 2021; Trang & Napasintuwong, 2016). Noteworthy similarities between SRP standards, VietGAP standards (Huy & Quang, 2019), and 1P5G techniques indicate a high likelihood of farmers in the Mekong Delta adopting SRP standards.

Three themes, namely "field management," "nutrition management," and "harvesting and post-harvest," exhibit high correlations with farmers' techniques, emphasizing the need to guide and support farmers in transforming their approaches to promote sustainable rice production.

However, nine requirements, including stubble and straw management, organic fertilizer selection, pest management, diary record-keeping, re-entry time after spraying, harvesting tools, personal protective equipment, and community irrigation systems, have failed to meet the set thresholds, impeding the attainment of sustainable rice production (Fig. 5).

4.1.1 Stubble and Straw Management

Effective straw and stubble management, crucial for sustainable rice production, faces challenges rooted in traditional practices such as burning, causing adverse impacts like soil organic matter depletion and greenhouse gas emissions (Mandal et al., 2004). Farmers often view burning as a convenient weed and pest control method (Huy & Quang, 2019; Phụng, Khiêm, Hùng, Alex Stuart, & Singleton, 2020), highlighting the necessity of raising awareness about its negative consequences. Encouraging alternative methods, such as straw collection systems or models involving livestock farming or mushroom cultivation, becomes imperative to reduce straw burning practices (Nam, Ingvorsen, Như, Chiếm, & Ngân, 2014).

4.1.2 Organic Fertilizer Selection

Farmers, particularly in An Giang province, face challenges meeting the threshold for organic fertilizer choice, primarily due to inconsistencies in green manure performance and labor-intensive operations (Becker, Ladha, & Ali, 1995). Labor shortages resulting from rural out-migration, a prevalent issue in the Mekong Delta, make the use of self-composted fertilizers impractical. Consequently, the mandate for organic fertilizer application may require modification to align with the practical constraints of rice production in the region.

4.1.3 Pest Management

Increasingly complex and variable pests and diseases, coupled with limited knowledge of pest management and changing labor structures, contribute to pesticide overuse among farmers (Phương, Trúc, Tín, & Duyên, 2016; Sơn, Tín, & Sánh, 2013; Tín, Sơn, Sánh, & Duyên, 2015). Educational investments, particularly through farmer field schools emphasizing Integrated Pest Management (IPM), are essential to enhance pest management practices (Rejesus & Jones, 2020; Van den Berg & Jiggins, 2007).

4.1.4 Information Keeping

Information keeping requirements face challenges associated with farmer education levels and

habits, indicating a broader difficulty observed in previous studies(Lam, Son, Van Doan, & Tuan, 2023; Thúy, An, & Tú, 2014). Active promotion of the benefits of record-keeping, regular training, and potential incentives, such as awards for exemplary record-keeping, are crucial to foster farmer engagement in maintaining farm records (Omotesho, Fatodu, & Ajibade, 2022). Additionally, integrating digital solutions, such as farm diary apps, holds promise in enhancing record-keeping practices (Park, Joe, Hong, & Park, 2015).

4.1.5 Re-Entry Time after Pesticide use

Re-entry time compliance after pesticide use is challenging for farmers, attributed to their habits and lack of attention (Thúy et al., 2014). Addressing this challenge requires strategies to increase farmers' awareness and establish alternative habits regarding field visits.

In conclusion, addressing these limiting factors requires tailored interventions and educational initiatives to align farmer practices with SRP standards, ultimately promoting sustainable rice production in the Mekong Delta.
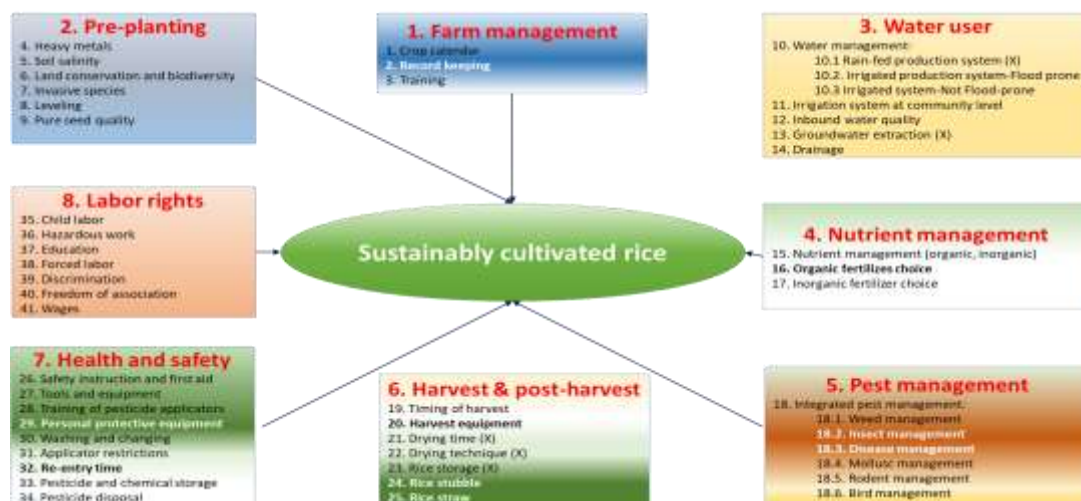

Fig 5. Themes and Requirements for Sustainably Cultivated Rice in the Mekong Delta.
Suitable and need intervention to improve
Not suitable and need to be modified
X: not available in the Mekong Delta because rice grains are sell directly in the field after harvest

4.2. Factors affecting the implementation of rice production according to SRP standards

The linear regression analysis conducted in this study reveals that six key factors significantly influence the SRP score, indicating the extent to which farmers adhere to sustainable rice production practices. These factors are (1) educational level, (2) rice farm size, (3) cooperative membership, (4) diary record-keeping, (5) collective irrigation, and (6) consumption linkage.

4.2.1 Educational Level and Rice Farm Size

Farmers cultivating larger rice farm sizes exhibit higher SRP scores, aligning with findings in prior studies (Connor et al., 2020; Kim Dang et al., 2021). This correlation underscores the inclination of farmers with larger cultivation areas to adopt advanced techniques. Moreover, higher educational levels of household heads positively contribute to elevated SRP scores. However, the Mekong Delta region faces a challenge as farmers generally possess low

educational attainment, with most having completed only secondary school (Connor et al., 2021; Trang & Napasintuwong, 2016).

4.2.2 Cooperative Membership

Participation in cooperatives emerges as a significant factor, with cooperative members attaining 2.65 points higher SRP scores compared to non-cooperative farmers. This finding resonates with earlier researches (Pham & Napasintuwong, 2020; Tu et al., 2018). Farmers engaged in cooperatives gain enhanced access to information on new techniques, fostering active application of these innovations (Tu et al., 2018). Government support for cooperatives, exemplified by Decision No. 1804/QD-TTg (October 13, 2020) and Decision No. 01/QD-TTg (January 3, 2023), further underscores the commitment to cooperative growth.

4.2.3 Diary Record-Keeping

Utilizing diary records positively correlates with higher SRP scores, as it is a mandatory condition in contemporary rice production standards, ensuring traceability. However, this practice presents a current challenge for Mekong Delta farmers. When coupled with cooperative participation, diary record-keeping strengthens cooperation between farmers and other sectors, facilitating the application of new technologies (Pham & Napasintuwong, 2020; Trang & Napasintuwong, 2016).

6. Conclusion

The study's results highlight a commendably high mean SRP score among surveyed farmers (84.7 points), with no farmer falling below the standard indicative of working toward sustainable rice cultivation. However, weaknesses exist across five SRP themes: "farm management," "nutrient management," "harvest and post-harvest," and "health and safety."

Nine SRP standard requirements pose challenges for farmers to meet threshold scores, including aspects like rice stubble, rice straw, organic fertilizer choice, and disease management, insect management, record keeping, re-entry time, harvest equipment, and personal protective equipment.

The six influential factors shaping SRP scores—educational level, rice farm size, cooperative membership, diary record-keeping, collective irrigation, and consumption linkage—underscore the multifaceted nature of the determinants of sustainable rice production practices in the Mekong Delta. Addressing these factors requires tailored interventions, educational initiatives, and strategic collaborations to propel the region toward more sustainable and resilient rice production practices.

Abbreviations

FAO: Food and Agriculture Organization

GIZ: German Corporation for International Cooperation

IRRI: International Rice Research Institute

OECD: The Organization for Economic Cooperation and Development

SRP: Sustainable Rice Platform

UNFCCC: United Nations Framework Convention on Climate Change

Declarations

Ethical Approval and Consent to participate

This study complied with the ethical standards of Vietnam, and Can Tho University, where this research was conducted.

Consent for publication

All authors have consented to the publication of this manuscript.

Competing interests

The authors declare that they have no competing interests.

Funding

Authors' contributions

LCB, TTN and THN planned and designed the research. LCB, TTN, THN, TKTN collected and analyzed the data. LCB, and TTN wrote and improved the manuscript. THN improved the manuscript, and THN supervised LCB's PhD study. All authors have read and approved the manuscript.

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