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PERCEPTION AND ADOPTION OF UPLAND CROPPING SYSTEMS IN SOUTH-EAST CAMBODIA

Persepsi Dan Adopsi Sistem Pertanaman Lahan Tinggi Di Kamboja Tenggara

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ABSTRACT

A survey was carried out to assess the opportunities and barriers for farmers to adopt intercropping and crop rotations in the uplands of Prey Veng and Svay Rieng provinces in South-Eastern of Cambodia. Survey methods with 37 respondents in Prey Veng and 39 respondents in Svay Rieng. Epidata Software was used to build a data entry template and the data was further exported into SPSS Software for final cleaning and analysis. Each province has differences in agricultural cultivation and crop types. Majority of agricultural land is owned by farmers in Prey Veng province at 78.4% and Svay Rieng province at 74.4%, while rental land is 21.6-25.6%. The practices of crop rotation and intercropping systems is very low, crop rotation at 5.1-13.5% and intercropping at 2.6-5.4%. Own land ownership and practices of crop rotation/intercropping in Prey Veng province are higher than in Svay Rieng province. Obstacles to the adoption of intercropping between provinces are different, in Svay Rieng Province are lack of access to irrigation, lack of access to markets, labor and credit; while in the province of Svay Rieng are small field size, lack of market, lack of

land ownership and lack of credit. In both provinces is the suitability of the technologies to the region and the high level of complexity. The barriers to adoption, especially lack of markets, labour and credit suggest the need for greater engagement of the private sector for the provision of advice and support.

Keyword: adaption, performance, perception, rotation-intercropping

ABSTRAK

Sebuah survei dilakukan untuk menilai peluang dan hambatan bagi petani untuk mengadopsi sistem tumpangsari dan rotasi tanaman di dataran tinggi Provinsi Prey Veng dan Svay Rieng di bagian Tenggara Kamboja. Metode survei dilakukan dengan 37 responden di Prey Veng dan 39 responden di Svay Rieng. Perangkat lunak Epidata digunakan untuk membangun template entri data dan data selanjutnya diekspor ke Perangkat Lunak SPSS untuk pembersihan dan analisis akhir. Setiap provinsi memiliki perbedaan dalam budidaya pertanian dan jenis tanaman. Mayoritas lahan pertanian dimiliki oleh petani di Provinsi Prey Veng sebesar 78,4% dan Provinsi Svay Rieng sebesar 74,4%, sementara lahan sewaannya adalah 21,6-25,6%. Praktik rotasi tanaman dan sistem tumpangsari sangat rendah, rotasi tanaman sebesar 5,1-13,5% dan tumpangsari sebesar 2,6-5,4%. Kepemilikan lahan sendiri dan praktik rotasi tanaman/tumpangsari di Provinsi Prey Veng lebih tinggi daripada di Provinsi Svay Rieng. Hambatan untuk adopsi tumpangsari antar provinsi berbeda, di Provinsi Svay Rieng adalah kurangnya akses ke irigasi, kurangnya akses ke pasar, tenaga kerja, dan kredit; sedangkan di Provinsi Svay Rieng adalah ukuran lahan kecil, kurangnya pasar, kurangnya kepemilikan lahan, dan kurangnya kredit. Di kedua provinsi, kesesuaian teknologi dengan wilayah dan tingkat kompleksitas yang tinggi menjadi hambatan. Hambatan-hambatan untuk adopsi, terutama kurangnya pasar, tenaga kerja, dan kredit, menunjukkan perlunya keterlibatan lebih besar dari sektor swasta untuk memberikan saran dan dukungan.

Keyword: adopsi, kinerja, persepsi, rotasi-tanaman

INTRODUCTION

Production of upland crops such as maize, cassava, soybean, mungbean, peanut and sesame contribute importantly to Cambodia's economy and food security, especially for those who live in the upland areas found in almost every province of Cambodia (Touch et al., 2020) Upland crop production has played an important role in contributing to household incomes in upland areas of Cambodia, accounting for about 4% of national GDP (Sopheap, Patanothai, & Aye, 2012). As the self-sufficiency in rice production has already been achieved, Cambodia is in a position to boost production of upland crops, to help improve rural household incomes, in line with the development policies of the government.

Between 2004 and 2012, the annual growth in agricultural gross production was 8.7 percent. Agricultural value added grew by 5.3 percent during this period. Compared with paddy rice (annual growth of 9%), maize production grew by 20% and cassava (51%) (World Bank, 2015). In several areas, cassava is being developed on a large scale, because the commodity acts as a food buffer, is easy to cultivate and easy to market. However, in the last 5 years there has been a decline in production from 23.18 ton.ha-1 in 2015 to 20.57 ton.ha-1 in 2019 (Ministry of Planning, 2021). In 2019, Cambodia produced around 13 million tons of cassava, slightly dropping to over 12 million tons in 2020 (Martin, 2023). This occurs due to the continuous monoculture cassava cultivation system, inadequate technical culture, such as lack of fertilization and use of local varieties (Martin, 2023; Beban & Gironde, 2023). Cassava plants with large tuber production are known to take up soil nutrients equivalent to the yield of harvested tubers (Howeler, 2014), if fertilization is not carried out there will be a decrease in soil fertility. Peuo et al. (2021) found that the decline in cassava productivity in Cambodia was due to poor knowledge of new techniques to increase productivity. Farmers did not know which variety was suitable for their specific agro-ecology, climate change conditions (increase in pests, diseases, and drought), and soil nutrient depletion. Poor management of cassava cultivation results in serious soil degradation. When cassava harvested and taken from the field, causing loss of nutrients in the soil. When cassava is grown for years in the same fields without the application of chemical fertilizers or manure, yields are likely to drop due to nutrient depletion (Howeler, 2014). During 4 consecutive years of cassava cultivation, root yield decreased from 18.9 t/ha in the first year to 6.4 t/ha, or only 34% of the first-year yield (Siem, 1992).

Putthacharoen et al. (1998) report loss of dry soil due to erosion of a number of crops grown on a 7% slope in Sri Racha, Thailand, over a 4-year period; Soil loss due to erosion by planting cassava for root production averages around 75 t/ha/year, maize, sorghum, and peanuts averages 15−20 t/ha/year, and pineapples only 13 t/ha/year. Cassava grown for forage production is planted at a closer distance resulting in faster canopy cover, but the average is still around 50 t/ha/year. The wider spacing of cassava and the slower formation of crowns results in more soil being exposed to rain resulting in more soil loss due to erosion. This high rate of soil loss also means high loss of soil nutrients (Howeler, 2001); this can be as high as, or higher than, that removed annually with harvested roots. Nutrient losses in runoff were found to be quite low for N and P, but still large for K (Phomasack, Sengtaheuanghung, & Phanthaboun, 1996). Erosion severely affects soil fertility, often resulting in infertile highly acidic conditions and very compacted soil layers, or—in soils derived from limestone—calcareous layers of soil that can cause severe micronutrient deficiencies. Cassava grown in heavily eroded

soils will have lower yields and may require large fertilizer inputs to achieve the same yields as those in non-eroded soils even without fertilizer application.

Efforts to maintain soil productivity and fertility can be achieved through various efforts, including through improvements to the intercropping planting system and crop rotation. Intercropping is a widespread cropping system to increase land productivity and decreases soil erosion. (Ouyang et al., 2017). Much research has shown that there is generally a trend toward higher yield under intercropping and crop rotation (Legodi & Ogola, 2020; Cenpukdee & Fukai. 1992; Honeycutt et al. 1995; Mohler, 2019; Tanveer et al., 2019; Thomas et al., 2017; Mohler, 2019).

Crop rotation strategies have been shown to improve agricultural sustainability (Li et al., 2021a, Li et al., 2021b), providing a trade-off between crop productivity and other ecosystem services (Martin-Guay et al., 2017; Jensen et al., 2000; Mingotte et al., 2021). The future potential of upland crop production in Cambodia will reflect farmers' perceptions of crop rotation and intercropping compared to other alternative farmer practices. Therefore, knowledge about farmers' perceptions regarding crop rotation and intercropping compared with other practices is important to determine appropriate strategies for promoting upland crops and the transfer of better production technologies for sustainable upland crop production systems. Currently, this information is unknown.

The success of implementing intercropping and monocropping planting systems as well as improving crop cultivation is influenced by agricultural cultural factors, facilities and infrastructure, farmers' perceptions and motivation. Prey Veng and Svay Rieng Province in South-east Cambodia as a potential area for the application of intercropping and rotation of cassava; however, the perceptions and motivations of farmers in accepting and implementing this technology are not yet known. Research on perceptions and barriers to implementing intercropping and rotation needs to be carried out to anticipate preparations and implementation failures later.

The main objectives of this research are to assess the performance and perception of Cambodian farmers on growing upland rotation and intercropping in southeast region of Cambodia.

RESEARCH METHOD

Target Area

The study was carried out in Prey Veng and Svay Rieng provinces which are located in the South-eastern part of Cambodia (Figure 1). Prey Veng province is located on the east bank of the Mekong River and is one of the largest rice producing regions in Cambodia. Svay Rieng province is located on

Cambodia's South-Eastern border with Vietnam, 125 km from Phnom Penh capital.

Figure 1.
Map of the study areas, Prey Veng and Svay Rieng provinces

Prey Veng is a rather quiet Cambodian province that just happens to have one of the countries' busiest highways running straight through it -National Highway No 1, which links Phnom Penh and Ho Chi Minh City in Vietnam. It is a small but heavily populated agricultural region located on the eastern banks of the Mekong River. The name of the province literally means 'tall forest', but this does not refer to its current state, as most of the forests in the province were destroyed over the past 30-50 years. Prey Veng province is bordered by the provinces of Kampong Cham to the northwest, Tbong Khmum to the northeast, Kandal to the west, and Svay Rieng to the east, and by Vietnam to the south. It is crossed by two major rivers, the Mekong and Tonle Bassac. The total land area of the province is 4,883 km², which equals 2.7% of the total land area of Cambodia (181,035 km²). This consists of 445.18 km² (9.12%) of human settlements, 3,100 km² (63.49%) of agricultural land, 194.61 km² (3.99%) of forest land, 1,082.86 km² (22.18%) of public land, infrastructure and water bodies. The remaining 60.35 km² (1.24%) is comprised of unused areas (Figure 1).

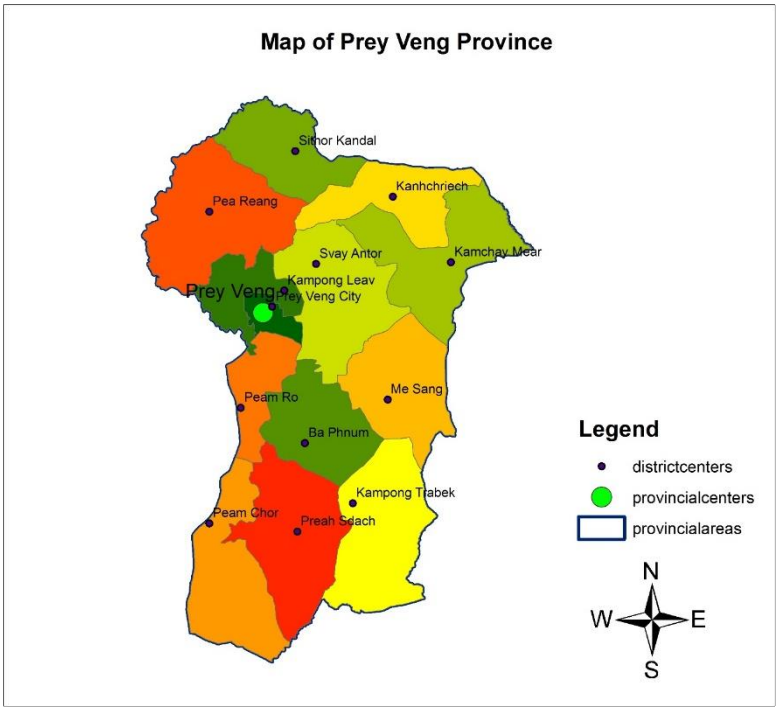

Figure 2.
Map of Prey Veng provinces

The total population of Prey Veng province was recorded as 947,357 persons (or 7.07% of the total population of 13,388,910 of Cambodia). The above number is divided among 80.54% farmers, 13.72% fishermen, 4.35% traders, and 1.39% government officials. The average density is 194.0 person per km². The majority of the population of Prey Veng province is of Khmer origin, and only 1.13% are from ethnic minorities such as Kinh (Viet), Muslim Chams or Lao. The province boasts of silt being deposited in each flood that helps make the region conducive to agriculture and fishing. It is part of what is called the "great green belt" of Cambodia. The main crop is rice and the province has the largest area devoted to rice in the country, contributing about 10% in the national crop. Prey Veng and is among the provinces with an annual rice surplus. Tobacco, mungbeans, sugarcane, palm sugar, cassava, sesame and fruits such as coconuts, mangoes and cashews, are also grown in Prey Veng province. However, despite its agricultural base, Prey Veng province is one of the least wealthy areas of Cambodia. The rate of people living below the poverty line is around 53%, 36% below the national average. In addition, its net migration is negative, reflecting the movement of people from their homelands to other locations to find other means of subsistence.

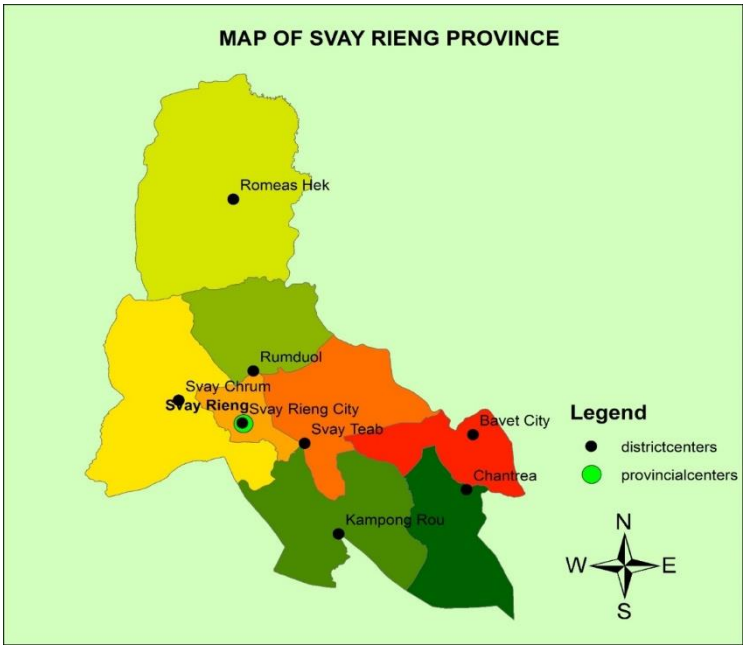

Figure 3.
Map of Svay Rieng Provinces

Svay Rieng province is located in the south eastern part of the Kingdom. It is bordered to the north and west by Prey Veng province, and to the south and east by Vietnam. The area of the province is 2,966 square kilometers. The capital of the province is Svay Rieng town, which is connected to the capital, Phnom Penh, by National Highway No 1, which links Phnom Penh with Ho Chi Minh City in Vietnam. Svay Rieng is also one of the poorest provinces of Cambodia due to the poor quality of the land. Most of the provincial population have a subsistence living based on farming and fishing. The territory of Svay Rieng is divided into eight districts, and each district is subdivided into 5 to 16 communes (Figure 3). The economy of the province can be measured by the number of commercial establishments and the number of persons engaged in commerce, as well as by total annual sales, annual expenses, and annual profit. According to the 2011 Economic Census, Svay Rieng was ranked eleventh in annual sales as well as in annual expenses among 24 provinces, followed by Kampong Thom Province with annual sales of 195 million US dollars and Kampong Chhnang with annual expenses of 159 million US dollars (Ministry of Planning, 2011).

Research Methods

The research was conducted using a survey method among selected respondents. Samples for the survey selected from the two districts in Prey Veng Province (Kamchaymear and Sithorkandal) and one districts in Svay

Rieng Province (Romeas Heak). There are 76 respondents collected in this research with 37 respondents in Prey Veng and 39 respondents in Svay Rieng (Tabel 1). The criteria for selecting the 76 households were the farmers have experience and own land to plants maize, cassava, peanut, mungbean and soybean.

Table 1. Place And Number Of Respondents Involved In Research On Perceptions And Adoption Of Upland Cropping Systems

No	Province	District	Commune	Number Of Respondents	Total Of Respondent
1	Prey Veng	Kamchaymear	Krobov	12	37
		Sithorkanda	Phnov1	25	
2	Svay Rieng	Romeashek	Koki	27	39
			Dong	12	
	Total				**76**

Source: Primary Data (2023)

The survey was conducted throughout January-April 2023. The survey was carried out by visiting respondents' house or land, conducting face-to-face interviews, and filling out questionnaires directly. To ensure representativeness and accuracy of the data, the survey employed both quantitative and qualitative methods which allowed information from both approaches to be cross-checked. From the quantitative side, the questionnaire tool was designed to accommodate individual interviews with upland crop cultivating households in the target area. A questionnaire involving, about 5 parts of Famers Identification, Upland Production, Extension Services, and Demographics. The questionnaire contains both typical and critical questions ranging from the general bio-data to the status of upland crop production, adaptation of cropping system, performance and perception of the farmer conditions.

Data Analysis

Data sourced from filling out questionnaires is tabulated using a data entry template. Data were analyzed using basic statistical procedures including frequencies, cross tabulations, multiple responses, and numerical descriptive statistics. Several variables were paired T-tested with SPSS software. Furthermore, the data that has been analyzed is presented in the form of tables and diagrams.

RESULT AND DISCUSSION

Agricultural Culture In The Province

Research was conducted in 2 provinces in Southeastern Cambodia, namely Prey Veng: Latitude 11o29'11" N; 105o19'41" E and (b) Svay Rieng: Latitude 11o09'28" N; 105o49'29" E. From Prey Veng Province, 12 Respondents came from Krobov Village, Kamchaymear and 25 Respondents from Phnov1 Village, Sithorkanda commune; while from Svay Rieng Province, 27 respondents came from Koki Village, and 12 people from Koki Village, Romeashek commune. Total respondents were 76 people.

The average age of respondents was 52 in both Prey Veng and Svay Rieng provinces and the proportion of female interviewees was 38% in both provinces, dominated by farmers over 50 years old. (Table 1)

Table 1. Education, Age, And Gender Of Respondents Involved In Technology Adoption In Prey Veng And Svay Rieng Province, Cambodia

Variable	Prey Veng (%)	Svay Rieng (%)
Education		
Eelementary school	14	8
Yunior High School	38	44
Senior High School	32	36
University	16	12
Age (years old)		
<25	13	8
25-50	32	36
>50	56	56
Gender: Man	62	62
Female	38	38

Source: Primary Data (2023)

The crops grown by the surveyed farmers included bamboo, cashew, cassava, maize, mungbean, peanut, rice, rubber, sesame, soybean, stylo and sweet potato. The average number of crop species grown per farm was 2.4 with more diversity in Prey Veng (2.8) compared to Svay Rieng (2.0). The main crop species grown in Prey Veng were peanut, maize, sesame, rice and mungbean, whereas the main crops grown in Svay Rieng were cassava, cashew and rubber (Figure 4). At Prey Veng, 19% of farmers grew modern varieties whereas at Svay Rieng almost zero farmers grew modern varieties.

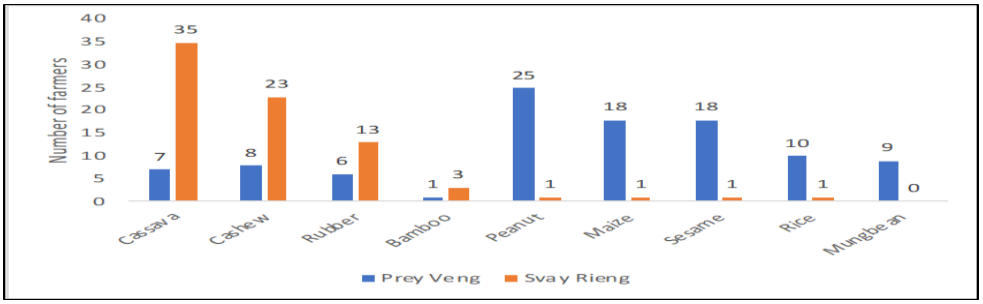

Figure 4.
Comparison Between Prey Veng And Svay Rieng For The Nine Main Crop Species Grown

The differences between provinces for area of individual crops grown was significant for all species except bamboo according to Fisher's exact test at $p<0.05$. Survey farms in both Prey Veng and Svay Rieng are on Prey Khmer soil group has a sandy textured profile that can extend deeper than 50 cm (White et al., 1997). The reason for the difference in crops grown in the two areas is that the depth of sand in the profile is greater in Svay Rieng compared with Prey Veng (Hin pers. Comm.) and this might limit crop diversification options in both provinces.

At Prey Veng, the average area for crop species was 0.9% which was slightly less than at Svay Rieng (1.2 ha). The area per crop was greater at Svay Rieng for all crop species except mungbean and maize (Figure 5). The area of cassava and rice decreased in 2023 compared to the average in both Prey Veng and Svay Rieng (Figure 5). The area of cashew and rubber increased in Prey Veng in 2023 but decreased in Svay Rieng.

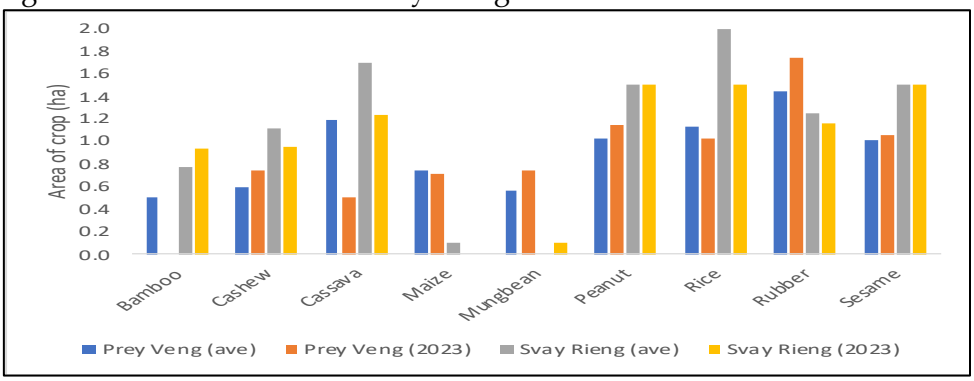

Figure 5.
Comparison Between Prey Veng And Svay Rieng For The Area Per Main Crop Species Grown On Average Compared With The Most Recent Year, 2023 (Ha)

In Prey Veng, the crops grown for the longest time were sesame, peanut, mungbean, maize and rice. More recently, Prey Veng farmers have begun to grow cashew, rubber and bamboo. Cassava was grown only from 2016 to 2019 (**Figure 6**). At Svay Rieng, the crops grown for the longest time were sesame, peanut, cassava and bamboo. Crops grown more recently at Svay Rieng were maize, rice cashew and rubber. These results suggest that farmers are beginning to shift to more sustainable cropping systems.

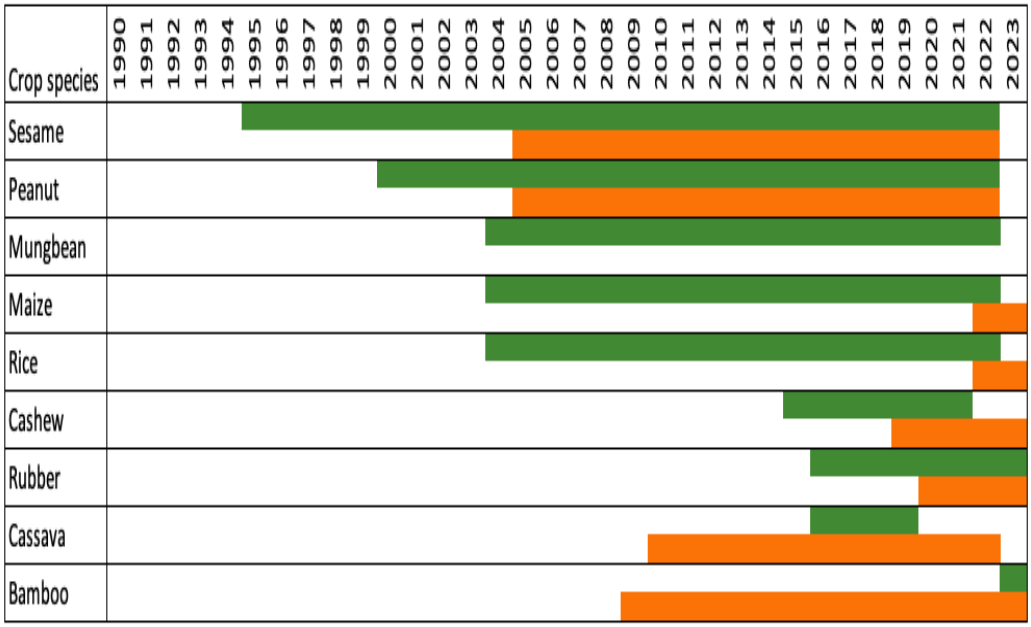

Figure 6.
Starting and ending year for the nine most important crop species

Most of the crop production in these two provinces can be sold directly and then stored and collected for sale and then waiting for a good price; and varies from each crop. At Prey Veng, 100% of cassava, mungbean, rice and sesame were sold whereas less was sold for rubber (50%), cashew (49%). Maize (38%) and peanut (32%). In contrast much less produce was sold in Svay Rieng with only three crops being sold, cashew (77%), rubber (44%) and cassava (29%).

Apart from cassava, the majority of farmers in Svay Rieng Province grow parennial crops (Rubber and cashew) while in Prey Veng Province they plant seasonal crops (peanut, maize, sesame, rice and mungbean). Cassava, cashew, rubber and bamboo are planted continuously. Farmers' experience in growing annual crops in Svay Rieng Province is low. This is a societal culture that can hinder the adoption of rotational cropping and intercropping technology. The average age of farmers is 52 years and 38% women, which is a good condition for technology adoption. The estimation results of the ESR model show that

plots managed by women are 14.6–23.1% less productive than plots managed by men. Female land managers are more likely to apply intercropping and minimum tillage, while male managers tend to apply rotation and high yielding varieties; The productivity of land managed by men is better than that managed by women (Tufa et al., 2022). The level of adoption of modern agricultural technology by women is low (Radovic-Markovic, Kabir & Jovicic, 2020). As farmers get older, they participate more and/or adopt better farming technologies as they gain experience (Adams & Jumpa, 2021; Mignouna et al, 2011; Kariyasa & Dewi 2011).

Advice or training on intercropping or crop rotation

Interviewees were asked "has there been an agricultural extension services for intercropping and crop rotation in this area before". Overall, only 25% of respondents reported that they had received advice or training on intercropping or crop rotation (Figure 7).

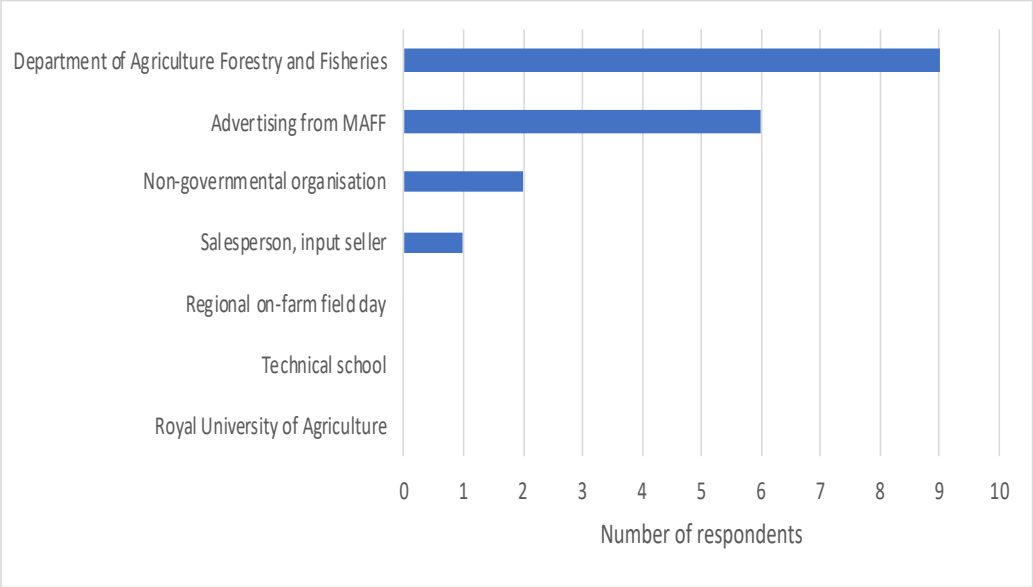

Figure 7.
Number of Respondents Receiving Advice or Training on Intercropping or Crop Rotation

There is a close relationship between the average level of education and training of the population, and, the spread of new technologies. Farmers with a high level of education can study independently; However, for farmer with low education, technology adoption can be done through training (Bucciarelly, Odoardi & Muratore, 2023). In these two provinces, the level of training is

relatively low, so further training and outreach is needed to increase farmers' understanding and adoption of crop rotation and intercropping technology.

The survey results show that the majority of agricultural land is owned by farmers in Prey Veng province at 78.4% and Svay Rieng proving at 74.4%, while rental land is 21.6-25.6%. The practices of crop rotation and intercropping systems is very low, crop rotation at 5.1-13.5% and intercropping at 2.6-5.4%. Own land ownership and the application of crop rotation/intercropping in Prey Veng Province are higher than in Svay Rieng Province (Table 2). The low number of crop rotation and intercropping practices is equivalent to the number of farmers who receive training and socialization on these technologies. These results are in accordance with previous studies, agricultural extension interventions provide mixed results, with a range of technology adoption unchanged to 65% (Awotide et al., (2016); Ghimire et al., (2015); Kadigi, et al., (2004); Kato, 2019).

Table 2. Land ownership and intercropping/rotation system practices in Prey Veng and Svay Rieng Province

No	Land Ownership And Cropping System Practices	Province		Average (%)
		Prey Veng (%)	Svay Rieng (%)	
1.	Owned	78,40	74,40	76,40
2.	Rented	21,60	25,60	23,60
3.	Crop Rotation	13,50	5,10	9,30
4.	Intercropping	5,40	2,60	4,00
5.	Crop rotation and intercropping	5,40	2,60	4,00

Source: Primary Data (2023)

Land ownership in these two provinces is relatively good. Land ownership influences technology adoption by farmers, because land owners tend to be able to invest or allocate needs that must be met in technology adoption (Abdulai et al. (2011); Oostendorp and Zaal (2012)). However, research by Zeng et al. (2018) found that land-tenant farmers can also adopt corn variety technology with a profit orientation. With high levels of land ownership, the adoption of new technology will not cause problems in these two provinces

Barriers to the adoption of intercropping and crop rotation technologies

The average age of respondents was 52 in both Prey Veng and Svay Rieng provinces and the proportion of female interviewees was 38% in both provinces. All respondents are farmers.

Respondents were asked "are there any barriers to adopting new technology of this mixed cropping and rotation?". In Prey Veng, respondents cited lack of access to irrigation as the most important barrier to adoption of mixed cropping and crop rotation. Also important was lack of access to markets, labour and credit were important barriers to adoption in Prey Veng (Figure 8). In Svay Rieng province, the most important barrier to adoption was small field size, lack of market, lack of land ownership and lack of credit. Other barriers for both provinces were questions about the suitability of the technologies to the region and the high level of complexity.

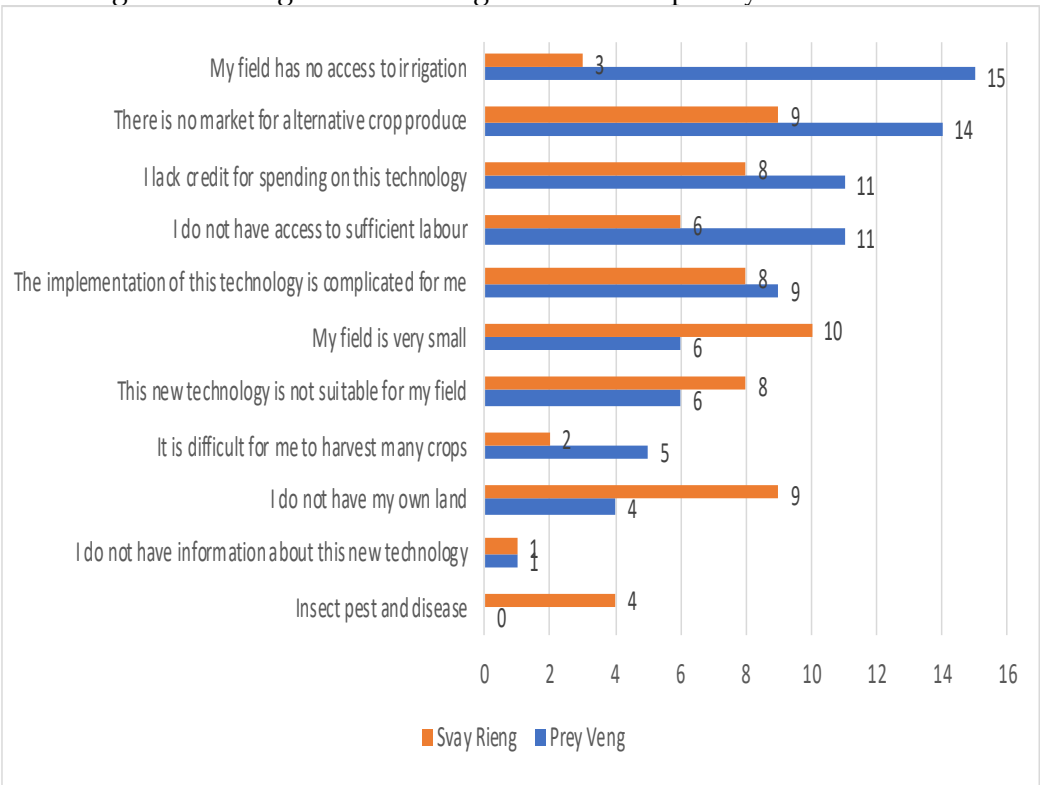

Figure 8.
Barriers to Adopting New Technology of Mixed Cropping and Rotation Cited By Respondents

Respondents were asked "do you think you will plant mixed crops or rotation crops next year and afterward". In response, 68% of Prey Veng and 56% in Svay Rieng province said they would plant more mixed and rotation crops.

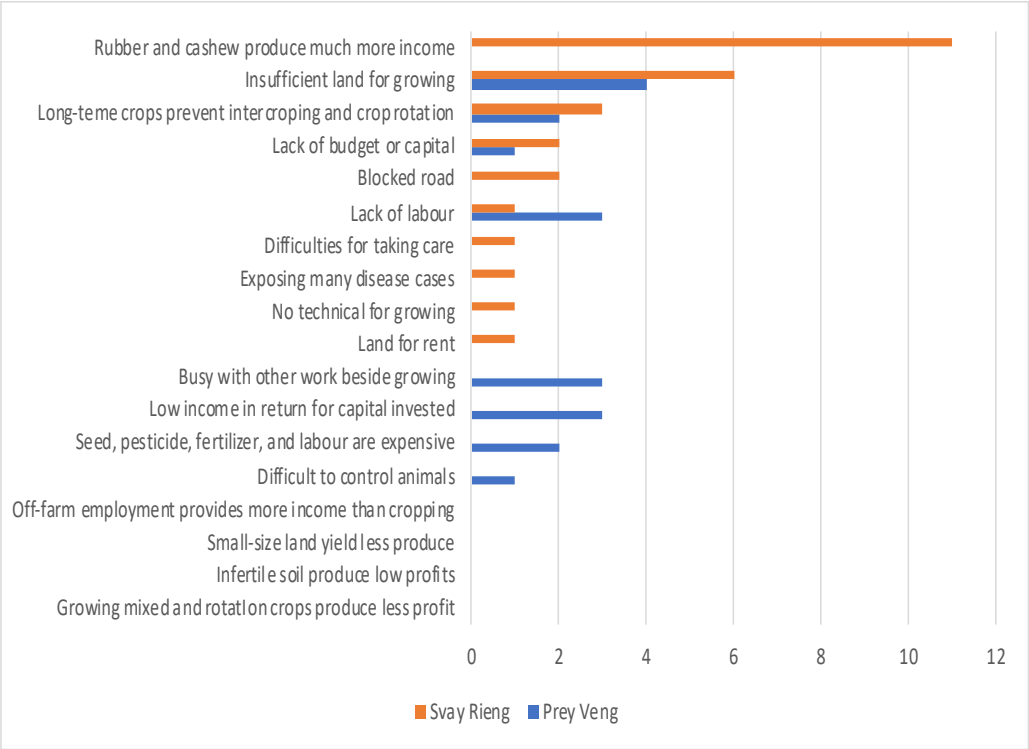

Figure 9.
Comparison of Reasons Given For Not Planting Mixed and Rotation Crops In Prey Veng And Svay Rieng Provinces

The reasons given for not planting more mixed and rotation crops in Svay Rieng were to do with production of perennial crops such as rubber and cashew, lack of capital and road access. In Prey Veng, reasons given were insufficient land, lack of labour, off-farm employment and low returns on capital (Figure 9).

Farmers were asked "in your opinion, what do you think about the mixed crops and rotation crops" with 28 questions (Figure 10). Increasing family income was the most important reason for crop diversification in both Prey Veng and Svay Rieng. Using land to its best capacity, provision of income in all seasons and increased soil fertility were also important reasons in both provinces.

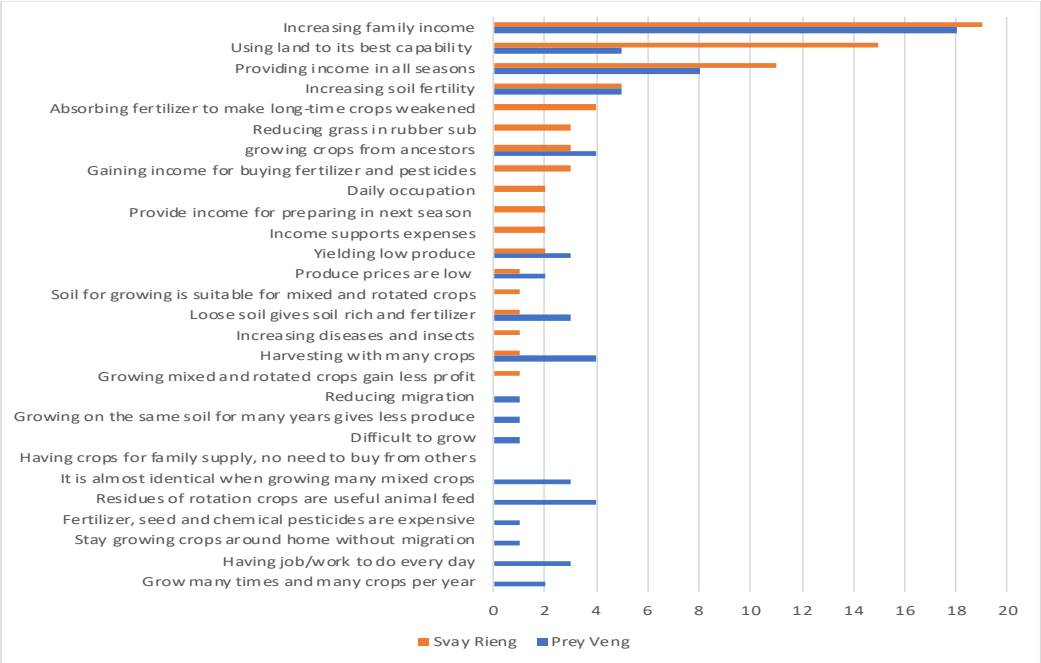

Figure 10.
Comparison of Reasons Given For Adopting Mixed and Rotation Crops In Prey Veng And Svay Rieng Provinces

The response from Prey Veng (68%) and Prey Veng (56%) farmers was quite good regarding the desire to adopt crop rotation and intercropping. residents in Svay Rieng province say they will plant more mixed and rotational crops. Their main reason is an increase in family income. Adoption of this technology is also influenced because farmers have different land size. This is in accordance with research that agricultural technology adoption is influenced by age, gender and farm size (Lavison, 2013; Mignouna et al., 2011; Mwangi & Kariuki, 2015); extension access, extension visits, awareness. Begho et al. (2022) found that that education, extension and training, soil quality, irrigation, income and credit are significant driving factors in farmers' adoption decisions. The results of rotational and intercropping crop experiments in these two areas produced better harvest quantities and economic value compared to monocropping and continuous cropping systems, which can be used as a driving factor for technology adoption by farmers.

Survey respondents described important barriers to adoption of intercropping and crop rotations despite the benefits reported in the literature. Important barriers to adoption included lack of access to markets, labour and credit. Lack of access to irrigation and small farm size were also cited as barriers to adoption. Only 25% of respondents reported that they had received advice or training on intercropping or crop rotation, mainly through

government agencies. The barriers to adoption, especially lack of markets, labour and credit suggest the need for greater engagement of the private sector for the provision of advice and support. This could be achieved by engagement of input sellers. For example, input sellers provide credit for purchase of inputs and can also guarantee buy back of produce. Akudugu, Guo & Dadzie (2012) grouped the success of agricultural technology adoption as influenced by economic, social and institutional factors. Another factors are technology and household-specific (Mwangi & Kariuki, 2015). This can be overcome if farmers have institutions that will regulate, provide education and overcome problems in implementing technology adoption.

The results of this study are different from the cases of Nigerian farmers (Abaca et al., 2021), there are gaps in the implementation of cassava variety development which must be in accordance with the attributes of the farmer's choice. The majority of farmers have difficulty getting access to information and the existence of superior varieties due to a lack of information dissemination.

CONCLUSION AND SUGGESTION

Conclusion

The majority of farmers in Svay Rieng Province grow cassava, cashew, rubber, and bamboo but in Prey Veng Province grow peanuts, maize, sesame, rice and mungbeans. Majority of agricultural land is owned by farmers in Prey Veng province at 78.4% and Svay Rieng proving at 74.4%, while rental land is 21.6-25.6%. The practices of crop rotation and intercropping systems is very low, crop rotation at 5.1-13.5% and intercropping at 2.6-5.4%. Own land ownership and practices of crop rotation/intercropping in Prey Veng province are higher than in Svay Rieng province. Obstacles to the adoption of intercropping between provinces are different, in Svay Rieng province are lack of access to irrigation, lack of access to markets, labor and credit; while in the province of Svay Rieng are small field size, lack of market, lack of land ownership and lack of credit. In both provinces is the suitability of the technologies to the region and the high level of complexity. Only 25% of respondents reported that they had received advice or training on intercropping or crop rotation, mainly through government agencies so this technology is not widely known to be implemented.

Suggestion

It is necessary to conduct field schools for farmers in increasing knowledge and skills to increase crop productivity through crop rotation and intercropping. Barriers to implementation, particularly lack of markets, labor and credit, point to the need for greater involvement of the private sector to provide advice and support, particularly through the involvement of input sellers. It is necessary to conduct research on the adoption of intercropping and crop rotation technology on plant productivity and soil fertility after improvements and fulfillment of barriers to technology adoption in the two provinces.

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