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Comparison of Feasibility and Profitability of Sugarcane Farming Between Cane Plant (PC) and Ratoon Cane (RC) in Lemahabang District, Cirebon Regency

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ABSTRACT

This study was conducted from May to June 2025 and aims to compare the feasibility and profitability of sugarcane farming between the *Plant Cane* (PC) and *Ratoon Cane* (RC) cultivation systems in Lemahabang District. The methods used include cost, revenue, and revenue analysis, as well as a number of economic indicators, namely Net Farm Income (NFI), Revenue-Cost Ratio (R/C), Benefit-Cost Ratio (B/C), Return on Investment (ROI), Break Even Point (BEP), and Net Profit Margin (NPM). The results of the analysis showed that RC farming has a lower average production cost and higher income than PC. The R/C (3.22), B/C (2.22), and high ROI on RC indicate that this system is economically more efficient and nominally profitable. However, the NPM for RC was negative (-18.74%), indicating the risk of losses to some farmers due to yield fluctuations or cost inefficiencies, while PC showed a positive NPM of 19.03%, reflecting the stability of profit margins. The results of the Mann–Whitney test showed that all indicators of feasibility and profitability differed significantly between the two systems ($p < 0.05$). Thus, RC systems are nominally superior but have higher risk, while PC systems are more stable in terms of profitability albeit with lower net profits. The selection of cultivation systems should be adjusted to the business objectives, managerial capacity, and risk tolerance of each farmer.

Keywords: Sugarcane, Plant Cane, Ratoon Cane, Farming Eligibility, Profitability.

INTRODUCTION

Sugarcane is a seasonal crop that is very suitable for cultivation in tropical climates (Rokhani et al. 2020). In addition to having high economic value, sugarcane is also a strategic commodity that supports farmers' income and supports national food security (Respati 2022; FAO, 2021). The area of sugarcane land in Indonesia is quite large, with East Java as the main production center contributing 47.34% to the total national sugar production in 2018–2022 (Respati, 2022). However, sugarcane productivity in various regions, including Cirebon Regency, still faces challenges, especially related to cultivation systems and cost efficiency (Saputro et al., 2021; Daryanto, 2012).

Sugarcane cultivation in Indonesia is generally carried out through two main systems, namely Plant Cane (PC) and Ratoon Cane (RC). Plant Cane is an early planting with new seedlings, requiring higher investment costs, but providing greater productivity potential as new plants tend to be disease-free and have better vigor (Evizal 2018). On the contrary, Ratoon Cane utilizes shoots from previous plants, so that it is able to reduce production costs by up to 20–25% compared to PC (Saputro et al., 2021). However, RC systems are at risk of a 10–20% decrease in productivity per cycle due to pathogen accumulation, decreased soil fertility, and other agronomic problems (Singh et al. 2021).

Farming feasibility analysis is an important step in agribusiness planning, as it involves a thorough evaluation of technical, financial, and production risk aspects (Hardaker et al.,

2004). Some of the financial indicators used include Net Farm Income (NFI), Benefit-Cost Ratio (R/C Ratio), Benefit-Cost Ratio (B/C), Return on Investment (ROI), and Break Even Point (BEP) (Gittinger, 1986; Issa et al. 2020). In addition to feasibility, farming profitability is also the main indicator of business sustainability, because it reflects the efficiency of farming in generating net profit from business income (Soekartawi, 2003; Walyupin et al., 2018)). Although PCs produce higher production, larger costs often make their profit margins not always better than RC's (Yuliandari et al., 2024). In making farming investment decisions, farmers not only consider profitability, but also business feasibility which includes aspects of cost, income, and risk in the long term (Dina et al. 2023). This shows the importance of comparative analysis between the PC and RC systems as a basis for consideration in increasing sugarcane farmers' income in a sustainable manner (Wijaya et al., 2021)

The research by Rokhani et al. (2020) highlights sugarcane as a seasonal crop suitable for cultivation in tropical climates, offering high economic value. However, this study does not delve deeply into the challenges faced in sugarcane productivity in specific regions, including Cirebon, which is the focus of this research. Similarly, Saputro et al. (2021) identified challenges in sugarcane cultivation systems and cost efficiency, but did not provide specific solutions regarding which system—Plant Cane (PC) or Ratoon Cane (RC)—would be more efficient. This study fills that gap by comparing the two cultivation systems (PC and RC), analyzing their feasibility and profitability, and offering recommendations for improving farmers' income in Cirebon sustainably. Additionally, Daryanto (2012) emphasized the need to increase sugarcane productivity in Indonesia, but did not explore the management of costs directly related to the different sugarcane cultivation systems. This study addresses that gap by applying financial feasibility analysis such as Net Farm Income (NFI), Benefit-Cost Ratio (B/C), and Return on Investment (ROI) to evaluate the profitability of the PC and RC systems, providing a clearer picture of the factors affecting investment decisions for farmers in the long term.

This study aims to analyze the differences in the feasibility and profitability of sugarcane farming between the Plant Cane (PC) and Ratoon Cane (RC) systems in Lemahabang District, Cirebon Regency. The results of this study are expected to be a reference in making decisions on optimal and efficient sugarcane cultivation strategies, both for farmers and related parties.

METHOD

This research was conducted from May to June 2025 in Lemahabang District, Cirebon Regency (West Java). This area was chosen deliberately (purposive) because it is a sugarcane production center in West Java with the implementation of PC and RC systems. The type of research is quantitative compared to the survey approach. Data was collected through questionnaires and structured interviews with sugarcane farmers using Plant Cane and Ratoon Cane. Sampling uses stratified proportional sampling based on cultivation systems (Sugiyono, 2017). The sugarcane farmer population consists of 41 Plant Cane users (28.3%) and 104 Ratoon Cane farmers (71.7%). With the Slovin formula (margin error of 10%), a sample of 60 respondents was obtained (allocation: PC n=17, RC n=43).

The instruments include agricultural economic variables, such as production costs (fixed and variable), crop yields (tons per ha), gross income, to the calculation of economic indicators (NFI, R/C, B/C, ROI, BEP, NPM). The analysis data was carried out descriptively (mean value, standard deviation, minimum-maximum value) and inferential. Before the comparison test, the data were tested for normality using the Kolmogorov–Smirnov ($n \geq 50$) and Shapiro–Wilk ($n < 50$) tests. Since not all variables are normally distributed, the Mann–Whitney U (non-parametric) test was used to test for significant differences between PC and RC on

feasibility and profitability indicators with a significant level of 5% (Nachrowi & Usman, 2006). The analysis was carried out with SPSS statistical software.

RESULTS AND DISCUSSION

Respondent Characteristics

The characteristics of the respondents are one of the important aspects of the study, as it can provide an overview of the background of the farmers who are the subject of the study. The characteristics observed included the number of respondents, age, length of farming, education level, and land area managed. A summary of the characteristic data is presented in Table 1 below:

Table 1. Respondent Characteristics

Characteristics	Plant Cane	Ratoon Cane
Number of Respondents	17	43
Age (years)	46,5	46,6
Long Farming (years)	8,5	10,1
Education (High School/Equivalent)	13	29
Land Area(Average)	7,1	7,3
Family dependents	3,5	4,2

Source : Primary Data, 2025

Based on this data, the majority of respondents in this study were farmers who used the Ratoon Cane (RC) system, which was 43 people (71.7%), while the users of the Plant Cane (PC) system were 17 people (28.3%). The average age of farmers in both systems was relatively the same, which was around 46 years, indicating that most of the respondents were in productive age, which was theoretically able to adapt to technological innovations and new cultivation systems.

Table 2. Frequency Age

	Age (years)				
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	28	1	1.3	1.7	1.7
	29	2	2.7	3.3	5.0
	31	2	2.7	3.3	8.3
	33	3	4.0	5.0	13.3
	34	2	2.7	3.3	16.7
	35	2	2.7	3.3	20.0
	36	2	2.7	3.3	23.3
	37	1	1.3	1.7	25.0
	38	1	1.3	1.7	26.7
	39	1	1.3	1.7	28.3
	40	1	1.3	1.7	30.0
	41	2	2.7	3.3	33.3
	42	5	6.7	8.3	41.7
	43	3	4.0	5.0	46.7
	45	5	6.7	8.3	55.0
	46	2	2.7	3.3	58.3
	47	1	1.3	1.7	60.0

Age (years)					
		Frequency	Percent	Valid Percent	Cumulative Percent
	48	2	2.7	3.3	63.3
	49	3	4.0	5.0	68.3
	51	2	2.7	3.3	71.7
	53	1	1.3	1.7	73.3
	55	1	1.3	1.7	75.0
	56	4	5.3	6.7	81.7
	58	3	4.0	5.0	86.7
	62	1	1.3	1.7	88.3
	63	1	1.3	1.7	90.0
	64	1	1.3	1.7	91.7
	69	1	1.3	1.7	93.3
	70	2	2.7	3.3	96.7
	72	1	1.3	1.7	98.3
	75	1	1.3	1.7	100.0
	Total	60	80.0	100.0	
Missing	System	15	20.0		
Total		75	100.0		

Source: Primary Data (SPSS), 2025

The majority of respondents were between 36 and 45 years old (28.3%), reflecting the dominance of farmers from the middle productive age group. Most of the other respondents were evenly distributed in the age groups of 28–35 years (21.7%) and 46–55 years (18.3%). This shows that sugarcane farming activities are still actively carried out by the productive age group, with a small proportion of the older generation (>65 years old) still involved.

In terms of farming experience, respondents who use the RC system have a longer average farming time (10.1 years) than PC users (8.5 years). This indicates that RC farmers tend to be more experienced and may prefer this system because of its efficiency in the long run.

Table 3. Frequency of Farming Experience

Long Sugarcane Farming (year)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	5	6.7	8.3	8.3
	4	4	5.3	6.7	15.0
	5	10	13.3	16.7	31.7
	6	5	6.7	8.3	40.0
	7	7	9.3	11.7	51.7
	8	4	5.3	6.7	58.3
	9	2	2.7	3.3	61.7
	10	7	9.3	11.7	73.3
	11	3	4.0	5.0	78.3
	12	1	1.3	1.7	80.0
	13	3	4.0	5.0	85.0
	14	1	1.3	1.7	86.7
	15	1	1.3	1.7	88.3
	16	1	1.3	1.7	90.0
	20	1	1.3	1.7	91.7
	25	2	2.7	3.3	95.0

Long Sugarcane Farming (year)					
		Frequency	Percent	Valid Percent	Cumulative Percent
	30	2	2.7	3.3	98.3
	42	1	1.3	1.7	100.0
	Total	60	80.0	100.0	
Missing	System	15	20.0		
Total		75	100.0		

Source: Primary Data (SPSS), 2025

Most of the respondents had farming experience between 3–10 years (58.4%), with an almost balanced portion between the beginner (3–5 years) and intermediate (6–10 years) groups. However, about 26.7% of farmers have been farming for more than 20 years, indicating the existence of senior farmers who have long experience in sugarcane cultivation. This indicates that sugarcane farming is managed by farmers of various levels of experience, from beginners to experienced.

The education level of the majority of respondents was at the high school level or equivalent, namely 42 out of 60 respondents (70%). This shows that most farmers already have sufficient educational provisions to understand modern agricultural practices, including the calculation of costs and efficiency of farming. Interestingly, the RC system is also used by farmers with a background in junior high school and even elementary education, which can indicate that this system is relatively easier to implement by farmers with various levels of education.'

Table 4. Frequency of Recent Education

Final Education					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		15	20.0	20.0	20.0
	SD	4	5.3	5.3	25.3
	SMA	42	56.0	56.0	81.3
	SMP	14	18.7	18.7	100.0
	Total	75	100.0	100.0	

Source: Primary Data (SPSS), 2025

Most farmers (56%) have a final education at the high school level, which suggests that the majority of farmers have a secondary education background. Only a small percentage (5.3%) have an elementary education, and 18.7% are junior high school graduates. This means that most farmers have a sufficient level of education to receive and understand cultivation technical training. Educational data is also important in explaining the readiness to adopt new technologies in the agricultural system.

The average land area managed by farmers in both systems is almost the same, namely 7.1 ha for PC and 7.3 ha for RC. This shows that the difference in cultivation systems used is not so much influenced by the size of the land, but rather by production strategies and efficiency preferences.

Table 5. Frequency Land Area

Land Area (ha)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.5	1	1.3	1.7	1.7
	2.0	10	13.3	16.7	18.3

Land Area (ha)					
		Frequency	Percent	Valid Percent	Cumulative Percent
	2.5	2	2.7	3.3	21.7
	3.0	9	12.0	15.0	36.7
	4.0	9	12.0	15.0	51.7
	5.0	5	6.7	8.3	60.0
	6.0	4	5.3	6.7	66.7
	7.0	2	2.7	3.3	70.0
	8.0	3	4.0	5.0	75.0
	9.0	2	2.7	3.3	78.3
	10.0	2	2.7	3.3	81.7
	11.0	2	2.7	3.3	85.0
	15.0	3	4.0	5.0	90.0
	16.0	1	1.3	1.7	91.7
	19.0	1	1.3	1.7	93.3
	20.0	2	2.7	3.3	96.7
	40.0	2	2.7	3.3	100.0
	Total	60	80.0	100.0	
Missing	System	15	20.0		
Total		75	100.0		

Source: Primary Data (SPSS), 2025

Most farmers (81.7%) manage less than 10 hectares of land, dominating the range of <5 ha (45%). This shows that sugarcane farming in Lemahabang District is dominated by small to medium farmers. Only 8.3% of farmers manage >20 ha of land. This scale of business also influences decisions in choosing an efficient and low-risk sugarcane cultivation system.

Based on the results of a survey of 60 respondents, it was found that the majority of sugarcane farmers in Lemahabang District make farming their main job, both as land-owning farmers and farm laborers. In addition to farming, some respondents also have side jobs as traders, breeders, and other informal workers. The following is presented the distribution of the main livelihoods of the respondents:

Table 6. Main Livelihood of Sugarcane Farming Respondents

No	Main Types of Livelihoods	Plant Cane (PC)	Ratoon Cane (RC)	Number (People)	Percentage (%)
1	Sugarcane Farmers	11	32	43	71,67
2	Farm Workers	2	5	7	11,67
3	Merchant	1	2	3	5,00
4	Peternak	2	1	3	5,00
5	Others (motorcycle taxis, handymen, etc.)	1	3	4	6,66
	Total	**17**	**43**	**60**	**100,00**
	Total	**17**	**43**	**60**	**100,00**

Source : Primary Data 2025

Based on Table 6, it can be seen that most of the respondents (71.67%) work as sugarcane farmers. This shows that sugarcane is the main source of income and the economic backbone for the farming community in Lemahabang District. Others work as farm laborers (11.67%), who are generally involved in the sugarcane agricultural production process but do not own their own land. In addition, there are respondents who also have a livelihood as traders and breeders, 5% each. Meanwhile, other jobs such as motorcycle taxis, handymen, and other

odd jobs were found in 6.66% of respondents, which indicates the diversification of farmers' household income to reduce dependence on only one economic sector.

Analysis of Farming Costs and Income

The details of the average cost of farming show that the total cost of PC (IDR 53,030,882/ha) is much greater than that of RC (IDR 37,476,494/ha). This reflects the high initial investment of PCs (tillage and seedlings) while RC cuts those costs. On the other hand, the average gross income of RC (Rp594,034,700/ha) is slightly higher than that of PC (Rp514,096,800/ha). RC's net income (NFI) (Rp76,097,530/ha) far exceeds PC (Rp12,517,310/ha).

Table 7. Average Farming Costs and Income

Cost/Revenue Component	Plant Cane (PC)	Ratoon Cane (RC)
Fixed Fee (Rp/ha)	8.420.588	8.153.023
Variable Cost (Rp/ha)	44.610.294	29.323.471
Total Cost (Rp/ha)	53.030.882	37.476.494
Total Income (Rp/ha)	514.096.800	594.034.700
Net Farm Income (NFI) (Rp/ha)	13.521.870	76.097.530

Source : Primary Data 2025

Based on table 7 above, the total cost of farming in the Ratoon Cane system (Rp 37.48 million/Ha) is lower than Plant Cane (Rp 53.03 million/Ha). This shows a higher cost efficiency of Ratoon Cane (Mulyo & Adi, 2010), and based on the results of the study Saputro et al., (2021) that Ratoon Cane is able to cut production costs by up to 25% because it eliminates the need for new soil cultivation and seedlings. In contrast, Plant Cane requires a large initial cost (seedlings, labor-intensive) despite the potential to generate higher productivity.

Although the productivity of Ratoon Cane land tends to be lower agronomically, data shows that the total income of Ratoon Cane (Rp 594.03 million/Ha) is higher than Plant Cane (514.10 million/Ha). This is likely to occur because the mature soil structure and roots on the Ratoon Cane land produce a stable sugar yield Evizal (2018). Ratoon Cane's accumulated income was influenced by the number of respondents. As a result, Ratoon Cane's NFI (Rp 76.10 million/Ha) is much higher than Plant Cane (Rp 13.52 million/Ha), indicating that Ratoon Cane absolutely provides a greater net profit. This is in agreement with the results of the research Singh et al. (2021) that Ratoon Cane's profit margin is higher than Plant Cane.

Table 8. Feasibility and Profitability Indicators

Indicator	Plant Cane (PC)	Ratoon Cane (RC)
Net Farm Income (Rp/ha)	13.521.870	76.097.530
Revenue-Cost Ratio (R/C)	1,24	3,22
Benefit-Cost Ratio (B/C)	0,24	2,22
Return on Investment (ROI %)	24,25	222,21
Break Even Point (kg gula/ha)	3.680,91	2.585,62
Net Profit Margin (NPM %)	19,03	–18,74

Source : Primary Data 2025

Farming Qualification (R/C, ROI, BEP)

A. Plan Cane

1. **R/C RatioR/C = Total** Revenue ÷ Total CostAverage R/C: **1.24**
   Interpretation: Every Rp1 fee generates Rp1.24 in revenue. Because R/C > 1, farming is considered economically feasible.

2. **Benefit-Cost Ratio(B/C)**
   B/C Ratio = Total Benefit Total CostAverage R/C: ÷**0.24**
   Interpretation: In plant cane, the value of B/C = 0.24 means that every Rp 1 cost only results in Rp 0.24 net profit (still feasible, but low).
3. **ROI (Return on Investment)**

   ROI = (Net Profit ÷ Total Cost) × 100%Average ROI: **24.25%**
   Interpretation: Farming generates a net profit of 24.25% of the total costs incurred. The higher the ROI, the more profitable the venture will be.
4. **BEP (Break Even Point)**
   BEP = Total Cost ÷ Sugar Price/kg Average BEP: **3,680.91 kg**
   Interpretation: Farmers must produce a minimum of 3,681 kg of sugar per hectare to break even.

B. Ratoon Cane

1. **R/C Ratio Average R/C: 3.22**
   Interpretation: Every Rp1 fee results in Rp3.22 in revenue. This value demonstrates very high-cost efficiency and excellent feasibility.
2. **Benefit-Cost Ratio(B/C)**
   B/C Ratio = Total Benefit Total Cost Average R/C: ÷**2.22**
   Interpretation: Ratoon Cane is very profitable because every Rp 1 cost generates Rp 2.22 net profit.
3. **ROI Average ROI: 222,21%**
   Interpretation: Farmers earn more than double the cost of production. This farming is very feasible and attractive in terms of investment.
4. **BEP (Break Even Point)**
   Average BEP: **2,585.62 kg**
   Interpretation: RC farmers only need to produce 2,586 kg of sugar per hectare to cover the cost, lower than PC faster break-even.

Profitability (NFI and NPM)

Profitability analysis aims to evaluate the ability of farmers to generate profits from the income obtained. The main indicators used in this study are Net Farm Income (NFI) and Net Profit Margin (NPM).

A. Plant Cane (PC)

1. **Net Farm Income (NFI)**
   NFI = Total Revenue – Total CostAverage NFI: IDR 12,517,310
   Interpretation: Sugarcane farmers in the *cane system* earn a net profit of around IDR 12.5 million per farmer. This value reflects the ability of farmers to generate profits after all production costs are incurred.

2. **Net Profit Margin (NPM)**
   NPM = (Net Profit ÷ Revenue) × 100%Average NPM: 19.03%

Interpretation: Every Rp1 of income generates Rp0.19 in profit. This shows quite efficient profitability.

B. Ratoon Cane (RC)

1. **Net Farm Income (NFI)**Average NFI: IDR 76,097,530
   Interpretation: The net profit of *ratoon cane farmers* is very high. However, this value varies greatly between farmers, depending on the actual production rate and cost efficiency.
2. **Net Profit Margin (NPM)**
   Average NPM: -18.74% *(negative)*
   Interpretation*:* Although NFI is high, a negative NPM indicates that most farmers are at a loss. It is likely to be caused by high costs that are not offset by stable incomes, or the existence of income inequality.

The average NFI PC (IDR 13,521,870/ha) showed limited net profit, while RC reached IDR 76,097,530/ha. However, the NPM indicator shows a contrast: PCs generate a positive NPM of +19.03%, meaning that 1 Rp of revenue gives 19 cents of net profit. Meanwhile, RC actually has a negative NPM of -18.74%. This indicates that even though RC has a high income, the cost of production is so large that some farmers experience a net loss.

However, the Net Profit Margin (NPM) profitability indicator shows a different dynamic. PC NPM of 19.03%, indicating that every Rp1 of revenue generates Rp0.19 net profit. In contrast, the NPM RC was negative -18.74%. This means that even though RC income is high, most RC farmers actually experience a net loss (possibly due to fluctuations in yields and prices). This condition shows that PCs are more stable in generating net profit margins, while RCs are riskier despite their greater potential.

Statistical Test

Mann-Whitney Test

The Mann–Whitney test confirms that the difference between PC and RC across all economic indicators is statistically significant (p-value < 0.05). In other words, RC and PC farming are significantly different in NFI, R/C, B/C, ROI, BEP, and NPM. The results of the test support that the cultivation system affects the economic performance of farming. The combined interpretation shows that RC is nominally more profitable (high NFI, R/C, B/C, ROI) but contains risk of loss (negative NPM), whereas PC is more stable with a positive profit margin. These findings are in line with previous literature: several studies (Singh et al., 2021; Saputro et al., 2021) reported cost efficiency advantages in ratoon cane systems even though their productivity tended to be lower.

Tabel 9. Uji Mann-Whitney (Plant Cane vs Ratoon Cane)

Economic Indicators	U-Value	z-Value	p-value (2-tailed)	Information
Net Farm Income (NFI)	53.000	-5.127	< 0.001	Significantly different
Revenue Cost Ratio (R/C)	68.000	-4.880	< 0.001	Significantly different

Economic Indicators	U-Value	z-Value	p-value (2-tailed)	Information
Benefit-Cost Ratio (B/C)	68.000	- 4.880	< 0.001	Significantly different
Return on Investment (ROI)	68.000	-4.880	< 0.001	Significantly different
Break Even Point (BEP)	0.000	- 5.996	< 0.001	Significantly different
Net Profit Margin (NPM)	68.000	- 4.880	< 0.001	Significantly different

Source : Primary Data (SPSS), 2025

By interpretation, all the differences in economic value between PC and RC were significant ($p<0.001$). Thus, statistically the feasibility and profitability performance of PCs are significantly different from RCs. For example, PC's NFI ranking value is higher than RC's, confirming that PCs produce NFI better when viewed in terms of ranking. Likewise, significant differences were identified in the R/C Ratio, B/C Ratio, ROI, BEP, and NPM. Overall, these results support a clear difference between PC and RC farming.

CONCLUSION

The study comparing the feasibility and profitability of sugarcane farming between the *Plant Cane* (PC) and *Ratoon Cane* (RC) systems in Lemahabang District revealed significant differences across all key economic indicators, including Net Farm Income (NFI), Revenue Cost Ratio (R/C), Return on Investment (ROI), Break Even Point (BEP), and Net Profit Margin (NPM), confirmed by a Mann–Whitney test with p-values < 0.05. While RC farming incurs lower production costs and achieves higher NFI, R/C, ROI, and BEP, it carries a negative NPM (-18.74%), indicating a risk of losses due to yield fluctuations or cost inefficiencies. Conversely, PC farming has higher initial costs but offers a more stable and positive NPM (19.03%), reflecting lower risk despite smaller nominal profits. Thus, RC offers higher profitability but greater risk, whereas PC provides stability with modest returns. Future research is suggested to explore integrated cultivation models that combine PC and RC systems, such as rotational approaches, to optimize profitability while mitigating financial risks for farmers over the long term.

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