On-farm Productivity and Profitability of Paired-Row-Rice Diversified Cropping System in West Coast Plains and Ghat region of India

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ABSTRACT

Globally diversification of rice based cropping system buildups ecosystem resilience and food security. In the summer season, weed growth and water availability is a major problem for rice cultivation, it can be managed with the help of intercropping. A field experiment was carried out during summer season of 2023-24 at Integrated farming systems research station, Karamana, Thiruvananthapuram to study the production potential of diversified intercrops in paired row planted rice in summer fallows of double cropped lowland rice fields. The field experiment was laid out in a randomized, completely block design with 10 treatments and three replications. The treatments were T_1: Paired row of Rice + Grain Cowpea, T_2: Paired row of Rice + Finger millet, T_3: Paired row of Rice + Foxtail millet, T_4: Paired row of Rice + Proso millet, T_5: Sole crop of Paired row Rice, T_6: Sole crop of Grain Cowpea, T_7: Sole crop of Finger millet, T_8: Sole crop of Foxtail millet, T_9: Sole crop of Proso millet, T_{10}:Fallow. Among the treatments, the higher number of tillers m^{-2} and leaf area index were in the sole crop of paired row rice (T_5). Among the yield attributes, rice had the highest number of productive tillers m^{-2}, grain yield and straw yield in the sole crop treatment(T_5). Sole crop treatments performed best in terms of growth and yield attributes than their intercropping treatments. The highest yield (5.85 t ha^{-1}) was observed in the sole crop of rice (T_5), which was superior to all other treatments. The yields recorded in T_1 (paired row of rice + grain cowpea) and T_4 (paired row of rice + proso millet) were statistically at par and significantly higher than T_3 (paired row of rice + foxtail millet). Paired row of rice + grain cowpea (T_1) recorded the highest monetary advantage index of ₹ 55820 ha^{-1}. The analyzed data showed that T_5(sole crop of paired row rice) resulted in an 8 to 15 per cent grain yield increase over intercropping treatments. It can be concluded from the study that among the intercrops, grain cowpea can be recommended for diversification in paired row planting of rice in summer fallows for higher productivity and profitability.

Keywords: Cowpea, Finger millet, Foxtail millet, Intercropping, Proso millet, Paired row, Rice

1. INTRODUCTION

Rice (*Oryza sativa L*.) is a staple food crop for billions of people worldwide and holds a prominent position among the food crops cultivated in India. In Kerala the predominant cropping system is rice- rice-fallow (John *et al.,* 2014). The summer season is typically left fallow due to limited water availability, which hinders the proper cultivation of rice under standing water conditions. However, adopting regular cultivation without standing water poses the challenge of increased weed growth. To address this issue, paired row planting combined with intercropping can be implemented as an effective strategy for weed control. Crop diversification in the summer period is one of the ways to increase output and income (Varughese *et al*., 2007). Intercropping is one of the promising methods of crop

diversification in which two or more are grown together in the same field during the same growing season (Andrew and Kassam, 1976).

Growing rice using a paired row planting system with residual moisture can indeed provide additional income. However, the wider spacing between paired rows often leads to increased weed growth, necessitating labor-intensive intercultural operations for weed management. An effective strategy to address this issue is to introduce intercrops between paired rows, which can help reduce weed infestation and enhance income per unit area. Studies, such as Shah *et al.* (2021), have shown that the addition of intercrops can significantly curb weed growth, creating a more efficient and profitable system for farmers.

Millets are increasingly recognized for their low water requirements and ability to thrive in arid and semi-arid conditions, which makes them suitable for intercropping in residual moisture settings, such as between rows of rice during summer. Their resilience against drought and high water efficiency enhances land productivity, while reducing the need for irrigation (Maitra *et al.,* 2021*)*. This intercropping can also mitigate weed growth and improve soil health. In addition, leguminous crops like cowpea, with their nitrogen-fixing abilities, further support soil fertility and yield in mixed cropping systems, presenting an economically and ecologically promising approach (Bates, 2022).

Mixed cropping systems are considered more socio-economically and ecologically advantageous for farmers compared to monocropping systems, particularly under drought conditions. These systems are widely adopted by smallholder farmers as they offer greater on-farm benefits, including enhanced resource utilization, risk diversification, and resilience to climatic stresses (Léonidas *et al.,* 2024). Intercropping in rice improved the system productivity, profitability and sustainability in terms of higher gross margin, net return and benefit-cost ratio (Alam *et al*, 2021). The main objective of the study was to evaluate the performance of rice and intercrops in terms of growth and yield attributes and economics.

2. MATERIALS AND METHODS

The experiment was conducted at Integrated Farming System Research Station (IFSRS), Karamana during summer season of 2023-2024. Soil in the experiment site was sandy clay loam in texture, moderately acidic pH, medium in available nitrogen and potassium and high in phosphorus. The mechanical composition of the soil is given in Table 1. Before the experiment rice was cultivated in the site. The experiment consisted of 10 treatments T_1: Paired row of Rice + Grain Cowpea,T_2: Paired row of Rice + Finger millet, T_3: Paired row of Rice + Foxtail millet, T_4: Paired row of Rice + Proso millet, T_5: Sole crop of Paired row Rice, T_6: Sole crop of Grain Cowpea, T_7: Sole crop of Finger millet, T_8: Sole crop of Foxtail millet, T_9: Sole crop of Proso millet, T_{10}: Fallow. . The experiment was conducted in Randomized Complete Block Design with 3 replications. The varieties used for the experiment are Uma, Bhagyalakshmi, Co 15, Co (Te)7 and TNAU 202 for rice, grain cowpea, finger millet, foxtail millet and proso millet, respectively. The spacing followed for the crops were Rice – 35 cm-(15 cm x 15 cm)- 10 cm (35 cm between the pairs, 15 cm within the pair, 10 cm between plants), Grain cowpea – 30cm x15 cm, Finger millet -25 cm x 15 cm, Foxtail millet- 22 cm x 10 cm, Proso millet- 25 cm x 10 cm. The average temperature during the cropping period were 25.50° C (minimum) and 32.21°C (maximum), maximum relative humidity was 90.20% and minimum was 72.58% during the period with an average rainfall of 22.22 mm during the cropping period. The fertiliser recommendation used for the crops are given in Table 2.

For measuring the growth attributes, five plants were randomly selected from the net plot area and tagged as observational plants. Growth attributes were recorded at monthly

intervals from these observation plants. Plant height of rice and millets were taken from the base of the plant to the tip of the longest leaf, and the average height was expressed in cm. For cowpea the height of the observational plants was measured at monthly intervals, from ground level to the tip of the growing bud, with the average height expressed in cm. The total number of tillers within a square meter area was counted at monthly intervals and at harvest. The mean was then expressed as the number of tillers per m^2. Leaf area of the observational plants was computed using leaf length and leaf width at monthly intervals and expressed in cm^2. The observation is made on fully open and physiologically active leaves. Leaf Area Index (LAI) was recorded at monthly intervals for crops viz., rice, grain cowpea, finger millet, foxtail millet and proso millet using the formula given below.

$$LAI = \frac{LxBxNxK}{Spacing\ (cm)}$$

L- length of leaf , B- Breadth of leaf, N- Number of leaves per plant, K- constant

Net income was calculated using the given formula.

$$\text{Net income (₹ ha}^{-1}\text{)} = \text{Gross income (₹ ha}^{-1}\text{)} - \text{Total cost of cultivation (₹ ha}^{-1}\text{)}$$

The benefit : cost ratio was calculated as the ratio of gross income to cost of cultivation.

$$BCR = \frac{\text{Gross income (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

The Monetary Advantage Index (MAI) quantifies the financial benefit of an intercropping system compared to a sole cropping system. It was calculated using the formula

$$MAI = (\text{Value of combined intercrop}) \times \frac{(LER - 1)}{LER}$$

All the statistical analysis were done using KAU grapes software (Gopinath *et al*, 2021).

Table 1. Mechanical composition of the soil of the soil in the experimental site

Fractions	**Content in soil(%)**
Coarse sand	47.69
Fine sand	10.61
Silt	8.53
Clay	32.69

Table 2. Details of manure and fertilizers applied to rice and intercrops

Sl. No.	**Crops**	**FYM (t ha^{-1})**	**N (kg ha^{-1})**	**P (kg ha^{-1})**	**K (kg ha^{-1})**
1.	Rice	5	90	45	45
2.	Grain cowpea	20	20	30	10
3.	Finger millet	5	45	22.5	22.5
4.	Foxtail millet	12.5	44	22	0
5.	Proso millet	5	50	30	20

3. RESULTS

3.1 Growth attributes

Intercropping with grain cowpea, finger millet, foxtail millet, and proso millet did not significantly affect the rice plant height (Table 3).

The analyzed data indicated that the plant height of intercrops were significantly influenced by the intercropping treatments. The sole crop of grain cowpea (T_6) recorded the highest plant height of 75.29 cm at harvest. The sole crop of finger millet (T_7) recorded the highest mean plant height, measuring 116.32 cm at harvest. The sole crop of foxtail millet recorded the highest plant height, measuring 133.73 cm at harvest. The analyzed data showed that the plant height of proso millet was highest in the sole crop of proso millet (T_9), it recorded plant heights of 107.10 cm at harvest (Table 4).

The analysed data showed that the number of rice tillers was significantly influenced by intercropping treatments. At harvest, the highest number of tillers was observed in the sole crop of rice (432.3), which was on par with rice + grain cowpea (T_1), rice + foxtail millet (T_3) and rice + proso millet (T_4) (Table 3).

Intercropping treatments had significant effect on number of tillers per m^2. The highest number of tillers per m^2 (84.67) was recorded in the sole crop of finger millet (T_7) at harvest compared to rice + finger millet (T_2). The number of tillers per m^2 was highest (184.83) in sole foxtail millet (T_8). A higher number of tillers per m^2 was in the sole crop of proso millet (T_9) at harvest (98.80) (Table 4).
The results indicated that intercropping treatments had significant effect on the leaf area index (LAI) of rice. At harvest, the highest LAI (3.23) was observed in the sole crop of rice (T_5), on par with T_1 and T_3. The lowest LAI was recorded in T_2, which was statistically similar to T_4 (Table 3).

The analyzed data indicated that intercropping treatments significantly influenced the LAI of intercrops. The highest LAI (3.70) was recorded in the sole crop of grain cowpea (T_6). The highest LAI (1.48) values were recorded in the sole crop of finger millet at harvest. The highest LAI values were recorded in the sole crop of foxtail millet (T_8) at harvest (0.97). The results indicated that the sole crop of proso millet recorded the highest LAI value of 1.09 at harvest (Table 4).

The analyzed data revealed that the number of branches per plant of grain cow pea was not influenced by intercropping treatments (Table 4).

Table 3. Growth parameters of rice at harvest stage

Treatments	**At Harvest**		
	Plant height (cm)	**Number of tillers per m^2**	**LAI**
T_1: Rice + Grain Cowpea	113.67	428.7	3.03
T_2: Rice + Finger millet	106.33	382	2.10
T_3:Rice + Foxtail millet	110.33	425.3	2.63
T_4: Rice + Proso millet	112.33	427.3	2.28
T_5: Sole crop of Rice	115.43	432.3	3.23
SEm (±)	3.425	3.1	0.21
CD (0.05)	NS	9.93	0.682

Table 4. Effect of intercropping on growth attributes of intercrops

Treatments	**At harvest**			
	Plant height (cm)	**Number of branches per plant**	**LAI**	**Number of tillers per m^2**
T_1: Rice + Grain Cowpea	64.86	4.52	1.92	
T_6: Sole crop of Grain Cowpea	75.29	5.98	3.70	
T value	-3.74	-2.22	-7.74	
P value	0.02	0.091	0.001	
T_2: Rice + Finger millet	110.36	-	0.96	33.00
T_7: Sole crop of Finger millet	116.32	-	1.48	84.67
T value	-3.11	-	-3.18	-5.62
P value	0.036	-	0.033	0.005
T_3: Rice + Foxtail millet	116.75	-	0.25	69.33
T_8: Sole crop of Foxtail millet	133.73	-	0.97	184.83

T value	-4.67	-	-8.13	-11.66
P value	0.010	-	0.001	0.000
T_4:Rice + Proso millet	98.37	-	0.687	44.47
T_9: Sole crop of Proso millet	107.10	-	1.09	98.80
T value	-5.34	-	-8.17	-32.22
P value	0.006	-	0.001	0.000

3.2 Yield attributes

Intercropping had significant effects on number of productive tillers per m^2 of rice. The highest number of productive tillers per m^2 (409.7) was observed in the sole crop of rice (T_5), which was statistically on par with T_4 (paired row of rice + proso millet), T_3 (paired row of rice + foxtail millet), and T_1 (paired row of rice + grain cowpea). In contrast, the lowest number of productive tillers (357) at harvest was recorded in T_2 (paired row of rice + finger millet) (Table 5).

The results indicated that the highest number of productive tillers per plant (3.03) was recorded in the sole crop of finger millet (T_7), while the lowest (1.87) was observed in the intercropping treatment (T_2). Similarly, the sole crop of foxtail millet (T_8) exhibited a significantly higher number of productive tillers per plant (1.57) compared to intercropping. For proso millet, the sole crop (T_9) recorded a higher number of productive tillers per plant (2.26) than the intercropped treatments (Table 6).

Intercropping had significant effect on number of pods per plant of grain cowpea. The analyzed data revealed that the sole crop of grain cowpea (T_6) recorded the highest number of pods per plant (15.87) as compared to intercropping (Table 6).

A thorough analysis of the data indicated that the grain yield of rice was significantly affected by the treatments. The highest yield (5.85 t ha^{-1}) was observed in the sole crop of rice (T_5), which was superior to all other treatments. The yields recorded in T_1 (paired row of rice + grain cowpea) and T_4 (paired row of rice + proso millet) were statistically at par and significantly higher than T_3 (paired row of rice + foxtail millet). The lowest yield (4.97 t ha^{-1}) was recorded in T_2 (paired row of rice + finger millet) (Table 5).

Results indicated that intercropping had a significant effect on grain yield of the intercrops. The grain yield was highest (3375 kg ha^{-1}) in sole crop of grain cowpea (T_6) compared to rice + grain cowpea (T_1).The highest grain yield of finger millet (2223 kg ha^{-1}) was recorded in its sole crop (T_7), while the intercropping treatment of rice + finger millet (T_2) yielded 666 kg ha^{-1}. Similarly, the highest grain yield of foxtail millet (2352 kg ha^{-1}) was observed in its sole crop (T_8), whereas the intercropping treatment of rice + foxtail millet (T_3) produced 642 kg ha^{-1}. For proso millet, the sole crop (T_9) recorded the highest grain yield (949 kg ha^{-1}), while the intercropping treatment of rice + proso millet (T_4) yielded 269 kg ha^{-1} (Table 6).

The analyzed data revealed that the straw yield of rice was significantly affected by the treatments. The highest straw yield (7.00 t ha^{-1}) was recorded in the sole crop of paired row rice (T_5), which was significantly superior to all intercropping treatments. Among the intercropping treatments, paired row rice + grain cowpea (T_1) produced a straw yield of 6.61 t ha^{-1}, followed by T_4 (paired row rice + proso millet) and T_3 (paired row rice + foxtail millet). The lowest straw yield (5.48 t ha^{-1}) was observed in the paired row of rice + finger millet (T_2) (Table 5).

Results on the haulm yield revealed that the highest haulm yield (4526 kg ha^{-1}) was obtained in sole crop of grain cowpea (T_6). The highest stover yield of finger millet (4927 kg ha^{-1}) was recorded in its sole crop (T_7), while the intercropping treatment of rice + finger millet (T_2) produced 1666 kg ha^{-1}. Similarly, the sole crop of foxtail millet (T_8) recorded the highest stover yield (4067 kg ha^{-1}), whereas the intercropping treatment of rice + foxtail millet (T_3) yielded 1587 kg ha^{-1}. For proso millet, the highest stover yield (2415 kg ha^{-1}) was observed in its sole crop (T_9), while the intercropping treatment of rice + proso millet (T_4) yielded 904 kg ha^{-1} (Table 6).

Table 5. Effect of intercropping on yield attributes of rice

Treatments	**Productive tillers per m^2**	**Grain yield (t ha^{-1})**	**Straw yield (t ha^{-1})**	**Harvest index**
T_1: Rice + Grain Cowpea	397.3	5.31	6.61	0.45
T_2: Rice + Finger millet	357	4.97	5.48	0.48
T_3:Rice + Foxtail millet	398.7	5.07	6.17	0.45
T_4: Rice + Proso millet	401.7	5.25	6.3	0.46
T_5: Sole crop of Rice	409.7	5.85	7.00	0.46
SEm (±)	4.2	0.02	0.04	0.00
CD (0.05)	13.72	0.066	0.14	0.006

Table 6. Effect of intercropping on yield attributes of intercrops

Treatments	**At harvest**				
	Number of pods per plant	**Number of productive tillers per plant**	**Grain yield (kg ha^{-1})**	**Stover yield or Haulm yield (kg ha^{-1})**	**Harvest index**
T_1: Rice + Grain Cowpea	14.07	-	1122	2678	0.30
T_6: Sole crop of Grain Cowpea	15.87	-	3375	4526	0.43
T value	-3.61	-	-16.78	-27.57	-15.06
P value	0.023	-	0.000	0.000	0.000
T_2: Rice + Finger millet	-	1.87	666	1666	0.29
T_7: Sole crop of Finger millet	-	3.03	2223	4927	0.31
T value	-	-3.26	-7.00	-6.18	-1.607
P value	-	0.031	0.002	0.003	0.183

T_3: Rice + Foxtail millet	-	1.15	642	1587	0.29
T_8: Sole crop of Foxtail millet	-	1.57	2352	4067	0.37
T value	-	-6.200	-23.83	-10.37	-3.35
P value	-	0.003	0.000	0.000	0.029
T_4:Rice + Proso millet	-	1.98	269	904	0.23
T_9: Sole crop of Proso millet	-	2.26	949	2415	0.28
T value	-	-11.05	-18.87	-48.17	-5.40
P value	-	0.000	0.000	0.000	0.006

3.3 Economics

The economic analysis revealed that the paired row of rice + grain cowpea (T_1) generated the highest net income (₹129,686 ha^{-1}), followed by the sole crop of grain cowpea (T_6), which recorded net returns of ₹119,537 ha^{-1}. In contrast, the lowest net returns were observed in the sole crop of proso millet (T_9), with a negative value of ₹4,830 ha^{-1}. The benefit-cost ratio (BCR) was highest (1.82) in the paired row of rice + grain cowpea (T_1) intercropping system, followed by the sole crop of grain cowpea (T_6) and the sole crop of paired row rice (T_5), both recording a BCR of 1.79 (Table 7).

The monetary advantage index (MAI) was highest for the paired row of rice + grain cowpea (T_1), recording ₹55,820 ha^{-1}. This was followed by the paired row of rice + proso millet (T_4) with ₹31,662 ha^{-1}, paired row of rice + finger millet (T_2) with ₹27,866 ha^{-1}, and paired row of rice + foxtail millet (T_3) with ₹27,073 ha^{-1}, respectively (Table 7).

Table 7. Effect of intercropping on economics of the system

Treatments	**Net income (₹ ha^{-1})**	**BCR**	**MAI (₹ ha^{-1})**
T_1: Paired row of Rice + Grain Cowpea	129686	1.82	55820
T_2: Paired row of Rice + Finger millet	63097	1.42	27866
T_3: Paired row of Rice + Foxtail millet	68246	1.45	27073
T_4: Paired row of Rice + Proso millet	54122	1.36	31662
T_5: Sole crop of Paired row Rice	93117	1.79	-
T_6: Sole crop of Grain Cowpea	119537	1.79	-
T_7: Sole crop of Finger millet	52686	1.73	-
T_8: Sole crop of Foxtail millet	54181	1.75	-
T_9: Sole crop of Proso millet	-4830	0.92	-
T_{10}: Fallow	-	-	-

4. DISCUSSION

The results revealed that the highest number of tillers (432.3 m²) was recorded in the sole crop of rice (T_5). However, paired row planting with intercrops such as grain cowpea (T_1), foxtail millet (T_3), and proso millet (T_4) produced tiller counts statistically on par with sole rice (Table 4). This suggested that paired row planting effectively accommodates intercrops while sustaining rice productivity. The reduced tiller count in T_2 (rice + finger millet) reflects higher competition between rice and finger millet in this treatment for nutrient and space.

Paired row planting in sole rice (T_5) achieved the highest LAI (3.23), indicating optimal canopy development. Among intercropping treatments, rice + grain cowpea (T_1) and rice + foxtail millet (T_3) recorded comparable LAI values, reflecting effective utilization of sunlight and nutrients in these combinations. Intercropping rice with finger millet (T_2) resulted in the lowest LAI (2.10), possibly due to increased competition for resources.

For intercrops, sole cropping systems recorded higher LAI values than intercropped treatments, as seen in grain cowpea (3.70) and proso millet (1.09). This indicated that paired row planting supports intercrop growth while sole cropping remains more conducive to maximum canopy expansion.

Sole rice (T_5) had the highest number of productive tillers (409.7 m²), followed closely by T_4 (rice + proso millet), T_3 (rice + foxtail millet), and T_1 (rice + grain cowpea). This indicates that paired row planting supports productive tiller formation, especially when paired with suitable intercrops. The lowest productive tillers in T_2 (357 m²) again highlight the competitive nature of finger millet in intercropping systems. For intercrops, sole cropping significantly outperformed intercropping, with finger millet and proso millet recording higher productive tiller counts in their respective sole treatments. Paired row planting offers distinct advantages for incorporating intercrops in rice-based systems. The wider spacing between rows reduces competition for light and enables efficient utilization of residual moisture. Additionally, the intercropping system suppresses weed growth, reducing the labour and cost associated with manual weeding. Rajani *et al*. (2022) recorded that sole foxtail millet had significantly higher grain weight per 0.5 m row length (99.40 g) in intercropping system with niger in different row ratios. According to Aravind et al. (2023), the grain yield of foxtail millet was significantly affected by intercropping. Sole cropping produced the highest grain yield (2208 kg ha^{-1}), followed by intercropping with vegetable cowpea, green gram, and coriander in two different ratios. Saikumar *et al*. (2023) reported that aerobic rice intercropped with black gram produced the highest number of spikelet's per panicle (77.53). This result was on par with the sole crop of aerobic rice, black gram + aerobic rice with 100% RDN, black gram + aerobic rice with 50% RDN, and cowpea + aerobic rice with 100% RDN.

The highest grain yield for rice (5.85 t ha^{-1}) was observed in the sole crop treatment (T_5), reflecting the absence of competition. Similar results were reported by Gami *et al.,* (2024) in rice – soybean intercropping system. Paired row planting with grain cowpea (T_1) and proso millet (T_4) resulted in grain yields statistically superior to other intercropping

treatments. This highlights the potential of these combinations to sustain rice productivity while diversifying farm income. Paired row planting of rice, combined with suitable intercrops such as grain cowpea and proso millet, demonstrates the potential to sustain rice productivity while diversifying cropping systems. This approach offers a balanced strategy to optimize resource use, suppress weeds, and enhance overall farm profitability in summer fallow conditions. Further refinement in crop combinations and management practices can enhance its viability and adoption.

Among intercrops, sole cropping yielded the highest outputs, with grain cowpea (3375 kg ha^{-1}) and finger millet (2223 kg ha^{-1}) outperforming their intercropped counterparts. This trend underscores the resource competition inherent in intercropping systems. Mariam (2023) conducted an experiment on red gram-cowpea intercropping and inferred that the number of pods per plant produced by bush cowpea was higher in sole crop of bush cowpea at (13.33) compared to intercropping treatments.

The straw yield of rice was highest in the sole crop (7.00 t ha^{-1}), with paired row planting of rice + grain cowpea (T_1) yielding 6.61 t ha^{-1}. For intercrops, stover yields were significantly higher in sole cropping systems, with finger millet (4927 kg ha^{-1}) and foxtail millet (4067 kg ha^{-1}) leading.

Despite slightly lower yields compared to sole rice, intercropping system of rice + grain cowpea (T_1) maintain productivity while enhancing ecological and economic benefits. These systems make efficient use of available land and resources, particularly in water-scarce summer fallows.

The economic analysis revealed that the paired row of rice + grain cowpea (T_1) generated the highest net income (₹129,686 ha^{-1}), followed by the sole crop of grain cowpea (T_6), which recorded net returns of ₹119,537 ha^{-1}. Erythrina *et al.* (2022) reported that intercropping resulted in a significantly higher gross margin compared to monocropping. Saikumar *et al* (2023) reported that the highest gross returns (Rs.180065 ha^{-1}), net returns (Rs.103858 ha^{-1}) and BCR (2.36) were recorded by cowpea + aerobic rice with 50% RDN.

5. CONCLUSION

The study highlights the benefits and limitations of intercropping in paired row rice systems during summer fallows. Sole cropping of rice achieved the highest grain and straw yields showed its potential for maximizing rice productivity. However, intercropping treatments, particularly rice + grain cowpea (T_1), demonstrated comparable results in terms of productive tillers and overall yield, along with the highest economic returns. These findings suggest that paired row planting with suitable intercrops, such as grain cowpea, can balance productivity with profitability while improving resource use and reducing weed pressure. This approach holds promise for sustainable cropping systems, especially in water-limited conditions, offering farmers a viable strategy to enhance income. Governments should fund research initiatives that explore various intercropping combinations, focusing on those that maximize yield and economic returns, such as rice + grain cowpea. This could

lead to the development of best practice guidelines tailored to local conditions. There is also possibility of future studies with various other pulse crops as intercrops in rice.

DISCLAIMER

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Details of the AI usage are given below:
1. ChatGPT
3.Grammarly
4. Quillbot

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