Socio-economic characteristics of farmers practicing Rice-Wheat cropping System (RWCS) in Haryana: A comparative analysis

Abstract

The Rice-Wheat Cropping System (RWCS) is a cornerstone of India's food security, particularly in the states of Haryana, Punjab, and Uttar Pradesh. However, the sustainability of RWCS is increasingly threatened by issues such as soil degradation, groundwater depletion, and climate vulnerabilities, exacerbated by the resource-intensive practices introduced during the green revolution. The study was conducted during 2023-24 using an ex-post facto research design. Multistage sampling by simple random sampling method was used to derive sample for the study and the data was collected through personal interview. This study focuses on the socio-economic profile of small and large farmers practicing RWCS in Haryana, a critical region for this cropping system. By comparing personal, economic, social, and behavioral characteristics between these two groups, the research highlights the disparities in access to resources, extension services, and agricultural technologies. These differences have significant implications for the adoption of sustainable farming practices. The study underscores the importance of targeted interventions and effective extension services to bridge these gaps, thereby enhancing the sustainability and profitability of the RWCS in Haryana. Understanding these farmer-specific challenges and opportunities is crucial for policymakers aiming to ensure the long-term viability of this vital agricultural system.

Keywords: RWCS, Personal, Economic, Social, Behavioral, Haryana

1. Introduction

Rice and wheat are staple foods in India, and the Rice-Wheat Cropping System (RWCS) is crucial for the nation’s food security. This monocropping system is predominantly practiced across South Asia, particularly in India’s Indo-Gangetic Plains (IGP), including Uttar Pradesh, Punjab, and Haryana. The RWCS covers 9.2 million hectares in India (Jat *et al.*, 2020) and contributes to over half of the country's food grain production, playing a vital role in maintaining food sovereignty. The Green Revolution significantly boosted food grain production, especially for rice and wheat, through technological advancements such as high-yielding varieties (HYVS), chemical fertilizers, and pesticides. However, these improvements made the RWCS more resource-intensive, leading to soil degradation and groundwater depletion, which threaten its long-term sustainability (Chauhan *et al.*, 2012). Other significant threats include soil nutrient depletion, rising production costs, labor shortages, environmental

pollution from improper crop residue management, increased greenhouse gas emissions, herbicide-resistant weeds, and climate vulnerabilities (Dhanda *et al.*, 2022). The lack of sufficient procurement, assured minimum support prices (MSP), subsidized irrigation, and electricity, along with farmers' limited awareness and adoption of sustainable practices, has further discouraged the shift to more sustainable cropping methods.

Sustainable intensification technologies have been developed to tackle RWCS monocropping issues, such as irrigation, labor, tillage intensity, and residue burning. To address these challenges, stakeholder awareness, capacity building, and policy advocacy are essential. Resource-conserving practices like zero tillage, direct seeding in wheat, improved water use, residue management to prevent straw burning, and crop diversification can enhance productivity, minimize inputs, conserve resources, reduce environmental and economic risks, and boost profitability (Kakraliya*et al.*, 2018).

Haryana, a significant contributor to the Rice-Wheat Cropping System (RWCS) in the Indo-Gangetic Plains, plays a vital role in ensuring the nation's food security. More than half of the state practices RWCS (Department of Economic and Statistical Affairs, Haryana, 2023). Though efforts have been made to study the profile of farmers practices RWCS (Rohila*et al.*, 2016; Mukteshawar*et al.*, 2022), there was a lack of comparative studies between small and large farmers. Studies have shown that there is considerable difference between large and small farmers in terms of access to resources, extension services, economic ability and behavioral characteristics (Kaur and Kaur, 2015; Reddy, 2015). Thus, studying the comparative socio-economic profile of rice-wheat growing farmers in Haryana is essential to understand the diverse challenges and opportunities faced by these farmers, particularly in a region critical to India's agricultural output. The disparities between small and large farmers are crucial as they directly impact the adoption of sustainable farming practices, access to agricultural technologies, and overall farm management efficiency. For instance, larger farmers may have better access to modern farming equipment, extension services, and financial resources, enabling them to adopt advanced agricultural practices more readily than smaller farmers, who may struggle with limited resources.

Understanding these differences helps in identifying the specific needs and challenges of different farmer groups, thereby enabling policymakers to design targeted interventions. This helps in studying the perception of farmers about the sustainability of farmers and overcome the issues (Chikkalaki*et al.*, 2023).By addressing these issues, this study can contribute to enhancing the sustainability and profitability of the RWCS in Haryana, ultimately benefiting the entire agricultural sector.Agricultural extension services play a vital

role in bridging these gaps. Extension services provide essential support to farmers by disseminating knowledge, introducing innovative farming techniques, and offering training in sustainable practices(Hameed and Sawicka, 2023). For small and marginal farmers, who may lack the resources and knowledge to implement modern practices, extension services can be a lifeline, helping them increase productivity and profitability. Effective extension services can also help farmers overcome the challenges associated with the RWCS by promoting sustainable practices, such as crop rotation, conservation tillage, and efficient water management, extension services can help farmers mitigate these issues and enhance the long-term sustainability of the RWCS in Haryana.

2. Methodology

The study was conducted during 2023-24 in Haryana using an ex-post facto research design. A multi-stage sampling approach with simple random sampling was employed to determine the sample size. Haryana, consisting of 22 districts, saw the purposive selection of two districts*i.e.,* Karnal and Kaithal, due to their high rice and wheat crop area and productivity (Department of Economic and Statistical Affairs, Haryana, 2023). From each district, two blocks were randomly chosen: Karnal and Gharonda from Karnal district, and Kaithal and Kalayat from Kaithal district. Three villages were then randomly selected from each block: Pundarak, Burhanpur, and Begumpur from Karnal block; Gagsina, Kutail, and Raipur Jattan from Gharonda block; Teek, Manas, and Deoband from Kaithal block; and Balu, Julani Khera, and Chausala from Kalayat block, totaling 12 villages for the study. In each village, ten small farmers (<2 ha) and ten large farmers (>10 ha) were randomly selected, resulting in a sample of 120 small farmers (n_1) and 120 large farmers (n_2), with a total of 240 respondents (n). This approach was chosen to facilitate comparisons of socio-economic characteristics between small and large farmers.

Based on the literature review, 15 variables *viz.*, age, education, family size, family type, annual income, farming experience, farm mechanization, extension contact, cosmopoliteness, mass media exposure, scientific orientation, management orientation achievement motivation, risk orientation, market orientation were selected to arrive at a complete picture of the socio-economic profile of the respondents in the study area. These variables are divided into personal, economic, social and behavioural for easy comprehension.

3. Results and Discussion

3.1 Personal characteristics of the respondents

The distribution of the respondents according to their personal characteristics in Table 1shows that 48.34 per cent of small farmers and 43.34 per cent of large farmers are middle-aged, likely due to inheriting and continuing farming on their own land since old times. In contrast, 28.33 per cent of small farmers and 40.83 per cent of large farmers were older, often retiring and leaving farm management to middle-aged farmers. Only 23.33 per cent of small farmers and 15.83 per cent of large farmers are young, with many moving to cities for better opportunities. Kumar *et al.* (2020) and Shubham *et al.* (2022) reported similar findings.

Education levels reveal that 25per cent of small farmers had completed middle school and 23.34per cent high school, while 25.83per cent of large farmers had studied up to senior secondary school. Large farmers generally had better education due to greater financial resources and fewer farming duties during their education. Small farmers often lacked the economic means and time for higher education. These findings align with Rohila*et al.* (2016) and Dilip (2021).

Regarding farming experience, 50per cent of small and 52.50per cent of large farmers had medium experience, indicating that experience is independent of farm size. Most respondents had long-term experience with RWCS. This is consistent with Dilip (2021) and Chikkalaki*et al.* (2024a).

Table 1: Distribution of respondents according to their personal characteristics (n=240)

S. No.	Variable	Category	Range	Small farmers (n_1=120)		Large farmers (n_2=120)	
				f	%	f	%
1	Age	Young	≤ 35 years	28	23.33	19	15.83
		Middle	36- 50 years	58	48.34	52	43.34
		Old	>50 years	34	28.33	49	40.83
2	Education	Illiterate		07	5.83	05	04.17
		Read and write only		10	8.33	08	06.67
		Primary school		10	8.33	12	10.00
		Middle school		30	25.00	24	20.00
		High school		28	23.34	26	21.66
		Senior secondary		22	18.34	31	25.83
		Diploma		07	5.83	06	05.00
		Graduate		05	4.17	05	04.17
		Post graduation and above		01	0.83	03	02.50
3	Farming experience	Low	≤ 5.89	25	20.83	19	15.83
		Medium	5.89- 21.92	60	50.00	63	52.50

		High	≥ 21.92	35	29.17	38	31.67

f= Frequency, %=Percentage

3.2 Economic characteristics of the respondents

Table 2 shows that 45.83per cent of small farmers had low annual income, while 69.17per cent of large farmers had high annual income. This disparity arises because large farmers cultivate more land, leading to greater production and income. These findings are consistent with Ahuja *et al.* (2016) and Singh (2022).

Table 2: Distribution of respondents according to their economic characteristics (n=240)

S. No.	Variable	Category	Range	Small farmers (n_1=120)		Large farmers (n_2=120)	
				f	%	f	%
1	Annual Income	Low	≤ 255146	55	45.83	03	02.50
		Medium	255146-570920	53	44.17	34	28.33
		High	≥ 570920	12	10.00	83	69.17
2	Farm mechanization	Low	≤ 4	72	60.00	13	10.83
		Medium	4-9	32	26.67	41	34.17
		High	≥ 9	16	13.33	66	55.00

f= Frequency, %=Percentage

Farm machinery is crucial for efficient rice and wheat cultivation. Most small farmers (60.00%) had low mechanization, while a majority of large farmers (55.00%) had high mechanization, likely due to better financial resources. Table 3 shows that while all large farmers owned tractors, 79.17per cent of small farmers also did. However, ownership of specialized equipment varied. 45.83per cent of small farmers owned a puddler compared to all large farmers, 52.50per cent of small farmers had a cultivator versus 76.67per cent of large farmersand similar disparities existed for rotovators, MB ploughs, and seed-cum-fertilizer drills. Small farmers often hiredequipments due to high costs, and few owned expensive machinerysuch as super seeders or combine harvesters. These results align with Singh *et al.* (2020) and Singh (2022).

Table 3: Distribution of respondents according to possession of farm machinery for farm mechanization (n=240)

S. No.	Farm machinery	Small farmers (n_1 =120)		Large farmers (n_2=120)	
		f	%	f	%
1	Tractor	95	79.17	120	100.00

2	Disc harrow/ cultivator	63	52.50	92	76.67
3	Rotovator	47	39.17	97	80.83
4	MB plough	43	35.83	96	80.00
5	Seed cum fertilizer drill	41	34.17	95	79.17
6	Zero till seed drill	38	31.67	96	80.00
7	Super seeder	06	05.00	23	19.17
8	Puddler	55	45.83	120	100.00
9	Laser land leveller	-	-	03	02.50
10	Combine harvester	-	-	05	04.17

f= Frequency, %=Percentage

3.3 Social characteristics of the respondents

Table 4 shows that family size and type were similar among small and large farmers. Over half of both small (51.67%) and large farmers (56.67%) had medium family sizes, and most belonged to nuclear families (70.83% of small farmers and 65.83% of large farmers). This trend reflects the shift toward nuclear families for greater economic independence and privacy, mirroring urban lifestyles. These findings are consistent with Anjana and Sindhu (2022) and Shubham *et al.* (2022).

Table 4: Distribution of respondents according to their social characteristics

S. No.	Variable	Category	Range	Small farmers (n_1=120)		Large farmers (n_2=120)	
				f	%	f	%
1	Family size	Small	≤ 4 members	37	30.83	27	22.50
		Medium	5-6 members	62	51.67	68	56.67
		Large	> 6 members	21	17.50	25	20.83
2	Family type	Joint		35	29.17	41	34.17
		Nuclear		85	70.83	79	65.83
3	Extension contact	Low	≤ 6.30	41	34.17	31	25.83
		Medium	6.30-12.50	57	47.50	61	50.84
		High	≥ 12.50	22	18.33	28	23.33
4	Cosmopoliteness	Low	≤ 6.61	36	30.00	27	22.50
		Medium	6.61-12.99	47	39.17	53	44.17
		High	≥ 12.99	37	30.83	40	33.33
5	Mass media exposure	Low	≤ 9.94	35	29.16	29	24.16
		Medium	9.94-17.46	44	36.67	44	36.67
		High	≥ 17.46	41	34.17	47	39.17

Table 5 and 6 reveal that both small (47.50%) and large farmers (50.83%) had medium levels of extension contact. They frequently interacted with private extension agencies, often input dealers, who are accessible and provide efficient services (WMS=2.71 for small farmers and WMS=2.83 for large farmers). In contrast, public extension personnel, such as ADOs, scientists from SAUs, and KVKs, were less frequently contacted due to time constraints and geographic limitations. These findings align with Singh *et al.* (2020) and Shubham *et al.* (2022).

Table 5: Distribution of small farmers according to nature of extension contact (n_1=120)

S. No.	Personnel/Agency	Frequency of contact						WMS	Rank
		Regular		Occasional		Never			
		f	%	f	%	f	%		
1	Scientists of KVK	19	15.83	58	48.34	43	35.83	1.80	IV
2	Private extension agencies	91	75.83	23	19.17	06	05.00	2.71	I
3	SAUs	23	19.17	59	49.17	38	31.67	1.88	III
4	Agriculture Development Officers (ADOs)	32	26.67	59	49.17	29	24.16	2.03	II

f= Frequency, %=Percentage, WMS= Weighted Mean Score

Table 6: Distribution of large farmers according to nature of extension contact (n_2=120)

S. No.	Personnel/Agency	Frequency of contact						WMS	Rank
		Regular		Occasional		Never			
		f	%	f	%	f	%		
1	Scientists of KVK	25	20.83	74	61.67	21	17.50	2.03	IV
2	Private extension agencies	103	85.83	14	11.67	03	02.50	2.83	I
3	SAUs	34	28.33	63	52.50	23	19.17	2.09	III
4	Agriculture Development Officers (ADOs)	36	30.00	65	54.17	19	15.83	2.14	II

f= Frequency, %=Percentage, WMS= Weighted Mean Score

Table 8 shows that 39.17 per cent of small farmers and 44.17 per cent of large farmers had medium cosmopoliteness levels, frequently visiting nearby cities and maintaining

contacts outside their social circles due to good transport and internet access in the study area. This aligns with Ahuja *et al.* (2016), and Chikkalaki*et al.* (2024b).

Table 7 and 8 reveal that both small and large farmers (36.67% each) had medium mass media exposure. Most used mobile phones (81.67% of small and 89.17% of large farmers) for accessing multimedia and the internet, making them more popular than television and newspapers. Radio usage has declined, and few read farm magazines due to technical content. These findings are consistent with Singh *et al.* (2020) and Kathpalia *et al.* (2021).

Table 7: Distribution of small farmers according to pattern of mass media use (n_1=120)

S. No.	Mass media	Frequency of use						WMS	Rank
		Regular		Occasional		Never			
		f	%	f	%	f	%		
1	Newspaper	38	31.67	50	41.67	32	26.66	2.05	IV
2	Farm magazine	05	04.16	08	06.67	107	89.17	1.15	VI
3	Radio	23	19.17	31	25.83	66	55.00	1.64	V
4	Television	79	65.83	36	30.00	05	04.17	2.62	III
5	Internet	85	70.83	27	22.50	08	06.67	2.64	II
6	Mobile	98	81.67	16	13.33	06	05.00	2.77	I

Table 8: Distribution of large farmers according to pattern of mass media use (n_2=120)

S. No.	Mass media	Frequency of use						WMS	Rank
		Regular		Occasional		Never			
		f	%	f	%	f	%		
1	Newspaper	57	47.50	45	37.50	18	15.00	2.33	IV
2	Farm magazine	08	06.67	25	20.83	87	72.50	1.34	VI
3	Radio	18	15.00	26	21.67	76	63.33	1.52	V
4	Television	90	75.00	25	20.83	03	02.50	2.71	III
5	Internet	95	79.17	21	17.50	04	03.33	2.76	II
6	Mobile	107	89.17	11	09.17	02	01.66	2.88	I

f= Frequency, %=Percentage, WMS= Weighted Mean Score

3.4 Behavioral characteristics of the respondents

Table 9 shows disparities in behavioral characteristics between small and large farmers. Scientific orientation varied, with 45.00 per cent of small farmers at a low level

compared to 42.50per cent of large farmers at a medium level, likely due to larger farmers having better education and economic resources. Similarly, 42.50 per cent of small farmers had low management orientation, while 45.00per cent of large farmers had medium orientation, reflecting their ability to plan farm activities in advance. Similar results were reported by Khushbu & Sabharwal, 2022).

Achievement motivation was low for 50.84 per cent of small farmers but medium for 45.83 per cent of large farmers, indicating that larger farmers had better achievement motivation owing to their better economic resources. These results are supported by Ahuja *et al.,* 2016 and Vinay Kumar *et al.,* 2022. Risk orientation among respondents showed that 47.50 per cent of small farmers at a low level, while large farmers were more evenly distributed between medium (40.83%) and high (40.00%) levels, this can be attributed to their financial stability and risk management capacity. Kumar *et al.,*(2020) and Dilip (2021) reported similar results.Market orientation was low for 40.83 per cent of small farmers and medium for 45 per cent of large farmers, with minimal difference due to state procurement policies at MSP and limited marketing diversification. These results are in accordance with Ahuja *et al.,*(2016) and Vinay Kumar *et al.,*(2022).

Table 9: Distribution of respondents according to their behavioral characteristics

S. No.	Variable	Category	Range	Small farmers (n_1=120)		Large farmers (n_2=120)	
				f	%	f	%
1	Scientific orientation	Low	≤ 8.78	54	45.00	31	25.83
		Medium	8.78-17.02	43	35.83	51	42.50
		High	≥ 17.02	23	19.17	38	31.67
2	Management orientation	Low	≤ 5.50	51	42.50	28	23.33
		Medium	5.50-11.70	48	40.00	54	45.00
		High	≥ 11.70	21	17.50	38	31.67
3	Achievement motivation	Low	≤ 7.54	61	50.84	24	20.00
		Medium	7.54-14.53	43	35.83	55	45.83
		High	≥ 14.53	16	13.33	41	34.17
4	Risk orientation	Low	≤ 3.33	57	47.50	23	19.17
		Medium	3.33-6.77	43	35.83	49	40.83
		High	≥ 6.77	20	16.67	48	40.00
5	Market orientation	Low	≤ 3.07	49	40.83	31	25.83
		Medium	3.07-6.43	48	40.00	54	45.00
		High	≥ 6.43	23	19.17	35	29.17

Conclusion

The Rice-Wheat Cropping System (RWCS) is integral to India's food security. Despite its critical role, RWCS faces numerous sustainability challenges exacerbated by its resource-intensive nature, including soil degradation, groundwater depletion, and rising production costs. The Green Revolution's technological advancements, while boosting productivity, have intensified these issues, highlighting the need for sustainable practices. In Haryana, a key region for RWCS, disparities between small and large farmers are evident. Large farmers generally have better access to resources, technology, and financial support, which allows them to adopt advanced practices and manage their farms more efficiently. In contrast, small farmers face limitations in resources and technology adoption, impacting their productivity and sustainability efforts.

The study underscores the importance of understanding these disparities to develop targeted interventions. For small farmers, improving access to extension services and modern technologies is crucial. Extension services play a vital role in disseminating knowledge on sustainable practices and bridging the gap between small and large farmers. Resource-conserving practices such as zero tillage, direct seeding, and improved water management can enhance productivity and sustainability. Addressing these issues requires a multifaceted approach, including policy advocacy, stakeholder engagement, and capacity building. By focusing on these areas, the RWCS in Haryana can be made more sustainable, ensuring long-term food security and environmental health. Enhancing the adoption of sustainable practices among both small and large farmers will contribute to the overall sustainability and profitability of RWCS, benefiting the agricultural sector as a whole.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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