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Constraints affecting innovations of rice farmers in the Kole wetland system

[1]S Vivek and [2]Binoo P Bonny

[1, 2]Department of Agricultural Extension, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur, Kerala, India

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Corresponding Author: S Vivek

Abstract

The rice cultivation practices of the Kole wetland in Kerala have become well-known, boasting a history that spans three centuries. However, there has been a significant decrease in the cultivation area and overall yield in Kerala. The challenges confronting innovations in rice production in the Kole wetland system have not been thoroughly examined using suitable methodologies. Consequently, this research employed Henry Garrett's ranking technique to assess and prioritize the constraints influencing the innovations of rice farmers in the Kole wetland system. The data were collected from 150 farmers chosen at random. The results revealed that rice farmers encounter challenges related to accessing and utilizing inputs and technology, adopting marketing innovations, and facing economic, environmental, and institutional constraints. Erratic rainfall (74.07%), delay in procurement (72.03%), unavailability of labour (70.23%), research and extension don't know the real production problems farmers face (70.10%), and high cost of inputs (68.87%) were the major constraints noted in average values. The research suggests that utilizing the Henry Garrett technique for ranking constraints is more effective compared to relying on simple frequencies.

Keywords: Constraints, Garrett's ranking, innovations, agricultural technology, marketing

Introduction

The Kole wetland in Kerala has gained renown for its rice cultivation practices, with a history spanning 300 years. The Kole land is a component of the distinctive Vembanad-Kole wetland ecosystem in Kerala and has been designated as a Ramsar site since 2002 (Islam and Rahmani, 2008) [6]. Its name, 'Kole,' directly translates to 'bumper crop' in Malayalam, highlighting the wetland's remarkable productivity.

The Kole wetlands are situated between the Chalakudy River in Thrissur district and the Bharathapuzha River in Malappuram district. These wetlands become submerged during the monsoon season, and agricultural activities take place in the summer months when water levels are lower. According to a significant study conducted by Johnkutty and Venugopal (1993) [13], the shallow lagoons in the Karuvannur and Kecheri river basins, located between the Chalakudy and Bharathapuzha rivers, were reclaimed in the 18th century for rice cultivation. The *Kole* wetlands form the lion's share of the area under rice cultivation in the Thrissur and Malappuram districts.

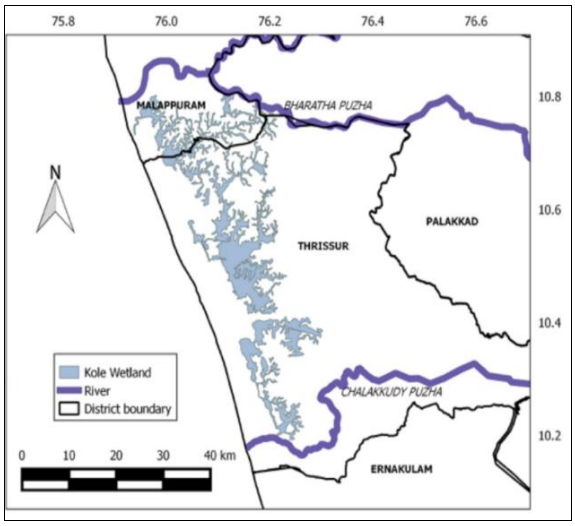

Fig 1: Map of Kole wetlands (Sarath *et al.*, 2017) [10]

Padasekharams are a collection of contiguous rice fields wherein the land owners form themselves into groups to form a Padasekharam Samithi in a democratic way under Section 7A of the Kerala Land Development Act, 1964 and registered under the Societies Act (Sreenivasan, 2012) [12]. The Padasekhara samiti or committees manage the major joint operations in these rice fields.

The area of cultivation and total yield registered a drastic decline in Kerala between 2005 and 2020. Lately, rice farming in the Kole lands of Thrissur has become less appealing due to various challenges, prompting farmers to seek immediate intervention. To elevate rice cultivation beyond a basic livelihood pursuit and turn it into a flourishing enterprise, there is a requirement for innovation in production and management practices, along with the mechanization of the cultivation process.

The present study was conducted to assess the major constraints affecting the innovations of rice farmers in the Kole wetland system in order to derive solutions to improve the productivity of rice and the socio-economic status of farmers.

Materials and Methods

The study was conducted in the Kole wetland rice growing tracts of Thrissur district of Kerala state. Kole land, which is one of the major rice-producing wetland systems of the state, was purposively selected for the study. Based on the list of Padasekharams under Kole from the records of the state Department of Agriculture, two *Padasekharam*s with maximum area were selected. A total of 150 farmers, averaging 75 per Padasekharam, were selected randomly.

Henry Garret's (1969) [5] ranking method was used to identify and analyse the most constraints faced by the rice farmers of the Kole area. Various authors from different countries have used this technique to analyse the constraints in different fields of study (Balasubramaniam *et al*., 2022; Shanthini, 2020) [1, 11]. The ranks on constraints for each respondent were converted into a score as per the following procedure.

Step 1: Rank all of the variables collected from each respondent. The study used a pairwise ranking technique to obtain the ranks of all constraints in each category. Following that, each respondent ranked all constraints based on their severity in their opinion.

Step 2: Estimate the number of respondents who responded to each rank. This shows the summary of the respondents who fall into a specific rank for each constraint.

Step 3: Calculate the percent position by using the Henry Garrett formula presented below.

$$\text{Per cent position} = \frac{100(Rij - 0.5)}{Nj}$$

where Rji is the rank given for the ith variable by the jth respondent, and Nj is the number of variables ranked by the jth respondent.

Step 4: The equivalent value of the percent position was found out using the Garrett Table. The estimated percent position was then converted into scores using Garrett's Table (Dhanavandan, 2016) [3]. The score is then calculated by multiplying the number of respondents in that particular rank by the Garrett value.

Step 5: The total value for each constraint was estimated by summing the scores obtained in the fourth step.

Step 6: The total value was divided by the total number of respondents to get the averages.

Step 7: The ranks of each constraint were estimated. Ordering the average value in descending order yields the ranks of each constraint. The higher valued averages ranked first, implying that it is the most saviour problem.

Results and Discussions

Constraints in the AIS of wetland rice farmers

Constraints associated with the AIS of wetlands in Kerala can potentially restrict the innovativeness of rice farmers. The extensive literature review and preliminary survey tests identified 23 constraints that posed problems to farmers in agricultural innovation process. These constraints were categorised into five groups: input and technology access and use, marketing, economic, environmental and institutional attributes. Constraint analyses were taken up separately for the Kole and Kuttanad wetland systems studied, and the results are presented here.

Constraints in the AIS of the Kole Wetland rice system

A comprehensive account of the constraints that affected the innovations of rice farmers of the Kole wetland system of Kerala is visualised in Figure 2. A detailed account of the sub-components delineated under each selected major constraint is presented as follows.

Input and technology access and use constraints: Constraints related to input and technology access and use of innovations in the Kole wetland rice system were evaluated as perceived by the farmers. The results are presented in Table 1, and it revealed that the most critical constraint ranked first was the high cost of inputs. The constraint had an average Garret score of 68.87. This indicated that, as the input prices escalated, farmers could not buy inputs, and they chose to cultivate with fewer inputs or even excluded its use. This ultimately resulted in lower yields and reduced food security and farmer incomes (FAO, 2022) [4]. The unavailability of inputs was ranked second among the constraints faced by Kole rice farmers, with an average Garret score of 56.40. This could be attributed to the input providers' inability to stock sufficient inputs such as fertilisers, manures, soil ameliorants, etc., well before the crop season during which the demand would be high was ranked third. Rice variety Uma, developed by the Rice Research Station, Mancombu of Kerala Agricultural University and released in 1998, is the most widely cultivated variety in the Kole lands. This variety had high yield potential and tolerance to pests and diseases in the initial years of cultivation (Devika *et al*., 2004) [2]. However, over time, Uma has shown vulnerability to various pests and diseases and has started causing losses to rice farmers in recent times. This has resulted in an increased surge among

rice farmers toward the need for a more promising rice variety to replace Uma. Even though new varieties like Manupriya and Manuratna developed by the Agricultural Research Station, Mannuthy of Kerala Agricultural University were released in 2006 and 2018, respectively, for the wetlands of Kerala, including Kole lands, the seeds are not widely available among the farmers. These varieties were introduced in Kole lands as part of on-farm trials and frontline demonstrations. Still, the seeds are not available in open markets or the National Seeds Corporation (NSC), which form the major seed suppliers to farmers. As such, the farmers could not utilise the potential of these varieties for higher yields and pest tolerance even though they were ready to practice it. Another constraint Kole rice farmers faced was the high cost of new technologies, which showed an average Garret score of 31.41. (Mridula and Devi (2016) [9]

Table 1: Constraints affecting input access and use innovations of Kole wetland rice farmers

(n= 150)

Input access & use constraints	Rank scores				Total Garret score	Average Garret score	Rank
	1	2	3	4			
High cost of inputs	9198	672	352	108	10330	68.87	1
High cost of new technologies	146	280	1100	3186	4712	31.41	4
Unavailability of inputs	1095	6888	396	81	8460	56.40	2
Absence of improved rice varieties	657	952	5324	81	7014	46.76	3

Constraints related to marketing innovations: A major part of the rice produced in Kole wetlands is marketed through the decentralised paddy procurement scheme of the Government of Kerala since 1997-98. It forms an innovative scheme aimed at the farm gate procurement of the produce with the State Civil Supplies Corporation (Supplyco) as the nodal procurement agency. Though the program ensured farm gate procurement at pre-notified prices and quality standards, the farmers reported many constraints concerning the marketing innovation. The constraints evaluated in the study were delay in procurement, delay in disbursing the price of paddy procured, lack of storage facilities, lack of processing facilities, and value addition, and recurring conflicts between rice mill agents and farmers in the *Kizhivu* (Determination of procurement quantity based on pre-set quality standards). The results of the constraints related to marketing innovations in Kole lands are included in Table 2. The results in Table 2 indicate that among the constraints, delay in procurement of paddy was ranked first with a mean Garret score of 72.03. The Kerala State Civil Supplies Corporation (Supplyco) procured paddy at Rs. 28.20 per Kg, much above the minimum support and market prices with a state government subsidy component. The farmers reported an average delay of more than a month for procuring harvested produce. Due to the lack of proper paddy storage facilities and their pressing need for money to repay the loans, many farmers were forced to resort to distress sales much below the procurement price, incurring losses. The delay in disbursing the price of paddy ranked second with an average Garret score of 60.07. Most farmers had crop loans from banks to repay after the sales of the produce. The delayed payments led them into debt traps, forcing them to abandon the cultivation of the next crop season. Even though Supplyco has entered into an agreement with the consortium of banks to pay off the paddy procurement dues of the farmers, it involved pledging paddy receipt sheets (PRS) with the bank. In this, the farmer dues were paid as post-harvest credit on PRS issued by millers. It also entailed taking an undertaking from the farmers that they would repay unless the government paid it as agreed. In turn, every delay in repayment negatively impacted the SIBIL score of the farmers and their eligibility for future loans. As such, the delay in payment of procurement price has multipronged implications for the farmers and needs to be redressed with better repayment strategies.

The conflicts between rice mill agents and farmers in determining *Kizhivu* were ranked as the third important constraint related to marketing innovations, with a mean value of 51.37. As part of meeting the prescribed fair average quality (FAQ) specifications related to moisture content (16%), damaged (2%), discoloured and broken grains (3%), foreign matter (organic and inorganic 1%), a certain quantity of paddy was deduced from the total procured paddy by the agents of millers, known as *Kizhivu*. This reduction was decided entirely at the discretion of the rice mills, as there was no empirically measurable equipment in the procurement fields, leading to conflicts with farmers. The lack of storage facilities (41.50) and processing facilities and value addition (31.10) were ranked as the fourth and fifth marketing constraints.

Table 2: Constraints affecting marketing innovations of Kole wetland rice farmers

(n= 150)

Constraints	Rank scores					Total Garret score	Average Garret score	Rank
	1	2	3	4	5			
Delay in procurement	9750	660	250	120	25	10805	72.03	1
Delay in disbursing the price of paddy procured	900	7740	200	120	50	9010	60.07	2
Lack of storage facilities	225	240	1000	4560	200	6225	41.50	4
Lack of processing facilities and value addition	75	180	650	1160	2600	4665	31.10	5
Conflicts between rice mill agents and farmers in the determination of *Kizhivu**	450	720	6350	160	25	7705	51.37	3

* Determination of procurement quantity based on pre-set quality standards

Economic constraints: Economic constraints that have the potential to affect innovations in Kole wetlands covered issues related to the high cost of labour, unavailability of labour, lack of financial resources, and lack of farmer-friendly credit facilities. Constraint ranking of Kole rice farmers based on Garret scores are given in Table 3.

It can be observed from the results in the table that the farmers perceived the unavailability of labour as the most significant economic constraint, with a mean Garret score of 70.23. The finding has profound implications for rice cultivation as rice formed one of the most labour-intensive crops. This is reflected in the fact that the farmers of the Kole wetland rice systems mainly depended on migrant labourers from other states, and the participation of local labourers was minimal. During the crop season, the high demand for labour led to the non-availability of labour on time increasing the cost of production, ultimately leading to low productivity. The high labour cost was ranked as the second important constraint, with an average Garret score of 57.35. The study by Lauren *et al.* (2008) [14] revealed that the unavailability of labour and the high cost of labour are the emerging constraints in the rice production systems. Further, the study by Mridula and Devi (2016) [9] on rice farmers' perception of mechanisation in the Kole lands of Thrissur reported that labour shortage and high wages were the two critical constraints that need to be urgently redressed. Lack of financial resources (43.77) and lack of farmer-friendly credit facilities/loans (32.01) were found to be the third and fourth critical economic constraints.

Table 3: Economic constraints affecting innovations of Kole wetland rice farmers

(n= 150)

Economic constraints	Rank scores				Total Garret score	Average Garret score	Rank
	1	2	3	4			
High cost of labour	1095	7392	88	27	8602	57.35	2
Unavailability of labour	9344	1120	44	27	10535	70.23	1
Lack of financial resources	219	784	5104	459	6566	43.77	3
Lack of farmer-friendly credit facilities/loans	146	224	1408	3024	4802	32.01	4

Environmental constraints: Farming, especially in the wetland systems, formed an innovation built on the agroecosystem's environment and natural resource base. Therefore, all technological and process innovations aimed at improving the efficiency and productivity of the Kole rice system were evaluated on identified environmental constraints, and the results are included in Table 4.

The table results revealed that the uneven rainfall distribution was ranked at the top with an average Garret score of 74.07. This could be attributed to the inherent vagaries of below-mean-sea level rice cultivation followed in the Kole lands that depended profoundly on rainfall patterns. The untimely and unseasonal rains resulting from climate vagaries posed a severe threat to farmers in maintaining the FAQ of paddy grains to avail themselves of the benefits of the procurement scheme. As such, the innovations aimed at building system resilience and sustainability have a bearing on rainfall distribution. (Li *et al*., 2023) [7].

Table 4: Environmental constraints affecting innovations of Kole wetland rice farmers

(n= 150)

Environmental and natural constraints	Scores of ranks					Total value	Average	Rank
	1	2	3	4	5			
Pest and diseases	1350	7560	100	80	50	9140	60.93	2
Weeds	375	1200	6150	40	25	7790	51.93	3
Erratic rainfall	10875	120	50	40	25	11110	74.07	1
Water pollution	225	120	250	1080	2825	4500	30.00	5
Saltwater intrusion	75	180	1450	4640	25	6370	42.47	4

Problems of pests and disease were ranked second with a mean Garret score of 60.93. Along with the reports on the recurring resurgence of many pests, the emergence of new diseases and pests posed a severe threat to rice production in Kole lands. They caused heavy damage to rice crops and led to less remunerative yields. Weeds, especially in the submerged context of Kole, were found to be another critical problem that affected rice production. A survey conducted by Kerala Agricultural University in Kole lands to study the predominance and weed competition reported that grassy weeds were the most severe problems in Kole lands. Saltwater intrusion was (42.47) also found to be a significant constraint. This was the result of Kole lands being surrounded by canals connecting backwaters. Water pollution, perceived as the result of indiscriminate use of fertilisers and pesticides in the system, received only fifth rank among the constraints, with an average Garret score of 42.47. This could be attributed to farmers' wide acceptance of integrated pest and nutrition management processes in Kole rice production.

Institutional constraints: Institutional constraints affecting the innovations of rice farmers of the Kole wetland system were evaluated based on the identified factors such as information access among farmers, training, extension contact, knowledge of field problems among researchers and extension officers and sources for farmer feedback on innovations. The results on institutional constraints derived based on Garret ranking of farmer rating data are presented in Table 5.

Table 5: Institutional constraints affecting innovations of Kole wetland rice farmers

(n= 150)

Institutional constraints	Rank scores					Total Garret score	Average Garret score	Rank
	1	2	3	4	5			
Lack of information on new agricultural technology or techniques	7800	840	750	560	75	10025	66.83	3
Lack of training	7350	1560	500	360	175	9945	66.30	5
Lack of contact with extension staff	7650	1440	300	360	225	9975	66.50	4
Research and extension don't know the real production problems farmers face	8700	1320	300	120	75	10515	70.10	1
Lack of opportunity to feedback to extension/research about innovations	8325	1200	450	240	100	10315	68.77	2

Results in the table revealed that among the various institutional constraints, lack of knowledge of the research and extension staff on the actual production problems faced by the farmers received the top rank with an average Garret score of 70.10. This suggested ineffective interactions among research-extension-farmer systems of the transfer of technology (TOT). The study by Mardiharini *et al.* (2023) [8] suggested that increased frequency and intensity of government and private research and extension are crucial factors in enhancing the capacity and capability of rice farmers, understanding the problems farmers face, and developing need-based innovations. Lack of opportunity to give feedback to extension/research about innovations was ranked as the second important constraint, with a mean Garret score of 68.77. It indicated the importance of having intrinsic feedback loops in all formal TOT systems to ensure timely and reciprocal interaction among all its actors. This would allow farmers to give feedback on various technological innovations introduced by the extension and research systems, which could serve as a corrective mechanism and increase farmer satisfaction with the extension services. The lack of information on new agricultural technology or techniques (66.83), lack of contact with extension staff (66.50), and lack of training (66.30) were the other institutional constraints ranked third, fourth and fifth respectively, by the rice farmers of Kole wetland system.

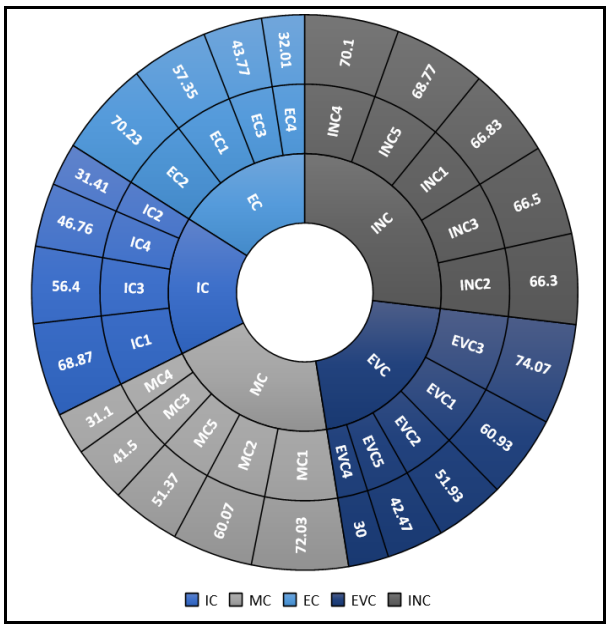

Fig 2: Constraints affecting innovations of rice farmers of Kole wetland system

IC- Input access & use constraints; MC-Marketing constraints; EC-Economic constraints; EVC-Environmental constraints; INC- Institutional constraints

IC1	High cost of inputs	EC4	Lack of farmer-friendly credit facilities/loans
IC2	High cost of new technologies	EVC1	Pest and diseases
IC3	Unavailability of inputs	EVC2	Weeds
IC4	Absence of improved rice varieties	EVC3	Erratic rainfall
MC1	Delay in procurement	EVC4	Water pollution
MC2	Delay in disbursing the price of paddy procured	EVC5	Saltwater intrusion
MC3	Lack of storage facilities	INC1	Lack of information on new agricultural technology or techniques
MC4	Lack of processing facilities and value addition	INC2	Lack of training
MC5	Conflicts between rice mill agents and farmers in the determination of *Kizhivu**	INC3	Lack of contact with extension staff
EC1	High cost of labour	INC4	Research and extension don't know the real production problems farmers face
EC2	Unavailability of labour	INC5	Lack of opportunity to feedback to extension/research about innovations
EC3	Lack of financial resources		

Conclusion

The study focused on identifying the key constraints that impacted the innovations of rice farmers in the Kole wetland system. These constraints were classified into different categories according to their significance in the study area, utilizing Garratt's ranking technique. This approach was deemed more effective for prioritization compared to basic frequency distributions. The study revealed rice farmers encounter challenges related to accessing and utilizing inputs and technology, adopting marketing innovations, and facing economic, environmental, and institutional constraints. There existed a need for increased frequency and intensity of government and private research and extension interactions for enhancing the capacity and capability of rice farmers, understanding the problems farmers face, and developing need-based innovations. Steps should be taken to make available the newly released varieties at the required amount of seeds at the most crucial time. The construction of proper paddy storage facilities will help the farmers to overcome distress sales. An effective

system should be developed to ensure the availability of agro machinery in a timely manner and at affordable rents, and a greater number of skill-oriented training in the farm mechanization sector. There should be intrinsic feedback loops in all formal TOT systems to ensure timely and reciprocal interaction among all its actors which will allow farmers to give feedback on various technological innovations introduced by the extension and research systems.

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Competing Interests
The authors have declared that no competing interests exist.

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