I J P S INTERNATIONAL JOURNAL OF PLANT SCIENCES
ISSN-0973-1547 Volume 18 | RAAAHSTSE | 2023 | 21-26
DOI: 10.15740/HAS/IJPS/18.RAAAHSTSE/21-26
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RESEARCH ARTICLE

Impact of mechanization on rice fallow pulses in cauvery delta zone of Tamil Nadu

■ S. Angles and K.R. Jahanmohan

SUMMARY

The rice fallow pulses crop is one of the major crop in Thanjavur District of Tamil Nadu state, in recent years the area under rice fallow pulses are dwindling due to use of heavy machinery like combine harvesters and tractor mounted balers. Hence, this study was conducted with an objective to assess the impact of mechanization on the rice fallow pulse and to quantify the economic loss due to non-cultivation of rice fallow pulses. Multistage Stratified Random Sampling method was employed for drawing the 100 numbers of samples farm households from Kumbakonam and Orathanadu blocks of Thanjavur district.Among the various consequences, season skipping was the main consequence of heavy machinery usage in rice farming on pulses cultivation in both the study blocks. The reduction in yield of fallow pulses to the tune of more than 50 per cent was felt as the major impact of mechanization in rice farming. Farmers in both the study blocks have cited that the reduction in yield was the major impact which was due to sub optimal plant population due to use of combine harvesters and tractor mounted balers. Non-availability of labour and associated higher cost for labourers was the prime for preference of heavy machineries like combine harvesters and balers in rice farming. It is suggested for development of paddy harvesters specifically for the regions where rice fallow pulses were practices, promotion of irrigated pulses in alternate season and to extend the price incentive which would incentivize the farmers to bring more area under pulses crops.

Key Words : Black gram, Green gram, Mechanization, Production constraints, Rice fallow pulses

How to cite this article : Angles, S. and Jahanmohan, K.R. (2023). Impact of mechanization on rice fallow pulses in cauvery delta zone of Tamil Nadu. *Internat. J. Plant Sci.*, **18** (RAAAHSTSE): 21-26, **DOI: 10.15740/HAS/IJPS/18.RAAAHSTSE/21-26,** Copyright@ 2023:Hind Agri-Horticultural Society.

Article chronicle : Received : 13.03.2023; **Accepted :** 20.03.2023

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The area under rice fallow pulses has been declining in Thanjavur district which was one of the well-knownregion for cultivation of pulses under rice fallow conditions. The rice fallow conditions provide an excellent ambience for pulses besides confers economy by the way of utilization of residual moisture and nutrients and provided a potential supplementary income to the farmers. Due to short growing duration, resilience, and

minimal input requirements, pulse crops have unique benefits that offer a great opportunity to exploit stored soil moisture (Kar *et al.,* 2004 and Kar and Kumar, 2009). A close observation of the area statistics on pulses in Thanjavur district revealed that the pulses area has halved during the past two decades and the impact is more on the green gram and Black gram. The pulses are excellent source of protein in our diet and ICMR recommends for an intake of 60 – 120 g of pulses per day based on the activities. But the average per capita consumption in India was mere 53 g during 2022 only and reduced production level and associated supply side contractions could be the major reason for the above phenomenon.

It is crucial to utilise underutilised potentials in India, where it is estimated that 11.695 million hectares (ha) of land are left fallow after the rice harvest, with roughly 82 percent of that land being in Eastern India and the remainder in the three southern states of Tamil Nadu, Karnataka and Andhra Pradesh (Singh *et al.,* 2016). The resources present in the rice fallows clearly giving an opportunity to introduce different pulse crop and it will surely be an excellent inclusion. If the location specific constraints are been managed efficiently then those unutilized lands can be efficiently converted into productive one (Chowdhury *et al.*, 2020). Rice cultivation in the delta region is unique owing to the typical soil characteristics and presence of heavy clay compels the farmers to opt for rice cultivation. Poor drainage and high water holding capacity do not permit other crops which are highly susceptible for water inundation. Rice, by virtue of its physiological properties, suits well in the deltaic soils and farmers in the delta have prudently introduced pulses especially black gram and green gram as a sequential crop (Narendrakumar *et al.,* 2016). The cropping pattern observed in the delta region is Rice – Rice – Pulses. Pulses crops are sown to break the monoculture of rice and thereby the associated problems like increase of pest and diseases load, soil fatigue etc., are judiciously managed. The pulse crop sown after the Samba/thaladi season rice crop would efficiently taps the residual soil moisture and the residual nutrients and being a nitrogen fixing plant, acts a source of Nitrogen nutrient for the next Kuruvai rice crop (Mishra and Kumar, 2018). Moreover, the pulses crop demands less labour and the labour requirement is needed only for sowing and harvesting operations and does not fall during peak season of labour demand situations.

Of late, usage of heavy machineries is in vogue in the delta owing to reduction in labour supply and associated higher wage rate for the labour. Peak season labour demand increases the magnitude of this phenomenon to a greater extent and Thanjavur being a deltaic district, farm production decisions were taken simultaneously by large number of farmers in short period escalates the demand for the labour Pulses were sown as relay crop and they are sown 7 to 10 days prior to harvesting and their germination period would be over by the time of harvest of rice crop and after rice harvest, the pulses crops establishes well results in sizable yield to the farmers. But, crisscrossing of heavy machineries like combine harvester, tractor mounted baler etc., besides hindering germination of pulses, trampled the budding pulses crop leading to severe loss in plant population thereby seriously reducing the yield levels.

There will be many constraints for the farmers that lead to skipping of crop, the farmers' lack of knowledge of water-conservation practises, and lack of extension services directly or indirectly deter farmers from planting a second crop (Joshi *et al*., 2002). The production of pulses in rice fallow can be increased with the use of suitable crop types and agricultural techniques (Kumar *et al.,* 2018). However increased knowledge of cultivars, timing of planting, seed rate, seed treatment, rice harvesting equipment, herbicide application, foliar spray, moisture stress reduction, and pest and disease control are all assumed to have contributed to improved yields and earnings (Umamaheshwari *et al.*, 2019).

In this context, reduction in area and fall in production levels necessitates to study this phenomenon so that the reasons could be demystified and plausible suggestions could be designed to offset this anomaly and thereby the farmers may have ensured supplemental income. The study was taken up with the objective to assess the impact of mechanization on the rice fallow pulse and to quantify the economic loss due to non-cultivation of rice fallow pulses that could suggest appropriate alternative strategies for the revival of rice fallow pulses in the delta region.

MATERIAL AND METHODS

The study was conducted in Thanjavur district of Tamil Nadu state which is situated entirely in Cauvery Delta Zone. The major crop is Rice and cropping pattern is Rice – Rice – Pulses. Black gram and green gram was the two predominant pulses crop raised as relay crop in the rice fallow after the second season rice crop. The normal area under pulses crop is 35,000 hectares

but the area is declining and it has recorded the least area of 14,748 ha in 2020-21 and less than 25,000 ha for five years in the last decennial period.

Multistage Stratified Random Sampling method was employed for drawing the samples and district was the universe. Blocks were in the first stage and high intensive pulses villages were in the second stage and farm households are the ultimate strata in this sampling design. Accordingly, Kumbakonam and Orathanadu blocks were selected and five villages in each block was selected randomly and in each village 10 sample households were selected and a total of 100 farm households were selected for studying the impact of mechanization in rice fallow pulses.

Garrett ranking technique :

Garrett ranking technique was used to analyse the constraints faced by the farm households in pulses cultivation, preference for machinery usage in rice farming and suggestions to offset these hurdles for increasing the area under pulses in Thanjavur district.

The ranking was calculated through the following formula :

$$\text{Per cent position} = \frac{100\,(R_{ij}-0.5)}{N_{ij}}$$

where,

R_{ij} = Rank given for i^{th} item by the j^{th} individual

N_{ij} = Number of items ranked by j^{th} individual.

By referring the Garret table, the per cent position estimated were converted into scores. For each parameter, the scores by various respondents were added and the mean value was calculated. The mean thus obtained for each of the attribute were arranged in descending order. The attribute with the highest mean value was considered as the most important parameters and the others would follow in the order (Garrett and Woodworth, 1969).

RESULTS AND DISCUSSION

The Cauvery Delta Zone (CDZ) has a total land area of 1.45 million ha, which is equivalent to 11 per cent of the state area. In this zone, rice fallow pulses are cultivated regularly after the Samba rice crop in December- January contributing a major share (>40%) to pulse production in the state. Nearly 3.1 lakh ha of Samba rice area is under rice fallow/ follow pulses and the yield realized ranged from 300 to 500 kg ha which is low compared to the potential yield under irrigated conditions.

Consequences of usage of heavy machinery for rice harvesting :

The responses of farmers on the consequences of usage of heavy machinery for rice cultivation subsequently on rice fallow pulses in the study area were collected and the results are tabulated in Table 1. Among the various consequences, season skipping was the main consequence of heavy machinery usage in rice farming on pulses cultivation in both the study blocks. The movement of heavy machineries creates large impressions especially in heavy clay soils ultimately making them unfit for sowing of relay cropping and hence

Table 1 : Consequences of usage of heavy machinery for rice harvesting

Sr. No.	Details	Kumbakonam		Orathanadu	
		No	%	No	%
1.	Season skipping	19	38.00	18	36.00
2.	Sub optimal plant population	14	28.00	17	34.00
3.	Soil hardening	7	14.00	7	14.00
4.	Deferred sowing and end season drought	10	20.00	8	16.00
	Total	50	100.00	50	100.00

Table 2 : Impact of mechanization on rice fallow pulses

Sr. No.	Details	Kumbakonam		Orathanadu	
1.	Reduced yield	21	42.00	19	38.00
2.	Poor germination of pulses	13	26.00	16	32.00
3.	Higher seed rate	10	20.00	8	16.00
4.	Diseconomy in labour utilization	6	12.00	7	14.00
	Total	50	100.00	50	100.00

the farmers resort to season skipping and the pulses crops sown is withdrawn by the famers. Perceptible damage to pulses crop especially at germination stage was observed owing the movement of machinery like combine harvesters and tractor mounted balers and farmers have listed as the second major consequence of machinery usage. Few farmers wait for some period to obviate the machinery damage and resort to deferred sowing and due to that the flowering and pod maturity phase of the pulses crop got entangled with end season drought resulting in severe yield loss. Since, vast area in Thanjavur district is under deltaic tract with presence of heavy clay soils, soil hardening is also noticed due to traversing of machinery and it has been mentioned as the fourth consequence of machinery usage.

Impact of mechanization on rice fallow pulses :

The impact of mechanization on pulses cultivation were collected from the sample respondents and results are depicted the Table 2. The reduction in yield of rice fallow pulses to the tune of more than 50 per cent was felt as the major impact of mechanization in rice farming. Farmers in both the study blocks have cited that the reduction in yield was the major impact which could be due to existence of sub optimal plant population. As a corollary effect, poor germination of pulses due to machinery movement was the next important impact. In order to compensate the population loss, the farmers are resorting to higher seed rate, even up to fifty per cent addition in the recommended seed rate. Higher seed rate results in increased cost of cultivation and seed availability at peak season also adds more difficulty to the farmers. Farmers (12 to 14 %) have also cited about the diseconomy in labour utilization especially for harvesting operations as the labour demand nearly on par rate for a normal field for harvesting these sub optimal plant population fields thereby increasing the cost of cultivation of rice fallow pulses.

Constraints faced by farmers in cultivation of rice fallow pulses :

The constraints faced by farmers in rice fallow pulses were collected form the sample respondents and the constraints were subjected to Garrett's Ranking Technique and mean scores and ranks are presented in the Table 3. The sub optimal plant population was considered as the prime constraint in rice fallow pulses cultivation by the sample respondents with a mean score

Table 3 : Constraints in cultivation of rice fallow pulses

S. No.	constraints	Rank	Mean score
1.	Sub optimal plant population	I	72.58
2.	Non-availability of labour	II	64.81
3.	Constraints in marketing	III	58.94
4.	Incidence of pests and disease	IV	52.36
5	Unavailability of good quality seeds	V	48.22

Table 4 : Reasons for preference of combine harvesters

Sr. No.	Reasons	Rank	Mean score
1.	Non-availability of labour	I	78.85
2.	High labour cost	II	67.18
3.	Large area for harvest in short period	III	56.04
4.	Non availability of thrashing floor	IV	42.58
5	Climatic conditions	V	38.50

Table 5 : Reasons for preference of balers

Sr. No.	constraints	Rank	Mean score
1.	Non-availability of labour and high cost	I	70.54
2.	Higher straw recovery	II	66.82
3.	Easy transportation	III	59.40
4.	Occupies less space	IV	54.88
5	Enhanced stored period	V	50.04

of 72.86. Reduction in plant population results in reduced yield and hence, this could be the reason for citing it as prime reason by the farmers. Non-availability of labour and higher labour cost was mentioned as the second important constraint by the farmers. As the yield is low on one side and labourers demanding unequivocally higher labour charges especially for harvesting might have directed the farmers to cite this reason as the important constraint. Existence of difficulties in marketing especially low price wjile selling the produce has been cited as third important constraint in cultivation of rice fallow pulses. Owing to the existence of harsh climatic conditions and susceptible nature of varieties, incidences of diseases like yellow mosaic in pulses are at increasing trend and hence, incidence of pests and diseases was cited as the next important constraint. The yield level is greatly influenced by the availability of good quality seeds and in rice fallow pulses, farmers resort to self grown seeds and certified seeds are not preferred owing to its paucity in availability and hence, this was cited as the fifth constraint faced by the sample respondents.

Reasons for preference of combine harvesters for harvesting rice :

The respondents were asked to rank the reasons for preferring the combine harvesters for rice harvesting as farmers are fully aware of its consequences in pulses cultivation and the results are discussed in Table 4. The study area is in the Cauvery Delta Zone in which the decisions on sowing operations are taken on the availability of water in the irrigation channel.Large numbers of famers in vast area are forced to take decisions uniformly which leads to acute peak season demand for labour availability labour intensive operations like harvesting. Hence, farmers prefer combine harvesters and hence, it was cited as prime reasons for opting machinery for harvesting. Prevalence of higher cost for labour and reduced efficiency of labourers might have impacted the farmers to choose high labour cost as the second important reason for machinery preference. Moreover, the machines can harvest large area at comparatively shorter period and hence, this was third important reason for selecting machinery to perform harvest operations. Non-availability of threshing floor and non-proximal location of such facility might have opted the respondents to select this one as reason. Besides, the climatic conditions prevailing in the delta over past few years like unseasonal rainfall in the harvest season have opted the farmers to cite this as another reason for machinery harvesting as this require comparatively lesser time to complete the harvesting process. To better exploit and understand the ecology of rice-fallows for strategic crop management, substantial research is required (Kumar *et al.* 2019).

Reasons for preference of balers :

The farmers prefer tractor mounted balers to bundle the straw and reasons for such preference were ranked and presented in the Table 5. Non-availability of labour was the first reason cited for the preference for balers as the collecting and heaping the straw in the open field is cumbersome and laborious process which demands more labour and higher cost towards labour charges. Usage of balers leads to higher straw recovery and owing to its compaction, transportation becomes relatively more easier and hence, accorded second and third reason for preference. Obviously, occupying less space and enhanced stored period were ranked as fourth and fifth reasons for preference of balers.

Summary and policy options :

The reduction in yield of rice fallow pulses to the tune of more than 50 per cent was felt as the major impact of mechanization in rice farming. Farmers in both the study blocks have cited that the reduction in yield was the major impact which could be due to existence of sub optimal plant population. Non-availability of labour and associated higher cost for labourers was the prime for preference of heavy machineries like combine harvesters and balers in rice farming. It is concluded that the use of machineries for rice harvesting is inevitable and hence there is need for development of the machineries specifically for harvesting the rice without much effect on the rice fallow pulses. It is suggested that in order to increase the area under pulses promotion of irrigated Pulses in Chitirai pattamwith potential varieties (VBN 8) for better utilization of land and water resources.In order to increase the farm income the alternate crops like Gingelly (TMV -7 and VRI (SV) -1) in Maasi Pattam can be promoted. The price of Rs.63/ Kg at Market Committee and price incentive may be extended to pulses also which would incentivize the farmers to bring more area under pulses crops.

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