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Research Paper

Rice- Fallows: A Destiny or Opportunity to Farmers from Bhagalpur District of Bihar

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ABSTRACT

The study attempted to critically review the status and scope of rice fallows in India, specifically to the Bhagalpur district of Bihar. Technological progress and capital-intensive cultivation through conversion of marginal lands mitigated the ever-increasing demand of food production for burgeoning population to some extent but a continuous expansion of fallow lands brought serious concern on policy dynamics. The changes in temporal and spatial distribution of fallow lands are mostly documented due to increasing variability in the precipitation and irrigation water, and low level of mechanization. However, this is not true in case of flood and drought prone areas, and state like Bihar, where farmers are financially weak and technological expansion is very limited. The results revealed that, the most important constraint for rice fallows was rainfed ecology, low soil moisture content after the harvest of paddy and lack of irrigation facilities. The farmers also identified lack of short duration and high yielding varieties, poor plant stand, no use of fertilizers and chemicals and severe weed infestation in the field as the other major constraints. The size of land holding was found positively significant with rice fallows area indicating that the income penalty of keeping land fallow could not be tolerated by marginal small farmers.

Highlights

- The study on current fallow and permanent fallows are very limited and the availability of data at regional level is very dearth.
- The seasonal fallow (*rabi*) after rice harvest in Bihar has ample scope for utilization through growing short duration pulses using residual moisture and reviving canal irrigation system.

Keywords: Current fallows, land use, resource poor, rice fallows

Economic development and human welfare largely depend on optimum and efficient utilization of available land and water resources for agricultural and non-agricultural purposes. It is evident that a large proportion of India's land shows advanced and continuous degradation, threatening to undermine the capacity to increase food production and alleviate poverty. Sustainable increase in agriculture production without affecting the natural resources base is therefore very important to achieve food security (Karunakaran and Neduraman, 2012). The agricultural sector face the dilemma of meeting increasing levels of food demand where no more or very little new land may be brought into cultivation and on the other hand, the rate of growth of cereal is expected to decrease. Dynamics of land use is a complex phenomenon, affected by several socio-economic, agro-climatic and ecological variables. Technological progress and capital-intensive cultivation through conversion of marginal lands into mitigated the ever-increasing demand of food production for burgeoning population to some extent (Ramasamy *et al.* 2005). Land is said to be rare when the opportunity cost of land or the land

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rent is "low", whereas the land rent is nil as the land became abundant (Hubert and Moreaux, 2005).

There were few studies that examined the issues related to fallow lands in India. In spite of increasing demand for land for agricultural and non-agricultural purposes, a continuous expansion of fallow lands was found. The area under current fallows in India recorded a compound growth rate of 0.84 per cent per annum while the area under other fallows has grown at the rate of 0.95 per cent per annum during this period (Pandey and Tewari, 1996). These changes in the temporal and spatial distribution of fallow lands are due to increasing variability in the precipitation and irrigation water, and low level of mechanization. Managing and bringing the seasonal fallow lands under crop cultivation would enhance agricultural production and food security of the poor and marginal farmers (Pandey and Ranganathan, 2018). In this backdrop, the paper is articulated in two parts. Since, there is dearth of literature; in the first part extensive review of literature was done to have a fair knowledge of the subject. The second part consists of the results from the field survey that substantiate the observations of previous sections.

Distribution of rice fallow areas in India

As per the recent estimates, ~22.3 million ha (Mha) of suitable rice– fallow areas exist in the South Asia, with 88.3 per cent in India, 0.5 per cent in Pakistan, 1.1 per cent in Sri Lanka, 8.7 per cent in Bangladesh, 1.4 per cent in Nepal, and 0.02 per cent in Bhutan (Gumma *et al.* 2016). The fallow lands are distributed across the country but have a greater concentration in the states of Odisha, Chhattisgarh, West Bengal, Assam, Bihar, Jharkhand, Uttar Pradesh, Andhra Pradesh, Maharashtra, Madhya Pradesh, Tamil Nadu and Karnataka (Table 1). These fallow areas are suitable for intensification with a short duration (≤3 months), low water consuming grain legumes, i.e. chickpea, lentil, blackgram, greengram, and oilseeds, viz. linseed and safflower to improve the smallholder farmer's incomes and the soil health. As per the estimates of the Expert Group on Pulses, potential pulses area under the rice fallows is 2.46 million ha (NAAS 2013, Annual Report DPD 2016– 17).

Table 1: District wise distribution of areas under the rice-fallows

States	Rice fallow area (in million ha)	Major Districts
Odisha	2.96	Baleshwar, Dhenkanal, Sundergarh, Mayurbhanj, Puri, Kalahandi, Bolangir, Kheonjar and Cuttack
Chhattisgarh	2.86	Bilaspur, Dhamtari, Kanker, Jashpur, Raipur, Durg, Korba, Rajgarh, Kabirdham, Mahasamund and Rananadgaon
West Bengal	1.16	Bankura, Purulia, Medinapur, West Dinajpur, Malda, Jalpaiguri, Bardhaman and Birbhum
Assam	1.04	Marigaon, Naogaon, Lakhimpur, Kokrajhar, Bongaigaon, Nalbari, Kamrup, Barpeta, Darrang, Cachar, Goalaghat, Jorhat, Dibrugarh, Tinsukia and Sonitpur
Jharkhand	0.48	Ranchi, Purbi/Paschim Singhbhum, Hazaribagh, Gumla, Sahibganj, Deogarh, Palamau, Dumka, Dhanbad
Bihar	0.74	Kishanganj, Gaya, Aurangabad, Jamui, Nawada, Banka, Katihar, Bhagalpur
Uttar Pradesh	0.50	Ghazipur, Bhadohi, Maharajganj, Bahraich, Balrampur, Gonda, Siddarthanagar, Mirzapur, Chandauli, Sonbhadra, Lakhimpur Kheri, Pilibhit, Etawah
Maharashtra	0.63	Dhule, Amravati, Nagpur, Wardah, Bhandara, Chandrapur and Nanded
Other states	3.46	Andhra Pradesh: Krishna, Guntur, East Godavari, West Godavari, Srikakulum, Nellore and Prakasam
		Karnataka: Shimoga and Belgaum
		Madhya Pradesh: Shahdol, Seoni, Balaghat, Damoh, Mandla, Rewa, Betul and Sidhi
		Tamil Nadu: Salem, Namakkal, Tiruchirappalli, Cuddalore, Ramnathpuram, Madurai, and Villupuram

Source: *Annual Report 2016–17, Directorate of Pulses Development, Government of India.*

Challenges of rice fallows

The Rice–fallow areas are those *kharif* paddy grown areas that were kept fallow in rabi season. The main reasons for leaving the lands fallow during the winter season are lack of irrigation, late harvesting of long–duration high yielding rice varieties, moistures stress at sowing during the Rabi crops due to early withdrawal of monsoon, water logging and excessive moistures in November/December (Ali and Kumar 2009).

The majority of the rice fallows lie in Eastern India which consists of 73.66 million ha of geographical area (22% of India's total geographical area). This region contributes to 34.6 per cent of total national food production from a net cultivated area of 33.6 M ha (Bandopadhyaya *et al.* 2015). The food grain productivity in this region is the highest in West Bengal followed by eastern Uttar Pradesh, Bihar, Assam, Odisha, Jharkhand and Chhattisgarh, respectively. The cropping intensity ranges from 115 per cent in Chhatisgarh to 177 per cent in West Bengal. This region is inhabited by 38 per cent of the total national population (Census of India 2011) but the agricultural development is much below its potential levels (Bandopadhyaya *et al.* 2015). As a consequence, employment prospects in farming segment are restricted, compelling a mass of people to stay under the poverty and malnutrition. The per capita accessibility of cultivated land in regions is the lowest (0.15 ha) in the country (Kumar *et al.* 2016).

Majority of the farm possessions are marginal to small and extremely fragmented, which hampers implementation of mechanized farming in this region. The region receives 1100–1200 mm annual rainfall that is much enough to meet water necessity of different crops. The spatial and temporal variation is found in the rainfall pattern and distribution volatility in the farming process. Rice is the main crop and grown mostly as transplanted during rainy season. The resource-poor farmers of this region are not able to meet expense of irrigation and fertilizers to produce their crop during *rabi*.

Thus, growing a second crop after harvest of *kharif* rice depends on the efficient use of residual soil moisture. But, including the second crop in rice–fallows is a great challenge as post-rainy season that often confront a series of abiotic and biotic stresses (Kumar *et al.* 2018). Earlier studies reported that irrigation, use of fertilizers, monsoon rainfall and size of operational holdings (Ramasamy *et al.* 2005; Bardhanand Tewari, 2010) are some of the factors that determine the extent of fallow lands. A few household level studies (Ranganathan and Pandey 2017; Ranganathan and Pandey 2018) have also identified tenancy, irrigation, mechanization, livestock holdings, non-farm income opportunities, and distance from nearest town as important factors in farmers' decision to leave the land fallow. Ramasamy *et al.* (2005) analyzed the factors affecting the extent of fallow lands at the farm level using cross-section and revealed that increase in farm size, non-agricultural income and labour shortage have strong positive impact on the extent of fallow lands, while the credit availability and irrigation facilities are found to reduce the extent of fallow lands at the farm level. They also identified infrastructure and institutional factors, such as road density and access to institutional finance as important determinants of the extent of fallow lands.

Rice fallow situations in Bihar

In Bihar, the area under fallow lands has been increasing over time thereby reducing the net sown area. A larger concentration of current fallow lands was accounted for in Gaya, Patna, Purnea, Munger, Jehanabad & Kishanganj districts. Sinha *et al.* (2019) analyzed the factors responsible for changes in land use pattern especially increase in current fallows, shrinking net sown area and shifting of land for non-agricultural purposes in Bihar. The categories of land such as barren, culturable waste permanent pastures and grazing lands have shown declining trend and these land may probably have shifted towards other categories of area under non-agricultural uses, land under tree crops and groves as well as fallow lands. Erratic monsoon and labour scarcity during the study period of present century resulted in accumulation of current fallow lands. It was further observed that the non-agricultural use of land was identified as the dominant factor for changes in common lands as it affected the current fallows negatively. Intensive cultivation, resulting in changing marginal land into more productive agricultural lands through capital intensive cultivation, ignited by technological changes. The importance of institutional factors leading to under utilization of agricultural lands, especially when the people employed in urban areas keep lands idle for using it after retirement or for speculative purposes. However, this is not true in case of flood and drought prone areas, and state like Bihar, where farmers are financially weak and technological expansion is very limited.

Scope of cultivation in rice fallows

About 11.7 million ha area remains fallow after rice harvesting in the country, of which ~82% (9.73 million ha) area lies in Eastern states (Kumar *et al*. 2018). Research finding revealed that these unutilized areas can be converted into 2[nd] cropping by utilizing the residual soil moistures during *rabi* (Das *et al*. 2014). Similarly, oilseeds, viz. linseed and safflower can be grown under the moisture stress condition (Kumar *et al.* 2018, Mishra and Kumar 2018). Special advantages with pulses crop that being short-duration, resilient and low-input requiring in natures, suggest an incredible prospect to use of residual soil moistures (Kar *et al*., 2004; Kar and Kumar, 2009).

In India, pulses are grown on ~24–26 Mha land with yearly production of 17–18 MT (Singh *et al.* 2017). At present, because of large gap between supply and demand of pulses, India imports a huge quantity. So as to meet up the rising needs of pulses, it should be included as an integral part in rice–fallows with the dual advantage of area expansion and sustainable production.

Hence, promotion of pulse/oilseed crops in these unutilized lands would improve the sustainability of paddy cultivation in addition to attractive productivity and augments the incomes of farming community (Reddy and Reddy 2010). Thus, introduction of lentil/lathyrus/chickpea/linseed/safflower/mustard in these areas through suitable agricultural production techniques might usher in 2[nd] Green Revolution in such diffident, poverty and under privileged region (Singh *et al.* 2017). With appropriate crop varieties and agricultural practices, productivity of these pulses and oilseeds can also be improved in rice– fallows (Kumar *et al*. 2018).

MATERIALS AND METHODS

Rice fallows: Evidence from Bhagalpur district of Bihar

Data & Methodology: The author attempted a case study on rice fallows of Bhagalpur district of Bihar to document the underlying socio economic factors and constraints. Sultanganj block was purposively selected due to highest rice fallows in the district. In the next stage, five villages from Sultanganj block was selected using simple random sampling without replacement method. Twenty farmers from each villages were selected randomly, totalling a sample size of 100.

Analytical techniques

Garrett's ranking technique was used to identify the important reasons for keeping rice fallows by the farmers. Farmers were asked to rank the reasons of keeping fallows after rice cultivation. The rank given by the respondents then converted into per cent position using the formula given below:

$$\textit{Per cent Position} = 100^* \, (R_{ij} - 0.50)/N_j$$

Where, R_{ij} – Rank given for i^{th} item by j^{th} individual

N_j – Number of items ranked by j^{th} individual

In the second stage, the per cent positions were then converted to scores by referring to tables given by Garrett and Woodworth (1969). In the third stage, the summation of these scores for each factors was worked out for the number of respondents who ranked for each factor. In the fourth stage, mean scores were calculated by dividing the total scores by the number of respondents. In the last stage, overall ranking was obtained by assigning ranks such as 1,2,3… etc in the descending order of the mean score. The mean score for all the factors were ranked, following the decision criterion that higher the value, the more important is the order of preferences by respondents.

Multiple linear regression analysis without intercept was used to study the relation between the rice fallow and socio-economic variables. The following linear model was used for rice fallows under different socio-economic variables.

$$Y = b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + u_i$$

Where,

Rice fallow (Y): Rice fallow is the dependent variable, and it was considered in hectare.

Age of the farmers (X_1): Three categories of farmers age was considered as 18-30 years (1), 31-50 years(2) and 51 and above years (3) respectively.

Education status of the farmers (X_2): The education status of the farmer considered as illiterate and literate. For this dummy variable was used in which '0' represents illiterate respondent and '1' represents literate respondent.

Land Holding Size (X_3): Land holding size of the farmers was considered in hectare.

Total Income (X_4): Total income of the farmers includes both farm income as well as non-farm income of the farmers. It was considered in rupees annually.

Error term (U_i): Error term is the difference between the actual value of the independent variable and the value predicted by the regression equation.

The stochastic term u_i is useful to reflect intrinsic randomness in the data b_1, b_2, b_3 and b_4 are partial regression coefficient. The meaning of partial regression coefficient is that b_i measures change in the mean value of Y per unit change in X_i, holding other variables constant.

RESULTS AND DISCUSSION

Table 2 portrays salient features of land use pattern of Bhagalpur district.

Table 2: Land use statistics of Bhagalpur district

Sl. No.	Particulars	Area ('000 ha)	Percentage
1	Geographical Area	248.20	100.00
2	Cultivable area	153.60	61.89
3	Forest Land	0.78	0.31
4	Land under non-agricultural use	51.50	20.75
5	Permanent pastures	63.00	25.38
6	Cultivable wasteland	2.30	0.93
7	Land under Misc. Tree crops and groves	6.57	2.65
8	Barren and uncultivable land	22.60	9.11
9	Current fallows	7.20	2.90
10	Other fallows	3.20	1.29

Source: *https://agricoop.nic.in/sites/default/files/BR13_Bhagalpur_28.12.2013.pdf*

Almost 4.19 per cent land (10400 hectares) remained fallow in the district consisting of 7200 hectares of current fallows and 3200 hectares of other fallows.

Table 3: Constraints faced by farmer to keep the land fallow in *rabi* season after *kharif* rice harvest

Sl. No.	Constraints	Garrett's mean score	Rank
1	Rainfed ecology and Lack of irrigation	61.04	I
2	Low soil moisture residual availability	55.98	II
3	Poor physical condition of the top soil layer due to puddling of rice field, develop deep cracks	54.48	III
4	Lack of short duration and high yielding varieties	54.40	IV
5	Poor plant stand	53.88	V
6	No use of fertilizers/chemicals	52.78	VI
7	Severe weed infestation including parasitic weeds	50.86	VII
8	High disease incidence	44.20	VIII
9	Lack of credit and market infrastructure	40.62	IX
10	Lack of mechanization	33.68	X

Table 3 represents the prevailing constraints of bringing these current-fallows under cultivation. The results revealed that, the most important constraint for rice fallows was rainfed ecology and lack of irrigation facilities available in the area with the mean score of 61.04. Most of the farmers depend on the rain water as source of irrigation and also there is lack of sufficient irrigation facilities with the farmers that results for fallowing of the land. The second important problem was low soil moisture content after the harvest of paddy with mean score of 55.98, since after the harvest of the paddy crop the soil moisture level remains very low which makes the growing of the next crop very difficult for the farmers keeping the land ideal. The farmers also identified poor physical condition of the top soil layer due to puddling of rice fields and development of deep cracks in the soil as third constraint for rice fallows with mean score of 54.48. The fourth, fifth, sixth and seventh constraints were given to lack of short duration and high yielding varieties, poor plant stand, no use of fertilizers and chemicals and severe weed infestation in the field with mean score of 54.40, 53.88, 52.78 and 50.86, respectively.

To examine the relationship between keeping rice fallows and socio-economic factor, a multiple linear regression line without intercept was fitted and the results presented in Table 4. The coefficient of determination (Adj. R^2 = 80.5%) showed that about 80.5 per cent of the variation in area under rice fallows was explained by the variables included in the model. It was observed that out of four variables included in the model only one variable i.e. land holding size of the farmer significantly explained the variation in rice fallow area. It indicates that small and marginal size of farmers possessing small size of land cannot afford to keep their land fallow after rice cultivation while the medium and large sized farmers could manage to keep the land fallow. Other variables i.e. age, education and total income were not significant.

Table 4: Relation between rice fallow and socio-economic factors

Particulars	Coefficient	t- statistics
Age of head of household	0.294	0.854
Education level of head of household	0.034	1.221
Ownership holding	0.195*	5.682
Annual income of the household	0.005	0.334
Adjusted R^2	0.805	—

*a. Dependent variable: Area under rice fallow; * significant at 1% level, ** significant at 5% level.*

CONCLUSION

It can be concluded that the rainfed ecology and lack of irrigation facility in the study area was the first and foremost constraint that was responsible for keeping the land fallow after rice cultivation while low soil moisture residuals ranked second. Short duration pulses and oilseeds may be cultivated with the available moisture content in the soil. In this regards, farmer's field trials and awareness campaigns on improved practices and correct method of use of inputs need to be undertaken for the benefit of rice producers. In order to discourage the rising tendency in current fallows or to bring current fallows under cultivation, cheap sources of irrigation are needed. Revival of canal irrigation, large scale expansion of electric/solar operated irrigation devices may be the suitable way, which in turn lowers the production cost and enhance the margin of profit to the farmers. Intensification of existing agricultural systems is need of the hour to take care of the rising demand of food grain production in the country (Kumar *et al.* 2016). In this perspective, there is an enormous opportunity to increase the total cropping area through strategic research in rice–fallows (Kar and Kumar 2009).

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