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RESEARCH PAPER

Cropping intensity as influenced by resource base of farmers in Sujala III watershed in Northern Dry Zone of Karnataka

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Abstract: The challenge before Indian farming is to transform rainfed agriculture into more sustainable and productive systems through participatory watershed development. The World Bank funded Sujala III watershed project was implemented in Gadag, Koppal and Vijayapur districts. An attempt was made to analyze the influence of resource base on cropping intensity among farmers of Sujala III watershed in Northern Dry Zone of Karnataka. A sample of 60 farmers from each of upper, middle and lower reach from two sub watersheds were selected making up total of 180 farmers. The findings of the investigation shown that, nearly half (47.22 %) of the farmers had medium resource base, 27.78 per cent of the farmers had low and 25.00 per cent of them had high resource base. In view of cropping intensity, 45.56 per cent of Sujala III watershed farmers were found to have low cropping intensity followed by high with 38.33 per cent farmers and medium (16.11 %) cropping intensity.It was observed that, lower reach farmers had got higher (155.02 %) cropping intensity followed by middle (144.48 %) and upper reach (124.29 %). Further the study observed that, 45.88 per cent of farmers with medium resource base were found in high cropping intensity category followed by farmers with high resource base (37.78 %) and low resource base (26.00 %). However, lower cropping intensity was accounted for forty six per cent of low resource base farmers, 45.88 and 44.44 per cent of medium and high resource base farmers respectively. The chi square value of 34.78 was found significant at one per cent level of significance which indicates that, there was positive and significant association between resource base and cropping intensity. With increase in resource base, cropping intensity had also increased.

Key words: Cropping intensity, Rainfed, Resource base, Watershed

Introduction

Rainfed agriculture is complex, diverse and risk prone which is characterized by lower productivity levels and low input usage. An insight into the rainfed regions exposes a grim picture of water scarcity, rapid depletion of ground water table, fragile ecosystems and poverty. Land degradation due to soil erosion caused by wind and water, poor rain water use efficiency, high population pressure, acute fodder dearth, poor livestock productivity, underinvestment in water use efficiency, absence of assured and remunerative marketing opportunities and poor infrastructure are vital concerns of enabling policies. The challenge before Indian farming is to transform rainfed agriculture into more sustainable and productive systems through participatory watershed development with emphasis on integrated farming systems for augmenting productivity, income and livelihood security in a sustainable manner to provide better support for the population dependent upon it (Anon, 2011).

It was estimated that the total land degradation that occurred in India was 147 million hectares. Under this broad figure, 94.00 million hectares were claimed by water erosion, sixteen million hectares by acidification, 14.00 million hectares by flooding and nine million hectares through wind erosion. On an average, 29.00 per cent of the soil that is eroded is lost in the sea while 61.00 per cent is just relocated (Battacharyya *et al.,* 2015).

Realizing the significance of rainfed/dry land agriculture in the country, a great number of projects for productivity enhancement were implemented by the Government of India on the basis of watershed approach.The Central Government may provide coordination, technical guidance, financial assistance, training and research inputs besides monitoring the progress of implementation and evaluating the impact of major programmes. However, the outcome of watershed management programme much relies on how effectively they are planned, implemented and involve local people at grass root level.

Sujala is one such watershed development project which was designed by Government of Karnataka and implemented by the Watershed Development Department with the prime objective to improve the productive potential of selected watersheds and associated natural resource base, strengthen the community and institutional arrangements for natural resource management.The World Bank assisted Sujala III project was implemented in 2015 aimed to come out with site specific information at watershed level, mainly on soil and site characteristics for watershed development in Karnataka (Anon, 2021).The project was implemented in Gadag, Koppal and Vijayapur districts in Northern Dry Zone of Karnataka. An attempt was made to study the cropping intensity as influenced by resource base of farmers in Sujala III watershed in Northern Dry Zone of Karnataka.

Material and methods

An "*ex-post-facto*" research design was employed in present investigation which was conducted in Gadag and Koppal

districts of Northern Dry Zone of Karnataka during 2020-21 under the University of Agricultural Sciences, Dharwad. Dindur sub watershed belonged to Gadag district and Bedwatti sub watershed belonged to Koppal district were chosen for the study. Further, from each sub watersheds three micro watersheds were selected and from each micro watershed, 10 farmers from each of upper reach, middle and lower reaches of watershed were selected on stratified random sampling procedure. Thus, the total sample size was 180 farmers. Further, the primary data required for the study was collected through personal interview using structured and pre tested interview schedule. Statistical tools like mean, standard deviation, frequency, percentage, chi square test, correlation were used to analyze the data.

Resource base was operationalized as the type and extent of possession of resource by farmer that supports crop production system. The resources such as land, type of soil, status of soil, source of irrigation and vegetative cover were considered to compute resource base. Scale developed by Binkadakatti (2013) and followed by Rajeshwari (2020) was used with slight modifications.

The cropping intensity was calculated according to the procedure followed by Mavinakatti (2013). The index used for calculating the cropping intensity was as follows.

$$\text{Cropping intensity (\%)} = \frac{\text{Gross cropped area}}{\text{Net sown area}} \times 100$$

The respondents were grouped in to three categories as "low", "medium" and "high" based on mean and standard deviation as a measure of check.

Results and discussion

Resource base of the farmers in Sujala III watershed

The Table 1 portrays the resource base of farmers of Sujala III watershed in terms of land type, type of soil, soil fertility status, source of irrigation as well as vegetation cover and the findings shown that, more than half (55.00 %) of the farmers from upper reach, 58.33 per cent of farmers from middle reach and 76.67 per cent of lower reach farmers had irrigated land whereas, 45.00, 41.67 and 23.33 per cent of upper, middle and lower reach farmers respectively had rainfed land. In total, 63.33 per cent of Sujala III watershed farmers were found in irrigated land category and 36.67 per cent of them in rainfed category. Majority of the farmers from upper reach (98.33 %), middle reach (88.33 %), lower reach (88.33 %) and overall Sujala III watershed (91.67 %) had red soil. Whereas, remaining farmers of upper reach (01.67 %), middle reach (11.67 %), lower reach (11.67 %) and overall watershed (08.33 %) had black soil dominated land. With respect to soil fertility status, 56.67 per cent of upper reach farmers had good fertility status of soil followed by poor (23.33 %) and medium (20.00 %). Close to three fourth (68.33 %) of middle reach farmers belonged to category of good fertility status of soil followed by medium (20.00 %) and poor (11.67 %) category. Similarly, an overwhelming per cent of lower reach farmers (85.00 %) had good fertile soil followed by medium (13.33 %) and meagre per cent of them (01.67 %) had poor fertile soil. In total, 70.00 per cent of Sujala III watershed farmers belonged to good category followed by medium (17.78 %) and poor (12.22 %) category. Further, more than half (55.00 %) of the upper reach farmers had bore well as their source of irrigation, 56.67 per cent of middle reach farmers had bore well and 01.67 per cent of them depend on canal for irrigation. Among lower reach farmers, close to three fourth (71.67 %) of them depend on bore well followed by canal (05.00 %) for irrigation and 61.11 and 02.22 per cent of Sujala III watershed farmers depend on bore well and canal for irrigation respectively. Regarding vegetation cover, 86.67 per cent of the farmers from upper reach had forest trees, one forth (25.00 %) of them cultivated fruit trees, five per cent cultivated fodder crops and none of them had cultivated grass. Majority of the middle reach farmers established forest trees (88.33 %) followed by fruit crops (28.33 %), grass and fodder crops (01.67 % each). Among lower reach farmers, ninety per cent of them

Table 1. Resource base of the farmers in Sujala III watershed n=180

Resource	Category	Location of field in watershed							
		Upper reach (n_1=60)		Middle reach (n_2=60)		Lower reach (n_3=60)		Overall (n=180)	
		F	%	F	%	F	%	F	%
Land type	Irrigated	33	55.00	35	58.33	46	76.67	114	63.33
	Rainfed	27	45.00	25	41.67	14	23.33	66	36.67
Type of soil	Black soil	01	01.67	07	11.67	07	11.67	15	08.33
	Red soil	59	98.33	53	88.33	53	88.33	165	91.67
	Sandy soil	00	0.00	00	0.00	00	0.00	00	0.00
Fertility status	Good	34	56.67	41	68.33	51	85.00	126	70.00
	Medium	12	20.00	12	20.00	08	13.33	32	17.78
	Poor	14	23.33	07	11.67	01	01.67	22	12.22
Source of irrigation	Canal	00	0.00	01	01.67	03	5.00	04	02.22
	Bore well	33	55.00	34	56.67	43	71.67	110	61.11
	Open well	00	0.00	00	0.00	00	0.00	00	0.00
Vegetation	Forest trees	52	86.67	53	88.33	54	90.00	159	88.33
	Fruit trees	15	25.00	17	28.33	26	43.33	58	32.22
	Grass	00	0.00	01	01.67	06	10.00	07	03.89
	Fodder crops	03	05.00	01	01.67	05	08.33	09	05.00

cultivated forest trees followed by fruit crops (43.33 %), grass (10.00 %) and fodder crops (08.33 %). Overall, 84.33, 32.22, 05.00 and 03.89 per cent of Sujala III watershed farmers had established forest trees, fruit trees, fodder crops and grass consecutively in their field.

Distribution of the farmers of Sujala III watershed based on their resource base

The data pertinent to distribution of the farmers of Sujala III watershed according to resource base is presented in Table 2 and it is evident that, in upper reach, exactly half of the farmers (50.00 %) belonged to high resource base category whereas, thirty percent and twenty per cent of them categorized under low and medium resource base group. Among middle reach farmers, 43.33 per cent of them possessed medium resource base and followed by high (31.67 %) and low (25.00 %) resource base. Similarly, in lower reach, 43.33 per cent of farmers were classified under medium resource base category and equal per cent (28.33 %) of them were found under low and higher category each. In total nearly half (47.22 %) of the farmers had medium resource base, 27.78 per cent of the farmers had low and 25.00 per cent of them had high resource base.

It is clear from the findings of the investigation that, nearly half (47.22 %) of the farmers had medium resource base and reach wise distribution revealed that, most of the farmers belonged to medium to high resource base category. Most of the farmers of study area were medium farmers with 10 to 25 acres of land holding with good soil fertility status. Higher per cent of farmers depend on bore well for irrigation. This could be due to after the implementation of soil and water conservation measures like trench cum bund, farm pond, waste weir and bore well recharge, there was an increase in ground water table which resulted in establishment of more number of bore wells. Bore well recharge done under the project also resulted in functioning of the existed nonfunctioning bore wells.

It was also noticed that, considerable per cent of farmers had cultivated forest and fruit trees (table 1). As a result of seedlings distributed by Department of Horticulture and Forestry Department, the farmers had got good vegetation cover in their field. The bunds and drainage line treatments stabilized with grasses also improved vegetative cover. Further, horticultural interventions through promotion of fruit crops under Sujala III project had also resulted in better vegetation cover which enabled the farmers to have medium to high resource base. Kanimozhi (2017) and Padmaja (2018) also reported observed that majority of the respondents had possessed lower resource base.

Distribution of the farmers of Sujala III watershed based on their cropping intensity

It is evident from the table 3 that, in upper reach of watershed, sixty per cent of the farmers had low cropping intensity followed by 31.67 per cent of them with high and only 08.33 per cent of them with medium cropping intensity. From the middle reach, equal per cent (36.67 %) of farmers belonged to high and low categories of cropping intensity each and remaining 26.67 per cent of them were observed in medium category. In case of lower reach farmers, more than two fifth (43.33 %) of them belonged to high cropping intensity category followed by low (41.67 %) and medium (15.00 %).In total, 45.56per cent of Sujala III watershed farmers had got low cropping intensity followed by high with 38.33 per cent farmers and medium (16.11 %) cropping intensity. On comparing mean values, it could be noticed that, lower reach farmers (155.02 %) had got higher cropping intensity followed by middle (144.48 %) and upper reach (124.29 %).

The reason for higher cropping intensity in lower reach was that, the runoff water from upper reach settles minerals and nutrients in lower reach making the soil more fertile in lower regions as against upper reach which is characterized with shallow and less fertile soil. Hence lower reach enriched with

Table 2. Distribution of the farmers of Sujala III watershed based on their resource base n=180

Category	Location of field in watershed							
	Upper reach (n_1=60)		Middle reach (n_2=60)		Lower reach (n_3=60)		Overall (n=180)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Low	18	30.00	15	25.00	17	28.33	50	27.78
Medium	12	20.00	26	43.33	26	43.33	85	47.22
High	30	50.00	19	31.67	17	28.33	45	25.00
Mean	59.78		63.56		67.33		61.89	
SD	11.58		11.67		11.10		11.50	

Table 3. Distribution of the farmers of Sujala III watershed based on their cropping intensity n=180

Category	Location of field in watershed							
	Upper reach (n_1=60)		Middle reach (n_2=60)		Lower reach (n_3=60)		Overall (n=180)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Low	36	60.00	22	36.67	25	41.67	82	45.56
Medium	05	8.33	16	26.67	09	15.00	29	16.11
High	19	31.67	22	36.67	26	43.33	69	38.33
Mean	124.29		144.48		155.02		138.14	
SD	52.55		55.86		58.37		56.12	

fertile soil supports better crop stand and higher cropping intensity. Because of the variations between the reaches, overall distribution of Sujala III watershed farmers ranged from low (48.56 %) to high (38.33 %) cropping intensity. Shilpa *et al.* (2017) reported that the cropping intensity was observed to be increased from 120.00 per cent to 146.89 per cent in watershed villages. A study conducted by Rajendra (2020) also indicated that, more than two fifth of farm pond beneficiaries had high cropping intensity (>139.33 %). Present findings also got supported by Rathod and Pawar (2014) and Tekale *et al.* (2017),

Association between resource base and cropping intensity among the farmers of Sujala III watershed

It is observed from the finding displayed in the Table 4 that, forty six per cent of the farmers with low resource base had low cropping intensity, twenty eight per cent of them had medium and twenty six per cent had high cropping intensity. Close to half (45.88 %) of farmers with medium resource base were found in high cropping intensity category followed by farmers in high resource base (37.78 %) and low resource base (26.00 %) category. Medium cropping intensity was observed among the twenty eight per cent of farmers with low resource base, 17.78 per cent of high resource base farmers and 08.24 per cent of farmers with medium resource base. However, lower cropping intensity was accounted for forty six per cent of low resource base farmers, 45.88 of medium and 44.44 per cent of high

Table 4. Association between resource base and cropping intensity among the farmers of Sujala III watershed n=180

Resource base	Cropping intensity			Total
	Low	Medium	High	
Low	23(46.00)	14(28.00)	13(26.00)	50(100.00)
Medium	39(45.88)	07(08.24)	39(45.88)	85(100.00)
High	20(44.44)	08(17.78)	17(37.78)	45(100.00)
Total	82	29	69	180

χ^2value- 34.78**** - Significant at 1 per cent
Figures in parenthesis indicate per cent to total

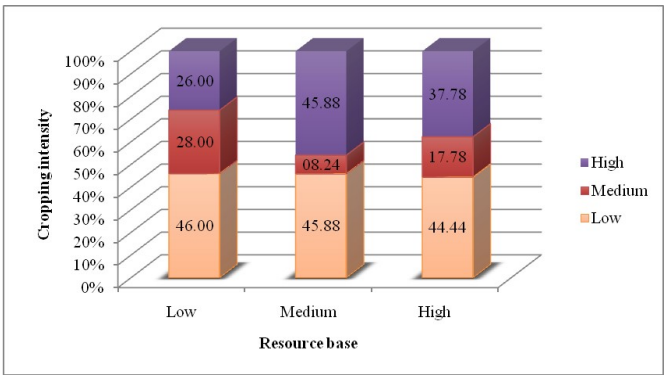

Fig. 1. Association between resource base and cropping intensity among the farmers of Sujala III watershed

Table 5. Relationship between resource base and cropping intensity of farmers of Sujala III watershed n=180

Resource base	r value
Land type	0.383**
Type of soil	0.235*
Fertility status	0.397**
Source of irrigation	0.406**
Vegetation	0.093^{NS}

** - Significant at 1 per cent * - Significant at 5 per cent
^{NS} - Non-significant r = Correlation coefficient

resource base farmers. The chi square value of 34.78 was found significant at one per cent level of significance which indicates that, there was positive and significant association between resource base and cropping intensity. With increase in resource base, cropping intensity had also increased (Fig. 1).

Relationship between resource base and cropping intensity of farmers of Sujala III watershed

The relationship between resource base and cropping intensity was assessed using correlation test and the results are presented in Table 5. It is apparent from the table that, there was a positive and significant relationship between dimensions of resource base like land type, fertility status and source of irrigation at one per cent level of significance. Type of soil had significant relationship with cropping intensity at five per cent level of significance. Whereas, vegetation cover had no relationship with the cropping intensity.

The farmers who have irrigated land are able to provide protective irrigation to the crops. Irrigation also enables the farmers to take up cultivation in *rabi* and summer season which results in higher cropping intensity. The increased number of bore wells and canal irrigation as a result of soil and moisture conservation measures also lead to higher cropping intensity. The farmers with good fertile soil had experienced better crop stand, hence a positive relationship between soil fertility and cropping intensity. It was noticed that majority of the farmers had red soil dominated land which is more suitable for the major crops of study area like maize, sorghum, groundnut and greengram. Hence all these factors influence the cropping intensity positively.

Conclusion : It can be concluded from the study that, the cropping intensity was high among the farmers of lower reach as against upper reach. The resource base possessed by the farmers greatly influenced the cropping intensity. Nearly fifty per cent (45.88 %) of the farmers with medium resource base and 37.78 per cent of high resource base farmers had higher cropping intensity. There was a significant change in cropping intensity between the farmers' categories of resource base. However, management of the resources also plays vital role in augmenting the cropping intensity.

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