www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(8): 781-786

www.thepharmajournal.com
Received: 04-06-2021
Accepted: 06-07-2021

Sagar
Ph.D. Scholar, Department of Agricultural Economics, UAS, GKVK, Bengaluru, Karnataka, India

Murtuza Khan
Retired Professor, Department of Agricultural Economics, UAS, GKVK, Bengaluru, Karnataka, India

Mahin Sharif
Assistant Professor, Department of Agricultural Economics, UAS, GKVK, Bengaluru, Karnataka, India

Udaykumar MS
Senior Research Fellow, Department of Agricultural Economics, UAS, GKVK, Bengaluru, Karnataka, India

Corresponding Author
Sagar
Ph.D. Scholar, Department of Agricultural Economics, UAS, GKVK, Bengaluru, Karnataka, India

Unlocking the potential of rainfed crops through a science-led intervention in Karnataka: Impact of Bhoochetana scheme on economic security of blackgram farmers

Sagar, Murtuza Khan, Mahin Sharif and Udaykumar MS

Abstract
Limited by water scarcity and deficiency of soil nutrients, rainfed areas are hotspots of poverty, malnutrition and degradation of natural resources. The yield level of rainfed crops is less compared to the potential yields. In order to increase the productivity of rainfed crops, The Government of Karnataka initiated a novel project called 'Bhoochetana' to improve the yield level of major dry land crops to an extent of 20 per cent by supplying micro-nutrients and bio-fertilizers at subsidized prices to farmers. The study was conducted to analyse the economic impact of Bhoochetana scheme in blackgram production in Kalaburagi district of Karnataka. The results revealed that, per hectare yield of black gram was 1.85 quintals more for beneficiary farmers over non-beneficiary farmers. Beneficiary farmers' realized higher net returns of ₹ 4038 per hectare over non-beneficiary farms which can be attributed to the application of micronutrients and bio-fertilizers. A significant positive co-efficient of dummy variable indicate that, Bhoochetana beneficiaries realised higher blackgram production by 0.27 quintals per farm. Lack of awareness about recommended dose of fertilizers with a garret score of 58.65 was the major constraints faced by Bhoochetana beneficiary farmers.

Keywords: potential, rainfed crops, science-led intervention, Bhoochetana, blackgram farmers

Introduction
Rain-fed agriculture accounts for 80 per cent of the world's farm area, and generates almost 60 per cent of the world's staple food production, providing the livelihoods of 80 per cent of the world's population. In India, 40 per cent of the population depends on rain-fed agriculture, covering an area of 85 million hectares, and produces 44 per cent of food and fodder requirements of the country (Yirdaw *et al*, 2017) [1]. Rain-fed areas in India covering 60 per cent of agriculture produce 75 per cent of pulses and more than 90 per cent of sorghum, millet, and groundnut. These areas are the hot spots of poverty, water scarcity, droughts, land degradation and low rainwater use efficiency ((Raju *et al*, 2013) [2, 7].
The productivity of Rainfed agriculture is crucial for food security and economy of Karnataka, as it has the second largest rainfed area in India after the state of Rajasthan. The importance of agriculture in Karnataka is evident from the fact that it provides employment for more than 60 per cent of the people and directly contributes to 18 per cent of the GDP (Wani *et al*, 2015) [3]. Rainfed areas are not just thirsty but also hungry as they are deficient in important soil nutrients. Interestingly, the diagnosis of sample fields across the state revealed that, most of farms in the state have widespread deficiencies of ignored secondary and micronutrients to the tune of 52 per cent in S, 55 per cent in Zn and 62 per cent in B. The S, B and Zn deficiencies are even more widespread than mostly focused macronutrients P and K (Sahrawat *et al*, 2007) [4]. This holds back the potential productivity of major rainfed crops. The yields levels of major rainfed crops in the rainfed areas of the state are ranging from 1-1.5 tonnes per hectare, which is two to five times less than those on research farms (Wani *et al*, 2009) [5]. Scientific technologies including better cultivars could unlock the vast potential of rainfed agriculture.
According to a study carried out by the ICRISAT, a large gap exists between current farmers' crop yields and potential yields (Singh *et al*, 2009) [6]. This is the case with all major rainfed crops in the state. This resulted in stagnant to declining growth rate in agriculture during the years 2000 to 2008 which necessitated the need to revive agriculture in the state. Realizing this urgency, a flagship initiative called 'Bhoochetana' (Meaning "Revival of Land") was launched on 23 May 2009 to fulfil the need to increase crop productivity and strengthen agriculture-

-based livelihoods in the state. The Government of Karnataka set up a high-level committee and in consortium with ICRISAT developed a strategic scheme to bridge the yield gap between farmers' fields and achievable yields with the help of science-based productivity enhancement interventions. The scheme aimed to make a difference in the lives of farmers in all districts of the state by increasing average productivity of selected crops by 20 per cent. The target is to reach millions of smallholder farmers in the rainfed region to adopt need-based nutrient application for improving crop productivity.

Bhoochetana is a technology package comprising of soil test based nutrient management, distribution of inputs (seeds, seed treatment chemicals, micronutrients and bio-fertilizers) at 50 percent subsidized prices and integrated extension services. Available empirical evidence showed that, the programme had made significant impact on the performance of agriculture in the state (Raju *et al*, 2013 and Wani *et al*, 2012) [2, 7].

Analyzing "whether the Boochetana scheme has a significant impact on the welfare improvement" is crucial for an economist. With this backdrop, a micro-level study was conducted to assess the economic impact of Bhoochetana scheme between beneficiaries and non-beneficiaries in Kalaburagi district of Karnataka. Karnataka state is a fifth major producers of pulses (> 2 Million tons) in India. (Ministry of Agriculture & Farmers Welfare, Govt. of India 2017-18). Kalaburagi district of Karnataka was chosen for the study as it is one of the major rainfed areas with district annual average rainfall of 777 mm (Directorate of Economics and Statistics, 2017) [10] and rainfed area accounts for 86.2% of the total area under agriculture (Govt. of Karnataka, 2016) [11]. Since the crop specific study gives better understanding of the impact of Bhoochetana scheme in bridging the yield gap, this study is focused on blackgram as it is the third most important pulse crop after redgram and Bengal gram which is grown in an area of 24436 hectares (Govt. of Karnataka, 2016-17) [12]. in the study area. The study area also reports a large scale production and consumption of blackgram as it has high protein content and helps in reducing malnutrition.

Data and Methodology

Data

The primary data pertaining to inputs used, yield, economics of crop production *etc*. were collected from sample farmers for the agriculture year 2017-18 in Kalaburagi district of Karnataka. Random sampling technique was used in the selection of sample farmers in the study area. The data was collected from 120 sample farmers which constituted 60 Bhoochetana beneficiaries and 60 non-beneficiaries.

Methodology

Data Collection

The primary data pertaining to socio-economic characteristics, resources used, yield, economics of crop production *etc*. were collected from sample farmers for the agriculture year 2017-2018 by using pre-tested, structured interview schedule in Kalaburagi district of Karnataka.

Data Analysis

Estimation of costs and returns of blackgram production

Cost of cultivation was calculated by considering both variable and fixed costs as well as explicit and implicit costs. Under the variable costs, labour cost (both family and hired), cost of inputs and interest on working capital were considered. Under the fixed costs, rental value of land, depreciation (straight line method), interest on fixed capital, land revenue and taxes were computed. Gross returns from blackgram production, net returns over total cost, cost of production per quintal and returns per rupee of expenditure were calculated (estimated).

Partial budgeting

Partial budgeting, a simple yet powerful tool was used to estimate the direct economic benefit (or loss) at farm-level by adoption of Bhoochetana scheme. It focuses only on the changes in income and expenses that would result from implementing an alternative technology. Thus, all other components of farm profits which remain unchanged by the decision were not considered. In this study, the impact of Bhoochetana scheme on income of blackgram farmers was evaluated by considering the additional costs incurred in application of inputs (micronutrients and bio-fertilizers) and decrease in gross returns (if any) were considered under debit. If there is any decrease in costs or incremental returns realized by adoption of Bhoochetana scheme, they were considered under credit (if any) were taken under credit as shown in table 1. Sum of credits were subtracted from the sum of debit to estimate net gain or loss.

Table 1: Partial Budgeting Tool

Debit	Credit
Increase in cost due to application of Bhoochetana inputs = A Decrease in gross returns due to application of Bhoochetana inputs = B Total = A+B	Decrease in cost due to application of Bhoochetana inputs = C Increase in gross returns due to application of Bhoochetana inputs= D Total = C+D
Credit-Debit = Net gain / loss	

Resource Use Efficiency (RUE)

Resource use efficiency in blackgram production was estimated among beneficiaries and non-beneficiaries of Bhoochetana by using Cobb-Douglas type of production function and its empirical form is shown in equation (1).

$$Y = a\prod_{i=1}^{7} X_i^{\beta_i} + e^u, \text{where } i = 1 \text{ to } 7 \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where, Y_i is the gross returns (₹) from blackgram, β_1 to β_7 parameters to be estimated, X_1= area (acres) under blackgram crop, X_2 =Seed quantity (kg), X_3= FYM and fertilizer cost (₹), X_4= Cost of human labour (₹), X_5= Cost of bullock labour (₹), X_6= Cost of machine labour (₹), 'a' is a Constant and 'u' is a random error.

Marginal Value Product (MVP): The estimated coefficients were used to compute the MVP. We can assess the relative importance of factors of production by studying the marginal value product. Marginal Value Product of X_i, *i.e*. for the i^{th} input, it is estimated by the following formula (equation 2)

$$MVP = bi \times \frac{GM(Y)}{GM(Xi)} \times P_y \dots\dots\dots\dots\dots\dots\dots\dots (2)$$

GM (Y) and GM (Xi) represent the geometric means of output and input respectively, b_i is the regression coefficient of i^{th} input and P_y is price of output. The model was estimated as in equation 3.

$$r = MVP/MFC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where, 'r'is the efficiency ratio, MVP is the marginal value product of variable input and MFC is the marginal factor cost (price per unit input).

Based on economic theory, a firm maximizes profits with regards to resource use when the ratio of the marginal return to the opportunity cost is one. The values are interpreted thus, if r is less than 1 indicates that the resource is excessively used (there exist scope for the reduction). If 'r' is greater than 1, indicates that the resource is under used or being underutilized (there is a scope to increase). If r is equal to 1, indicate optimum utilization of resource.

Bhoochetana Impact on blackgram production

Cobb-Douglas regression function was used to analyze the impact of Bhoochetana scheme on blackgram production and the functional form is presented in equation (4)

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}D^{b6}e^{u} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where, Y is total blackgram production (Quintals), X_1 is the area (acre), X_2 is seed (Kg), X_3 is nutrient cost (₹), X_4 is Human labour cost (₹), X_5 is bullock and machine cost (₹), D is a Dummy variable (D=1 for Beneficiary, 0 otherwise) and u is an error term.

Garrett's ranking technique

Garret's ranking technique provides the change of orders of constraints and advantages into numerical scores. The prime advantage of this technique over simple frequency distribution is that the constraints are arranged based on their importance from the point of view of respondents. Hence the same number of respondents on two or more constraints may have been given different rank. Garret's formula for converting ranks into percent was given by,

$$\text{Percent position}=100*(R_{ij}-0.5) / N_j$$

where,

R_{ij}= rank given for i^{th} factor by j^{th} individual

N_j= number of factors ranked by j^{th} individual

The per cent position of each rank was converted into scores referring to the table given by Garret and Woods worth (1969). For each factors, the scores of individual respondents were added together and divided the total number of respondents for whom scores were added. These mean scores for all the factors were arranged in descending order, ranks were given and most important factors were identified.

Results and Discussion

Estimation of costs and returns

The details of per hectare cost of cultivation in blackgram production for Bhoochetana beneficiary and non-beneficiary farmers are given in Table 2. The total cost of cultivation was found to be ₹ 52290 and ₹ 48003 per hectare, respectively for beneficiary and non-beneficiary farmers. Variable cost accounted for more than 70 per cent of the total cultivation for both beneficiary and non-beneficiary farmers. Human labour accounted for more than 30 per cent of the total variable cost in both beneficiary and non-beneficiary farmers. Fixed costs accounted for 26.12 per cent and 27.79 per cent of the total cost of cultivation in blackgram cultivation for Bhoochetana beneficiary and non-beneficiary farms, respectively.

The Cost of cultivation was higher in blackgram cultivation by Bhoochetana beneficiary farms compared to non-beneficiary farms, because of higher requirement of labour and also the application of micronutrients and bio-fertilizers under Bhoochetana scheme.

Table 2: Per hectare cost of cultivation of blackgram in the study area

Sl No	Particulars	Bhoochetana beneficiary			Non-beneficiary		
		Quantity	Total Cost (₹)	Per cent	Quantity	Total Cost (₹)	Per cent
I	Variable cost						
	Human labour (Man days)	55.62	17798	34.36	47.16	15091	31.44
	Bullock labour (BP days)	3.12	2839	5.48	3.12	2808	5.85
	Machine labour (hours)	2.63	1473	2.84	3.31	1705	3.55
	Seed (kg)	9	2025	3.9	8.18	1881	3.92
	FYM (tractor load)	2.5	3850	7.43	2.83	4245	8.84
	Fertilizer cost		7045	13.6		6667	13.89
	Micro nutrient and Bio fertilizer		736	1.42		0	0
	Interest on working capital @ 7 per cent		2504	4.83		2268	4.72
	Total variable cost		38270	73.87		34665	72.21
II	Fixed cost						
	Depreciation		740	1.41		742	1.55
	Land revenue		20	0.03		20	0.04
	Interest on fixed capital @ 10 per cent		760	0.14		76	0.16
	Rental value of land		12500	24.13		12500	26.04
	Total fixed cost		14020	26.12		13338	27.79
III	**Total cost of cultivation**		52290	100		48003	100

Per hectare returns from blackgram production

Yield and gross returns: Per hectare yield of blackgram was 1.85 quintals more for beneficiary farmers as against non-beneficiary farmers. Cost of production per quintal was highest for non-beneficiary farmers (₹ 3664) than beneficiary farmers (₹ 3497).

The net return from blackgram cultivation was found higher in case of Bhoochetana beneficiary farms (₹ 14985 per ha) compared to non-beneficiary farms (₹ 10947 per ha). Bhoochetana beneficiary farmers' realized higher net returns of ₹ 4038 per hectare over non-beneficiary farms and is because of the application of micronutrients and bio-fertilizers. The results are also in line with Hamsa *et al.*, [13] which showed that the application of the micronutrients in adopter category of groundnut resulted in an increased yield of 1.23 quintals extra over and above the non-adopters and 2.02 quintals extra over and above the non-adopters in ragi.

Table 3: Per hectare returns from blackgram production

Particulars		Bhoochetana beneficiary			Non-beneficiary		
I	**Returns**	**Quantity**	**Price/ Unit (₹)**	**Total (₹)**	**Quantity**	**Price/ Unit (₹)**	**Total (₹)**
	Main product (Quintals)	14.95	4500	67275	13.10	4500	58950
	Gross returns (₹)	67275			58950		
	Net returns (₹)	14985			10947		
	Cost of production (₹/Quintal)	3497			3664		
II	**Returns per rupee of expenditure**	1.29			1.22		

Returns per rupee of expenditure: Return per rupee of expenditure in blackgram cultivation was found to be higher in case of Bhoochetana beneficiary farms (1.29) compared to non-beneficiary farms (1.22).

Table 4: Relative benefits of Bhoochetana beneficiary farmers over non-beneficiary farmers in blackgram cultivation (₹/ha)

Debit		Amount	Credit		Amount
A)	**Increase in costs**		**C) Decrease in cost**		
i)	Human Labour	2707	i)	Machine Labour	232
ii)	Bullock Labour	31	ii)	FYM	395
iii)	Seed	143			
iv)	Fertilizer cost	378			
v)	Micro nutrients	736			
vi)	Interest on working capital @ 8 per cent	236			
B) Decrease in returns		-	D) Increase in returns		8100
Total debits		4231	Total credits		8727
Net gain per hectare (Total credit-Total debits) = ₹ 4496					

Results of partial budgeting are indicated Table 4, Bhoochetana Beneficiary farmers realized a net gain of ₹ 4496 per hectare over non-beneficiary farmers in blackgram cultivation. This is due to the use of micronutrients and bio-fertilizers which resulted in more yield.

Impact of Bhoochetana scheme on yield of blackgram

The coefficient of determination was 0.88 indicating that the variables included in the regression model explain about 88 per cent of the variation in the output of blackgram. The contribution of other factors which are not included in the regression model was 14.83 quintals per farm. The regression coefficient for the study area was 1.20 indicating that, for every one per cent increase in area from its geometric mean level, the output increases by 1.20 per cent from its geometric mean level. The regression coefficient for human labour was 0.19 and was statistically significant at five per cent level of significance indicating that, for every one per cent increase in expenditure on human labour from its geometric mean level, the output increases by 0.19 per cent from its geometric mean level. The regression coefficients for machine labour was 0.008 and was statistically significant at 5 per cent level of significance indicating that for every one per cent increase in expenditure on machine labour from its geometric mean level, the output increases by 0.008 per cent from its geometric mean level.

Table 5: Impact of Bhoochetana scheme on yield of blackgram in study area (Dependent Variable: Yield in quintals)

Particulars	Co-efficients	Co-efficient value	t value
Intercept	a	14.838	2.725
Area (ac)	b_1	1.206**	9.217
Seed (Kg)	b_2	-0.061	-0.045
Nutrients cost (₹)	b_3	0.096	1.376
Human labour cost (₹)	b_4	0.191*	2.834
Bullock labour cost (₹)	b_5	-0.041	-0.841
Machine labour cost (₹)		0.008*	2.282
D (1= Beneficiary, 0 otherwise)	b_6	0.276**	3.527
Coefficient of multiple determination (R^2)			0.88

Note: **, * indicates significance at one and five per cent, respectively.

Because of Bhoochetana scheme, the threshold yield level of beneficiary farmers shifted by 0.276 quintal per farm as given by the coefficient of dummy variable (D was significant at one per cent) used for Bhoochetana beneficiary farmers in the study area. Because of use of micronutrients and bio-fertilizers the yield of blackgram was more in case of beneficiary farmers compared to non-beneficiary farmers.

Resource use efficiency in blackgram production

The MVP to MFC ratio for seed (1.881), FYM+fertilizer (1.358), human labour (1.044) and machine labour (1.615) were more than one in case of beneficiary farmers, indicating underutilization of these resources, whereas, MVP to MFC ratio for area and bullock labour were less than one, indicating that expenditure on these resources should be reduced in order to make optimum allocation of resources

(Table 6). The regression coefficients for FYM+fertilizer (0.210) and Machine labour (0.023) were significant at one and five per cent, respectively among beneficiary farmers. In case of non-beneficiary farmers, MVP to MFC ration was more than one for area (1.240) showing underutilization of that resource and MVP to MFC ratio for other resources were less than one indicated over utilization of resources. The regression coefficient for FYM+fertilizer (0.014) was significant at five per cent level of significance among non-beneficiary farmers.

Table 6: Resource use efficiency in Blackgram production

Particulars	Beneficiary		Non-beneficiary	
	b	MVP/MFC	B	MVP/MFC
Area (acre)	0.106 (1.56)	0.254	0.520 (1.88)	1.240
Seed (kg)	0.012 (0.95)	1.881	-0.012 (-1.17)	-1.669
FYM+FERTILIZER (₹)	0.210** (3.95)	1.358	0.014* (2.76)	0.136
Human Labour (₹)	0.252 (1.09)	1.044	0.063 (2.16)	0.460
Bullock labour (₹)	-0.002 (-0.87)	-0.039	-0.022 (-1.22)	-0.623
Machine labour (₹)	0.023* (2.01)	1.615	0.002 (0.78)	0.654
R^2	0.78		0.83	

Note: 1. ** indicates Significant at one per cent and * indicates significant at five per cent
2. NS- Non-significant values

Constraints in functioning of Bhoochetana scheme

The constraints in functioning of Bhoochetana scheme are depicted in Table 7. It is evident from the results that, lack of awareness about recommended dose of fertilizers (Rank I) with a garret score of 58.65 was the major constraints faced by Bhoochetana beneficiary farmers. Non availability of Bhoochetana inputs at right time was ranked second with garret score of 56.85 followed by Lack of accessibility to RSK with a score of 51.98. Shortage of micronutrients or insufficient micronutrients was the fourth major constraint with garret score of 41.37 followed by Poor response/ cooperation from the concerned officers with a score of 40.75 and long distance to RSK and high transportation cost was the sixth constraint with a garret score of 32.78.

Table 7: Constraints faced by Bhoochetana beneficiary farmers

Particulars	Rank	Score
Lack of awareness about recommended dose of fertilizers	I	58.65
Non availability of Bhoochetana inputs at right time	II	56.85
Lack of accessibility to RSK	III	51.98
Shortage of micronutrients	IV	41.37
Poor response/ cooperation from the concerned officers	V	40.75
Long distance to RSK and high transportation cost	VI	32.78

Conclusion

Rainfed areas holds great prospect of contributing substantially to a country’s food production. Unless production from these areas increases, the real breakthrough in agriculture may not be possible. This study highlighted that, application of Bhoochetana inputs (Micronutrients and bio-fertilizers) have enhanced the yield level of rainfed crops and consequently income of farmers. Hence, the potential of rainfed areas can be unlocked if schemes like Bhoochetana are implemented and monitored properly through timely supply of recommended balanced micronutrients and certified bio-fertilizers to all the farmers. Therefore, the policy focus must be on initiating soil, water and nutrient management schemes like Bhoochetana across all the rainfed areas of the country for boosting agricultural productivity of rainfed crops and improve the income of the farming community in order to build economic security of rainfed farmers.

Reference

1. Yirdaw E, Tigabu M, Monge A. Rehabilitation of degraded dryland ecosystems. *Silva fennica* 2017;51(1):3-31.
2. Raju KV, Babu MR, Sarvesh KV, Muniyappa NC, Abhijit D, Wani SP. A mission to enhance productivity of rain-fed crops in rain-fed districts of Karnataka, India. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh, India 2013, 1-34.
3. Wani SP, Anantha KH, Sudi R, Krishnappa K, Dharmarajan BK. Bhoochetana: A Compendium of Success Stories. Research Report IDC-3. Patancheru. Telangana, India: International Crops Research Institute for the Semi-Arid Tropics 2015, 1-172.
4. Sahrawat KL, Wani SP, Rego TJ, Pardhasaradhi G, Murthy KVS. Wide spread deficiencies of sulphur, boron and zinc in dryland soils of Indian semi-arid tropics. Current science 2007;93:1428-1432.
5. Wani SP, Sreedevi TK, Rockstrom J, Ramakrishna YS. Rainfed agriculture - Past trends and Future prospects. Comprehensive assessment of water management in agriculture. 2009;7:1-35.
6. Singh P, Aggarwal PK, Bhatia VK, Murthy MVR, Pala M *et al*. Rainfed agriculture: Unlocking the potential. Comprehensive assessment of water management in agriculture 2009;7:1-35.
7. Raju KV, Wani SP, Anantha KH. BHOOCHETANA: Innovative Institutional Partnerships to Boost Productivity of Rainfed Agriculture in Karnataka, India. Resilient Dryland Systems Report No. 59. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh, India 2013, 1-34.
8. Wani SP, Sarvesh KV, Krishnappa K, Dharmarajan BK Deepaja SM. Bhoochetana: Mission to boost productivity of rainfed agriculture through science-led interventions in Karnataka. International Crops Research Institute for the Semi-Arid Tropics Management, Patancheru, Andhra Pradesh, India 2012, 01-74.
9. Pulses revolution from food to nutritional security, Ministry of Agriculture & Farmers Welfare, Government

of India 2017-48. https://farmer.gov.in/SucessReport2018-19.pdf. [Visited on 5th July, 2021]
10. Annual seasonal rainfall and area coverage during 2017 in Karnataka, Directorate of Economics and Statistics, Bengaluru. https://des.kar.nic.in/sites/rainfall_Seasonwise_Reports/ASR-2017.pdf. [Visited on 5th July, 2021]
11. District irrigation plan: Kalaburagi district, 2016. https://pmksy.gov.in/mis/Uploads/2016/20161224054016540-1.pdf. [Visited on 30 june, 2021]
12. Kalaburagi District at a Glance: 2016-17. Government of Karnataka. 2017, 50-53. https://cdn.s3waas.gov.in/s306997f04a7db92466a2baa6ebc8b872d/uploads/2018/08/2018080318.pdf.
13. Hamsa KR, Umesh KB, Veerabhadrappa Bellundagi, Gururaj B. Economic surplus approach for impact assessment of soil reviving programme in Karnataka: An economic analysis. Current Journal of Applied Science and Technology 2018;30(5):1-13.