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Food Security and Income Stability with Soil and Water Conservation Practice in Hebburu Sub-Watershed, Tumkur, Karnataka

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ABSTRACT

Sustained food production and enhanced farm income are the prime objectives of Indian agriculture to encourage farming through various initiatives under the caption "Doubling Farmer's Income" by 2022. In this connection, the study analyzed the impact of adoption of trench cum bunds (TCBs) as a soil and water conservation measures on economic and non-economic benefits in the watershed area. Partial budgeting technique was employed to analyze the data. The results indicated that, adoption of trench cum bunds had generated positive net returns and significant water recharge into the sub surface of soil.

Key Words: Benefits, Economics, Farmer, Food Production, Income, Partial Budgeting Technique. Sustainable, Trench cum bunds.

INTRODUCTION

Agriculture is the backbone of Indian economy which is contributing nearly 14 per cent of the country's gross domestic product (GDP). It also provides a source of livelihood for at least 57 per cent of people who lived in rural areas. Nearly, 31 per cent of India's population living in rural areas falls under below poverty line (Anon,2014). With over 60 per cent of Indian agriculture is dependent on rainfall (mainly from South-West mansoon received during June to September), which is at high-risk due to vagaries of the monsoon and local meteorological conditions. Moreover, the cultivable land is deteriorating due to soil erosion followed by dwindling water resources and adverse climate change, resulted in decreased agricultural productivity. With all these fallouts, Government has taken several initiatives to address this serious issue and called for doubling farmer's income. Now, the question is, how to double the farm income, is it possible only by providing subsidies to critical farm inputs or weave off agricultural loans. Further, is it Government the only authority to double the farmers' income?. What are the role of farmers to enhance farm income? In the meantime, the ever increasing population of the country has resulted in reduced per capita availability of agriculture land. Since, soil and water are the two non-renewable natural resources necessary for agriculture production, requisite measures are needed to conserve soil and water resources. Hence, it's time to showcase economic importance and benefits of soil and water conservation practices particularly the case of adoption of trench cum bunds (TCBs) in farm field to enhance crop yields through water productivity.

MATERIALS AND METHODS

Location of the study

The study was conducted in Hebburu Sub-

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watershed located at North latitude 13^0 11' 10.633" and 13^0 8' 45.647" and East longitude 76^0 59' 29.761" and 77^0 2' 52.968" covering an area of about 1478 ha bounded by Kembalalu, Kalyanapura, Ramakrishnapura, Rayavara, Kasaba Hebburu, Karnakuppe and Kembalapura villages (Fig 1).

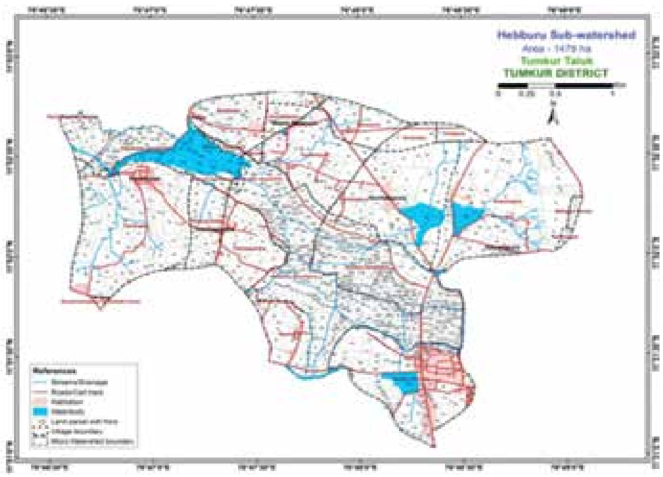

Fig 1. Grid wise households image of Hebburu Sub-Watershed

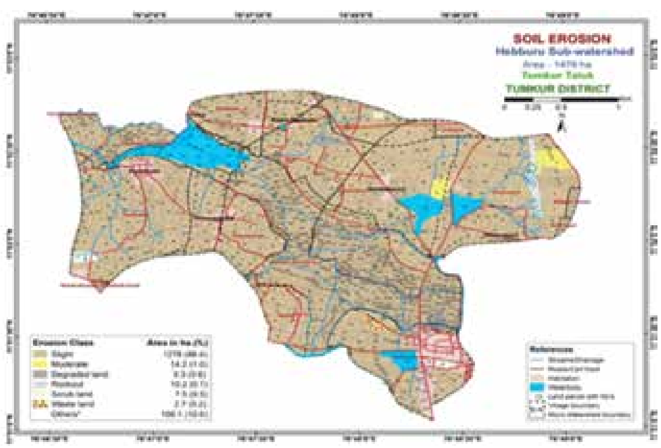

Fig 2. Extent of soil erosion in Hebburu Sub-Watershed

Selection of sample households

Hebburu sub-watershed consisted of Thimmasandra, Rajapura and Kalyanapura micro-watersheds. Purposive sampling method was employed where fifteen households from each micro-watershed who adopted TCBs were selected for the study. Data on socio-economic status, demographic characteristics, various aspects of agriculture like size of land holding, asset position, cropping pattern, cost and returns structure and other related information was collected for the year 2017-18 through personal interview. The data collected were subjected to various economic analyses viz., tabular presentation, averages and percentage. Partial budgeting technique was employed to assess the economic benefits from the adoption of TCBs in the study area.

Partial budgeting technique

It is a method of making a comparative study of costs and returns resulting from a change in a part of the farm business. This change may be made through a careful selection of alternative methods of production or practices, the choice of which is based on opportunity cost or relative profitability. It helps in the decision making process whenever small changes are contemplated as to which method to adopt, which practices to follow to reduce the unit cost and make higher profits. In the present study partial budgeting technique was employed to know the probability of investment on adoption of trench cum bund as a measure of soil and water conservation practice in farm field. It takes into account added cost and reduced returns on debit side, reduced cost and increased returns due to the adoption of trench cum bunds on credit side. The final credit minus debit figure was spread across the gross area differential under both the adoption and non-adoption of trench cum bund on per hectare basis.

RESULTS AND DISCUSSION

The average annual rainfall is 772 mm during 2001 to 2017, significantly higher than the long term average of 740 mm corresponding to the station near Hebburu sub watershed in Tumkur Taluk. Severe drought years were observed during 2002, 2003, 2006 and 2012. The peak rainfall year 2017 was considered for runoff distribution.

Table 1. Land characteristics and soil parameters of Hebburu Sub-Watershed.

Particular	Hebburu Sub-Watershed
Catchment area (ha)	1478
Soil type	Sandy clay loam
Slope	Gentle slope (1-3 %)- 983 ha
Soil erosion	• Slight erosion- 1278 ha • Moderate erosion- 14.20 ha • Degraded land- 9.30 ha
Problematic soils	➢ Strongly acidic- 278 ha ➢ Moderately acidic- 348 ha ➢ Slightly Acidic- 383 ha
Organic carbon content	Low (< 0.5 %)
Average Annual rainfall (mm)	772
Major crops	Arecanut, Coconut, Ragi and Horsegram

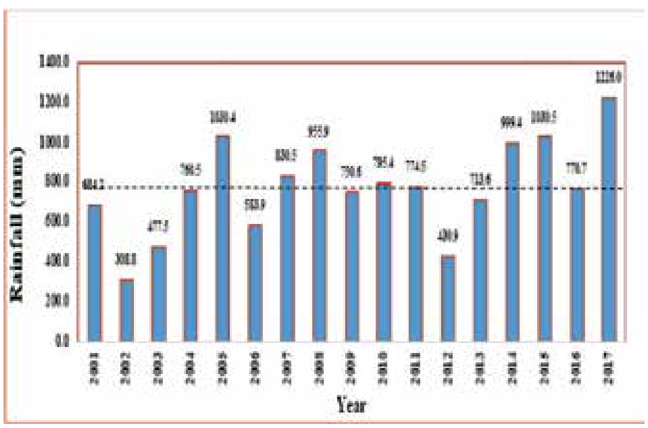

Fig 3. Average annual rainfall (mm) of Hebburu Sub-Watershed

In Hebbur Sub watershed, out of the total rainfall received (1225 mm) during the year 2017, about 73.36 per cent of rainfall could be absorbed through infiltration within bunding system. The runoff (Runoff rate = Rainfall intensity – Infiltration capacity) available for harvest was only 21.33 per cent (261.40 mm), which was equal to 1869 litre of water in one hectare that can be stored through the adoption of TCBS. Similarly, Tenge *et al* (2011) reported that adoption of trench ditches and bench terraces have showed improved soil moisture retention and increased maize and bean yields in the study area.

Budyko Curve

A Budyko curve represents the evaporative and dryness index which indicates the healthiness of water in the watershed. A value of dryness index less than one indicates a humid, energy limited catchment, whereas a value of dryness index more than one indicates a dry, water limited catchment. The results from the Budyko curve indicates that, in Hebburu sub-watershed, the value of AET/P v/s PET/ P was 1.10 indicating dryness (water limiting) in the watershed. Hence, for sustainable agriculture production, it is suggested to adopt the cropping choices and based on which the irrigation schedules have to be altered to reduce the total evapotranspiration.

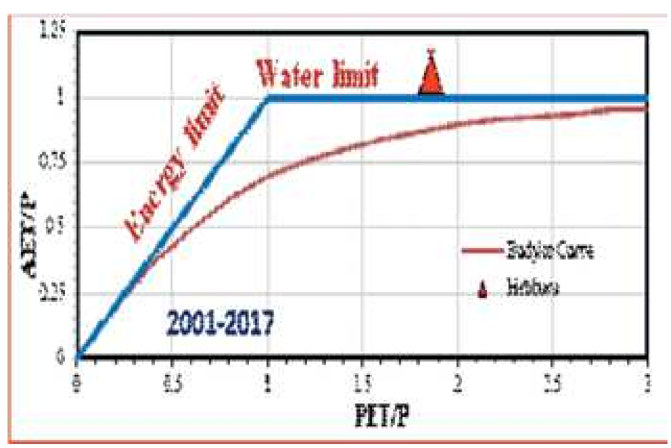

Fig 4. Budyko curve of Hebburu Sub-Watershed

Table 2.Runoff distribution of Hebburu Sub-Watershed.

Sr. No.	Component	Value
1	Total rainfall (2017) mm	1,225
2	Potential runoff (mm)	326.25
3	runoff excess beyond bunding system (mm)	64.81
4	Runoff available for harvest (mm)	261.4
5	Runoff available for harvest (m^3)	2614.4
6	Runoff available for harvest (in litres)	26,14,359
7	Runoff available for harvest (litre/ ha)	1,868.9

The data on households sampled (Table 3) for socio economic survey in Hebburu sub-watershed indicated that, among households surveyed (45), 31 (68.89 %) were marginal farmers, 8 (17.78 %) small farmers and 6 (13.33 %) semi medium farmers. Regarding population characteristics, there were 108 (55.96 %) men and 85 (44.04 %) women with average family size of four members. The literacy level was found less in the study area, as 23 per cent of the household members were illiterates and functional literates.

The Partial budgeting analysis indicated that, the average additional cost incurred due to adoption of TCBs and planting banana and pigeon pea in and on the bunds was Rs. 14,719/-, of which, a major cost was towards application of FYM and fertilizers and opening of TCBs (37.74 and 36.64 %). The other important items in the additional cost component were labour cost (16.32 %) and planting material cost (9.28 %). The reduced returns due to loss of area under ragi cultivation (0.01 ha) by opening of TCBs was to an extent of 1.82 t which accounted for Rs. 3,718/-. Hence, the total debit component through additional cost and reduced returns was Rs. 14,720/-. By planting banana in TCBs and pigeon pea on the bunds of TCBs, the incremental revenue due to additional yield was accounted to Rs. 26,367/. Thus, net returns accrued due to adoption of TCBs

Table 3. General characteristics of sample households in the study area. (N=45)

Sr. No.	Particulars	Number	Per cent
1	**Land holdings**		
	Marginal farmers	31	68.89
	Small farmers	8	17.78
	Semi-medium farmers	6	13.33
2	Male	108	55.96
	Female	85	44.04
3	Average family size	4.28	-
4	**Educational status**		
	Illiterates and functional literates	45	23.32
	Primary School	42	21.77
	High School	47	24.35
	PUC	20	10.36
	Degree and above	35	18.14

Table 4. Economics of adoption of TCBs through partial budgeting framework.

Particular	Methods	Debit			Credit		
		Added cost			Reduced cost		
		Quantity	Price (Rs.)	Value	Quantity	Price	Value
Opening of TCBs	A	5.17 Machine hours	780	4032.60	Nil		
	NA	0	0	0			
	D			4032.60			
Planting material	A	82 No.(banana) Pigeon pea	11	902 120			
	NA	0	0	0			
	D			1022			
Application of FYM and fertilizers	A	FYM 3.20 cart load Fertilizers	260 -	832 3320			
	NA	0	0	0			
	D			4152			
Labour charges for planting, FYM and fertilizer application	A	6.41 labour days	280	1794.80			
	NA	0	0	0			
	D			1794.80			
	Sub total			**11001.40**			
		Reduced returns			**Increased returns**		
Yield	A (ragi)	14.60 qtl			Banana 11.42 qtl Pigeon pea 0.16 qtl	2257 3700	25774.94 592
	NA (ragi)	16.42 qtl			0	0	
	D	1.82 qtl	2043	3718.26	-	-	
Total	14719.66			26366.94			
Net Gain (Credit-Debit)	11647.28						

Note: A- Adoption, NA (Non-Adoption), D (Difference)

were Rs. 11,647/- which outweigh the additional cost incurred for the adoption of conservation structure. The results were in contradictory to the findings of Shiferaw and Holden (2001) and Nigatu *et al*, (2017) that, the yield penalty due to area loss and high cost investment contributed for lower adoption of soil conservation practices.

Further, it was also noted that, in the existing rainfall situations, the average life of the TCBs was five years. Therefore, the estimated net benefit was Rs. 58,235/-. The results were in conformity with the study of Tasbi (2018), the adoption of soil and water conservation measures has resulted higher productivity in all the food crops compared to the non-adopters. Further, the annual net income generated through adoption of SWC measures was highest (Rs. 156,679/-) than the non-adoption (Rs. 105,258/-) indicating profitability of adoption of SWC measures in the farm. Reddy (1994) and Pagiola (1999), reported that majority of SWC practices adopted by farm households have generated adequate internal economic incentives.

Fig 6. TCBs planting with banana and pigeon pea

CONCLUSION

Farm households were under the apprehension that, adoption of TCBs might lose the area under cultivation, there by the yield will be lower. The study highlighted that adoption of TCBs as soil and water conservation technique has generated positive net returns and significant water recharge into the sub surface of soil. Therefore, it is worthwhile investment for adoption of the technology. Hence, farmers may be convinced in all the watershed areas for adoption of the technology through awareness programmes. Since, preventing soil erosion and water conservation measures are crucial for the sustainable agriculture production, creation of Watershed Association Groups are necessary for effective implementation of SWC measures in the watershed. Furthermore, result demonstration need to be conducted by the extension agents at block levels to motivate the farming community for the same. Further, isotopal studies have to be carried out at the watershed level to enhance the accuracy level of water storage.

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