Sustainable Agriculture through Integrated Management of Micro-Water Shed in Individual Land Holding under Alfisol Regions of Karnataka

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Abstract: The experiment was conducted at All India Co-ordianted Research Project for Dry land Agriculture, UAS, GKVK, Bangalore during 1995—2000. The experimental site is situated in Agro-climatic Zone-V of Karnataka State located at 12° 35′ North latitude and 77° 35′ East longitude and at an elevation of 930 m above mean sea level. The soils of the experimental site is red sandy clay loam & are represented by alfisols belongs to Vijayapur series classified as oxic haplustalf with soil depth of > 90 cm, possess good drainage and infiltration rate of 4 cm/hr—6 cm/hr. The soils are slightly acidic in reaction [pH 5—5.5] and CEC of 7—10 meq/100g. The experiment was laid out with using vegetative live barriers (vetiver and nase grass) for inter terrace management practice in an area of 0.6 hectare each with a land slope of 1.5 per cent. All the plots were provided water harvesting structure (Farm ponds with different lining materials) of 180 m^3 capacity at the outlet of the catchment. The studies on runoff and soil loss during 1996—1998 indicated that the highest mean runoff of 6.89 percent and soil loss 2.4 t per hectare under controlled plot as compared to inter terrace live barriers which recorded lower runoff (11.35% to 12.63%) and soil loss (1.4 t/(ha • year) — 1.7 t/(ha • year)). Similarly, the farm pond lined with LDPE with brick frame work continued to record lower total water loss due to seepage loss (62.0 l / (m^2 • day)) as compared to unlined pond (136.98 l/(m^2 • day)). However, the farm pond lined with the soil + cement (8:1) recorded the response loss of 109.58 l per m^2 per day. The stored water in the Farm pond could be used for protective irrigation to transplanted chilli (second crop) resulting 88% to 143% higher yield with a monitory returns of Rs. 28,583 per hectare as compared to other system.

Keywords: rain water management, In-situ moisture conservation, vegetative barrier, farm pond

1 Introduction

The land area degraded by different process in India is estimated to be about 117 million-hectare. Of which 113 million-hectare area affected by water erosion and 39 million-hectare by wind erosion. The management of soil and rainwater are considered to be a serious threat to the sustainable agriculture in India. The ill-managed soil is bereft /deprive of moisture, nutrition and highly eroded. Degradation of naturally endowed resources such as soil, water and vegetation and concomitant environmental pollution is considered to be the serious concern in the country. In India it is estimated that, almost 1.5 million hectare is being out of cultivated area every year due to faulty land management practices. It is observed that India has about 61 percent of arable land classified as degraded to a greater degree of degradation. The process if allowed to continue would create tremendous problems of depletion and degradation of resources like soil, water and plant nutrients through runoff and soil erosion resulting in silting up of major reservoirs and causing floods (Belgami, 1996). Hence, scientific land management based on the natural resources endowment, their problems and potentials and inter relationship of crops and in-situ moisture conservation practices on individual land holding is key to conservation of natural resources under arable land. Water is the precious under dry land situation, which can be conserved through proper management and harvest the inevitable run-off in a water harvesting structure for maximizing production under dry land conditions. Keeping this in view, the study was conducted through integrated management

of natural resources under individual land holding considering micro-watershed with the following objectives:

(1) To estimate the runoff & soil loss under different vegetative barriers for each land holding.

(2) To know the performance of different vegetative barriers for individual land holding with respect to landscape.

(3) To study the feasibility of farm ponds with different select materials for seepage control.

(4) To work out the economics for efficient utilization of harvested farm pond water for intensive cropping.

2 Materials and methods

The experiment was conducted at Dryland Agriculture Research Project, Gandhi Krishi Vignana Kendra (GKVK) University of Agricultural Sciences, Bangalore situated in Agro-chimatic Zone-V (Eastern Dry Zone) of Karnataka State. Selected large sized plots representing individual farm holdings were developed with live barriers Viz., khus (vetiveria ziziodies) (Plate-1) and nase grass (Pennisetum hohenackere) as inter-terrace in-situ conservation practices. Each holding has been provided with farm ponds lined with different lining materials like soil + cement (8:1) mixture plastering, Low Density Poly Ethylene, (LDPE) over said with bricks and (Plate-2) and Brick framework with soil + cement plastering in brick frame(Fig.). Dugout type of farm ponds was constructed in each catchment with 1:1 side slope having 180 m^3 capacity. Runoff is estimated from the different inter-terrace management practices for all the runoff causing rainfall events and the rainfall intensity was calculated with rainfall hydrograph for each rainfall storm which are collected from sensitive self-recording automatic raingauge. Based on the expected peak runoff from the catchment, 45 cm size H-flume were installed at the out let of the ponds to measure the depth of over flow from the ponds and the depth was recorded by automatic liquid stage level recorded. Finally the runoff hydrograph obtained from the stage level recorder subjected to analysis of runoff peak rate duration and amount. Daily total water loss (seepage + evaporation) from ponds lined with different lining materials were estimated from ponds lined with different lining materials were estimated in terms of depth of water and volume per unit area.

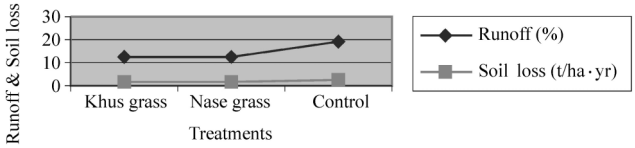

Fig. Mean annual runoff and soil loss under different inter-terrace management practices

3 Results and discussion

The runoff as influenced by duration, intensity of rainfall clearly indicated that the highest runoff of 22.21 mm was recorded on 26th September, 99 for the daily rainfall of 129mm with an intensity of 104 mm per hour. Irrespective of the land treatments, as the rainfall intensity increases with increasing amount produced more runoff, it means to say that the runoff is directly proportional to the rainfall amount and intensity(Table 1).

The studies on runoff and soil loss during the experimental period indicated that the control without any inter-terrace management practices recorded the highest mean runoff of 19.06 percent for the mean annual rainfall of 1089.4mm and soil loss 2.4 t per hectare per year as compared inter-terrace management practices which recorded the lower runoff (12.13% to 12.63%) and soil loss (1.4 t/(ha • yr) to 1.7 t/(ha • yr)[Table 2].

Among the different lining materials used for seepage control, the farm pond lined with LDPE with brick lining continued to be record lower seepage loss per sq. mt contact area (62 l/(m^2 • day)) as compared to unlined pond (136.98 l/(m^2 • day)). However the farm pond lined with soil + cement (8.1)

Table 1 Runoff as influenced by hydrological parameters under different live barriers from individual land holding during 1999

Date of Runoff event	Runoff causing rainfall (RCRF)			Runoff (mm)		
	Amount (mm)	Duration (mm)	Intensity (mm/hr)	Khus live barrier	Nase live barrier	Control (no inter-terrace)
13th May	25.4	90	40	0.41	0.54	0.37
18th May	31.00	120	66	0.28	0.42	0.26
26th May	26.40	130	45	0.66	1.03	0.62
11th June	35.4	85	65	2.07	5.47	2.75
16th June	16.4	120	40	0.17	0.13	0.20
30th June	23.6	150	28	0.07	0.19	0.27
6th July	27.4	110	30	0.43	0.74	0.51
1st August	10.8	180	16	0.25	0.51	0.75
13th August	38.6	150	80	14.04	16.14	18.95
20th August	98.8	225	120	18.08	23.64	33.44
25th September	15.6	60	40	0.99	0.84	0.99
26th September	129.0	360	104	22.21	36.46	45.19
28th September	51.0	330	40	8.61	10.33	14.62
1st October	25.4	180	35	5.99	7.65	11.65
3rd October	24.6	150	30	6.35	8.72	15.86
4th October	27.20	210	26	4.04	6.32	10.29
19th October	60.0	160	32	11.75	14.2	19.13
22nd November	12.2	570	12	0.22	0.18	0.41
29th November	41.4	330	64	7.68	5.49	8.16
Total	720.20	—	—	104.30	139.03	184.82
% to RCRF	—	—	—	14.50	17.90	25.60
% to total rainfall	—	—	—	9.50	12.60	16.90

recorder little higher seepage loss (109.58 l/(m^2 • day)) (Table 3). The stored water in the far pond could be used to intensify the crop productivity by double cropping system involving ground nut, soybean and fodder maize as early *kharif* crop (may) followed by transplanting chilli (September). The net monitory returns were realised in the double cropping system involving fodder maize-chilli with one projective irrigation (5cm depth) + organic mulching (*Rs*.28,583/ha) as compared to a similar system with groundnut/soybean (*Rs*.19,555/ha—20,947/ha) (Table 4).

Reference

Anonymous, 1998. Annual progress report, All India Co-ordinated Research Project for Dryland Agriculture, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore, Karnataka, India.

Belgami, 1996. Soil and water conservation techniques in non-arable areas. Short course in Integrated Dryland Technologies for watershed management held at University of Agricultural Sciences, Dharwad during 20-30 may, 1996, pp. 134-138.

Rattan Lal, 1994. Methods and guidelines for assessing suitable use of soil and water resources in the tropics, SMSS Tech. Monograph No.21, The Ohio State University, 2021, Columbus, USA.

Ullah,W., Gupta, S.K., Dalal, S.S. (1972), Hydrological measurements for watershed approch, Jugal Kishore & Co., Deharadun.

Plate 1 Khus live barrier as inter-terrace management practice

Plate 2 Farm pond lining with LDPE overlaid with bricks

Table 2 Mean annual runoff and soil loss under inter-terrace management practice in micro-watershed

Inter-terrace management practices	Runoff (%)					Soil loss (t/(ha • year))			
	1996	1997	1998	1999	Mean	1996	1997	1998	Mean
Khus live barrier at 15mt horizontal internal.	6.09	20.88	7.13	14.18	12.13	1.57	1.73	0.91	1.40
Nase live barrier at 15mt horizontal internal.	4.65	23.62	9.63	19.3	12.63	1.49	2.23	1.38	1.70
Control (No inter-terrace Management practices)	6.16	29.49	15.02	25.6	19.06	1.81	2.92	2.47	2.40
Annual rainfall (mm)	887.0	1,197.7	1,124.6	1,091.2	1,089.4	887.0	1,197.7	1,184.6	1,089.4

Table 3 Total and seepage losses of stored water from farm ponds lined with different lining materials

Farm pond treatment	Total water loss (cm/day) Mean of 1995 to 1999	Mean seepage loss (l/m^2 • day)				
		1990 to 1995	1996	1997	1998	Mean
Unlined pond	12.77	144.25	92.98	175.97	142.0	136.98
Lined with soil + cement (8.1)	3.91	35.45	43.29	164.28	121.17	109.58
LDPE over laid with Bricks	3.20	23.36	24.68	59.53	101.79	62.00
LDPE over laid with brick frame work with soil + cement 8:1	3.32	26.22	32.07	111.70	100.02	81.26

Table 4 Performance of double cropping system under projective irrigation from farm pond and organic mulching

Treatment	Yield (kg/ha)		
	Pod yield of groundnut	Grain yield of soybean	Fodder maize
I. First crop (may) without irrigation	694 (1151)	366 (923)	33847 (7607)
II. Chill as Second Crop (September)			
T_1- No irrigation & no mulch control	488 (10,601)	396 (6871)	385 (13,417)
T_2- No irrigation + mulch (4t/ha)	387 (10,426)	563 (11,517)	654 (13,417)
T_3-One irrigation 5cm with out mulch.	576 (12,986)	599 (12,233)	627 (20,073)
T_4- Two irrigation + mulch (4 t/ha)	801 (19,555)	907 (20,947)	936 (20,583)
T_5- Two irrigation with out mulch.	720 (17,282)	788 (17,675)	730 (23,283)
T_6- Two irrigation + mulch (4t/ha)	1006 (25,696)	1000 (23,613)	722 (25,821)

Figures in parenthesis indicate the net returns from the system in rupees per hectare.