



Water harvesting through farm pond and utilization of conserved water for vegetable crops

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ABSTRACT

A trial was conducted during 2005-06 & 2006-07 at All India Coordinated Research Project for Dryland Agriculture Phulbani, Orissa, India., with an objective to obtain the water loss and economics of the lined ponds. There were three treatments T1-Lined pond with soil cement plaster (6:1) 8cm thickness, T2-Unlined pond, T3-No pond. 10% of the cropped area was dug for construction of the pond in Lined and Unlined pond treatments. The size of the pond is 7m top width, 1m-bottom width, 3m height, and 1:1 side slope. The water harvested in pond was reutilized for the pumpkin crop, which was sown only in Lined pond treatment, as there was no water available in unlined pond so the crop was not sown there. Lined pond with soil cement (6:1) plaster of 8cm thickness gave highest Tomato yield of 4.8 t/ha during kharif 2008-09 and radish root yield of 25.5 t/ha in rabi seasons of 2008-09. The water loss was 326 lit/day in lined pond and 24,000 lit/day in unlined pond. The benefit: cost ratio in lined pond was 3.04 as compared to 1.64 in unlined pond during 2008-09.

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Introduction

The light textured well-drained upland soils in North Eastern Ghat Zone provide scope for cultivation of vegetables during rainy season. The intermittent dry spells and terminal drought affect the performance of those high value crops in most of the years. About 25% of the rainfall is lost as run-off. Harvesting of this run-off water in farm pond with proper lining will conserve the run-off water and recycling of this water for life-saving irrigation will protect the crop from drought/dry spell grown in 90% of land area. The ponds will be helpful for sustainability in productivity of dryland crops. Soil structure and organic matter status decide the water holding capacity of the soil. Soil physico-chemical characteristics depend on the systems of nutrient management. Keeping those points in view, the present experiment involving two water management systems (no pond and pond) has been designed. The runoff water can be harvested for re use in the Dryland crops for sustainable crop production (Singh 2003).

Objectives

1. To quantify the increase in land productivity and land use efficiency through on-farm water harvesting
2. To quantify the water/seepage loss in different ponds

Methodology

10% of the cropped area was dug for construction of the pond in Lined and Unlined pond treatments. Size of the pond is 7m top width, 1m-bottom width, 3m height, and 1:1 side slope. The water harvested in pond was reutilized for the pumpkin crop, which was sown only in Lined pond treatment, as there was no water available in unlined pond so the crop was not sown there.

Mishra and Sharma (1994) they developed equation for calculating the seepage loss for different situations and depth of farm pond for different capacity the capacity of the farm pond and side slope was decided accordingly.

Result And Discussion

Soil texture was shown below, which was loamy sand from top layer to sandy loam in bottom layer. The highest B:C ratio (3.04) was obtained in lined treatment due to two crops was harvested (Table 1). Highest energy output : input ratio was obtained in lined pond in both Kharif (1.57) and rabi (11.95) and lowest in T3 i.e. No pond treatment (Table 1(a)). Considering both kharif and rabi maximum energy output : input ratio was obtained in lined pond (5.83). The mean water loss and mean yield was presented in Table 2 & 3 respectively. The mean yield was highest (8.95 t/ha) in lined pond and water loss was lowest (192 lit/day) in lined pond. The yield of Cauliflower was highest in T₁ (4.8t/ha)(2008-09) and lowest seepage loss (192 lit/day) (mean) (Table-3 and 6). The lowest Cauliflower yield was obtained in no pond (T₃) treatment (3.02t/ha). Unlined pond gave a yield of 3.82 t/ha which was 20 % lower than the lined pond. The seepage loss in unlined pond was highest (30,500 lit/day) over the last four years. Srivastava et al. (1999) also found that in control the seepage loss was 3343.44 lit/day/sq.m, they found that polythelene was found suitable for Arunachal Pradesh which gave no seepage loss. The no of irrigation was 5 and one in case of lined and unlined pond respectively during 2008-09. (Table 5). The cost of lined pond was Rs9.967/- and that of unlined pond was Rs 2,993/- (Table 6). The water use efficiency was presented in (Table-7) which was highest in lined pond (4.016kg/ha/mm). The cost of lining per square meter was Rs 88/-. Fig 1 & 2 shows that the water loss in lined pond is in increasing trend may be due to some cracks where as the water loss in unlined pond is decreasing trend may be due to siltation. Fig.3 & 4 shows the radish after irrigating from lined pond and lined pond visited by farmers respectively.

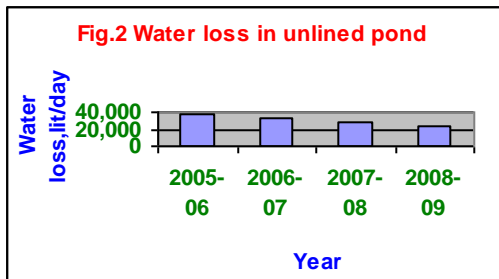
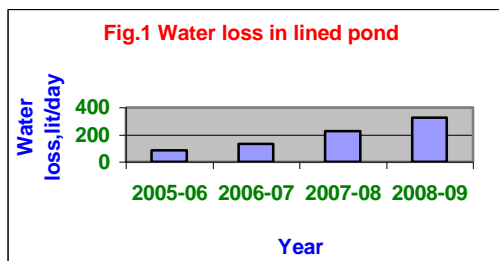


Fig.3 Rabi crop radish after giving irrigation from pond



Fig 4 Lined pond

Rainfall (mm)	:	
a) Normal	:	1407mm
b) Current year(2008)	:	1531.8mm
c) Cropping season	:	Cauliflower-1195.1mm Radish-515.8mm
d) Dry spells (> 10 days)	:	Weather was favorable to rice & groundnut but not favorable to Arhar as there was no rainfall between Sep 24 , to Oct 04, and Oct 10 to Nov 15, 2008
Crop & Variety	:	Cauliflower-Hemlata Radish-Pusachetki
Treatment details	:	T ₁ -Lined pond with soil cement plaster in 6:1 ratio (8 cm thickness) T ₂ - Unlined pond T ₃ - No pond (control)
Experimental design	:	No design

Plot size (sq.m)	:	
a) Gross plot	:	30m x 15m
b) Net plot	:	28.2m x 12.3m
Date of sowing	:	Cauliflower-25.6.2008 & transplanted on 19.7.2008 Radish-20.08.2008
Date of harvesting	:	Cauliflower-02.09.2008 to 26.09.2008 (14 different dates) Radish-03.10.08 to 28.10.08(6 different dates)
Spacing (cm)	:	Cauliflower-45 cm X 45 cm Radish-45 cm X 5 cm
Seed rate (kg/ha)	:	Cauliflower-350gm/ha Radish-6 kg/ha
Basal manuring (NPK) Top dressing	:	Cauliflower-25: 40:60 kg N-P ₂ O ₅ -K ₂ O /ha 1 st top dressing-50kg N /ha 2 nd top dressing-50kg N /ha Radish-25: 50:75 kg N-P ₂ O ₅ -K ₂ O /ha 1 st top dressing-25kg N /ha
Previous crop and fertilizer applied	:	As trial was conducted at same place so same fertilizer as mentioned above.
Layout Plan	:	

	T ₃
Lined Pond	Unlined Pond
T ₁	T ₂

Soil properties		Soil depth (cm)		
Physical		0-10	10-20	20-30
a) Texture	Class	Loamy sand	Sandy loam	Sandy loam
	% Sand	87.8	77.8	75.8
	% Silt	5.0	10.0	10.0
	% Clay	7.2	12.2	14.2

Table 1. Yield and economics during 2008-09

Treatments	Yield (kg/ha)		Cost of cultivation (Rs /ha)	Gross income (Rs /ha)	Net Income (Rs /ha)	B:C ratio
	Cauliflower (kharif)	Radish (rabi)				
T ₁	4,800	25,500	81,700	2,49,000	1,67,300	3.04
T ₂	3,822	-	46,685	76,440	29,755	1.64
T ₃	3,021	-	32,750	60,420	27,670	1.85
Mean	3,881	25,500	53,712	1,28,620	74,908	2.18
2008-09	1195.1 mm (Cauliflower)	515.8 mm (Radish)				

*Market value of the Cauliflower Rs 20 kg in 2007-08 Radish Rs 6/- per kg (2008-09)

Table 1 (a) Energy input and output in different treatments

Treatments	Kharif			Rabi		
	Energy input (MJ/ha)	Energy output (MJ/ha)	Energy Output : input ratio	Energy input (MJ/ha)	Energy output (MJ/ha)	Energy Output : input ratio
T ₁	11977	18816	1.57	8365	99960	11.95
T ₂	11817	14982	1.27	-		
T ₃	11793	11842	1.00	-		

Table 2. Water loss during 2005-06 &08-09

Treatment	Water loss (lit/day)				
	2005-06	2006-07	2007-08	2008-09	Mean
T ₁ -Lined pond with soil cement (6:1) plaster 8cm thickness	86	131	225	326	192
T ₂ -Unlined pond	37,000	33,000	28,000	24,000	30,500
T ₃ -No pond					

Table 3. Yield during 2005-06 to 2008-09

Treatment	Yield of Kharif produce (t/ha)				
	2005-06 tomato	2006-07 tomato	2007-08 Cauliflower	2008-09 Cauliflower	Mean
T ₁ -Lined pond with soil cement (6:1) plaster 8cm thickness	22.83	3.78	4.4	4.8	8.95
T ₂ -Unlined pond	21.33	3.55	3.82	3.82	8.13
T ₃ -No pond	19.83	3.52	3.53	3.02	7.48
Mean	21.33	3.62	3.92	3.88	8.19

Table 4. Yield during 2006-07 to 2008-09(Rabi)

Treatment	2006-07 Pumpkin,kg/ha	2007-08, Radish,kg/ha	2008-09, Radish,kg/ha	Mean kg/ha
T ₁ -Lined pond with soil cement (6:1) plaster 8cm thickness	34,500	22,500	25,500	27,500

Table 5. No. and quantity of irrigation applied during 2008-09

Treatment	No of Irrigation applied	Quantity of irrigation applied,lit
T ₁ -Lined pond with soil cement (6:1) plaster 8cm thickness	5	600X5=3,000
T ₂ -Unlined pond	1	300
T ₃ -No pond		

Table 6. Seepage loss in different treatments over the last four years

Treatment	Total cost of the pond (Rs)	Cost of lining (Rs/m ³)	Water loss from the pond (lit/day)	Time taken to dry up the pond (days)	Cost of storage (Rs/m ³)	Economic loss due to seepage loss (Rs/day)
1	2	3	4	5	6=(7/4)X1000	7=2/5
T ₁ -Lined pond with soil cement (6:1) plaster 8cm thickness	9967	88.5	192	391	133	25.49
T ₂ -Unlined pond	2993	0	30,500	2.45	40	1222
T ₃ -No pond						

Table 7 Water use efficiency in 2008-09

Treatments	Yield (kg/ha/mm)	
	Cauliflower (<i>kharif</i>)	Radish (<i>rabi</i>)
T ₁	4.016	49.437
T ₂	3.198	-
T ₃	2.528	-
Mean	3.247	49.437
2008-09	1195.1 mm (Cauliflower)	515.8 mm (Radish)

Table 8. Growth parameters in different treatments during 2008-09

Treatment	Cauliflower			Radish		
	Plant Height,cm	Spread,cm	No of leaves	Plant Height,cm	Spread,cm	No of leaves
T ₁ -Lined pond with soil cement (6:1) plaster 8cm thickness	45	61.6	17.6	25.8	45.4	26.8
T ₂ -Unlined pond	38.5	53.8	16.4	-	-	-
T ₃ -No pond	32.2	46.8	14.2	-	-	-

Table 9. Weekly rainfall distribution at Phulbani during 2008-09

Standard week	Period	Rainfall (mm)		No. of rainy days	
		Normal	2008	Normal	2008
1	1-7 Jan.,2008	1.22	0	0.08	0
2	8-14	4.21	0	0.23	0
3	15-21	2.2	0	0.18	0
4	22-28	1.44	61.4	0.13	3
5	29-4 Feb	2	0	0.1	0
6	5-11	4.41	2.4	0.3	0
7	12-18	6	0	0.53	0
8	19-25	1.1	0	0.13	0
9	26-4 Mar	5.5	0	0.3	0
10	5-11	3.23	0	0.3	0
11	12-18	2.8	0	0.33	0
12	19-25	4	12.6	0.3	2
13	26- 1 Apr	5.7	0	0.33	0
14	2-8	11.7	11.0	0.68	2
15	9-15	2.4	1.6	0.28	0
16	16-22	8.3	0	0.63	0
17	23-29	7.7	0	0.58	0
18	30-6 May	10.6	0	0.65	0
19	7-13	18.3	0	0.95	0
20	14-20	12.6	0	0.83	0
21	21-27	11.3	0	0.73	0
22	28-3 June	10.9	22.6	0.85	2
23	4-10	21.3	71.8	1.03	4
24	11-17	60.1	75.2	2.45	3
25	18-24	51.1	44.2	2.7	4
26	25-1 Jul	64	60.8	2.8	3
27	2-8	83.6	14.6	3.15	2
28	9-15	62	35.8	3.18	2
29	16-22	74.5	14.8	3.8	2
30	23-29	83.1	115.6	3.35	5
31	30-5 Aug	93.1	123.4	3.65	7
32	6-12	85.8	248.2	3.45	5
33	13-19	88.3	23.4	3.28	6
34	20-26	61.4	98.2	2.85	5
35	27-2 Sep	102.7	43.0	3.43	2
36	3-9	55.9	75.0	2.9	3
37	10-16	78.2	35.0	2.93	4
38	17-23	44.2	308.1	2.25	6
39	24-30	35.7	0	2.05	0
40	1-7 Oct	32.9	15.0	1.65	1
41	8-14	21.8	16.0	1.28	2
42	15-21	26.6	0	1.15	0
43	22-28	12.2	0	0.6	0
44	29-4 Nov	9.1	0	0.7	0
45	5-11	8.8	0	0.48	0
46	12-18	2.9	2.5	0.25	1
47	19-25	4.4	0	0.13	0
48	26-2 Dec	1.11	0	0.1	0
49	3-9	0.05	0	0	0
50	10-16	1.94	0	0.1	0
51	17-23	1.03	0	0	0
52	24-31	1.9	0	0.08	0
Total		1407.34	1531.8	65.19	76

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