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Assessment of farm pond with respect to water harvesting and recycling

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ABSTRACT : The study was conducted during the year 2010-11 at demonstration farm of the M.K.V., Parbhani . The observation regarding daily depth of water impounded in the farm pond was recorded on the farm pond constructed at that site. Daily rainfall and pan evaporation data was collected from the meteorological observatory of the University. The daily water evaporated (m^3) through the farm pond were calculated by multiplying daily depth of water evaporated from the farm pond to the water storage area for a particular day. The daily water storage area and volume of water impounded was estimated for particular depth of impounding of water. The harvested water in the farm pond was utilized for irrigating the safflower crop. For this the experiment was laid in Randomized Block Design with 6 replications and 3 treatments *viz.*, T_1 (one irrigation), T_2 (two irrigation), T_3 (No irrigation). The area of top section and bottom section of the farm pond was 309.491m^2 and 674.736 m^2, respectively. The average elevation of embankment at top was 413.130m. The average elevation of bottom of pond was 410.244m. The elevation at the bottom of outlet was 412.437m. The maximum depth of water impounded and storage volume in pond was 2.193m and 1079.20$m^{3,}$ respectively. Total evaporation and seepage loss through farm pond for the period 1st July 2010 to 31st December 2010 was 228.661 m^3 and 2775.554 m^3, respectively. The weight of silt deposited in the farm pond for the monsoon season 2010 was recorded as 11.95 tones. Treatment of two protective irrigation (T_2) recorded significantly higher grain yield (606.99 kg/ha) than treatment of one protective irrigation (T_1) and no protective irrigation (T_3).

KEY WORDS : Farm pond, Water harvesting, Recycling

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Rainwater management is the most critical component of rainfed farming (Gajri *et al.*, 1982). The successful production of rainfed crops largely depends on how efficiently soil moisture is conserved *in situ* or the surplus runoff is harvested, stored and recycled for supplemental irrigation. India has a long history of rainwater harvesting through a variety of structures and systems (tanks, ponds, khadins etc.), which are built by the Government and local bodies and managed by the community and village level institutions. However, after independence, with the availability of electricity and pumping technology, private investment on tube wells has enormously increased and the tank systems were gradually ignored. The emphasis shifted from community based structures, which use surface water, to individual investments which exploited ground water (Goyal, 1995).

METHODOLOGY

The study entitled, 'assessment of farm pond with respect to water harvesting and recycling' was conducted at the demonstration farm of Marathwada Krishi Vidyapeeth, Parbhani. The farm pond was constructed at demonstration cum seed production farm of the Marathwada Krishi Vidyapeeth, Parbhani. Area comes under assured rainfall zone. The soils are medium deep to deep black and mostly clay in texture with pH 7.5. The soil was upto 3-4 feet medium black from the top followed by 5-6 feet soft murum. Below soft murum hard murum was found. The catchment area of farm pond was 3.20 ha. The dimensions of the farm pond at bottom and top such as bottom length, bottom width, top length and top width were measured with the help of measuring tape. The area of top section and bottom section of the farm pond was 309.491m^2 and 674.736 m^2, respectively. The average elevation of embankment at top was 413.130m. The average elevation of bottom of pond was 410.244m. The elevation at the bottom of outlet was 412.437m. The maximum depth of water impounded and storage volume in pond was 2.193m and 1079.20$m^{3,}$ respectively. The daily rainfall and pan evaporation data for the period 1st June-31st December, 2010 were collected from

meteorological observatory, MKV, Parbhani. The depth of water impounded in the farm pond was measured daily for the period 1st July to 31st December, 2010. Water surface area and storage volume corresponding to respective head in the farm pond was calculated by drawing straight line stage storage relation graph. The values of water surface area and storage volume with respect to depth of water impounded in the farm pond for particular day was obtained from the stage storage relationship graph.

Evaporation and seepage are the two major storage losses from farm pond stored water. For estimation of evaporation loss from the farm pond; daily pan evaporation data were used. The evaporation loss through farm pond was calculated by multiplying pan evaporation by pan coefficient (0.7). The daily evaporation loss through farm pond was calculated. Daily seepage loss from the farm pond was estimated subtracting daily evaporation loss prevailing farm pond water storage (m^3). The (–) ve sign is assigned to indicate loss in daily storage volume while (+) sign is assigned to indicate increase in daily change in storage volume. While calculating daily seepage loss, (-) sign values of daily change in storage were considered. All the dimensions of the farm pond such as length and width at top and bottom section and depth were measured with the measuring tape. The area of farm pond at bottom and top section was calculated. The storage capacity of the farm pond was calculated. The silt deposition in the farm pond was determined by measuring the depth of silt deposited and its area distribution. For estimation of silt deposition in the farm pond the depth of silt deposited on bottom and banks of embankment of farm pond was measured. The depth of silt deposited at various points on bottom and banks of the farm pond was noted at 4m interval. The average depth of silt deposited on bottom as well as bank of the farm pond was calculated. The volume of silt deposited was calculated by multiplying area of silt deposited to the average depth of silt deposited on bottom and bank of the farm pond.

Plate A : Recycling of harvested water through farm pond

The consolidation of embankment of farm pond was assessed by measuring the dimensions of embankment of farm pond recorded on May, 2010 and subsequently on February, 2011. The dimensions of the embankment such as top width, bottom width and height recorded in May-2010 were used for estimation of cross sectional area of the embankment of the farm pond. The dimensions of the farm pond embankment such as top width, bottom width and height were again measured after monsoon season in the month February-2011. Cross sectional area of embankment was worked out. Cross sectional area of embankment of farm pond recorded in May 2010 and February- 2011 was compared. Reduction in cross section area of embankment and its consolidation was worked out.

Water harvested in the farm pond was lifted with the help of Honda Centrifugal Monoblock Pump for irrigation of safflower crop (Var. Parbhani-12) grown nearby the farm pond area. For this purpose, the experiment was laid in Randomized Block Design with three treatments and six replications. First protective irrigation was given at branching stage and second irrigation was given at boll formation stage of the safflower. The grain yield and total yield (grain yield + biomass) were recorded.

RESULTS AND DISCUSSION

Total rainfall of 1260.20mm was received during Monsoon season of 2010 with 58 rainy days. Maximum rainfall of 426.8mm was received in the month of July 2010. The stage storage relationship of farm pond is presented in Fig. 1.

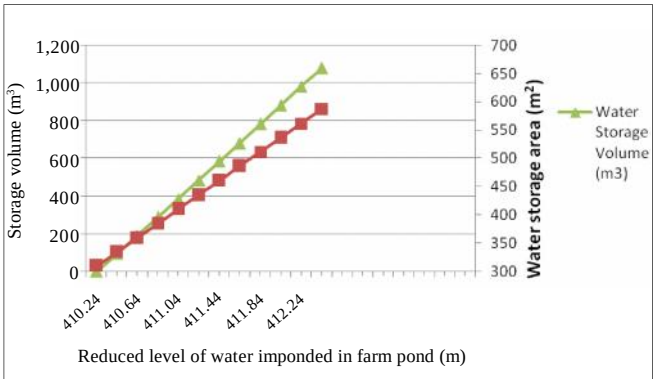

Fig. 1 : Stage storage relationship of the farm pond

Storage losses through farm pond are presented in Table 1. Total storage loss for the period 1st July to 31st December 2010 was found to be 3004.215m^3. The table shows that seepage losses comprise 92.39 per cent storage losses and remaining evaporation losses indicating thereby lining of farm pond by suitable lining material is necessary to reduce seepage losses.

Table 1 : Storage losses through the farm pond

Month	Evaporation loss through farm pond (m^3)	Seepage loss through farm pond (m^3)	Total storage losses(m^3)
July	37.838	821.164	859.002
August	34.305	762.017	796.332
September	43.849	497.705	541.554
October	46.164	293.207	339.371
November	37.258	140.324	177.582
December	29.247	261.137	290.384
Total	228.661	2775.554	3004.215

Table 2 : Weight of silt deposited in farm pond

Sr. No.	Particulars	Average depth of silt deposit (m)	Area (m^2)	Volume of silt deposited (m^3)	Weight of silt deposited (tones)
1.	Bottom section of farm pond	0.0248	309.491	7.675	10.36
2.	Embankment inner section of farm pond	0.0166	70.800	1.175	1.59
	Total				11.95

Table 3 : Consolidation of the embankment of farm pond

Sr. No.	Particulars	Dimensions of embankment of farm pond			
		Top width (m)	Bottom width (m)	Height (m)	Cross section area (m^2)
1.	Dimensions on (May-2010)	2.60	4.60	1.0	3.6000
2.	Dimensions on (Feb-2011)	2.54	4.60	0.85	3.0345
			Reduction in cross section area		15.7083%

Data presented in Table 1 revealed that the total water evaporated through the farm pond for the month of July-2010 was 37.838 m^3, August-2010 was 34.305 m^3, September-2010 was 43.849 m^3, October-2010 was 46.164 m^3, November-2010 was 37.258 m^3 and for December-2010 was 29.247 m^3. The maximum water evaporated through the farm pond was observed in the month of October-2010. Total evaporation loss through the farm pond for the period 1st July to 31st December 2010 was recorded as 228.661 m^3. Seepage loss for the month July-2010 was 821.164 m^3, August-2010 was 762.017 m^3, September-2010 was 497.705 m^3, October-2010 was 293.207 m^3, November-2010 was 140.324 m^3 and for December-2010 was 261.137 m^3. The Seepage loss in the month of December 2010 was increased as compared to November 2010 in spite of decrease in head. It was happened due to withdrawal of the water from the well situated on downstream side of the farm pond for irrigation purpose. Total seepage loss through the farm pond for the period 1st July to 31st December 2010 was recorded as 2775.554 m^3. The daily average seepage loss through the farm pond was estimated as 5.83 m^3. The average bulk density of the silt deposited in the farm pond was assumed to be 1.35 g/cm^3.

Data presented in Table 2 revealed that weight of silt deposited in the farm pond was found to be 11.95 tones. This quantity of silt deposited in farm pond was collected from 3.20 ha catchment area of the farm pond over the period of one season.

Table 4 : Rain water harvested in the farm pond

Date	Rain water harvested (m^3)
1/7/2010	316.25
2/7/2010	762.95
26/7/2010	23.75
29/7/2010	10.00
30/7/2010	3.75
31/7/2010	13.75
8/8/2010	854.20
14/8/2010	347.95
27/8/2010	90.00
28/7/2010	13.75
31/8/2010	238.75
17/9/2010	11.25
23/9/2010	250.00
23/10/2010	10.00
4/11/2010	76.25
Total	3022.60

From Table 3 it was observed that the dimensions of the embankment of the farm pond such as top width, bottom width and height on May 2010 were 2.60 m, 4.60 m and 1.0 m, respectively. The cross sectional area was estimated as 3.6000

Table 5 : Grain yield of safflower as affected by protective irrigation

Treatments	Replications							
	RI	RII	RIII	RIV	RV	RVI	Mean	% increase over control
T_1	590.53	574.07	514.40	557.61	508.61	503.42	541.49	100.64
T_2	636.48	642.66	575.44	624.14	575.44	587.79	606.99	124.91
T_3	288.75	259.25	277.77	256.51	262.00	275.03	269.88	
Mean							472.788	
S.E.±							8.823	
C.D. (P=0.01)							39.558	
C.D. (P=0.05)							27.828	
CV%							4.571	

m^2 . The dimensions of the embankment of the farm pond such as top width, bottom width and height on Feb. 2011 were found to be 2.54 m, 4.60 m and 0.85 m, respectively. The cross sectional area of the embankment of the farm pond was recorded as 3.0345 m^2 . Reduction in cross sectional area of the embankment was found to be 15.7083 per cent .

Data presented in Table 4 indicated total rain water harvested for the period July-December, 2010. The maximum rain water harvested in the farm pond was recorded as 854.20 m^3 on 8.8.2010 because of heavy rainfall (136.6 mm) received on 7.8.2010. Total quantity if rain water harvested in the farm pond for the period July-December, 2010 was found to be 3022.60 m^3. It was observed that the farm pond was filled at its full capacity on 2.7.2011 and 14.8.2010 and overflow was observed on these two days.

Data presented in Table 5 show grain yield of safflower as affected by protective irrigation. Data presented in Table 5 revealed that treatment of two protective irrigation (T_2) recorded significantly higher grain yield (606.99 kg/ha) than treatment of one protective irrigation (T_1) and no protective irrigation (T_3). Treatment (T_1) also recorded significantly higher grain yield (541.49 kg/ha) than treatment (T_3). Treatment T_2 and T_1 recorded 124.91 per cent and 100.64 per cent higher grain yield of safflowers as compared to Treatment T_3.

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