

## Farm Pond lined with Plastic Film

### Introduction

To fulfill the demand of irrigation potential in agriculture as supplementary irrigation water management play an important role, because rainfall in drought prone areas is highly erratic, storage must be an integral part of any rainwater harvesting system. It is therefore necessary to harvest water from any water sources e.g. precipitation, perennial sources, roof water etc. in ponds and reservoirs for various domestic, agricultural and industrial purposes over a period of time- to stretch its usage to the maximum. Following are the diversified use of stored water during off –season.

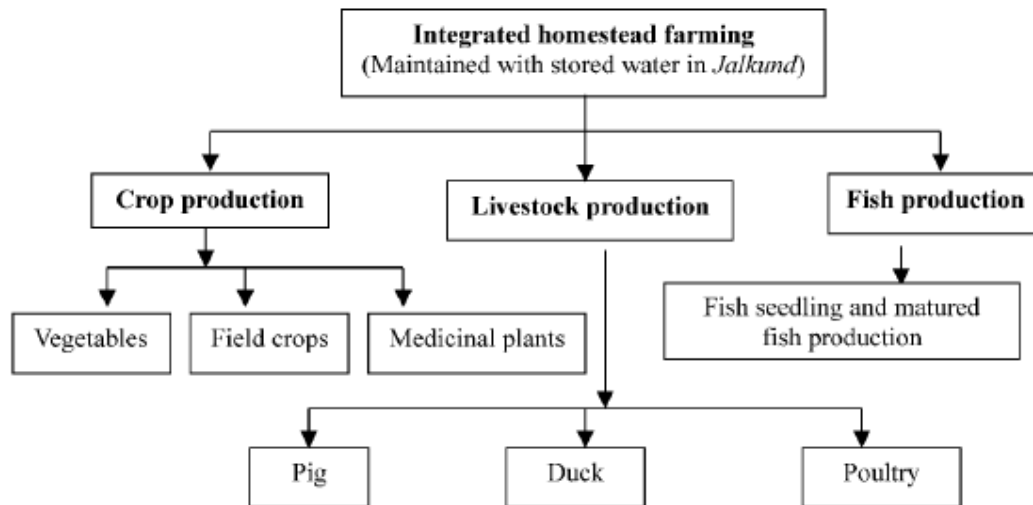


Figure: Flow chart showing diversified used of stored water during off-season

The major portion of stored water in earthen tanks has been lost due to seepage. It is found that water loss through seepage i.e. 1.21 to 10.54 cumecs/million sqm from heavy clay loam to porous gravelly soils in the earthen ponds is the major constraints to its failure. In other words we can say that the drop in depth per day (cm) of ponded water via seepage and evaporation is 10.36 to 90.65 cm from heavy clay loam to porous gravelly soils.

To avoid this depletion of stored water, pond sealing/ mechanically treating the ponds are necessary by installing lining of impervious material as Plastics film lining alone or in combination with conventional lining has proved to be an effective seepage proof in ponds and reservoirs but most effective and cost economic also. Plastics film is the flexible membrane, which is a hydraulic barrier consisting of a functionally continuous sheet of synthetic or partially synthetic or flexible material.

The Government of India has provided subsidy under National Horticulture Mission (NHM) - a centrally sponsored scheme on the construction of Plastics lined water harvesting tanks in all states to mitigate the scarcity of water for supplemental irrigation as well as diversified use of stored water during off-season. Under NHM, subsidy is available for two sizes - community tanks (where a number of farmers come together) for the purpose of supplemental irrigation to irrigate up to 10 ha of land and small farm tanks on individual basis.

### **Benefits of pond lining with Plastics films**

- Reduction in seepage losses to the maximum extent (95%).
- Harvesting and storing of rain water from early monsoons.
- Utilization of harvested rain-water for short during crops as well as during off season.
- Lining of ponds and reservoirs with plastics film improve water availability over a longer period of time.
- It is highly useful in porous soils where water retention in ponds and water harvesting tanks is minimal.
- Economical and effective method of storing water.
- Eliminates water logging and prevents upward intrusion of salts into stored water.
- Useful for the purpose of storage of drinking water, for pisciculture and for providing supplementary irrigation.
- Prevents soil erosion.
- Technique is also suitable for lining of effluent ponds and channels to reduce soil and ground water contamination.
- It can also be used in the lining of saltpans for improving productivity as well as quality of salt.

A large number of ponds have been lined with plastics film for providing water for variety of uses in the states of Maharashtra, Rajasthan, Gujarat, West Bengal, Karnataka, Himachal Pradesh, and Uttaranchal. The other states are also catching up as the need for stored water is going up every year.

### **Comparative study of lining materials**

**Concrete:** A concrete pond is initially labor intensive and costly. Allow for the thickness of concrete when you dig your pond, so you get the final depth and size you want. Line the finished hole with visquine, put chicken wire on top of the plastic, and work concrete from the top down, getting a final thickness of 2-4 inches. When the concrete is fairly hard, use a large wet soft brush to give a smoother finish to the concrete. Over time the concrete might settle and crack; these cracks can be fixed with silicone cement or concrete patching material used for repairing concrete sewer pipe.

If you use forms to pour a concrete pond, or build cement block walls on a concrete base, then you should use a suitable sealant. One type I used at the Scott Aquarium was a non-toxic epoxy paint developed for concrete tanks; it gave excellent results in sealing plus gave the rough concrete surface a smooth finish.

**HDPE** (high density poly-ethylene, with carbon black)

This lining material is one of the best available, and is UV light resistant, lasting many years (generally 100 plus). It is used in lining under gasoline storage tanks, public dumps, toxic settling ponds, aquaculture ponds, etc. It can be heat-welded together; use 20-40 mil thickness for small ponds.

**PE**(poly-ethylene)

This is one of the cheapest ways to line a pond. The hole must be free of roots and debris. Pull 3-5 overlapping layers of the cheap visquine (usually 6 mil thick) into hole. If possible, use black visquine containing UV light retardant. If using clear visquine, hide portions out of water from sun (using dirt, sod, wood, rocks, etc). If leaks occur you can put two or more layers of new visquine over the initial layers.

**Preformed ponds** (HDPE, fiberglass, bathtub, wooden barrel, misc types of plastic, plastic barrel, etc) There are many types of preformed things that can be dug into the ground to use as a hole liner. After a suitable-sized hole is dug, the bottom of the hole is tamped down and leveled for a solid base, and the insert is added and allowed to stick up two or more inches above the surrounding ground level to prevent horizontal water flow into the pond. Soil is added around the edges and settled over several days by watering. Once the soil around the edges is settled, then one can fill the insert and leach out any toxins. Design a spillway into top edge of insert to handle pond overflow during rains; screen overflow to retard fish escape. This is probably the easiest way to make a lined pond.

**Most widely used films are**

Sl.No.	Most widely used	Some what less widely used
1	<b>LLDPE</b> (Linear Low Density Polyethylene)	<b>FPP</b> (Flexible poly propylene)
2	<b>LDPE</b> (Low Density Polyethylene)	<b>FPP-R</b> (Flexible poly propylene - Reinforced)
3	<b>HDPE</b> (High density Polyethylene)	<b>CSPR-R</b> (Chlorosulfonated polyethylene - Reinforced)
4	<b>VLDPE</b> (Very Low Density Polyethylene)	<b>EIA-R</b> (Ethylene Interpolymer alloy - Reinforced)
5	<b>VFPE</b> (very Flexible Polyethylene)	
6	<b>PVC</b> (Polyvinyle Chloride)	

### Comparative properties of PE film materials

Property	Test method ASTM Coded	Unit	Values		
			LDPE film 0.5mm (500 microns)	HDPE film 0.5mm (500 microns)	Reinforced HDPE geomembrane 0.5mm (500 microns)
Material Density	1505	Gms/cc	0.920	0.940	0.939
Breaking Strength	6093, 638 Type IV	N/mm	12	14	28
Elongation	638	%	610	700	22 + for both MD & TD
Puncture Resistance	4833	N	120	176	491
Tear Resistance	1004	N	50	73	120
Bursting strength	751	Kg/cm <sup>2</sup>	4	4.3	8.5
Hydro Static Resistance	751	Kg/cm <sup>2</sup>	Sample to be Bursted at 2kg/cm <sup>2</sup> .	Sample to be Bursted at 3kg/cm <sup>2</sup> .	No through leakage upto 6kg/cm <sup>2</sup> .
Impact failure load at 1524 mm height		Gf	Load passed at 555 gf.	Load passed at 585 gf.	Passed more than 2000 gf Load

#### General criteria for pond construction

- **Survey of water resources/catchments:** The most important factor for designing farm ponds is water sources. There should be enough water available either by perennial, seasonal, runoff through watershed areas or by other sources to fulfill the pond but not in great excess.
- **Selection of Site:** Site should be selected where catchments areas should be more so that maximum areas can be covered for supplemental irrigation of the water stressed crops. The natural tendency of soil and elevation should also be taken into consideration.
- **Selection of size of tank:** The selection of size of tank is very important depends on catchments area, sources of water available, types of soil, frequency of irrigation and volume of water required etc. in in shape. The slope and shape of trapezoidal pond depends on the types of soil, its topography.

- **Depth of pond:** Depth of the pond should range from 3 to 5 m. Greater than 2 m of depth is necessary and would prove a less area as well as minimum evaporation loss and maintenance hazard. If space for adequate surface area is not available, this can be offset to some degree by increasing the depth of the pond.
- **Slope of pond:** Slopes lies “between” 1.5:1 to 3:1 have been recommended for clay to sandy loam soil.

### **Design criteria of pond:**

Design criteria for constructing farm pond play an important role that includes excavation, slope, shape, leveling and compacting the soil after considering all general criteria. The following parameter should be kept in mind

#### **A) Preparation of pit:**

- Point out the outer corner of the selected field using pegs
- Measure the bottom dimension of the pond by calculating depth and slope ratio. It appears in center of the outer corner of the selected site and marked it before excavation process.
- Excavate marked area first up to desired depth.
- After that excavate rest area in inclined manner from one edge of bottom to top of the outer edge of same side and repeat the same for next three sides.
- Spreading of excavated soil in the depressions for leveling and also on edges to make bunds of desired height from ground level.
- Leveled the excavated pond in order to suppress the angular projection
- Cut soil must be sealed or compacted unless the site is dug into a tight, clay formation so that film could be saved from puncture caused by these projections.
- After compaction the whole area of pond should be treated with 4% atrazine (weedicde solution) so that the plastic film could be saved from puncture caused by root infestation.
- After that all surface of pond should be smoothened properly.
- Construct a rounded trench of one cubic feet and should be 0.75m -1m away from bank of the pond for anchoring the PE film.

#### **Laying of PE films:**

For laying of PE films minimum of 500 micron film are best suited for lasting of film and the following procedure are taken into consideration:

- Choose the film as per BIS /ISI mark (IS: 15351 / IS: 10889 / IS: 2508)
- Use minimum of 500 micron black PE film

- Calculate the film requirement for dugout pond and cut it accordingly
- Measure and cut the film as per calculation
- PE films manufactured into panels of standard widths. Therefore convert the film into a single sheet as desired either mechanically by heat-sealing machine like Hot Air fusion welding machine or manually (by overlapping 15 cm of the edge of two sheet and scrubbed lightly using emery paper or sand paper (120 grade) using bitumen/Synthetic Rubber adhesive No -998 made by fevicol so that it fit exactly to fit into the pond.
- Monitor the film in sunlight for searching/puncture hole if any, sealed the hole with bitumen/adhesive or by heat-sealing procedure.
- Lay the film in the
- The ends of the film at the surface have to be firmly buried in a trench at the bank of the pond to avoid sagging in of the film.
- Care should be taken to avoid the wrinkles and film must be pleated at the corner.

### Pointing over the film

To protect the film from damage pointing over the laid film is required. Generally locally available material / easily available material to be used

- Over laying works can be done in many ways but most suitable and economic ways are one of them is overlaying brick alone completely on the four sides, bunds and bottom of the lined tank. Secondly overlaying it as brick framework of size 2' x 2' are made and placed mortar of cement and soil (1:8) inside the frame.
- Install water inlet and outlet pipe and fixed it on brick masonry post over laid PE film and other end of the pond. To measure the amount of water to be discharge from tanks 'V'-notch weir can be used.
- Drainage channel all along the border of the field is formed according to the gradient/slope to lead water to the pond.
- Live grass/ Turf is established on the bunds of the pond to prevent soil erosion

### Cost economics of pond:

Sl.No.	Work components	Pond No 1	Pond No 2
1	Dimension of pond	100 m X 100 m	20 m X 20 m
2.	Bottom dimension	91 m X 91 m	11 m X 11 m
3.	Depth of pond	3 m	3 m
	Slope	1.5:1	1.5:1
4.	Capacity of pond	27950 m <sup>3</sup>	919 m <sup>3</sup>
5.	Excavation and spreading the soil in depressions and on bunds	Rs. 572800/-	Rs. 19200/-
6.	Lining with 500 micron PE film	Rs. 634040/-	Rs. 38830/-

7.	Formation of brick pointing/ frame work (2' x 2') and over laying with cement and soil (1: 8)	Rs. 204500/-	Rs. 38800/-
8.	Labour, fixing, jointing, anchoring etc	Rs. 275675/-	Rs.16875/-
9.	Total cost (Rs)	Rs. <b>1687015/-</b>	Rs. <b>113705/-</b>
10.	Cost per unit (Rs/m <sup>3</sup> )	Rs. <b>60/-</b>	Rs. <b>124/-</b>

**Do's & Don'ts:**

- Site selection must be at appropriate place of water sources
- Cultivable command area should be near the pond.
- Avoid hard rock area, it will be labour expensive and angular projection in dugout pond may damaged the laid films.
- Leveled the excavated pond in order to suppress the angular projection
- The top layer of tank basin sub grade should be compacted to at least 90 % of proctor density by mechanical equipment like vibrocompaction and or by other suitable equipments.
- Any weak and soft spots presents, if presents, shall be removed and replace with compacted fills.
- Standing water or excess moisture in dugout pond should not be allowed for laying of films.
- Films rolls should be packed properly and should be of ISI marked.
- Keep the film rolls in original packing prior to actual use or laying the film
- See the uniform pressure is applied while sealing the film
- Don't rough handle or drag the film rolls as the film may be damaged in the process.
- Don't walk on the film while lining operation is in process to avoid any damage to the film
- Don't slide cover material like bricks, tiles etc. on the film to avoid any damage and displacement.
- Don't use hooks for lifting the rolls of film
- Don't use reprocessed PE film, quality may not be guaranteed and may lead to premature failure of the film.