

# Farm pond:

## Resilient technology for higher productivity in rainfed farming

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*Rainwater harvesting, storage and efficient utilization is important for preparedness for supplemental/pre-sowing irrigation as well as lifesaving/protective irrigation to rainfed crops to mitigate dry spells. Farm pond is one of the effective, simple and relatively low-cost ex situ rainwater harvesting structure at farm level. The network centers of All India Coordinated Research Project for Dryland Agriculture, located across rainfed agroecologies in India, have standardized agroecology specific farm pond sizes based on catchment-command area relationship and also developed methods/measures on various aspects of farm pond, i.e. inlet and outlet structures, seepage and evaporation control losses, and water lifting devices for packaging farm pond technologies. The farm pond sizes have been integrated into various national and state programmes/schemes, and implemented on farmers' fields in various states.*

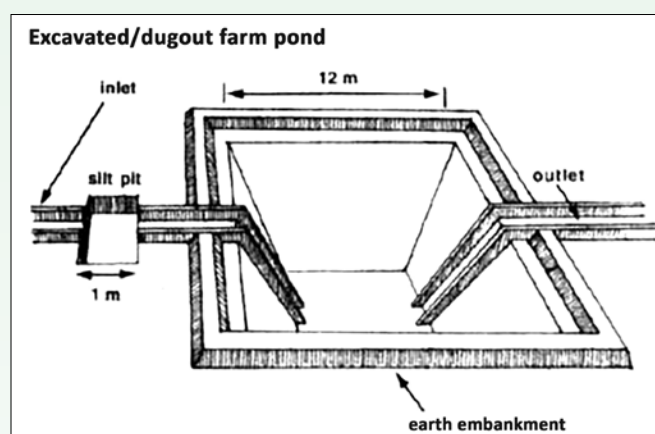
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**R**AINWATER harvesting, storage and recycling serve as both preparedness and real-time response to mitigate impacts of dry spells in rainfed crops. The climate/rainfall variability has resulted in the decrease of rainy days during the cropping season, but rainfall intensity has been increasing. Under this context, rainwater harvesting in the farm pond has got more significance. The central and state governments are promoting the construction of farm ponds under various schemes/programmes.

Farm ponds are constructed for the purpose of storing the surface runoff generated from the agricultural lands/catchment area. The stored water in farm ponds can be used for multiple purposes such as supplemental/protective/pre-sowing irrigation to rainfed and horticulture crops, fodder production, drinking water for cattle, pisciculture and domestic water use. The various aspects of the farm ponds, viz. site selection, pond capacity, inlet and outlet structures, seepage and evaporation control measures, efficient water utilization, lifting devices and pond construction cost are important for farm pond technology.

### Site selection for farm pond

Proper care should be taken while selecting a suitable site for the farm pond construction. Catchment area of



Structural components of dugout type farm pond

the farm pond should contribute the required storage. The site should be located at the lower elevation of the topography to facilitate better storage and less seepage losses. The stored water may flow by gravity and be used preferably for the lower adjoining sides of the pond. Farm ponds should be away from sites where the chances of contamination exist.

### Farm pond capacity

The capacity of farm pond depends on purpose for which water is needed and the runoff available from

the catchment. On the supply side, the pond capacity is basically determined by the surface runoff/water yield available from the catchment area demarcated for the pond. A dependable minimum value of 10–15% of the seasonal rainfall can be expected to go as runoff in case of black soils and 5–10% in case of red soils with mild to medium slopes. On the demand side, the pond capacity is decided by considering the total requirement of water for irrigation, livestock, domestic use, etc. Further, an allowance of 20% is always given to pond capacity towards losses and unprecedented flood situation. Usually one or two supplemental or protective irrigations with a depth of 50 mm or less would be planned from farm ponds for crops at critical growth stages. The network centres of All India Coordinated Research Project for Dryland Agriculture (AICRPDA) have standardized farm pond sizes specific to the agroclimatic zones. The details of agro-ecology specific



Farm pond with measuring device at Raichur (Karnataka)

farm pond sizes and lining material along with water lifting devices are given in Table 1.

**Table 1.** Agro-ecology specific farm pond sizes and lining material along with water lifting devices

| State             | Agroclimatic zone/<br>AICRPDA centre                     | Catchment<br>area<br>(ha) | Pond<br>capacity<br>(m <sup>3</sup> ) | Size of the pond<br>(side slope 1.5:1) (m) | Lining material<br>recommended                                                                       | Water lifting<br>device                              |
|-------------------|----------------------------------------------------------|---------------------------|---------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Andhra Pradesh    | Scarce rainfall zone/<br>Ananthapuramu                   | 1                         | 250                                   | 10 × 10 × 2.5                              | Soil: cement in 6:1/Sand:<br>cement in 6:1 ratio                                                     | 4–5 HP diesel<br>engine pump                         |
| Assam             | North Bank plain zone/<br>Biswananth, Chariali           | 1                         | 528                                   | 21 × 17 × 2.5                              | Cemented/concrete lining in<br>On-station; recommended<br>is polythene sheet lining of<br>200 micron | 0.5 HP centrifugal<br>pump                           |
| Karnataka         | Central, eastern and<br>southern dry zones/<br>Bengaluru | 1                         | 252                                   | 12 × 12 × 3                                | Soil: cement in 6:1 ratio<br>over the LDPE (400 micron)<br>thick sheet                               | 4–5 HP diesel<br>engine pump                         |
|                   |                                                          | 2                         | 516                                   | 16 × 16 × 3                                |                                                                                                      |                                                      |
|                   |                                                          | 3                         | 774                                   | 19 × 19 × 3                                |                                                                                                      |                                                      |
|                   |                                                          | 4                         | 981                                   | 21 × 21 × 3                                |                                                                                                      |                                                      |
|                   |                                                          | 5                         | 1205                                  | 23 × 23 × 3                                |                                                                                                      |                                                      |
|                   | Northeastern dry zone/<br>Raichur                        |                           | 250                                   | 21 × 21 × 3                                | HDPE sheet 500 micron                                                                                | 5 HP diesel<br>engine pump                           |
|                   | Northern dry zone/<br>Vijayapura                         | 1                         | 212                                   | 12.5 × 12.5 × 3                            | 500 micron thick UV<br>stabilized HDPE sheet<br>(HDPE pond liner)                                    | 1.5 HP, low head<br>high Speed diesel<br>engine pump |
|                   |                                                          | 2                         | 417                                   | 16 × 16 × 3                                |                                                                                                      |                                                      |
|                   |                                                          | 3                         | 608                                   | 18.5 × 18.5 × 3                            |                                                                                                      |                                                      |
|                   |                                                          | 4                         | 837                                   | 21 × 21 × 3                                |                                                                                                      |                                                      |
| Maharashtra       | Western Vidarabha<br>zone /Akola                         | 5                         | 1047                                  | 23 × 23 × 3                                | HDPE Geo membrane<br>500-micron thickness                                                            | 3 HP submersible<br>pumpset                          |
|                   |                                                          | 1                         | 370                                   | 18 × 11 × 3                                |                                                                                                      |                                                      |
|                   | Central Maharashtra<br>Plateau zone/Parbhani             | 5                         | 2750                                  | 45 × 27 × 3                                | Polythene sheet lining of<br>500 micron                                                              | 1.5 HP diesel<br>engine pump                         |
|                   |                                                          | 1                         | 741                                   | 20 × 20 × 3                                |                                                                                                      |                                                      |
|                   |                                                          | 2                         | 1285                                  | 25 × 25 × 3                                |                                                                                                      |                                                      |
|                   |                                                          | 3                         | 1946                                  | 30 × 30 × 3                                |                                                                                                      |                                                      |
| Madhya<br>Pradesh | Scarcity zone/ Solapur                                   | 1                         | 975                                   | 30 × 30 × 2                                | HDPE Geo membrane<br>500 micron thickness                                                            | 3 HP electric<br>pump                                |
|                   |                                                          |                           |                                       |                                            | 7 layer geo membrane<br>HDPE Sheet 750 micron                                                        | 2 HP submersible<br>pump                             |
|                   |                                                          |                           |                                       |                                            |                                                                                                      |                                                      |
| Odisha            | North eastern Ghat<br>zone/Phulbani                      | 0.5                       | 380                                   | 20 × 20 × 3                                | Soil: cement (6:1) mortar of<br>8 cm thickness                                                       | 1.5 HP diesel<br>engine pump                         |
| Punjab            | Kandi region/Ballowal<br>Saunkhri                        | 1                         | 696                                   | 22.4 × 13.8 × 2.5                          | Concrete lining (5 cm thick)<br>with bricks                                                          | Solar pump                                           |
| Rajasthan         | Southern zone/ Arja                                      | 2                         | 416                                   | 17 × 16 × 3                                | HDPE Sheet 750 micron                                                                                |                                                      |
| Tamil Nadu        | Southern zone/<br>Kovilpatti                             | 1                         | 487                                   | 25 × 13 × 1.5                              | Rubble masonry                                                                                       | 5 HP diesel<br>engine pump                           |
| Telangana         | Northern Telangana/<br>Adilabad                          |                           | 303                                   | 25 × 13 × 1.5                              | Rubble masonry                                                                                       | 5 HP diesel<br>engine pump                           |
| Uttar Pradesh     | Eastern plain and<br>Vindhayan zone /<br>Varanasi        |                           | 2806                                  | 26 × 21 × 2.5                              | No need of lining                                                                                    | 3 HP diesel pump                                     |

### Inlet and Outlet for farm pond

Inlet is designed as a chute spillway for conveying the runoff into the pond in a controlled manner. The entry section can be designed as rectangular broad crested weir. In case of small and medium size capacity farm ponds, the pipe inlets may also be used, which are relatively cheaper than the broad crested waste weirs and are easy to construct. In Karnataka, under the *Krishi Bhagya* scheme, for most of the ponds, reinforced concrete pressure (RCC) hume pipes have been used as inlets.



Farm pond with chute inlet spillway in Parbhani, Maharashtra

These are economical and advantageous to go in for an inlet cum-outlet structure wherever topography permits. When it becomes necessary to separate the two, the outlet is constructed as a rectangular or square channel or a pipe. This outlet position will be a little lower (15–20 cm) than the elevation of the inlet to avoid backing up of the water. The discharge capacity of the outlet can be assumed to be half as that of the inlet capacity at peak rate of runoff.

### Seepage control measures

On account of permeable nature of murrum/gravel strata underneath, especially in shallow to medium deep soil, 50–70% quantity of water is being lost through seepage and evaporation. The typical approach for seepage control is lining the pond. Nowadays, plastic sheet/film materials are extensively used, as these sheets readily adjust to the sub grade settlement and are highly impermeable. Among the different lining materials, the

polythene sheets (500-micron thickness) are extensively used, because they are relatively cheap, compared to the permanent and most effective lining materials such as brick, cement and masonry. Moreover, polythene sheets are easy to procure and lay in very short time. For the longevity of the polythene lining material, it should be ensured that all the time the water should be available in the pond. Various plastic/film materials like PVC, LDPE, HDPE, geo-membranes, LLDPE, silpaulin and geosynthetic clay liner (GCL) with different thickness/gauge of the sheet and locally available lining materials, viz. stone slabs, impermeable soils, cement/concrete, bricks and various proportions of soil: cement ratio with different thicknesses, and bentonite were evaluated at various centres, under the AICRP on dryland agriculture. The studies conducted on seepage control measures at Arjia centre, Rajasthan revealed that the lining with cement concrete + 750 micron thick polythene performed better than the other sealant materials, followed by lining with 500 micron thick polythene sheet, which is far cheaper than the former one. The studies conducted at Bengaluru centre revealed that geo-synthetic clay liner is most effective and cheapest among other sealant materials.

### Evaporation control measures

After seepage, a major portion of the harvested water is lost in the form of evaporation and this problem is more severe in the semi-arid and arid regions. The locally available material (neem oil, sawdust, groundnut shell, paddy husk, bamboo mat, etc) along with some safe chemicals (silicon oil, cetyl alcohol, stearyl alcohol and polyvinyl alcohol, etc) were evaluated at various AICRPDA centres for their efficacy. In addition to the above, various floating materials like floating rubbers and thermocols as well as biological materials like algae and water hyacinths may also be used for evaporation control. The evaporation retardant experiment was conducted for three years from 2016–17 to 2018–19 at Vijayapura centre. Among the chemical retardants, stearyl alcohol performed better with 46.2% reduction in evaporation over control. It was followed by neem oil, where the evaporation reduction was 33.8%. It was found that application of stearyl alcohol @10 mg/m<sup>2</sup> at an interval of 10 days was also effective. Similar studies were also conducted at Parabhani centre, Maharashtra,



Farm pond lining with sand: cement (6:1) in scarce rainfall zone, Andhra Pradesh



Concrete lining (5 cm thick) with bricks, Kandi region, Punjab

where application of cetyl alcohol @20 mg/m<sup>2</sup> at an interval of 10 days was found to be effective in controlling evaporation.

#### Efficient use of stored water in farm pond to increase the water productivity

The water productivity of the harvested water could be increased by using appropriate micro irrigation method. In case of sprinkler, apart from standard sprinkler, according to pump capacity and water availability, the micro and pop-up sprinkler may also be used. Further, the rain pipes are getting popular in northern Karnataka, which are efficient, cheap and need less head than the sprinkler irrigation, which may be tried for the irrigation. In case of drip, when farm pond water is used for the irrigation, there is a chance of clogging of drippers. Hence, for the turbid water, a special type of emitter may be adopted (some irrigation companies have come out with a design). Further, where it is compelled to use the surface method of irrigation, then alternate furrow and flow cutoff at 80% of border strip length may be followed. One or two supplemental irrigations of 5 cm depth through sprinklers using the stored water in farm pond increased the yield of rainfed crops/intercropping systems in rainy (*kharif*) and winter (*rabi*) season up to 74.4% as compared to no supplemental irrigation.

It is recommended to provide life-saving irrigation, when a long dry spell of 20–25 days persists. Supplementary irrigation may also be given at the various critical stages of the crops to boost the yield. The depth of water to be applied depends upon several

in the remote areas, where electricity is not available.

ICAR-CRIDA, Hyderabad recommended the low head (4 m), high speed (3000 rpm), light weight, low cost and fuel efficient (1.5–2 HP) petrol start diesel engine pump for small to medium size farm ponds, from which 6–7 sprinkler heads could be operated with in a sprinkler radius of 10–12 m. Further, low head surface solar pumps (1.2 HP) with the panel capacity of 1 KW are available. The pump capacity of 0.5 HP with the ground mounted solar panel system and float type platform for mounting the pump for compensating suction heads are suitable for small and marginal farmers. Because of the advancement in the solar energy technology, nowadays, submersible surface pumps and DC to 3 phase AC energy convertor are also available, which are more efficient, as using them 8 sprinkler heads could be operated. Such pumps were successfully tested at Vijayapura centre, Karnataka. For 1.2 HP pumpset, the total cost is 1.6 lakh, out of which some state governments are giving subsidy and some banks are also advancing the soft loans to the farmers.

#### Cost aspects of the farm pond

The structural components of the farm pond are pond excavation, dressing of bunds, inlet and outlet construction, lining of pond and silt trap construction. The cost varies on the basis of the selection of inlet and outlet types and the lining material. The major cost of the pond involves in the laying of the lining to the pond. The cost of various structural components of farm pond of capacity 488 cum (17 m × 17 m × 3 m), which was constructed in 2021 on farmer's field in the OFR (On-farm research) adopted village by Vijayapura, Karnataka was ₹29,783 (21%) in excavation, ₹57,200 (41%) in farm pond lining (500 micron thick HDPE liner) and ₹45,574 (33%) in inlet and outlet structure.

#### SUMMARY

Rainwater harvesting and efficient utilization is crucial not only for better performance of rainfed crops but also for higher productivity, profitability and sustainability of rainfed production systems. In rainfed areas, due to the climate/rainfall variability, rainy days during cropping season are decreasing and rainfall intensity is increasing. To address this, standardizing agro-ecology specific farm pond sizes and packaging farm pond technology for efficient utilization is very important. The standardized farm pond designs by AICRPDA centres have been integrated and implemented on farmers' fields through various national and state schemes such as RKVY, PMKSY, watershed programmes, PoCRA in Maharashtra; Krishi Bhagya Scheme in Karnataka; Panta Sanjeevani scheme in Andhra Pradesh etc. There is a need to further scale out farm pond as a resilient technology by converging with various national, state and district schemes to achieve agricultural sustainability and livelihood security in rainfed areas.

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Sprinkler operating from solar pump at Vijayapura, Karnataka

factors. When one/two supplementary irrigation has to be given during the long dry spells through surface irrigation, then depth of water should not be less than 5 cm. However, when it is given through the sprinkler irrigation, it should not be less than 3 cm. At various centres, about 30–75% increase in yield was observed by giving one/two supplementary irrigations.

#### Water lifting devices

The lifting of the water from the farm pond is a major challenge, because in most of the cases, ponds are located