

PHILIPPINE NATIONAL STANDARD

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ICS 65.060.35**

Rainwater and Runoff Management – Small Farm Reservoir



BUREAU OF AGRICULTURE AND FISHERIES STANDARDS

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Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled “Enhancement of Nutrient and Water Use Efficiency Through Standardization of Engineering Support Systems for Precision Farming” funded by the Philippine Council for Agriculture, Aquaculture and Forestry and Natural Resources Research and Development - Department of Science and Technology (PCAARRD - DOST).

As provided by the Republic Act 10601 also known as the Agricultural and Fisheries Mechanization Law (AFMech Law of 2013), the Bureau of Agriculture and Fisheries Standards (BAFS) is mandated to develop standard specifications and test procedures for agricultural and fisheries machinery and equipment. Consistent with its standards development process, BAFS has endorsed this standard for the approval of the DA Secretary through the Bureau of Agricultural and Fisheries Engineering (BAFE) and to the Bureau of Philippine Standards (BPS) for appropriate numbering and inclusion to the Philippine National Standard (PNS) repository.

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word “shall” is used to indicate mandatory requirements to conform to the standard.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

Rainwater and Runoff Management – Small Farm Reservoir

1 Scope

This standard specifies the minimum design requirements of a small farm reservoir.

A small farm reservoir shall be defined as a system consisting an earth dam to trap, harvest and store rainfall and runoff with an embankment height of less than 5 m. It has a pond area of about 1500 m².

2 References

The following normative documents contain provisions through which reference in this text constitute provisions in this National Standard:

PNS/BAFS/PAES 217:2017 Determination of Irrigation Water Requirements

3 Definition**3.1****designed height**

actual height of the embankment after settlement

3.2**finished height**

height of the embankment to be attained during construction

3.3**freeboard**

additional height of the dam provided as a safety factor to prevent overtopping by wave action or other causes

3.4**inside slope**

slope of the upstream face of the embankment

3.5**outside slope**

slope at the downstream face of the embankment

3.6

storage ratio

ratio of the storage capacity to the total earth volume required for embankment construction which indicates the relative cost of the different types of reservoir

3.7

unimodal rainfall pattern

rainfall pattern with five wet months of more than 200 mm/month, five dry months of less than 100 mm/month, two transition months of 100mm-200mm/month and total annual rainfall above 1500 mm.

4 Main Components

The main components of a small farm reservoir are shown in Figure 1.

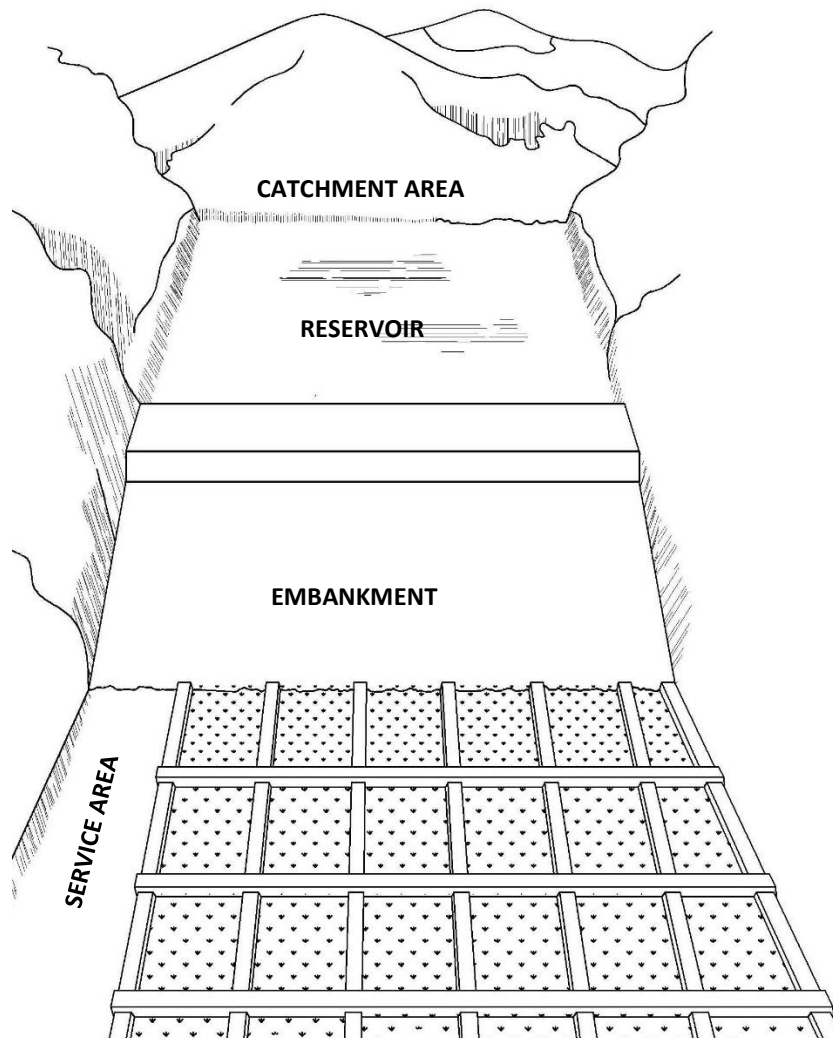


Figure 1. Main Components of a Small Farm Reservoir

5 Types

The shape of the reservoir to be constructed shall be based on local topography while the size shall be based on the required storage capacity and financial availability. Figure 2 shows the different types of reservoir while Table 1 summarizes the description, suitable slope and storage ratio.

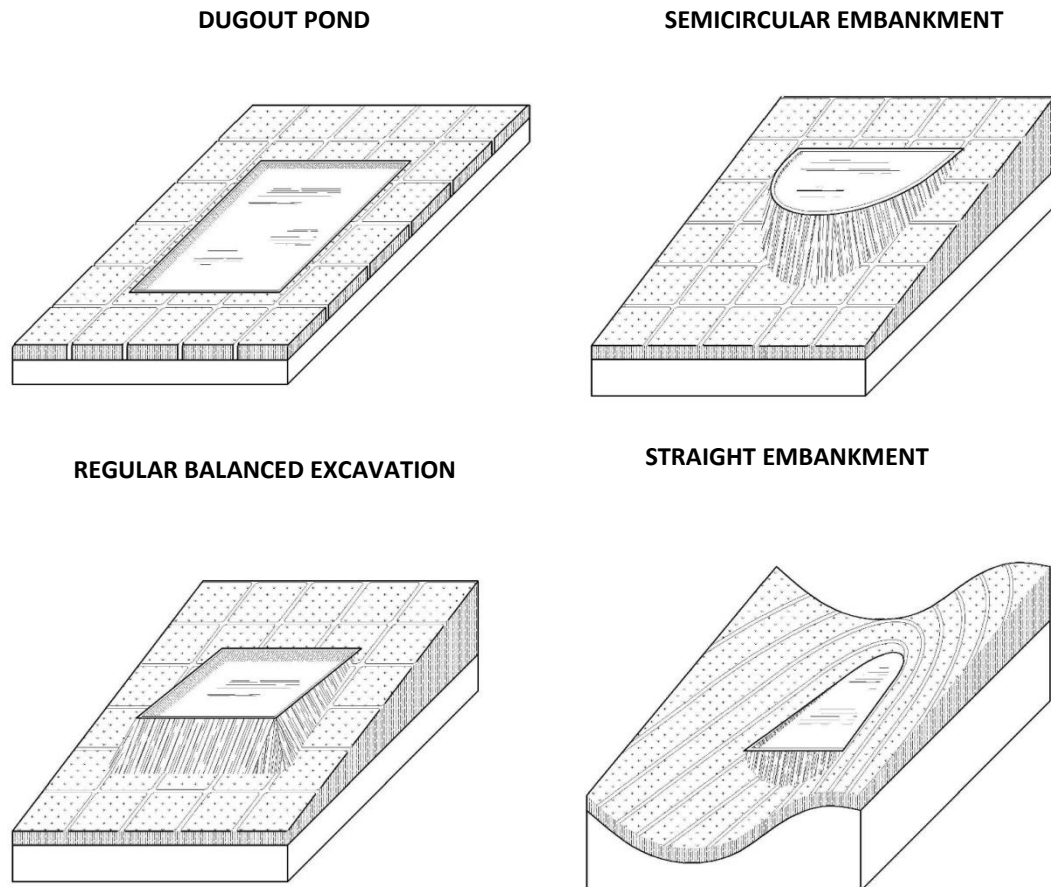


Figure 2. Types of commonly used on-farm reservoir

Table 1. Basic types of small farm reservoir

Type	General Description	Slope (%)	Storage Ratio
Straight Embankment	Suited to an area with an undulating topography. A dam is built across a valley and water is impounded on the upstream side of the dam.	2-15	2-7
Rectangular Balanced Excavation	On slightly sloping land, the excavated earth can be used to impound some water above ground level.	< 2	1.5-2.5
	On higher slopes, it can be designed so that all water is stored above service level.	2-12	1.5-2.5
Semicircular Embankment	Water is impounded against the slope behind a semicircular embankment.	4-7	2.5-4.0
Dugout Pond	The only designed suited to flat areas. A reservoir is constructed by excavating the earth leaving storage space that can be filled with water. Water is stored below the ground level and pumping is required to draw out water.	flat	1.0

6 Site Selection *Site Requirements

6.1 The reservoir shall be located in areas with slope 0% to 15%. It is most suited in areas with undulating topography.

6.2 Sufficient amount of embankment should be available in the site.

6.3 The soil texture within 1.5 m of the soil profile shall be loam, sandy loam, clay loam or sandy clay loam. Refer to Annex G of PAES 002:2013 for the determination of soil texture.

6.4 Peat soils, heavy clays, saline, alkaline, or sodic soils shall be avoided.

6.5 The catchment area should have a unimodal rainfall pattern to accumulate sufficient amount of water.

6.6 The reservoir and service area should be owned or tilled by the same farmer otherwise, there shall be a mutual agreement between parties.

6.7 The area shall not be covered by any other existing national or communal irrigation system within the next three years.

6.8 Construction equipment should be available however; manual construction can be opted for if labor is sufficiently available.

6.9 The farmer shall have willingness to establish the system and sufficient funds should be available.

7 Preliminary Design Activities

7.1 The reservoir area with high storage ratio shall be located.

7.2 The most appropriate reservoir design shall be selected based on the topography.

7.3 The soil profile in the reservoir site (1.5 min depth) shall be analyzed.

7.4 The potential reservoir capacity shall be computed using the formula:

$$Capacity (m^3) = \frac{Surface\ area (m^2) \times Depth (m)}{3}$$

For dugout pond design,

$$Capacity (m^3) = Surface\ area (m^2) \times Depth (m)$$

7.5 The existing land use and size of the catchment area shall be determined. The catchment area should be considered adequate to provide sufficient source of runoff based on Table 2.

Table 2. Minimum size of catchment area Per 1000 m² reservoir capacity

Land Use	Size
Terraced	0.2-0.5 ha
Grassland/Residential	0.6-1.0 ha

7.6 If there are deviations in the actual and estimated values of the catchment area, the following measures can be done:

- Increase the catchment area by lowering the location of the reservoir on the farm which in effect will reduce the service area
- Reduce the reservoir capacity proportionately

7.7 An engineering survey shall be conducted to plan the system and locate the components as shown in Figure 3.

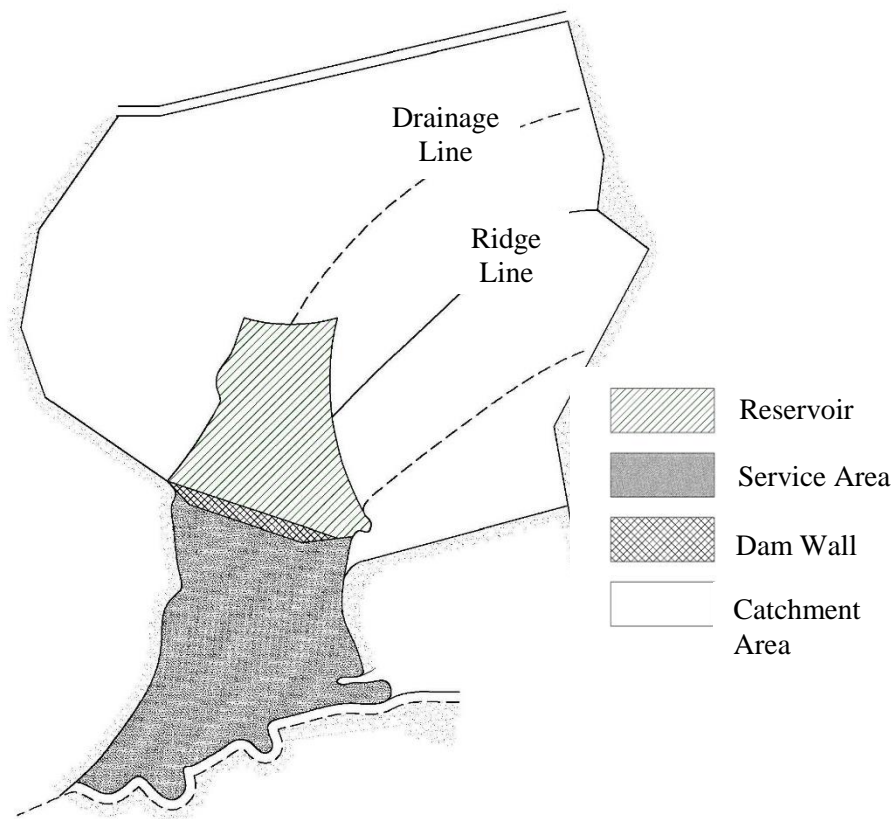


Figure 3. Location of SFR components

8 Design

8.1 Figure 4 shows the cross-section of the embankment.

8.2 The finished height (H') should be 20% higher than the designed height (H) to provide allowance for the settlement of the embankment.

8.3 The inside slope (IS) shall be equal to 3:1 ($H:V$) while the outside slope (OS) shall be equal to 2:1.

8.4 The width of the crest (B_t) can range from 2m to 3m.

8.5 Diversion channels shall be provided so that water in excess of storage requirements, or which contains a high concentration of sediments or toxic chemicals, can be directed past the reservoir.

8.6 The depth of the diversion channel shall be at least 0.75 m and the width shall be twice the depth or wider.

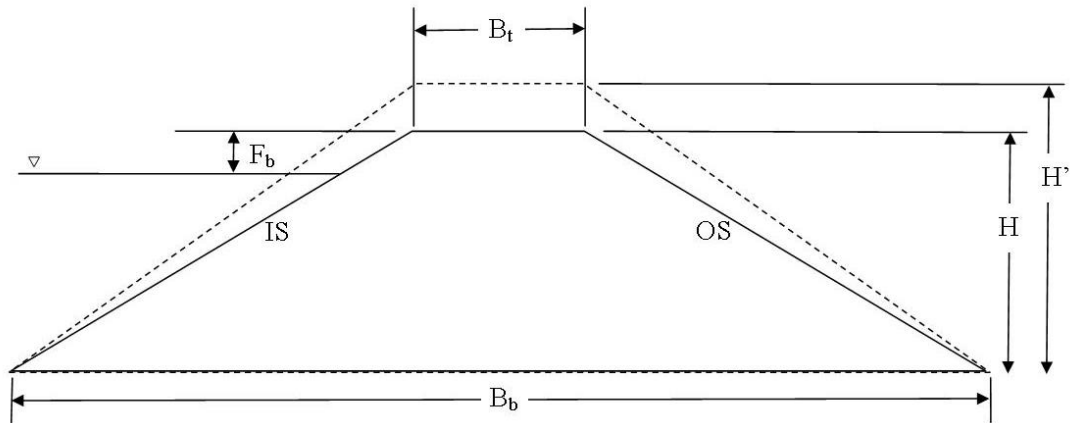


Figure 4. Embankment cross-section

9 Operation

9.1 Water collection and storage

9.1.1 Wet season runoff, which carries a high volume of sediment, shall not be allowed in the reservoir.

9.1.2 In case of a dugout pond, excavated soil shall be placed around the reservoir so that runoff can only enter at the inlet.

9.2 Water abstraction

Water from the reservoir can be abstracted using the following:

- Siphon Tube – applicable when the water level in the reservoir is higher than the service area
- Pump - applicable when the water level in the reservoir is lower than the service area
- Hose through the embankment

10 Management and Maintenance

10.1 Embankment and Water Control Structures

10.1.1 Permanent grass cover on the embankment shall be maintained to minimize erosion due to rain.

10.1.2 The grass cover shall be cut regularly to prevent thick cover of tall grasses and shrubs at the downstream face of the embankment. This will prevent rats and mice which may burrow in the embankment and eventually cause undermining of the embankment.

10.1.3 Trees shall not be planted near or along the embankment since decomposing roots leave channels under the embankment which eventually cause undermining.

10.1.4 Diversion structures and inlets shall be examined daily and restored in their original condition by rebuilding eroded parts and cleaning weeds.

10.2 Reservoir

10.2.1 The water surface shall be kept clear of floating vegetation, except for a buffer strip 1m to 2 m wide to help reduce wave erosion of the upstream embankments. Swamp cabbage (kangkong) can be used as buffer strip. It forms an edible mat and trimmings which shall be removed regularly.

10.2.2 Snails (golden apple snail) for human consumption or for animal feed shall not be raised in the reservoir since these will infest the whole farm and will damage rice plants.

10.2.3 The reservoir shall be fenced to prevent livestock from entering as they may damage the embankment and may stir up sediment from the reservoir floor. It is best, therefore, to provide a small wallowing/drinking pond downstream of the reservoir.

10.2.4 The reservoir shall be desilted annually.

10.3 Catchment Area

Table 3 lists some agroforestry practices which can be applied to catchment areas to prevent excessive erosion.

Table 3. Agroforestry Practices for Watersheds

Mainly agrosilvicultural (trees with crops)	
Spatial mixed	-Trees (fuel wood trees and fruit trees in combination with cash crops) -Plantation crop combination -Multistorey tree gardens
Spatial zoned	-Hedgerow intercropping (barrier hedges, alley cropping, also agrosylvopastoral) -Boundary planting -Trees on erosion-control structures -Windbreaks and shelterbelts (also sylvopastoral) -Biomass transfer

Mainly or partly sylvopastoral (trees with pastures and livestock)	
Spatial mixed	-Trees on rangeland or pastures -Plantation crops with pastures
Spatial zoned	-Live fences -Fodder banks

Trees and grasses usually spaced 5-10 m apart vertically at 5%-30% slope collect any soil eroded from the upper portion of contours. Contour barriers or hedgerows are used to collect any soil eroded from the upper portion of contours.

10.4 Service Area

The choice of maintaining the service area shall be determined by the environmental, physical, and socioeconomic issues in the locality. There shall be management flexibility into the chosen cropping system.

11 Bibliography

Philippine Council for Agriculture, Aquaculture and Forestry and Natural Resources Research and Development - Department of Science and Technology. 1993. Manual on Small Farm Reservoir (Book Series No. 137)

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National Standard for Rainwater and Runoff Management – Small Farm
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