Low-cost Water Storage Tank
Modified Thai Jar
Manual

Developed for
USAID/Nepal's
Education For Income Generation Program
(EIG)
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LOW COST WATER STORAGE

Appropriate irrigation technology for smallholder farmers

Modified Thai Jar

Installation Guidelines

CONTENTS

1. INTRODUCTION

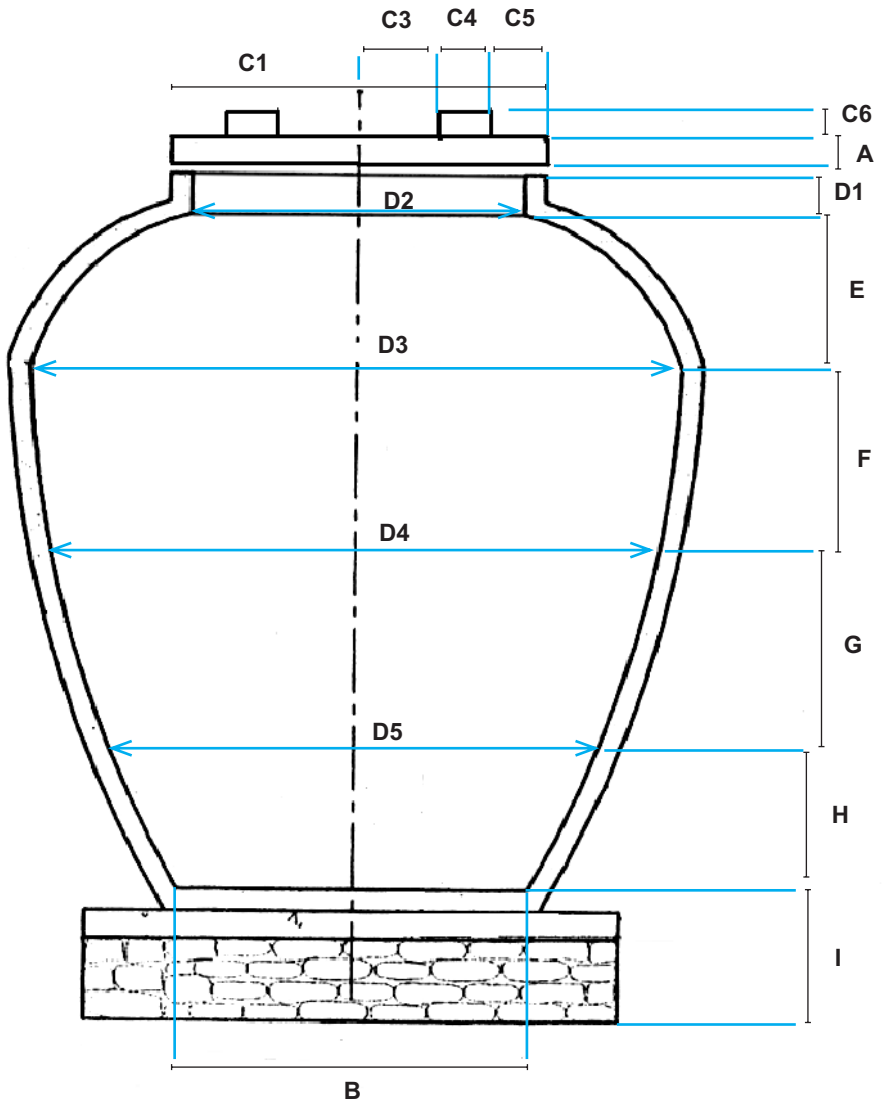
IDE/Nepal spent three years conducting field research in the middle hills of Nepal to perfect the development of several low-cost water tank models. The introduction of these tanks has shown them to be both appropriate and useful for all rural household water storage needs. There are two basic design models – Modified Thai Jar (MTJ) and Ferro-cement Lined tank (FCL) – which range from 1,000-10,000 liter capacity in sizes 1,000, 1,500, or 3,000 liter capacity and can be built either above ground or partially buried. FCL comes in sizes 6,000 or 10,000, is rectangular, and almost fully buried. Any water source can be collected in the tank, depending on the use and quality of water required. Most tanks in Nepal currently collect spring water from upland sources and/or rainwater.

Type: Modified Thai Jar
Capacity: 1000, 1500 and 3000 litres

Type:
Capacity:

These guidelines describe the construction and maintenance process of the MTJ tank and are primarily intended for local masons and construction technicians.

2. DRAWINGS

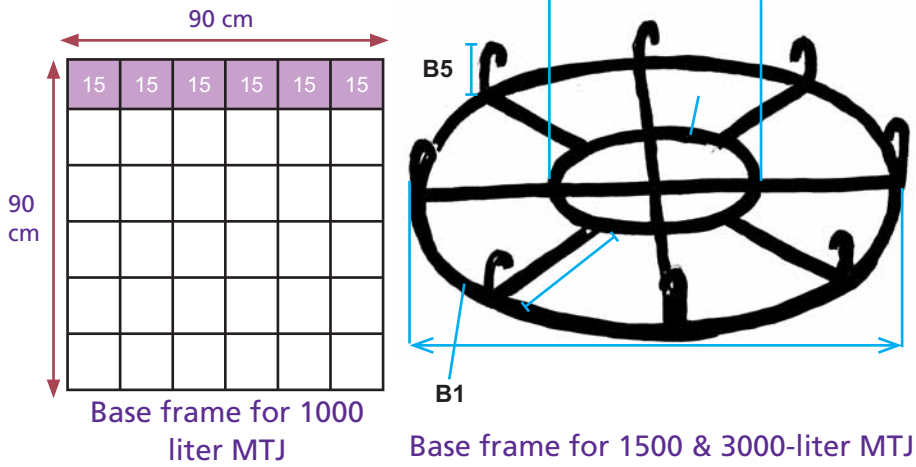


Overall MTJ dimensions

Overall MTJ dimensions

Label	Description	T		
		1000		
A	Cover Height	5		
B	Tank Base	70		
C1	Cover Diameter	70		
C2	Cover Radius	35		
C3	Handle to Center	15		
C4	Handle	10		
C5	Handle to Edge	10		
C6	Handle Height	8		
D1	Neck Height	15		
D2	Internal Neck Diameter	64		
D3	Internal Shoulder Diameter	130		
D4	Internal Waist Diameter	110		
D5	Internal Knee Diameter	90		
E	Neck to Shoulder	30		
F	Shoulder to Waist	33		
G	Waist to Knee	33		
H	Knee to Base	34		
I	Base to Foundation	20		

Note: All dimensions are in centimeters.



Base frame for 1000 liter MTJ

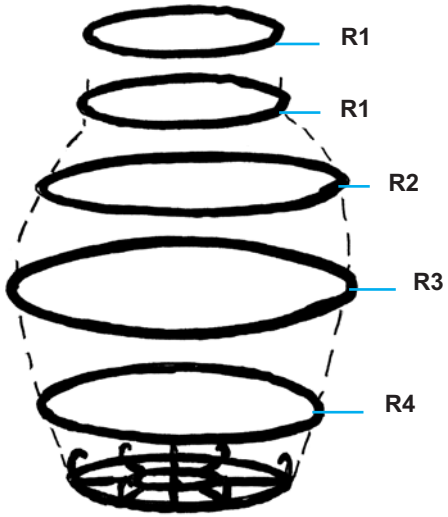
Base frame for 1500 & 3000-liter MTJ

Base Frame dimensions

Base Frame dimensions

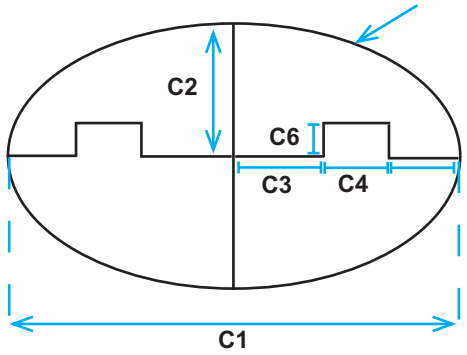
Label	Description	Tank Capacity (liters)		
		1000	1500	3000
B1	Circumference - Outer Ring	The 1000-liter tank has a 90x90 cm base frame with a gabion wire grid of 15x15 cm spacing.	276	402
B2	Circumference - Inner Ring		138	201
B3	Diameter - Outer Ring		88	128
B4	Link Rod between Rings		22	32
B5	Height of Anchor Rod		15	15
B6	Diameter - Inner Ring		44	64

Ring dimensions



Label	Description	Tank Capacity (liters)					
		1000		1500		3000	
		Diameter	Circum-ference	Diameter	Circum-ference	Diameter	Circum-ference
R1	Ring-Neck	67	210	67	210	87	273
R2	Ring-Shoulder	133	418	153	480	193	606
R3	Ring-Waist	113	355	133	418	173	543
R4	Ring-Knee	93	292	113	355	153	480

Cover dimensions



Label	Description			
C1	Outer Ring Diameter			
C2	Outer Ring Radius			
C3	Length Handle to Center			
C4	Length of Handle			
C5	Length Handle to Edge			
C6	Height of Handle			
C7	Circumference of the Ring			

Differences between construction features of tanks

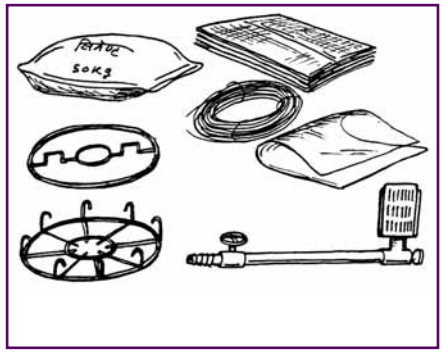
Description	Tank C		
	1000		
Tank Base			
Base Frame	Gabion Wire	Special F	
Tank Body			
Gabion Wire Vertical	No		
Reinforcement			
Two Neck Rings	Yes		
MS Rod Hoop Steel	No		
Binding Wire on the Body	Yes		
Avg. Thickness of Tank Wall	3 cm		
Tank Cover	Same t		

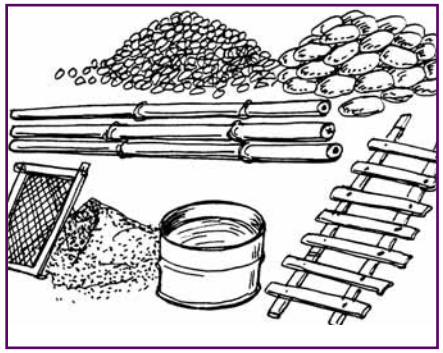
3. TANK COST ESTIMATES

Component	Unit	Rate (NRs)	1000 liter MTJ		1500 liter MTJ		3000 liter MTJ	
			Qty	Total	Qty	Total	Qty	Total
DIRECT CASH COMPONENT								
Cement	Bag	500	2	1000	4	2000	6	3000
White cement	Kg	20	2	40	3	60	4	80
7 mm steel rod	Kg	54	2	108	3	162	5	270
8# Gabion wire	Kg	61	1.5	91.5	2	122	4	244
Chicken wiremesh	m^2	45	1	45	2	90	4	180
Binding wire	Kg	55	1.5	82.5	2.5	138	4	220
Pipe fittings	Set	700	1	700	1	700	1	700
Filter	No.	150	1	150	1	150	1	150
Plastic sheet	m^2	320	0.35	112	0.55	176	1	320
Mason wage	NRs/ day	500	3	1500	4	2000	7	3500
Jute bags	No.	10	8	80	12	120	18	180
Tools	Lump sum	500	1	500	1	500	1	500
SUB TOTAL				**4409**		**6218**		**9344**
NON-CASH COMPONENT								
Stone	ft^3	22.7	2	45	3	68	4	91
Sand	ft^3	28.4	14	397	15	425	20	567
Gravel	ft^3	31.2	3	94	4	125	6	187
Unskilled labour	NRs/ day	200	4	800	4	800	9	1800
Bamboo, rope, water	Lump sum	125	1	125	1	125	1	125
SUB TOTAL				**1461**		**1543**		**2770**
GRAND TOTAL				**5870**		**7760**		**12114**

Note: Above material rates are based on the Kathmandu market price. Prices may vary regionally due to transportation costs.

4. MATERIALS AND TOOLS REQUIRED





Manufactured materials

Tools supplied by mason

T

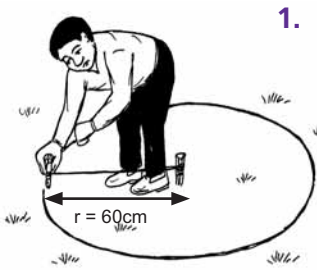
5. CONSTRUCTION STEPS

5.1 SITE SELECTION

Choose a site that has a total area of at least 2 metre X 2 metre and has the following criteria:

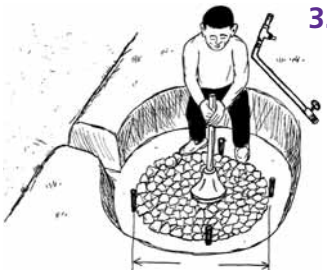
- Convenient to connect from the local water source
- Below the level of the roof and at closest and convenient location if rainwater collection is required
- Stable ground free from threat of a landslide or land settlement
- Not prone to damage by flooding
- Access to area where overflow water from the tank and waste water from the outlet of the tank can be diverted
- Is located a minimum of 2 metres above the crop field (for drip irrigation) or 8 metres (for sprinkler irrigation)

5.2 MAKING THE FOUNDATION

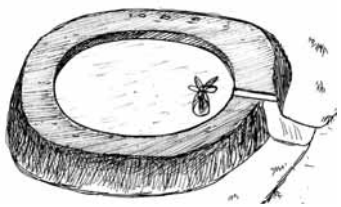


1. With the wooden peg at the centre of the tank site, mark the radius specific to the capacity tank and make a circle for the boundary of excavation for foundation. The radius for each capacity are: 1000-liter tank, 60cm; 1500-liter tank, 70 cm; 3000-liter tank, 90cm.

2. **Earthwork in foundation:** Dig a 45 cm deep foundation trench within the marked circle.



3. **Stone soling and compaction:** Set the area for the stone soling and laying the concrete floor by marking a circle with a 50 cm radius. Then lay dry stones in the foundation and compact them with iron rammers until they have a thickness of approximately 15 cms.



4. **PCC work & fixing pipe fittings:** After sufficient compaction of the stone, lay 5 cm thick plain cement concrete (PCC) with a ratio of 1:3:6 cement, sand, and gravel. Set the outlet pipes and fitting of the tank during the concreting process.

5.3 FORMWORK SETTING

1. **Assembling the pieces:** the pieces of formwork (mould) of the tank together to make the tank shape. Each numbered piece must be assembled in ascending order to ef the formwork. For the 1000-liter tank, this step includes attaching the base frame.

2. **Wrapping with jute:** surface of the assembled mould with jute material (burlap). In doing this, make sure that the outer surface is firm and any wrinkles are smoothened.

3. **Tying with binding wir** wire around the entire vertical surface of the mould in a spiral fashion. The spacing between two adjacent wires must be 2-3 cm.

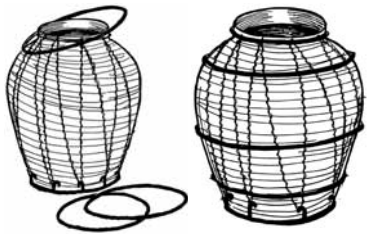
1000-liter tank

1500 & 3000-liter tanks

4. **Placing the formwork on the base:** After attaching the binding wire, check the formwork for accuracy Smoothen the wrinkles and undulating portions of the exterior surface of the mould. For the 1000-liter tank, lay the mould on the PCC floor of the foundation. Check the formwork to make sure it is completely vertical and then set it in a fixed position. For 1000-liter tank construction, skip to section 5.4. For the 1500 and 3000-liter tanks, place the formwork on the MS rod special base frame.

5. **Placing the neck rings:** For the 1500 and 3000-liter tanks, insert the two neck rings from the top and secure them in position with the binding wire.

6. **Tying the Gabion wire:** For the 1500 and 3000-liter tanks, tie Gabion wire vertically along the tank, attaching it to the neck rings and base hooks in an alternating pattern.



7. **Inserting middle rings:** For the 1500 and 3000-liter tanks, insert the three remaining rings in their respective positions, as designated in the dimensions table and diagram for rings in Section 2.

5.4 FINISHING THE OUTSIDE SURFACE

The steps below outline the procedure for finishing the outside surface of the tank.

1. **Preparing plaster for first coat:** Mix cement and sand in a ratio of 1:3 (cement: sand) to create the cement mortar mixture that will be used in step 3.

2. **Spraying cement powder:** Make the jute cover wet by spraying it with clean water. Apply 1:5 ratio net cement slurry. Then spray a light layer of cement powder by hand over the entire surface of the jute mould.

3. **First coat of plastering (r finishing):** Immediately after spraying the cement powder begin application of the first coat of plaster over the jute surface. Plaster from the top of the mould and work your way towards the bottom, making sure that this layer of plaster has a rough finish. W 4-6 hours for the coat to dry

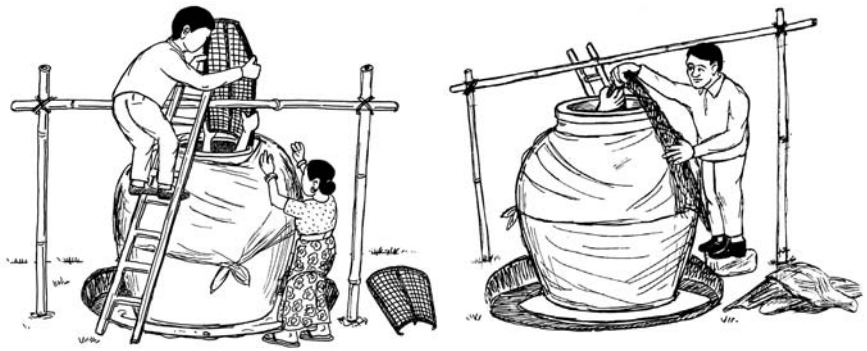
4. **Second coat of plastering:** waiting 4-6 hours, again mix cement and sand in a ratio of 1:3 (cement: sand) to create cement mortar Finish the outer surface with a second coat of cement plaster

5. **Toe concrete:** gravel in a ratio of 1:2:4 (cement: sand: gravel) to make plain cement concrete. On the outer surface of the bottom part of the tank, place a layer of the concrete to enhance the strength of the tank.

6. **Covering / Curing:** with a polythene sheet and allow it to set for at least 10 hours.

5.5 FINISHING THE INSIDE SURFACE

1. Removal of formwork: After sufficient setting of the outer plaster, the mould materials have to be removed. Climb inside the tank and remove the locks connecting the metal pieces. Once the locks are removed, pull the pieces of the formwork out of the tank interior. Then, remove the jute blanket. The removal of the formwork has to be performed very carefully because any shocks or disturbances can result in cracks in the plaster.



2. Inside plastering: Once the formwork and jute covering are removed, clean the entire interior surface with a soft brush and thoroughly remove dirt. Mix cement and sand in a ratio of 1:2 (cement: sand). Apply a coat of the cement sand plaster both on the inside wall and the bottom of the tank. Let the plaster layer dry for 10-15 hours.

3. Slurry painting: 10-15 hours after inside plastering, mix 3 kg of cement in 9 litres of water to make a net cement slurry. Paint the interior surface of the tank with the slurry. It is recommended to provide two layers of cement slurry, each about 2 mm in thickness, for better sealing of any hair cracks that may have occurred.

5.6 MAKING THE TANK COVER

1. Fixing wire mesh: Use 6 mm steel rod to prepare a skeleton of the cover according to the dimensions in Section 2, including two small handles.

2. Application of cement mortar: meter X 1 meter polythene sheet on solid ground. Lay the steel skeletal frame with the wire mesh over the polytehene sheet. Make cement sand mortar of 1:3 ratio (cement: sand). To pour the cement sand mortar on the steel frame and level it.

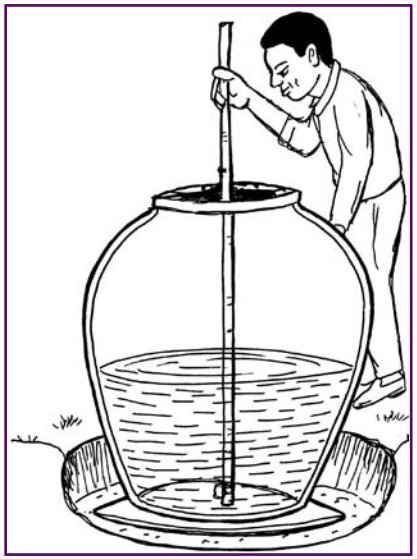
5.7 CURING

Curing of cement elements is the process of preventing fast dehydration of the structure which will negatively ef strength attainment. The common way of curing is to cover the structure and keep it moist for afew weeks after construction.

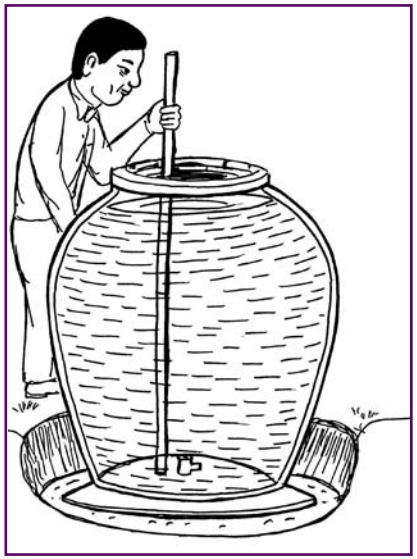
After completion of tank construction, it must be kept moist for at least one week to properly cure it. It is recommended to cover the tank with the jute material previously used in mould preparation to hold in moisture.

5.8 LEAK TEST

To test for leaks, water is filled into the tank to two different heights and the vertical height of the water column is measured.



Half-full leak test



Full tank test

1. Half-full tank test: One week after the completion of the construction, fill the tank half full. Measure the initial height of water. Cover the tank to prevent evaporation and leave it for 24 hours. Then measure the height of the water again. If there is an decrease of water depth, locate the point of the leak and seal the leak using cement plaster.

2. Full tank test: If the tank is found free of leaks in the half-full test, fill it with water up to the top and perform the same leak test procedure again.

5.9 PAINTING

Once the tank has been fully tested, paint the outer surface of the tank with 2 or 3 coats of white cement. DO NOT use dark color paint because it will absorb heat and create temperature stress on the tank. Temperature stress is a serious concern for this type of tank.

5.10 BACK FILLING

Once the tank is finished and has been tested for leaks, backfill the foundation with earth and compact it to stabilize. It is suggested to provide turf or stone pitching along the periphery of the tank. Make sure to provide an area for drainage water around the tank by making a surface drain with an adequate slope for diversion of water to gullies or crop fields.

6. MAINTENANCE AND REP

6.1 CLEANING

The tank must be cleaned at least once per year the amount of deposited sediments, it may need more frequent cleaning. Tanks need to be cleaned whenever the height of the sediment deposit exceeds 5 cm and approaches the outlet height. It is recommended to clean the tank during pre-

monsoon and post-monsoon months. Two people are required for tank cleaning. Fill the tank with water to a depth of 30 cm. Use a wooden stick to create turbulence with the sediments in the tank. Open the washouts and gate valves and drain the dirty water. Continue this process until the tank is completely clean. Upon completion of cleaning, close the washout and outlets.

6.2 LEAK REPAIRS

1. Identifying leaking spot: To identify leaky spots, regularly check for moisture on the outside surface of the tank.

Identifying leaking spot

2. Creating a hole: If a leak is found, use a chisel to create a hole with a 5 cm radius around the crack.

Creating a hole

3. Plastering: Cover the hole with chicken wire mesh and then apply cement sand plaster of ratio 1:3 from both sides of the hole to the equal thickness of the plaster wall around the hole. On the next day apply one more coat of net cement slurry from both sides.

Plastering