Acknowledgement

Author

Mr. Arumugham Kalimuthu, B.E, M.Sc (London), MBA,
WASH Institute
New Delhi

Edited by

Mr. Sampath, B.E.,
WASH Institute, New Delhi.

Mr. S. Ramesh, M.Sc. (Environmental Science),
WASH Institute, Kodaikanal.

Book Review and Feedback

Mr. L. Peter, Executive Secretary
Rural Education and Action for Liberation, Dindigul

Mr. Balaji Soundarajan, Technical expert, WASH
World Vision India.

Book Design

Tacto Graphics, Dindigul. www.tactographics.co.in

First Edition September, 2016

No part of this book may be reproduced in any form without
the written permission from WASH Institute
Foreword

Though water is essential for human lives, it is one of the most under-prioritised but over-abused commodities. ‘Water is central to our lives but has not been a central point of focus in our planning while we rapidly evolve into an urban society. Over time, early societies understood the importance and need for water and planned their lives around it. Civilizations were born and lost on account of water. Today, we have the advantage of this knowledge but we still fail to value it and build our societies around it. Water scarcity is mostly man-made, due to excess population growth and mismanagement of water resources and the problem has been compounded with increased urban development that has choked both surface and ground water resources.

The vision for World Vision's Water Sanitation & Hygiene (WASH) programme is that “Every child would have sustainable and dignified access to gender and disabled friendly sanitation & safe water”; and that every community would practice appropriate hygiene behaviour. This document would serve as a guide for developing and managing standardized and affordable water facilities.

It is imperative to have uniform standards and well defined processes in place to ensure good maintenance of water facilitation systems, with appropriate operational plans for their sustainability. The manual – “India Mark II Hand Pump Installation & Maintenance Manual” – is prepared to support this endeavour. It provides guidance for standardization of operations and maintenance of all water facilities with a special focus to bore well/tube well installations in all our Programs. It is primarily meant for area programs (goal owner), WASH teams, project management consultants and other key stakeholders involved in planning, designing, implementing and monitoring of WASH Programs at all levels. The manual can also be used by external readers and trainers as a guidance note for standardised implementation of water facilities.

For further information contact:

- WASH Technical Specialist:
- Balaji S. – Infrastructure Specialist
- Mahesh Nathan – Head, WASH

Cherian Thomas
National Director

The Societies begin no. 43 of 27 March 1996

World Vision is a Christian humanitarian organization working to create lasting change in the lives of children. Beliefs and communities bring a poverty and injustice.

World Vision serves all people regardless of religion, race, sex, disability or gender.
Handpumps are water lifting devices that are operated manually and used extensively as a primary drinking water source in most part of the country, especially the villages in India. Any breakdown of the hand pump is seriously affecting the continuous supply of drinking water in the area. Proper maintenance of the hand pumps is crucial to sustain the drinking water supply.

“This booklet aims at guiding the caretakers to have a better understanding about the hand pumps, their operation and maintenance.”
Types of Hand pumps

PHC 6

Most commonly used hand pump in high water table area is PHC 6. PHC 6 works with the principle displacement pumps. The piston is fitted with the piston valve which is a non-return valve and move vertically up and down within a cylinder assembly. The cylinder assembly is fitted with a foot valve which is also a non-return valve. Operating the handle of the PHC6 pump causes vertical movement of the pump or connecting rod that are connected to the piston and draws water to the delivery pipe up. In general, a shallow pump can lift water up to 40 to 60 feet deep from the ground level.

India Mark II

India Mark II hand pump is used widely in the country and the pump is used to draw water up to 100 feet deep. It can be installed in 100/150 mm diameter bore wells. The components of the hand pump can be divided as above-ground and below-ground mechanism. The above-ground mechanism comprising of raiser main/pipe, connecting rods and cylinder assembly. Major components in the cylinder (below-ground mechanism) are cylinder body, upper reducer cup, lower reducer cup, upper valve or piston, lower valve. In general, the pump should yield 12 liters of water for every 40 strokes.
Types of Hand pumps

India Mark II Extra Deep well pump

In case the water level is over 100 feet deep, India Mark II Extra Deep well Pump can be used and this pump is designed to lifting water up to 180 feet deep from the ground level. The down-hole components exist of a brass lined cast iron cylinder and the brass plunger has a triple cup seal of Nitrile rubber. The rising main is 32 mm dia GI pipe and the pump rods are of galvanised steel. This pump is not corrosion resistant and hence this should not be used where pH value is less than 6.5.

In case the static water level is over 180 feet deep, it is advised to use power operated pumps for lifting water.

Types of Hand pumps

India Mark III

The configuration of India Mark III and II are similar, only the “down-hole components” were changed in India Mark III in order to ease the maintenance at village level. The most important improvement in India Mark III is “open top cylinder”, which helps remove the plunger and also the foot valve without lifting the cylinder and the entire rising main/pipe. Components of India Mark III are pump head, handle, water tank, pump stand and pump rods are made of galvanized steel, rising main of galvanized GI pipe, pump cylinder cast iron / brass, plunger and foot valve of brass. This pump is not corrosion resistant and should not be used in aggressive water (pH value < 6.5).
Part of the India Mark - II Hand Pump
The mostly used pump in India for drinking water

India Mark II Hand Pump installed in a bore well

Part of the India Mark - II Hand Pump
The mostly used pump in India for drinking water

India Mark II Hand Pump Cylinder

[Diagram of pump components: Pump head, Handle, Head flange, Water tank, Top flange, Pump stand, Cement/Platform, Ground, Casing pipe, Socket, Rising main, Pumprod, Plunger, Cylinder, Check valve, Suction pipe, Riser pipe, Reducer cap, Sealing ring, Plunger rod, Plunger assembly, Cylinder, Brass liner, Check valve assembly, Sealing ring, Reducer cap]
The most important aspects of hand pump installation is providing a proper platforms for the pump. No or improper construction of platform leads to quick wear and tear of hand pump and also potential threat for water contamination. Hence, whether hand pump is shallow or deep, construction of platform is must. The platform should consist long drainage arrangements as shown in the technical drawing.

The spillage water from the hand pump should be safely disposed by constructing a soak pit as given in the drawing or the waste water can be diverted to a garden. The diverting water to the garden not only helps to dispose the wastewater but also helps to generate income from the produces, which can be utilised for the maintenance of the hand pump.
Site Selection

1. Location must be accessible to all people in a village or locality.
2. Easily approachable area by the users in all seasons.
3. Approachable location for drilling machine
4. Comparatively elevated area where water logging / flood does not occur.
5. Enough space available for construction of platform and drainage.
6. Scientifically investigated bore well point by considering the geological formation and aquifer systems.

Hand pump should not be located at places near: unlined drains, latrine pits, big trees and below electric lines.

Chlorination

Chlorination needs to be done after construction of platform but before installing the hand pump head. 300 grams of bleaching powder should be thoroughly mixed with 15 litres of water in a bucket and pour the solution into the borehole. (The quantum of bleaching powder is recommended from 150 to 200 grams maximum per cubic meter of water). Allow it for 6 hours before pumping water for usage. If the yield of bore well is not tested, chlorination must be done at least after monsoons. However, it is recommended to chlorinate, when total coliform bacteria are found to be present in the water, after pump repairs, when drinking water tastes or odours change and as part of the annual maintenance.

Do’s

- Keep the hand pump platform and its surroundings clean and hygienic.
- Construct soak pit/Kitchen Garden to drain the spillage water from the hand pump safely.
- Keep animals away from the hand pump
- Ensure no water stagnation around the hand pump.
- Every 15 days, ensure CGT* (Checking; Greasing; Tightening)

Checking

- The pump pedestal is firm on its base without shaking. If it is loose arrange for fresh foundation by reporting it to higher authorities
- Water discharge is satisfactory whether it is usual, little or delayed
- The handle is easy or difficult to operate
- All eight flange bolts and nuts are tight,
- The handle axle nuts and chain bolt and “Nyloc” nut are tight,
- Check whether there are holes or cracks in pump platform
- Check whether the platform, drainage, pump surroundings are neat and clean.

* For conducting CGT - the respective projects / ADP's with the help of WASH specialists will identify local agencies and orient them on the same. Training on CGT will also be given to the participants during the Mother’s group training and to the members of Hand pump monitoring committee.
Greasing

- Tightening
- Clean the chain and if found rusted rub with sand paper to remove it.

- Grease the whole chain and at its connection point

Tightening

- Tighten the axle nut and lock nut on the handle
- Tighten the Nylock nut firmly with the chain anchor bolt
- Tighten all the 8 flange bolt nuts
- Check the water quality at regular intervals. The suggested intervals for bacteriological contamination is every 3 months and for physical chemical test is every one year.
- Organise maintenance committee including appropriate maintenance fee collection from the users.
- Maintain proper record for the maintenance fee as well as hand pump repair and maintenance.

Don’ts

- Washing utensils / clothes on the platform.
- Bathing/Anal cleaning of the children on the platform
- Feeding water to the animals in the platform.
- Hard hitting of the handle assembly while pumping water.
- Employing the pump more than its designed capacity.
- Fixing of water tank towards the pedestal of the platform.
Trouble Shooting

Handle is easy to operate, Handle rests at bottom position and no water discharge
Causes
  a. Connecting rods got disconnected or the chain got disconnected from the first connecting rod.
  b. Cylinder got disconnected and fallen inside the bore well (happens rarely) or the cylinder got cracked.
  c. Bucket washers or the valve seats worn out.
Remedy
  a. Pull out the rising main assembly and reassemble the connecting rod wherever necessary.
  b. Replace cylinder assembly.
  c. Overhaul the cylinder and replace the valve seats and bucket washers.

No water discharge, Handle rests at the top position, Handle is hard to operate
Causes
  a. Riser main pipes got disconnected.
Remedy
  a. Pull out the raising main assembly and reassemble properly.

Delayed or slow or less water discharge
Causes
  a. Damaged rising main joints or loose or perforations in the riser pipe.
  b. Leakage in cylinder check valve or lower valve.
  c. Bucket washer worn out.
Remedy
  a. Replace the damaged pipes.
  b. Overhaul cylinder and replace rubber seats.
  c. Overhaul cylinder and replace bucket washers.

Handle hard to operate and water discharge is less or sporadic
Causes
  a. Leather bucket washers bulged.
Remedy
  b. Replace the leather bucket washers.

Folding of chain during return stroke
Causes
  a. Improper installation.
  b. Leather bucket washers bulged or jammed inside the cylinder.
Remedy
  a. Adjust the length of last connecting rod.
  b. Overhaul the cylinder and replace leather bucket washers.

Shaking of pump handle
Causes
  a. Loose handle axle nuts.
b. Worn out ball bearings or Bearings loose in the bearing housing.
c. Damaged spacer or short in length.

Remedy
a. Tighten handle axle nuts.
b. Replace ball bearings or Replace the handle assembly.
c. Replace spacer.

Noisy during operation
Causes
a. Stand assembly flange not levelled properly.
b. Bent connecting rod.
c. Hexagonal coupler welded offset.

Remedy
a. Level the flange.
b. Change the defective rod.
c. Change the defective rod.

Handle gets kicked back
Causes
a. Water level gone below and cylinder is sucking air

Remedy
a. Pull out rising main pipes assembly.
b. Deeper the bore well for the required water level depth and add sufficient rising main pipes and connecting rods.

Points to be considered while drilling

- The points for drilling of bore wells is normally done scientifically by a geologist using appropriate tools and equipment’s. Traditional water diviners use different methods to mark the potential points, but it is better to go for a scientific method of water divining.

- While drilling the bore well the following points should be paid proper attention
  - The bore well is drilled in the exact point given by the diviner.
  - The size of the bore should be (4.5 or 6.5 inch) as per the recommendation of the diviner.
  - The casing pipe need to be installed upto the point of loose soil.
  - The depth of the bore well should be as per the recommendations of the diviner and a proper record of the depth should be maintained.
  - A minimum of 1 inch yield during drilling is essential for the continuous supply of water in the hand pump.
  - The bore hole need to be closed properly till the installation of hand pumps to avoid falling of any hard material into the bore well.
  - Checking of water level before installing the hand pump need to be carried out to decide the type of hand pump (the water level should be within 100 feet from the ground for India mark-ll Hand Pump).