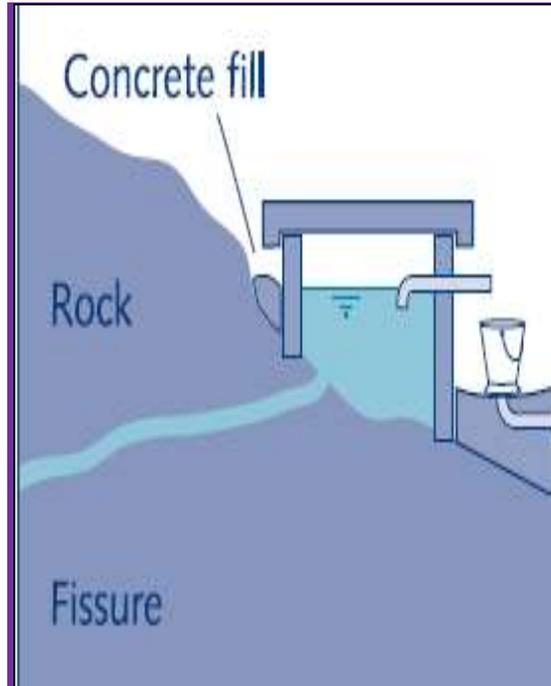
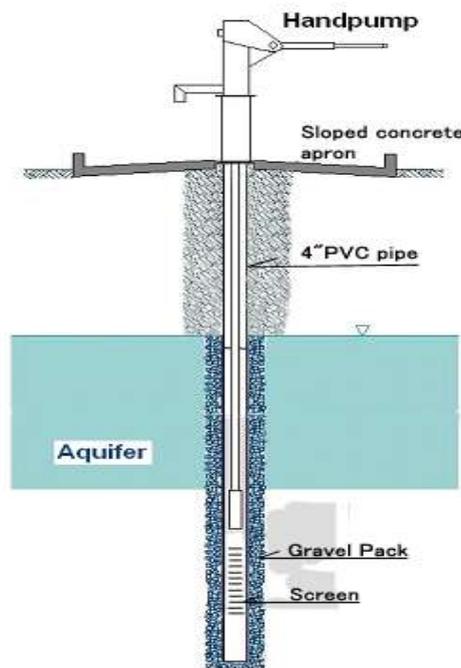
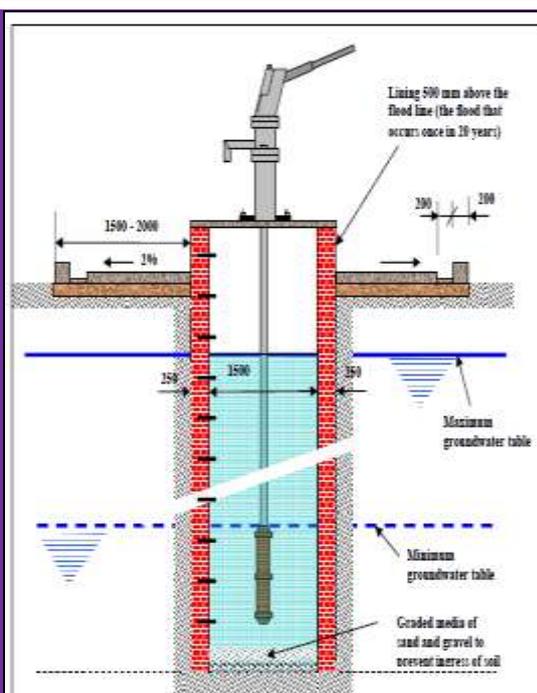




Rural Water Supply Operation and Maintenance Manual



Module - D

A Trainer's Manual for Technical Operation and Maintenance Requirements



DEMEWOZ CONSULTANCY

P.O.BOX 2023 CODE 1000
ADDIS ABABA ETHIOPIA
TEL: +251-(0)118-60 80 12/0911-158613
E-mail: d.consultancy02@gmail.com

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MODULES	RURAL WATER SUPPLY POINT SOURCES MANUAL
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MODULE – A FACILITATOR’S GUIDELINE

MODULE – B DESCRIPTION OF POINT WATER SOURCES AND TECHNOLOGIES

MODULE – C	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS FOR POINT WATER SOURCES
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MODULE – D COMMUNITY BASED SCHEME AND FINANCIAL MANAGEMENT

MODULE – F MONITORING AND EVALUATION OF RURAL WATER SUPPLY SCHEME

MODULE – G WATER SAFETY PLAN FOR RURAL WATER SUPPLY

MODULE – H PREPARATION OF ACTION PLAN AND IMPLEMENTATION OF O&M

MODULE - C: TECHNICAL OPERATION AND MAINTENANCE REQUIREMENTS

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DEFINITIONS OF TERMS:

Accessibility	Is having a functional and reliable water supply facility without any barriers within a radius of 1500 metres for Rural Water Supply
Access Coverage	Is the percentage of people with access to safe, adequate and reliable water supply within 1500m at 15 l/c/d for rural community.
Adequate Water	Is the quantity of water required to meet the minimum demand per capita per day. The standard being 15l/capita/day by 2015 for Rural people.
Community	Refers to a group of people living in a designated area who share residential and developmental challenges and benefits. It may also refer to all people sharing such challenges and benefit regardless of geographical and social boundaries
Community Based Management	Is the process of empowering community members to assume the lead role in decision making about the levels of services they require, whilst organizing themselves to plan, implement, operate and maintain their water supply and sanitation facilities.
Community Management	Is a form of community participation in which the community takes the final decision on all aspects of planning, implementation, management, monitoring, evaluation, O&M of the water supply facility
Evaluation	Is the periodic and systematic review and analysis of a practice to determine the relevance, effectiveness, efficiency and impact of programmes/projects compared to the set objectives.
Maintenance	Refers to activities required to sustain the water supply facilities in a proper working condition. It includes preventive maintenance, corrective maintenance and crisis maintenance.
Monitoring	Is the regular and continuous checking of whether plans, activities and situations are being implemented as planned, and includes the provision of feedback to facilitate the taking of corrective measures by relevant stakeholders.
Operation	Refers to the day to day running and handling of the water supply facilities in a manner that optimizes their use and contributes to a reduction in breakdown and maintenance needs
Preventive Maintenance	Refers to an activity that includes checking the status of hand pump components at regular fixed intervals
Rehabilitation	Is the correction of major defects and the replacement of equipment to enable the facility to function as originally intended.
Reliable Water Supply	Is the supply of water on a continuous basis meeting the minimum demand per capita per day
Repair	Is the restoration of a defective component to return the facility to acceptable working condition. The cost of the repair should be borne by the community.
Rural Area	“Areas of population outside urban and peri-urban using point or piped water supply system for which the community is responsible for the O&M” in addition, low population densities characterize rural areas, with small houses isolated from each other.
Safe water	Is water that is free from harmful quantities of physical, chemical and pathogenic matter and that meets the minimum Ethiopian standards (usually WHO Guidelines)

Seed Money	Is the initial sum of money disbursed to an organization in order to create/start a revolving fund for undertaking a designated programme
Scheme (Water)	The entire facility (concrete works, pipes, pumps) established to extract water from a water source, and distribute it to (close to) people's homes
Sustainable Supply Chain	Is a system of procuring and supplying spare parts that guarantees a continuous supply of spare parts.
Source (Water)	The natural water source only, i.e. spring, groundwater, river, etc
Supply chains	Is the term used for the process that relates all activities involved with the flow and transformation of goods from the raw materials stage through to the end-user, as well as the associated information flows
WASHCO	Is a committee of representatives from a number of Water, Sanitation and Hygiene Point Committee of the same village. Sometimes WASHCO committee may refer to 2 or more village representatives benefitting from a water and sanitation point.

4. MODULE – C: TECHNICAL O&M REQUIREMENTS

4.1 Introduction

This Training manual comprise of:

- Session – C1: Introduction to O&M - Sustainability
- Session – C2: Sustainability – Empower of Water Users
- Session – C3: Design of Operation and Maintenance Module
- Session – C4: O&M Requirements for Hand Dug and Shallow Wells
- Session – C5: O&M Requirements for On – Spot Spring Chamber
- Session – C6: O&M Requirements for HandPumps (Afridev and Indian Mark – II)

4.2 Purpose of the Training Manual

In order to achieve what the One WASH Program has set out to do, this manual intends to meet one of the policy objectives of developing materials and training of trainers' with regards to O&M. This manual also acts as a support training tool to facilitate improved and sustainable Operation and Maintenance (O&M) which is a key to service delivery of RWSS.

This manual is designed for use at Woreda, Kebele and community levels (WASHCOs). The more specific objectives of the manual at each stage are:

Woreda Level:

- ☛ To set up an institutional framework for improved O&M at the Woreda center.
- ☛ To develop the capacity of the Woreda Council (WC) and its stakeholders (WASHCOs) to formulate, implement, and monitor the Woreda O&M Action Plan for RWSS.
- ☛ To improve the capacity of the WC to train Area Development Committees (ADCs which include the APMs) in sustainable O&M of hand pumps.
- ☛ To develop the capacity of DC to train ADCs in the establishment of sustainable Community-Based Management of hand-pumps.

Kebele Level:

- ☞ To improve the capacity and skills of Kebele Water Office and Area Pump Mechanics (APMs)) in sustainable O&M of hand pumps,
- ☞ To raise the capacity and skills of Kebele Water Office and APMs for the establishment and management of a sustainable CBM system for the O&M of hand pumps. (Please note that for the purposes of this manual the 'ward' and 'catchment' areas are used interchangeably.)

Community Level:

- ☞ To mobilize and sensitize traditional community leaders for improved and sustainable O&M of RWSS facilities,
- ☞ To develop the capacity of the community to manage, operate and maintain RWSS facilities in a sustainable manner.

4.3 Manual to be referred

This training module is extracted from operation and maintenance Part-3 of the manual. Please refer it whenever necessary.

4.4 Session – C1: Introduction to O&M – The Concept of Sustainability

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
SESSION – C1	INTRODUCTION OF O&M: THE CONCEPT OF SUSTANABILITY
Introduction	Sustainability of community managed water projects is a desirable state but difficult to achieve. This session aims to get participants thinking about what a sustainable water project really means and how this relates to problems that typically plague water projects.
Objective	To identify what is needed to make a water project sustainable and relate this to their water project.
Outputs	Participants are clear on the meaning of sustainability
Timing	1 and ½ hours
Target Group	Worda Water Offices, Kebele Water Desk, WASHCOs, Artisans

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS	
Session Guide	Various points regarding sustainability of water projects are listed below.	
	Sustainability Factor	Sustainability Qualifiers
	Policy Context	<ul style="list-style-type: none"> ▪ Government-promoted O&M strategies; legal ownership, accountability and the allocation of responsibilities. ▪ Capacity is sufficient to implement relevant policies ▪ Donor practices promote local procurement and/or production ▪ Government attitudes and practices do not hinder indigenous or private sector participation
	Management and institutional arrangements	<ul style="list-style-type: none"> ▪ Institutional support for community management is budgeted and provided for ▪ Private sector alternatives to community management are investigated and promoted ▪ Government capacity is sufficient to fulfill regulatory and monitoring roles
	Financial issues	<ul style="list-style-type: none"> ▪ External support is minimized and implementation strategies include self supply ▪ Sustainable subsidies are developed to serve the poorest and most vulnerable ▪ Transparency and accountability measures are in place in financial management bodies (Government and governmental) ▪ Realistic cost-recovery targets are clearly defined and tariffs set accordingly ▪ Sustainable community financing strategies are developed
	Community and Social aspects	<ul style="list-style-type: none"> ▪ Communities are presented with a range of management models to choose from ▪ Demand is stimulated based on a wide range of community needs (i.e. not just health) ▪ Community cohesion is not assumed and heterogeneity is recognized as appropriate ▪ Differing levels of poverty are recognized and targeted subsidies developed where needed
	Technology	<ul style="list-style-type: none"> ▪ Appropriate technology choice is promoted, especially that which is closest to the user ▪ Flexibility in technology options is available and communities have a real choice

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS	
		<ul style="list-style-type: none"> ▪ There is limited or no importation of specialist equipment ▪ Private sector capacity is developed for drilling and development
	Environment	<ul style="list-style-type: none"> ▪ Groundwater monitoring systems are in place for water quality and quantity ▪ Government regulation and monitoring of private sector operators and water resources occurs
	Supply Chains	<ul style="list-style-type: none"> ▪ Supply chains for spare parts are linked with manufacturing, technical services and/or pump sales ▪ Indigenous private sector development is promoted with realistic incentives ▪ Non-profit sector support is utilized where no other options are commercially viable
<p>Step 1: Guided discussion using case studies</p>	<p>Different case studies are presented to stimulate a discussion on sustainability.</p> <p>Facilitator should use one or more of these case studies and present either as case studies or adapted as role plays and used for group discussions.</p> <p>Facilitator should present the case study and follow up with questions and Discussions.</p> <div style="background-color: #e6f2ff; padding: 10px;"> <p>Scenario A - Hand pump</p> <p>A hand dug well is constructed and fitted with a new hand pump which enables jerry cans to be filled more quickly thereby reducing queuing times. As the well is also closer to the village, women are spending 1-2 hours less per day fetching water.</p> <p>Because no attendant is assigned responsibility of looking after the water point: hygiene around well deteriorates; stagnant water provides a breeding ground for flies and some children get sick. Also children play with the pump, damaging the handle.</p> <p>Preventative maintenance checks (e.g. greasing of chain, tightening of bolts) are not carried out on the pump and it soon breaks down. The village opens up the manhole cover on the well and returns to using rope and bucket system. Water quality deteriorates further and drawing of water becomes less efficient.</p> <p>Queuing time for water collection increases and people complain that the water is dirty again and more children are getting sick. In response to the broken pump the administrator assigns one person as an attendant, however the damage has already been done – the pump is no longer working.</p> <p>No one within the village knows how to repair the pump. Two men were trained but both left the village to find work. Although a tool kit was</p> </div>	

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
	<p>donated to the village, these were taken by individuals and not returned so even if the technical know-how was available the necessary tools to repair the pump are not. Because preventative maintenance was not carried out, the cost of repairing the pump is now much greater. However because no charging system was developed by the WASHCO's, the village cannot pay for the required spare parts or the costs of a mechanic to come to the village.</p> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; margin: 10px 0;"> <p>Ask the group to discuss what they could have done differently as a WWO or WASHCO to avoid this problem: (the facilitator may guide the discussion but information should come from the group)</p> </div> <ul style="list-style-type: none"> ☞ A system for retailing the water should have been agreed before the project was finished and implemented at start-up. ☞ Somebody should have been assigned responsibility for looking after the pump and well. This person could be paid from revenue collected from the water charges and ensured children knew how to operate the pump correctly and maintained the hygiene around the well.
<p>Step 2: Identifying aspects of sustainability through analysis of diagrams</p>	<p>This tool requires the use of the diagrams in Attachment 1.</p> <ol style="list-style-type: none"> 1. Break participants into pairs or small groups 2. Provide each group with a diagram from Attachment 1. 3. Ask each group to analyze the diagram and explain: <ul style="list-style-type: none"> ▪ What the diagram shows; ▪ What may have contributed to the situation shown in the diagram; ▪ What should have been done to prevent the situation shown in the diagram, with respect to roles and responsibilities of the WWOs, WASHCOs, Artisans, water users?
<p>Step 3: What is Sustainability for the WASHCO?</p>	<p>This step aims to summarize the discussion and points made from Steps 1 and 2.</p> <p>Ask the participants <i>“How can you tell if a water project is being managed sustainability?”</i></p> <p>List all their ideas on a flip chart.</p> <p>Incorporating the answers from the group discussion, develop an understanding of what sustainability means to the community water project.</p>

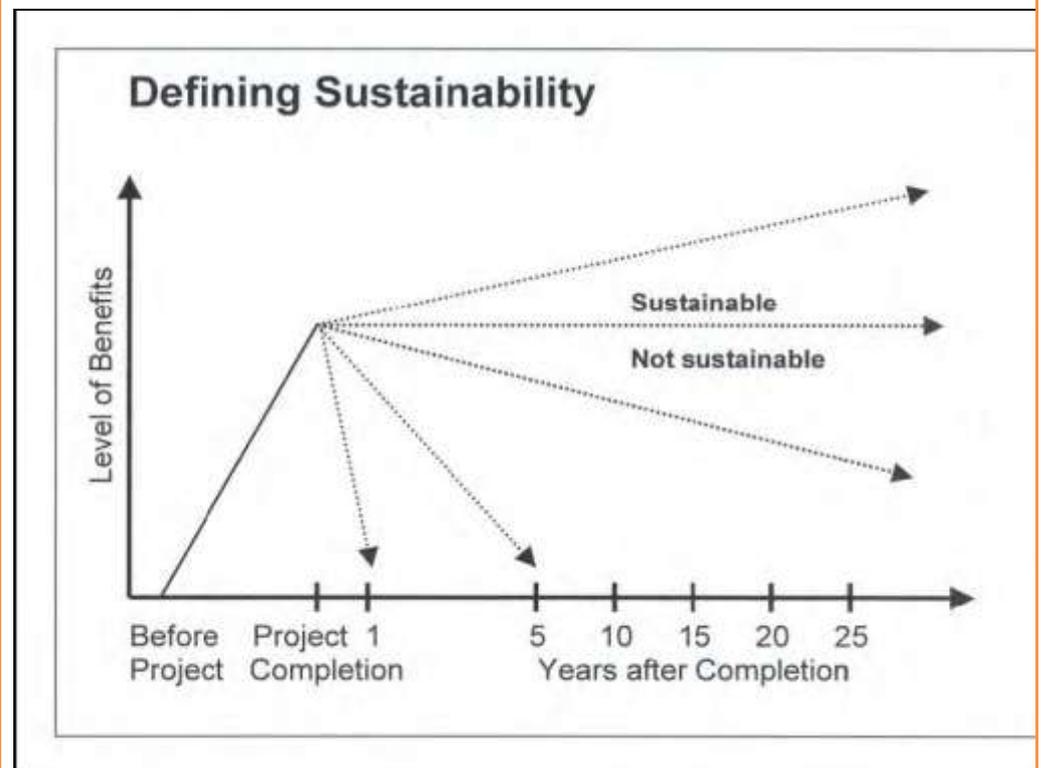
MODULE – C:

TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS

Sustainability for a water project is being achieved when:

- The water sources are not over-exploited but are naturally replenished;
- Water systems are maintained in a condition which ensures a reliable and adequate water supply;
- The benefits of the supply continue to be realized by all users indefinitely;
- The service delivery process demonstrates a cost-effective use of resources that can be replicated;
- The water supply system is maintained in a condition which is able to provide water services to meet the needs of the growing population and increasing water demand without external support.

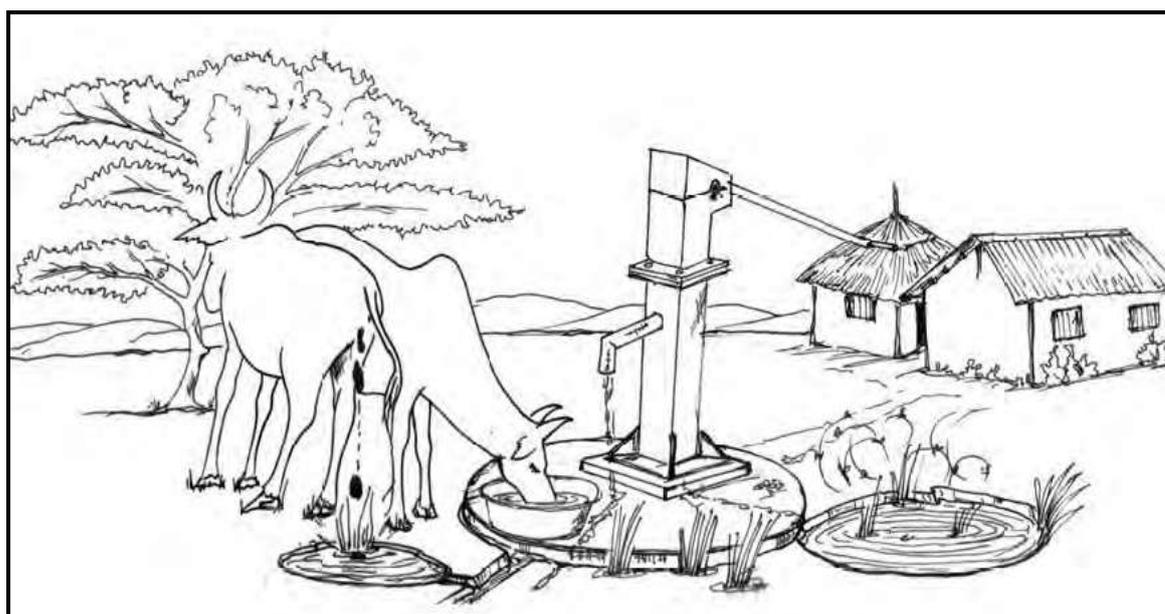
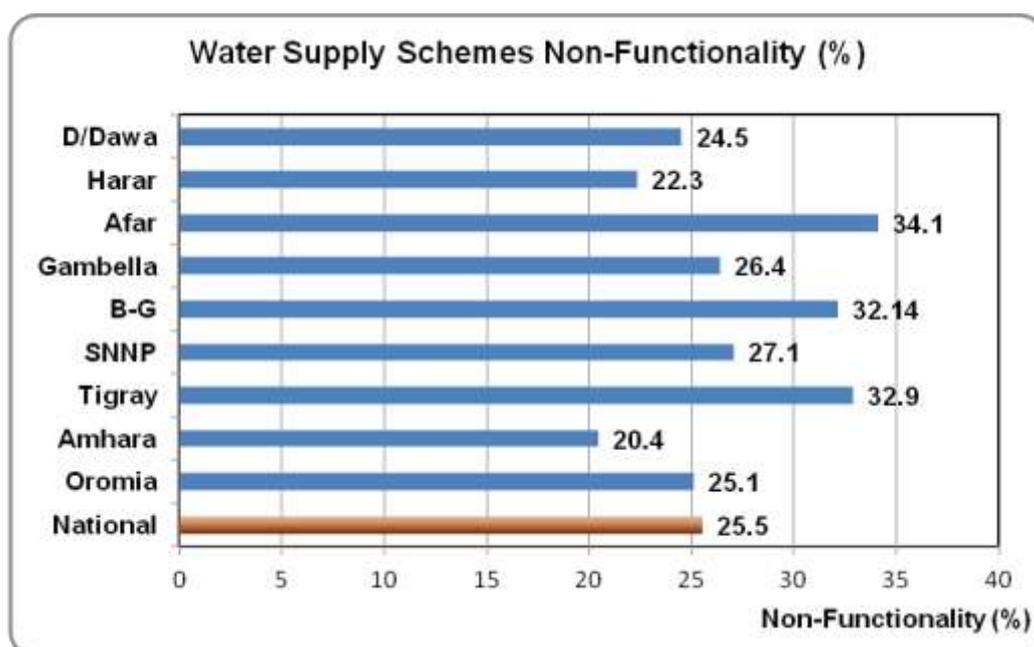
The diagram below can help to illustrate the concept of sustainability. The x-axis shows time and the y-axis shows the level of benefits. At project completion, a certain level of benefits is achieved. Thereafter the project may provide increasing or declining benefits, depending on the management of the project. A sustainable project is one where the level of benefits is equal to or better than the level of benefits obtained at project completion.

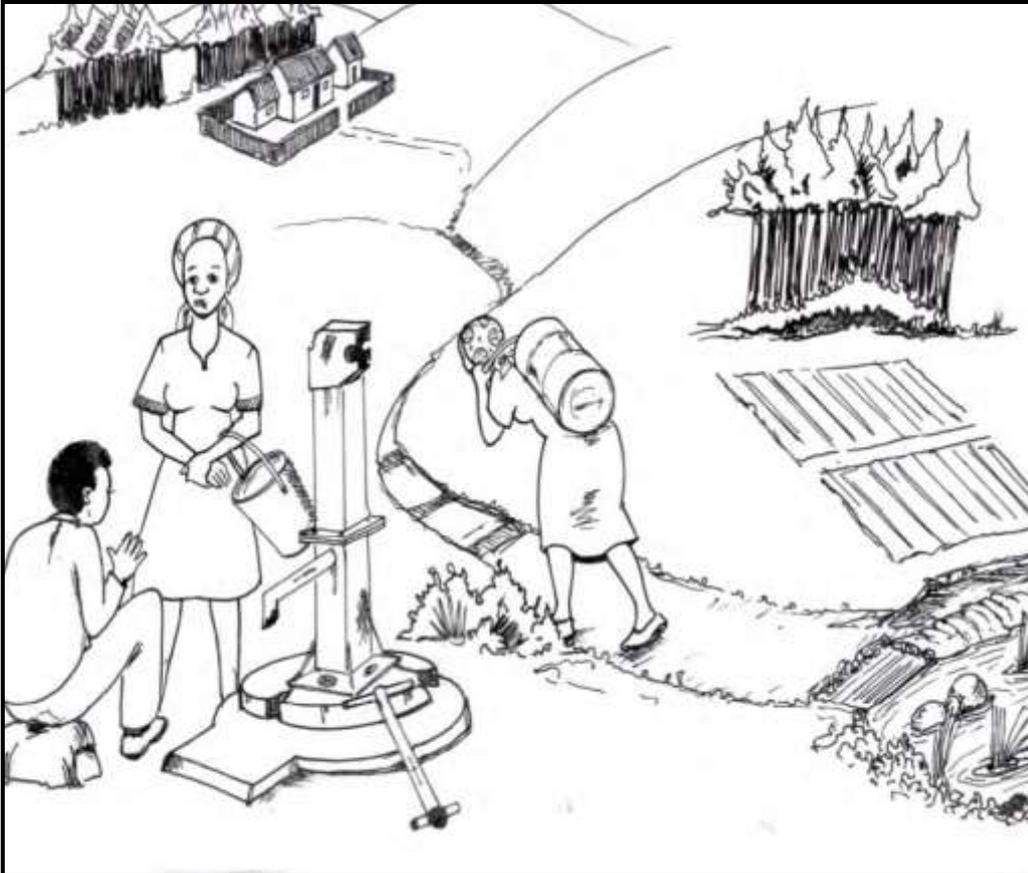
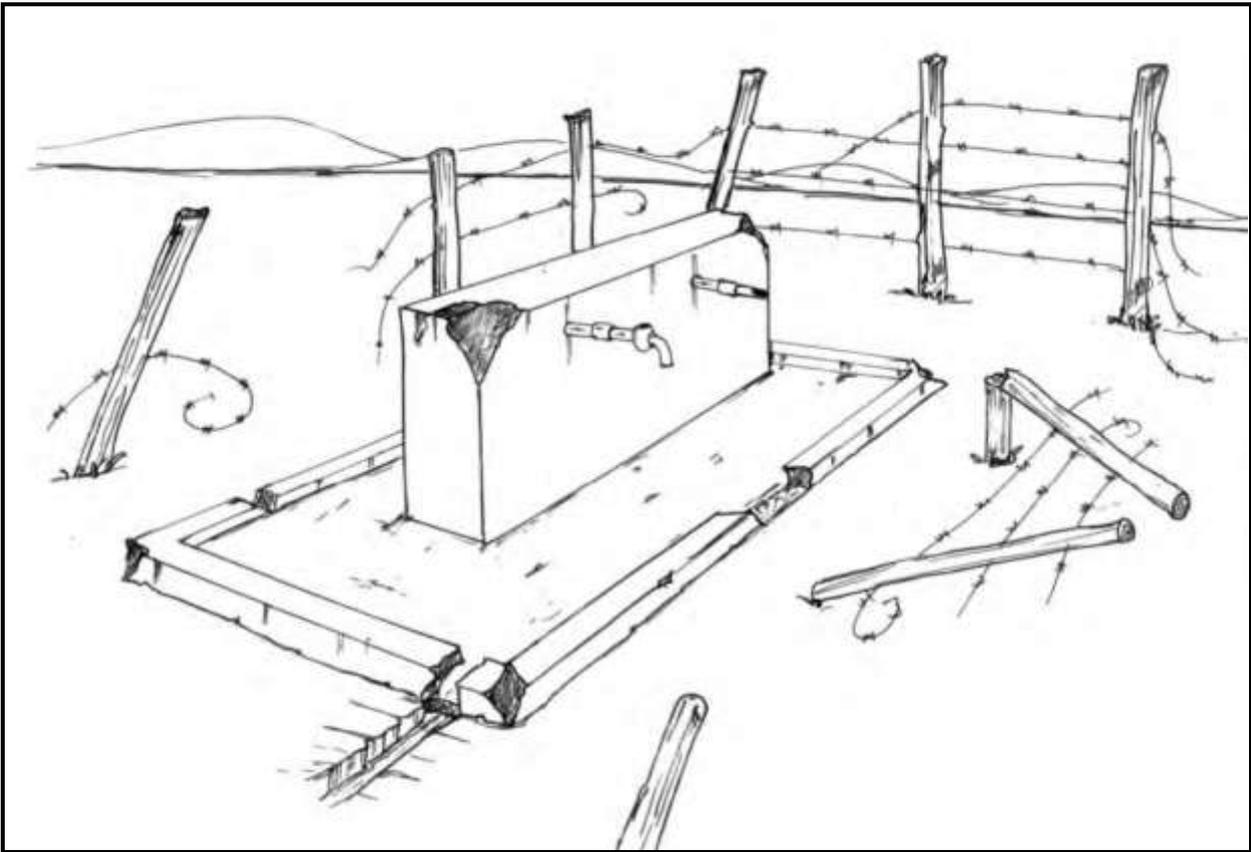


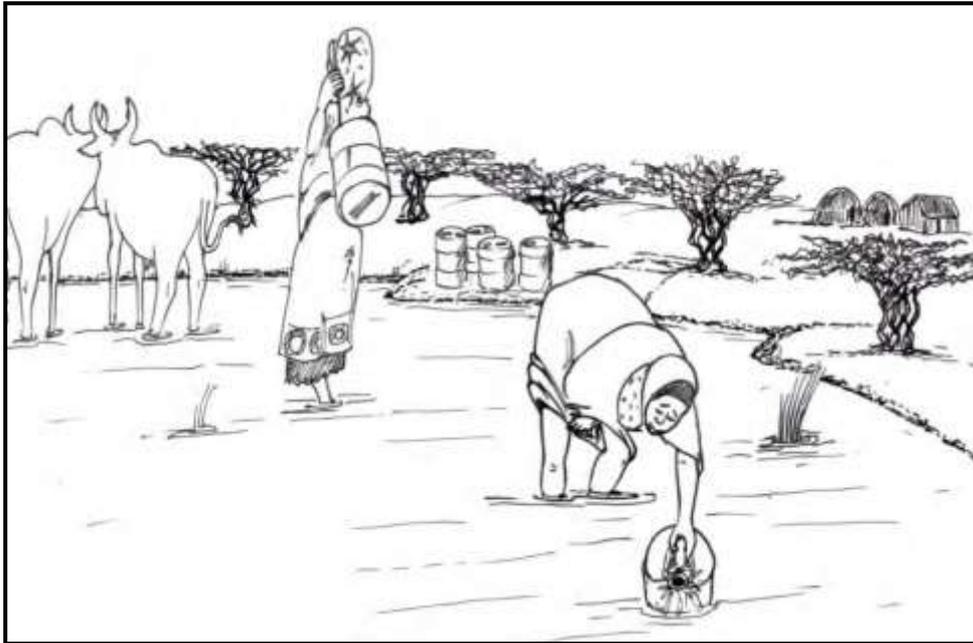
Review questions

What are the indicators of a water project that is being managed on a

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
	sustainable basis?
Session Attachments	Attachment 1: Tools to provoke discussion
Attachment 1:	Non-functionality of rural water supply Schemes (NWI_2011) and Diagrams for discussion on aspects of operation, maintenance and sustainability







Real Situation in Tigray Region





4.5 Session – C2: Sustainability – Empowerment of Water Users

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS																
SESSION – C2	SUSTANABILITY: EMPOWERMENT OF WATER USERS																
Introduction	Raising awareness amongst water users of their critical role in holding their WASHCOs accountable.																
Objective	To make the members aware of their rights, related to access to water services, information and the collective power they have in holding their leaders accountable.																
Outputs	Water user’s action plan to ensure accountability of committee members																
Timing	1 hour																
Target Group	Worda Water Offices, Kebele Water Desk, WASHCOs, Artisans																
Methodology	<p>This is not a discrete session which has to follow the agreed format. There may be specific public meetings to tackle the issue but equally important are focus group discussions, meetings with key informants and household visits. The target audience includes community groups, opinion leaders and community members. Emphasising the collective power of communities throughout the course of a training programme and at different points of a project life will be more effective than a one-off training session on the topic.</p> <p>The facilitator needs to be sensitive and balance this awareness raising and empowerment against the possibility that committee members may feel threatened, and be skilful in ensuring that any existing mistrust does not overpower the purpose of the training.</p>																
Session Guide																	
Supporting Information	<p>Issues of accountability, management indicators and community corrective action</p> <table border="1"> <thead> <tr> <th>Issue</th> <th>Management Indicators</th> <th>Community Action/checks</th> </tr> </thead> <tbody> <tr> <td colspan="3">Financial Management</td> </tr> <tr> <td>Accountability</td> <td>Proper book keeping issue receipts against payment for water, invoices for all payments made, stock book</td> <td>Develop system of auditing by users</td> </tr> <tr> <td>Appropriation of funds</td> <td></td> <td>Review income against expenditure</td> </tr> <tr> <td>Transparency</td> <td>Water meters as a mechanism to check</td> <td>Insist on installation of meters.</td> </tr> </tbody> </table>		Issue	Management Indicators	Community Action/checks	Financial Management			Accountability	Proper book keeping issue receipts against payment for water, invoices for all payments made, stock book	Develop system of auditing by users	Appropriation of funds		Review income against expenditure	Transparency	Water meters as a mechanism to check	Insist on installation of meters.
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MODULE – C:		TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS	
		against lost water/revenue against the collected money	
Water charging	Up to date records		Ensure WASHCO maintain paperwork and make it available for inspection
Leadership			
Elections	Fair elections procedures defined within constitution and followed		Insist on limited term of office and democratize elections
Communication	Minutes of meeting shared		Insist that decisions taken by committee are minuted and disseminated to users by posting on a public place Annual general meeting where community can question the WASHCO
	Gender & stakeholder balance of WASHCO (As stated in the proclamation, the majority of the members are women)		
Lack of legal redress in dealing with corruption	Bylaws high lighting action against misuse of office (The B-GR proclamation stated to develop By-law by each of WASHCO's)		Insist that WASHCO registers as association and initiates process to become a WSP as per the proclamation.
Poor service levels/user dissatisfaction			
Lack of equitable access to water	Byelaws provisions in regard to equity		Ensure that byelaws are appropriate, have been agreed by village as a whole and are followed
Service level at water points is poor	Byelaws guidance		
Larger livestock owners not paying in proportion to the amount of water they use.	Byelaws provisions in regard to equity		Public auditing of accounts and comparing revenue against production by use of water meters as a means of quantifying unaccounted for water
Conflict between users	Byelaws provisions in regard to conflict resolution		Mechanisms for conflict resolution should be articulated within byelaws.

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
<p>Step 1: Introductory discussion on Holding leaders accountable</p>	<ul style="list-style-type: none"> ▪ Ask the users or water user groups (basically anyone who takes water from the system) how they hold their leaders accountable. ▪ List all the responses. ▪ Ask the participants to state how they ensure that the WASHCOs are accountable to the Woreda Water Offices, i.e. do they meet their obligations? ▪ List all the responses from the participants. ▪ Let all the points be discussed openly.
<p>Step 2: Constraints Hindering proper service delivery</p>	<ul style="list-style-type: none"> ▪ Get users' opinions on the key constraints that affect the provision of water in their community. ▪ Ask the groups to write down on pieces of paper all their responses. ▪ Collect the pieces of paper and record the responses on the flip chart for discussions ▪ Discuss the points raised in details in plenary, recording all the emerging insights.
<p>Step 3: Relationship between water users & WASHCO</p>	<p>Make a brief presentation on the following topics:</p> <ul style="list-style-type: none"> ▪ The WASHCO is there to serve the interests of water users. ▪ Water users should have a right to know what the WASHCO does – content of meetings, decisions made, how community money is being managed etc. ▪ A constitution or set of by-laws can guide decision making. This sets and clarifies the limit of the WASHCO, empowering them to do their job. It can also provide assurance to users that certain practices will be followed and standards of service met. ▪ Failure to disclose information, follow agreed procedures or properly document decisions, incomes or expenditures should be viewed suspiciously and challenged by users. ▪ Users have a right to request information from the WASHCO and challenge them on issues related to the water system.

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
<p>Step 4: Rights of Water Users</p>	<p>Facilitators should initiate a discussion on the rights of a water user.</p> <ul style="list-style-type: none"> ▪ Ask the participants to state the rights of a water user. ▪ Note that with rights come responsibilities ▪ List the rights on a flipchart. ▪ Depending on the answers highlight the following in a short presentation: <div style="border: 1px solid black; border-radius: 15px; padding: 10px; margin-top: 10px;"> <p>Rights of water users</p> <ul style="list-style-type: none"> ▪ To attend community meetings, observe committee meetings and/or be informed of the outcome of the meetings. ▪ To influence operating hours for water access. ▪ To scrutinize project funds - know how much money is held in the project account and view all income and expenditure records. ▪ To amend/approve constitution, ▪ To participate in all general meetings </div>
<p>Step 5: Tools water users can use/demand and hold the WASHCO accountable</p>	<ul style="list-style-type: none"> ▪ Ask the participants if they know the tools they can use to hold committees accountable? ▪ List the tools suggested by the participants and discuss each point ▪ Depending on the answers highlight the following details: <div style="border: 1px solid black; border-radius: 15px; padding: 10px; margin-top: 10px;"> <p>Optional tools water users can use to demand accountability</p> <ul style="list-style-type: none"> ▪ Water meter readings at borehole and all outlets (water point and cattle troughs). E.g. the metered output from a borehole can be compared with the fuel consumption to check that fuel is being used correctly and not sold for other uses. ▪ Metered output at water points can be cross checked against revenue received by the operator. ▪ Request WASHCO to publish income, expenditure and bank balances on a public notice board on a weekly or monthly basis as a sign of openness and accountability. ▪ Regular public meeting between the WASHCO and water users. ▪ Minuted meetings of WASHCO which are shared through placing on public notice board. </div>
<p>Step 6: Signs of a failing committee</p>	<ul style="list-style-type: none"> ▪ Ask the participants, what the indicators of a failing WASHCO are? ▪ List their responses and allow for a thorough discussion of all the points. ▪ Depending on the answers highlight the following:

MODULE – C:	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
	<p>Indications of failing management</p> <ul style="list-style-type: none"> ▪ Hand-pump/generator not being promptly repaired ▪ Large queues at water collection points ▪ Conflict between domestic users and livestock owners ▪ Continued external support ▪ Lack of trust between community and their leaders ▪ Stagnant waters around water points ▪ Leaking pipes not being repaired ▪ Broken tap stands ▪ Lack of fuel/replacement parts to power generator ▪ Conflict between WASHCO and other management structures – elders,
<p>Step 7: Development of an Action Plan</p>	<p>Ask the participants to develop an action plan to ensure the WASHCO is accountable to the project members.</p> <p>Conclusion</p> <p>Members have a responsibility of ensuring that WASHCO is accountable and that they know how to ensure management committees are accountable.</p>
<p>Review</p>	<p>How can we as users make the WASHCO transparent and accountable?</p> <p>What can water users do to ensure that they also meet their obligation as water users?</p>
<p>Session Attachments</p>	<p>None</p>

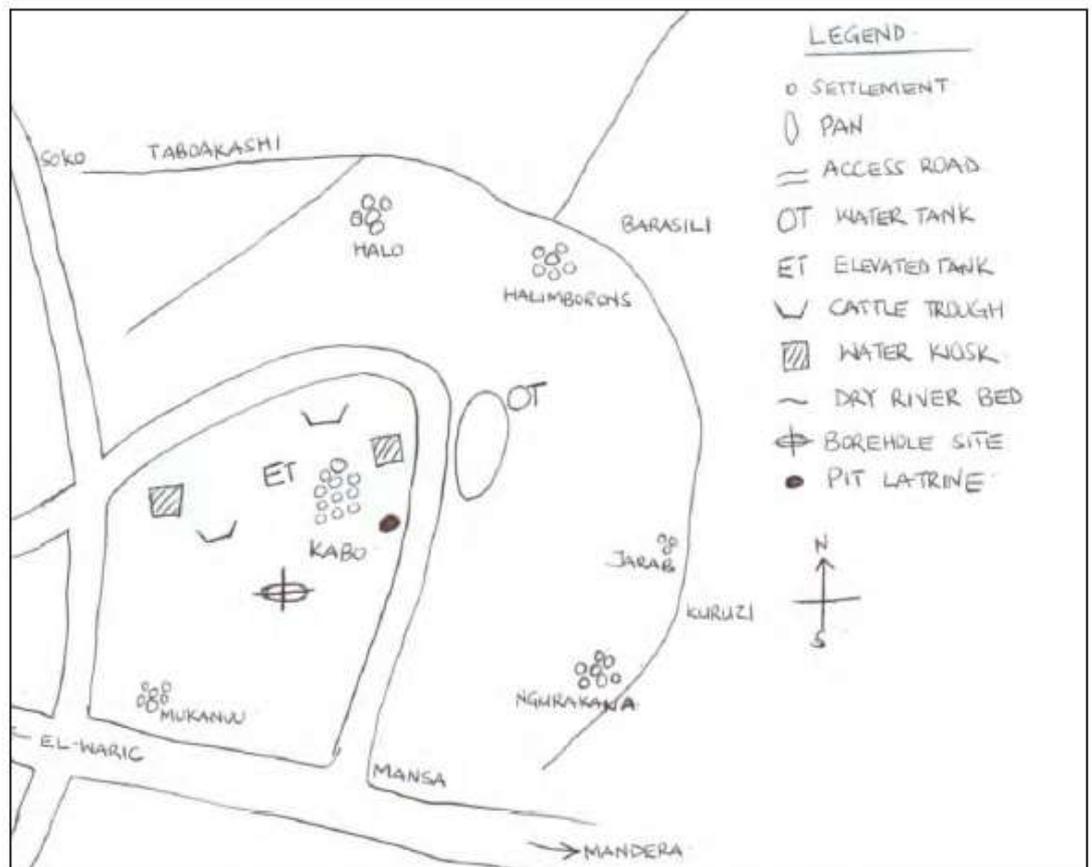
4.6 Session – C3: Design of an O&M Module

MODULE – C	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
SESSION – C3	DESIGN OF AN OPERATION AND MAINTENANCE MODULE
Appropriate Facilitator Background	Community Trainer with experience in community water projects; Technician with the relevant practical and technical background from Woreda Water Offices
Introduction	Material presented below is a generic guide to facilitators regarding the preparation of a training session to address the operation and maintenance aspects of a community water project. Facilitator should refer to other sessions for materials specific to each type of technology.
Objectives	<ul style="list-style-type: none"> ▪ Community members and WASHCO members will have a better awareness of the proper O & M tasks and be able to link this with the cost of operating and maintaining their systems. ▪ Operators or technical staff will be able to undertake the tasks specified in the Operation and Maintenance Schedule.
Outputs	<p>An Operation and Maintenance Plan which includes:</p> <ul style="list-style-type: none"> ▪ An O & M Schedule; ▪ □List of Tools; ▪ □List of Suppliers with contact details; ▪ Contact numbers for Local Service Providers that can provide technical assistance or services for maintenance tasks or in case of an unexpected breakdown.
Timing	Timing will vary according to each site. Adequate time should be provided for the different steps but typically one whole day will be required to cover the mapping exercise, site walk, discussions and practical demonstration of the maintenance tasks.
Target Group	<ul style="list-style-type: none"> ▪ Community members for general discussions ▪ WASHCO members require an understanding of the O & M requirements so that they can monitor and understand the cost implications of the O & M schedule ▪ Operators and technical staff for detailed discussions and practical exercises to be undertaken on the water facilities in the community.
Methodology	<ul style="list-style-type: none"> ▪ Presentation and discussion ▪ Site walks around the system components ▪ Practical demonstrations and exercises

Session Guide												
<p>Notes to facilitator</p>	<p>Facilitator should clarify any specific terminology, for example:</p> <ul style="list-style-type: none"> ▪ O&M = Operation and Maintenance ▪ CAP = Community Action Plan <p>1. This session aims to identify and categorize the observed problems in a water project. This is applicable to existing water projects. For projects under construction or newly completed, the facilitator should orientate the session to the identification of potential problems. The facilitator could use various scenarios to stimulate discussion on possible problems. In this case the facilitator should use his or her experience to describe potential problems related to each part of the system and get participants to think about and propose their own solutions.</p>											
<p>Step 1: Introduction</p>	<p>The facilitator should explain to the participants the different parts of the training schedule and who should participate in each session.</p> <table border="1" data-bbox="416 936 1497 1370"> <thead> <tr> <th data-bbox="416 936 879 974">ACTIVITY</th> <th data-bbox="884 936 1497 974">WHO SHOULD PARTICIPATE</th> </tr> </thead> <tbody> <tr> <td data-bbox="416 981 879 1048">General discussion on system components</td> <td data-bbox="884 981 1497 1048">Community, Committee members, operators</td> </tr> <tr> <td data-bbox="416 1055 879 1122">Site walk</td> <td data-bbox="884 1055 1497 1122">Community members, WASHCO members, operators</td> </tr> <tr> <td data-bbox="416 1128 879 1272">Discussions to draw up an Operation & Maintenance Schedule & discuss O & M issues</td> <td data-bbox="884 1128 1497 1272">WASHCO members, operators</td> </tr> <tr> <td data-bbox="416 1279 879 1370">Demonstration & practical exercise on O & M</td> <td data-bbox="884 1279 1497 1370">Selected WASHCO members, operators</td> </tr> </tbody> </table>		ACTIVITY	WHO SHOULD PARTICIPATE	General discussion on system components	Community, Committee members, operators	Site walk	Community members, WASHCO members, operators	Discussions to draw up an Operation & Maintenance Schedule & discuss O & M issues	WASHCO members, operators	Demonstration & practical exercise on O & M	Selected WASHCO members, operators
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Demonstration & practical exercise on O & M	Selected WASHCO members, operators											
<p>Step 2: Mapping Water Supply System</p>	<p>This is intended to be a PRACTICAL session to gather information about the community and the specific components of the water project. It is important that the participants create their own map with minimal interference and suggestions (the map will be examined again at the end of the session).</p> <p>The facilitator should guide participants on a MAPPING exercise to identify water supply infrastructure within the community and follow that with a SITE WALK to inspect the different components of the system or different water points.</p> <p>MAPPING EXERCISE</p> <ol style="list-style-type: none"> 1. Start by selecting a suitable area to sketch a map on the ground 2. Ask the group to use scrap materials to make a map of their project 3. Ask some members of the group to take other participants on a tour of the map, including the main landmarks, water infrastructure and other pertinent issues. 4. Based on the map and how people have described their community, initiate a discussion of issues on: <ol style="list-style-type: none"> a) What sort of problems make the systems to be non-operational; 											

- b) Which infrastructure is prone to problems;
5. Facilitator should capture the features of the map onto a flip chart for future reference, with specific reference to the infrastructure that is prone to operational and maintenance problems.

RESOURCE MAP



Step 3: Site Walk

SITE WALK

Undertake site walk to inspect the different components of the system, making sure to visit the points that were identified in the mapping exercise to be prone to operational problems. At each component, review the purpose of the component, the current status, who is responsible for operating and/or maintaining it, and the operational and maintenance tasks that are undertaken at each site.

The purpose of the site walk is to confirm the problems already mentioned, to identify additional problems, and to discuss possible solutions. This information will be used in developing the operation and maintenance schedule.

Step 4: Identification of system components and common problems

Based on the mapping and site walk exercises, the facilitator should ask the participants to identify, and name the different parts of the system; explain the importance of each component. For each component, state the purpose and the common problems.

	COMPONENT	PURPOSE	COMMON PROBLEMS
<p>Step 5: Identification of O & M problems</p>	<ul style="list-style-type: none"> ▪ Facilitator starts with a discussion about how the system as a whole performs with a few questions such as: <ul style="list-style-type: none"> ○ If the system stops working, is it usually because the water resource has run out or is it because the equipment or infrastructure has failed? ○ When the system stops working, how long does it remain „not working’? ▪ Refer to Session F3: Setting Performance Targets. ▪ Facilitator should ask participants to name some of the problems that they associate with why the system does not work as well as it should. ▪ Facilitator needs to categorize the problems into four groups: <ul style="list-style-type: none"> ○ Organizational issues ○ Water resource issues ○ Design and expansion of the project ○ Operation and maintenance issues <p>The intention is to focus on the operation and maintenance issues i.e. why the existing infrastructure is not working as well or as reliably as it should.</p>		
<p>Step 6: Developing an Operation & Maintenance Schedule</p>	<p>An operation and maintenance schedule is based on the understanding that performance is measured by the quality of service being provided. Indicators of performance include:</p> <ul style="list-style-type: none"> ▪ Frequency of disruptions to supply ▪ □Length of disruptions to supply ▪ Quality of water provided; ▪ Cost of water production vs. payment charged and paid <p>Preventing a problem is also much cheaper than fixing a problem and it keeps the system working. If the objective of the system is to provide a reliable service, then it is unacceptable for the system to break down or stop working. It is better to stop the system briefly for routine maintenance than to wait until it breaks down.</p> <p>The Operation & Maintenance Schedule provides information on WHAT has to be done, BY WHO, and WHEN. A supervisor can then check whether this is being done according to the agreed schedule.</p> <p>a) Developing O & M Schedule</p> <p>To develop an O & M schedule, the facilitator should go through each component of the system and discuss the tasks to be done, filling in the table as required.</p>		

TASK	RESPONSIBLE	HOW OFTEN

b) Developing Monitoring Tools

It is insufficient to develop the O & M Schedule without ensuring that the tasks are done. The easiest way to ensure that the tasks are done is to require the person responsible to sign off on a form when the task is done. This means that a form or forms should be designed to suit the O & M schedule – this will be scheme and component specific.

The example below provides an indication of a monitoring tool for routine monthly maintenance tasks

Task	Frequency	Jan.	Feb.	Mar.	Apr.	May
Change Oil	Each Month					
Patrol Pipeline	Each Month					

**Step 7:
 Building
 O & M
 knowledge and
 skills**

The above step has helped to prepare the O & M Schedule.

Facilitator should review the O & M tasks and who is expected to undertake the task and prepare specific training exercises to ensure that each task is properly understood and can be undertaken by the person expected to undertake the task.

Facilitator should adopt the following sequence of activities:

1. Demonstration of each O & M task. Discuss tools, materials, costs, any additional technical information or expertise required to undertake the task.
2. Allow each participant to undertake O & M task, explaining to the other participants what he/she is doing and why.
3. Review the ability of the trainees to undertake the tasks and repeat step 1 if required.
4. Review and amend O & M Schedule with trainees.

**Step 8:
 Troubleshootin
 g**

One of the problems faced by the community is when unexpected problems occur.

Trouble-shooting is a logical approach to identify the true cause of the problem and then to identify possible solutions.

The facilitator should take the participants through an exercise of considering what sort of problems might occur, the possible causes and possible remedies. This can

be helped by drawing up a table as shown below:

Problem	Cause	Solution

Step 9: Inputs, Spares, Tools and Technical Assistance

The facilitator should lead a discussion around the following topics:

a) INPUTS FOR ROUTINE OPERATIONS

Depending on the scheme/technology, the project may require various supplies to operate properly. These may include:

- Fuel;
- Lubricants – oils & grease;
- Chemicals;
- Electricity;
- Meters for new connections;
- □ Fittings for new connections;
- Filters, etc

The facilitator should discuss the arrangements required to ensure that sufficient supplies are stockpiled or what measures need to be done to ensure that the availability of the supplies is not interrupted. Issues include:

- Stores – adequacy, access into, safety, security;
- Stores Register;
- Requisition Forms;

b) SPARE PARTS AND MATERIALS

Discuss which spare parts are required for routine maintenance and to handle emergencies. Draw up a list of the spares that the project should have at all times.

These may include:

- Filters for Oil, fuel & air
- Washers;
- Materials for pipeline repairs – glue, piping, fittings;
- Taps & tap washers;
- Spare locks;
- Replacement meters;
- Valves;

- Painting materials, solvents;
- Construction materials.

c) SUPPLY CHAIN

It is insufficient to consider what spares are required without considering where these spares are sourced. It is helpful to draw up the list of suppliers and to decide what minimum quantity of the spares/materials should be kept in the store. When this minimum amount is reached, then a requisition form should be prepared to start the process of procuring additional spares/materials. LINKED WITH SPARE PARTS SUPPLY AND MANAGEMENT MODULE.

Spare	Min. Required in store	Name & contact of Supplier 1	Name & contact of Supplier 2	Expected cost per unit on delivery

d) TOOLS

Discuss the tools required for every operator or maintenance staff. Draw up a list.

Tools can be kept in the store or officially issued to staff members.

SAMPLE TOOL LIST

No.	Tools	Purpose (s)
1	Tool box	Storing tools
2	Wooden float	Mortar/masonry work
3	Plastering trowel	
4	Masonry trowel	
5	Spirit level	
6	Mason hammer	
7	Shovel	For G.I pipe work
8	Steel brush	
9	Die-stock	
10	Joining compound	
11	Pipe cutter	
12	Chain wrenches	
13	Pipe wrenches	

14	Oil can	For PVC pipe work
15	Heating plate	
16	Pocket-knife	
17	File	
18	Measuring tape	Multi-purpose tasks
19	Hacksaw	
20	Pliers	
21	Sisal	

(See Attachment 1: Diagram for General Tools – Specific Tools may depend on system type/technology).

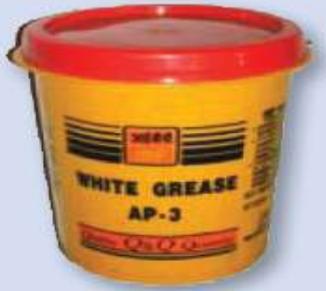
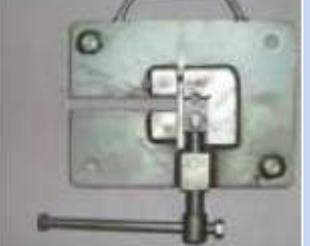
e) TECHNICAL ASSISTANCE AND SERVICES

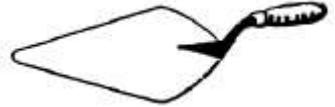
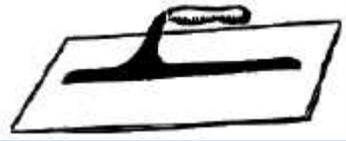
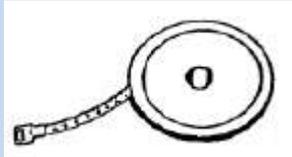
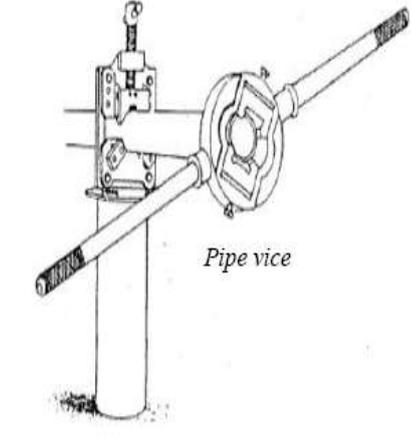
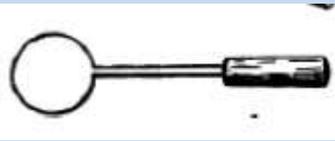
Discuss who and how additional technical assistance should be obtained from Regional Water Bureau, Zone or Woreda Water Offices. This should be established, BEFORE THERE IS AN EMERGENCY. Technical assistance includes services that are sourced periodically or individual/offices that can be contacted in case of a system breakdown. Draw up a list similar to the one shown below.

Components	Name of Technical Assistant	Contact Details	Back up Contact	Contact Details for Backup
Hand Pump Repair				
Generator Repair				
Electrical System				
Plumbing				

Review Questions	<ol style="list-style-type: none"> 1. Why is routine maintenance a good idea? 2. Which components are most likely to cause problems? 3. How does the O & M Schedule contribute to problem solving?
Session Attachments	Attachment 1: Essential tools for maintenance of a piped water system

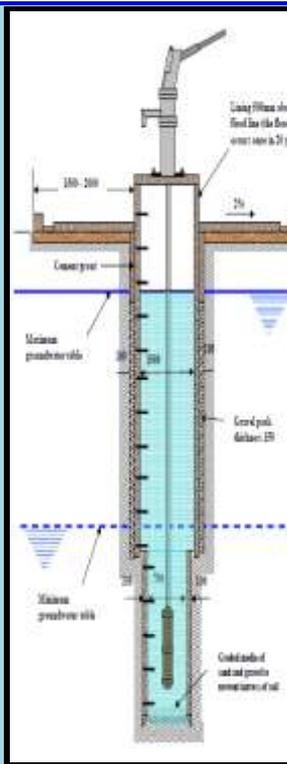
Attachment 1: Essential tools for maintenance of a piped water system

 <p>Tool Box</p>	 <p>Die Holder & Die</p>  <p>Wrench</p>	 <p>Tap Holder and Taps</p>
 <p>Oil Can</p>	 <p>Hacksaw</p>  <p>Wire Brush</p>	 <p>Spirit level</p>  <p>Open Spanners (17&19mm)</p>
 <p>Grease Tub</p>	 <p>Ball Pein Hammer</p>	 <p>Big Screw Driver</p>
 <p>C.R Vice</p>	 <p>Pipe Clamp</p>	 <p>Resting Tool</p>

 <p>Connection Tool</p>	 <p>Lifting Adapter</p>	 <p>Support Chain Tool</p>
 <p>Bearing Mounting Tool</p>	 <p>Axle Punch</p>  <p>Coupling Spanner</p>	 <p>Lifting Spanner</p>  <p>Crank Spanner (17 – 19 mm)</p>
 <p>Masonry Trowel</p>  <p>Steel Float</p>  <p>Wooden Trowel</p>	 <p>Hauling Rope</p>  <p>Measuring Tape</p>	 <p><i>Pipe vice</i></p>
 <p>Heating Plate</p>	 <p>Sisal Fibre</p>	 <p><i>Oil can</i></p>  <p><i>Knife</i></p>

4.7 Session – C4: O&M for Hand Dug and Shallow Wells

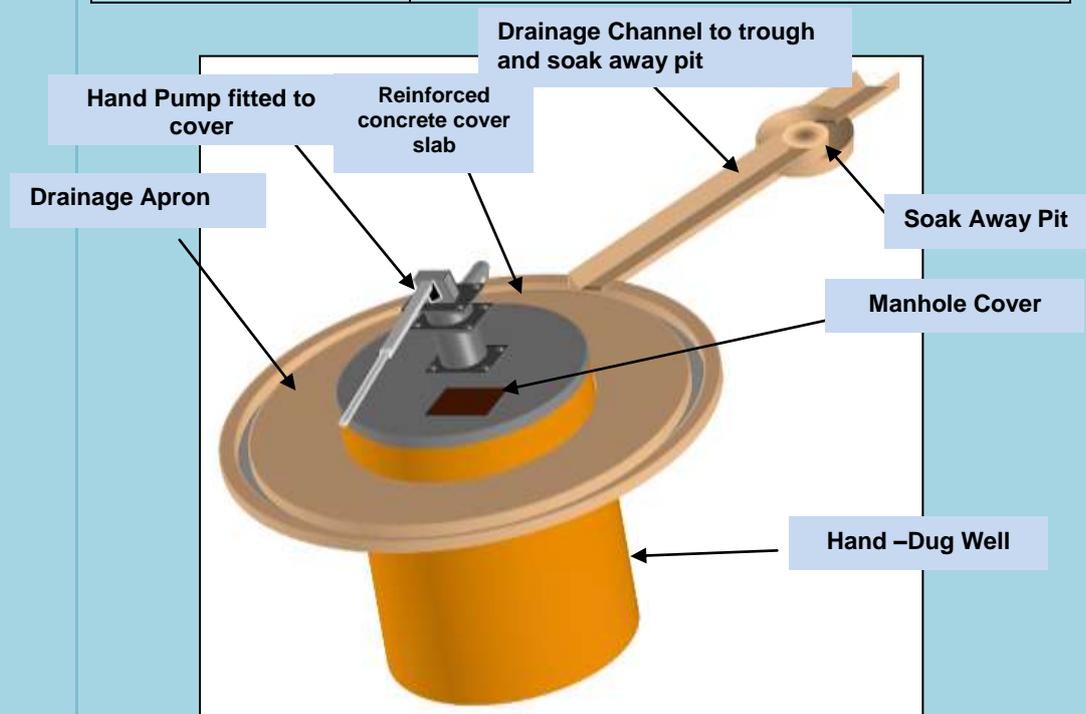
MODULE – C	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS						
SESSION – C4	HAND DUG AND SHALLOW WELLS						
Introduction	<p>This session covers hand dug and shallow wells. Water is drawn by a variety of methods. Reference should be made to the session that covers handpumps and other types of water lifting devices fitted on it.</p> <p>The traditional method of obtaining groundwater in rural areas is still the most common by means of hand-dug wells. (Usually 5 to 20 m depth).</p> <p>This system is an advanced type of hand-dug well which is constructed in accessible area by a medium drilling rig which can reach greater depth than hand-digging.(Up to 60 m depth).</p>						
Objective	<p>At the end of the session, the participants will be able to:</p> <ul style="list-style-type: none"> ▪ Identify the main components of HDW and SW ▪ Describe the functions of the key components ▪ Carry out well maintenance 						
Outputs	Capability of operation and maintenance of HDW and SW						
Timing	Session should take approximately 2 hr						
Target Group	Community Target Groups, WASHCO and Woreda Water Offices						
Methodology	<p>This is intended to be a PRACTICAL session. The components will be taught by demonstration on the system itself, not using drawings or description. The flip chart can be used to illustrate details if necessary.</p> <p>Reinforce the learning by allowing participants to identify components and describe their functions to each other.</p>						
Session Guide							
Step 1: System Identification	<p>System Components</p> <p>Potential system components are listed below. The facilitator should identify those components that are observed in the community HDW and shallow wells. Discuss issues related to each component.</p> <table border="1" style="width: 100%;"> <thead> <tr> <th>Item</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Head wall</td> <td>Wall built at the surface to prevent accidental entry into the well and to prevent runoff from entering the well</td> </tr> <tr> <td>Extraction System</td> <td>There are a variety of possible extraction</td> </tr> </tbody> </table>	Item	Description	Head wall	Wall built at the surface to prevent accidental entry into the well and to prevent runoff from entering the well	Extraction System	There are a variety of possible extraction
Item	Description						
Head wall	Wall built at the surface to prevent accidental entry into the well and to prevent runoff from entering the well						
Extraction System	There are a variety of possible extraction						



systems for open wells:

- Human ladder
- Rope & Bucket
- Rope & Washer pump
- Windlass
- **Handpumps (discussed in different session)**
- Manual Pump (e.g. Moneymaker or similar within the limit of its suction head)
- Motorized/diesel powered portable pump
- Solar powered pump

Apron	Hard material (concrete slab) around well head to provide a clean and safe area for users to draw water and to prevent seepage of contaminated water into the well.
Well lining	Hard material (e.g. concrete rings, brickwork, plastic culverts, etc) that is used to prevent the walls of the well hole from collapsing.
Drain	Constructed integrally with the apron to remove waste water away from apron and well head
Perimeter fence	Made from local material, to prevent unwanted access to well area



<p>Step 2: O & M Tasks</p>	<p>The facilitator should lead a discussion on how the well and extraction system is operated and maintained at present, drawing out issues. Relevant issues may include:</p> <ul style="list-style-type: none"> ▪ Safety – how to prevent children from falling into well; ▪ Inspect perimeter fence and system for controlling access to well area; ▪ Is well „protected“ or „unprotected“ ? What does this mean? ▪ Contamination of the water – how to prevent contamination by runoff, dirty buckets or unwanted things being put into the well; ▪ Method of extraction – the need for a system that can be used safely and reliably by children, women, and men; ▪ Inspect extraction system and check for wear or damage. Repair or replace as necessary; ▪ Inspection and repairs to the head wall and apron; ▪ Inspection and cleaning of the well (removing silt or any debris from inside the well); ▪ Disinfection of the well through application of chlorine; ▪ Inspect well area and remove rubbish and any faeces.
<p>Step 3: Maintaining Well Site</p> 	<p>A. Keep the Well Site Clean</p> <ul style="list-style-type: none"> ☞ Keep the site free from mud, weeds and excess water. Sweep the concrete apron around the pump every day. Weed it when necessary, and scrub the apron and pump stand to remove green slime when it appears. <p>B. Drain Spilled Water away from the Well Site</p> <ul style="list-style-type: none"> ☞ Make sure there are no pools of water around the handpump. Stagnant water will cause the area to become muddy, attract mosquitoes and pollute the well. ☞ Keep the drainage channel clean and open so that spilled water can drain away to the soakage pit, garden or animal trough. <p>C. Protect the Concrete Apron and Drainage</p> <ul style="list-style-type: none"> ☞ When the apron and drainage channel are not protected, they will crack and disintegrate. Make sure that they are protected against animals by properly maintaining the fence. If there is a sign of erosion around the apron, protect it by piling stones around it.

Step – 4: Get the Involving Community



Maintaining the pump site is the responsibility of the **WHOLE COMMUNITY**, not just the caretakers. Your job is to organize the work, not do it all yourself!

Box 1: Procedures for organizing the community for site cleaning by the caretakers

Here are some ideas for how to organize the community:

- ☞ Call a community meeting and get everyone's view about how best to organize pump site maintenance and rules about pump use.
- ☞ Divide the work of sweeping and scrubbing the apron amongst the women
- ☞ Divide the work of weeding the pump site amongst the men from different sections of the community on a rotating basis.
- ☞ Get children involved in sweeping, scrubbing and weeding.
- ☞ Organize a maintenance day at the end of the rainy season

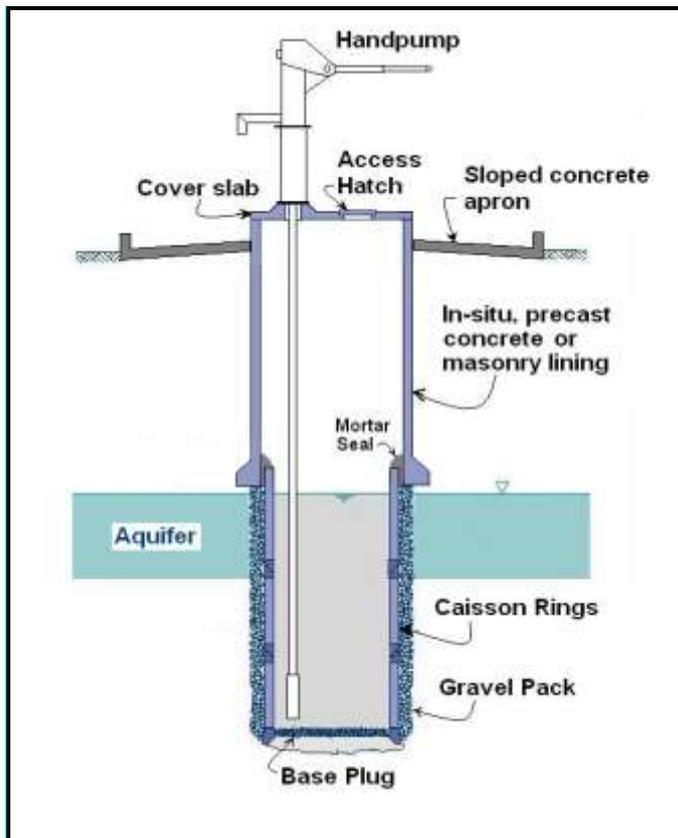
Step 5: Trouble Shooting

Discuss the potential unexpected problems and what might be the causes and solutions.

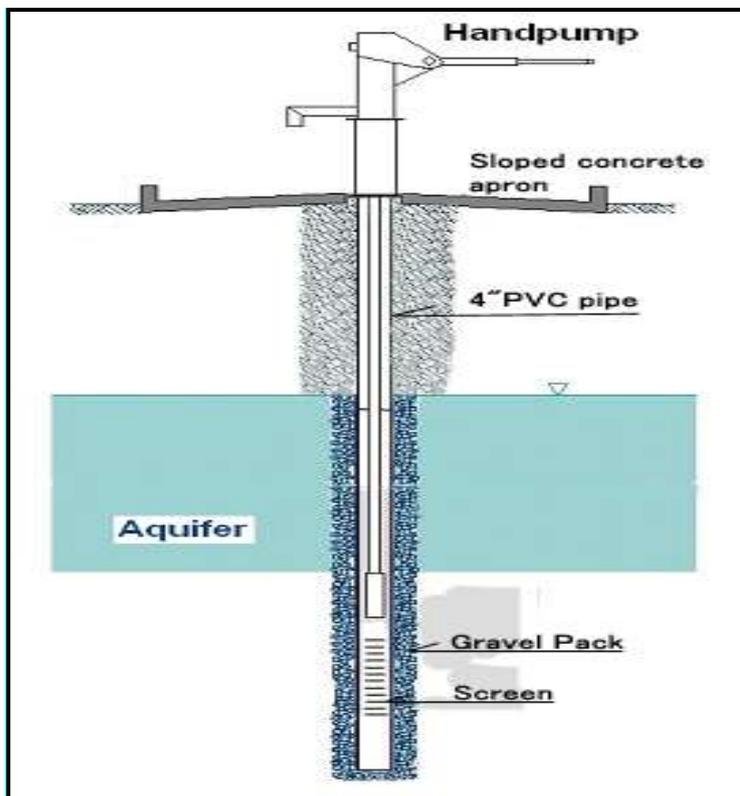
Problem	Problem Causes	Possible Solution
Collapsing well	Poor construction – usually insufficient well lining and well head	Repair/improve well lining, head wall and apron.
Well goes dry	Water level falls Water is extracted faster than the recharge rate	Deepen well – there is a limit to how deep a well can be safely excavated. This depends on the surrounding material
Well washed out by floods (in cases where well is placed in river bed)	Placing a well in a water course is risky and prone to damage due to the turbulence and force of the flood waters, and objects (e.g. logs, rocks) carried by the flood waters	Seek a safer place to construct the well – usually at the edge of the water course Alternatively, protect well from flood water by building hydrodynamic wellhead
Well silted due to	Wrong placement of	Raise the well head

	flooding	well in flood prone area or insufficient height on the well head to prevent runoff inflow	above flood level	
Step 6: Spares Tools & Technical Assistance	<p>Tools</p> <ul style="list-style-type: none"> ▪ Shovels, buckets, ropes and ladder to enable de-silting of well ▪ Masonry tools for repair to wellhead and apron. Spares ▪ Chlorine compound for well disinfection ▪ Materials for the extraction system <p>Supply Chain – O & M materials can be purchased at a well provisioned hardware store.</p> <p>Technical Assistance – De-silting a well is a task that requires experience to enter and work in the confined space of a well. This experience is usually available within the village</p>			
Review	<ul style="list-style-type: none"> ▪ What are the main risks to the water users from using the wells and drinking the well water; ▪ Have reasonable steps been identified and taken to minimize risks to water users and those drawing water? ▪ What steps should be taken to improve water quality from the wells? 			
Session Attachments	Attachment 1: Diagrams of wells			

Attachment 2: typical Hand Dug Well fitted with Hand Pump



Attachment 3: Typical Shallow well fitted with Hand pump



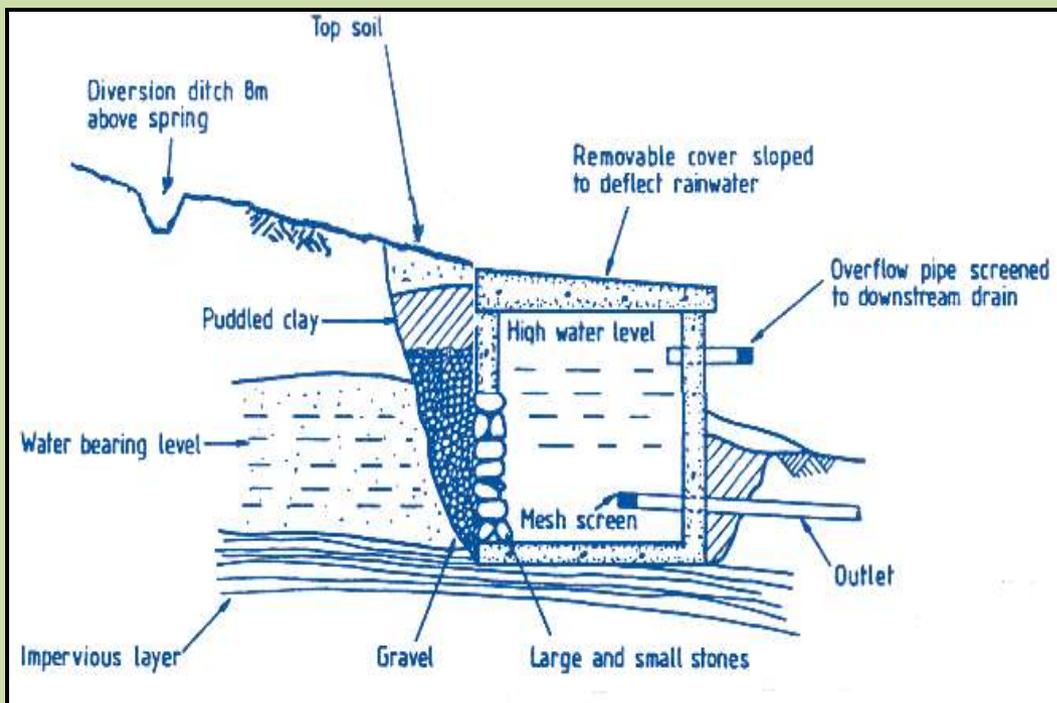
4.8 Session – C5: O&M for On-Spot Spring Chamber

MODULE – C	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
SESSION – C5	ON – SPOT SPRING CHAMBER
Introduction	This session covers on-spot spring box and appurtenant. The main parts of a spring protection are a drain under the lowest natural water level, a protective structure providing stability and a seal to protect surface water leakage. The drain usually is placed in a gravel packed and covered with sand & may lead to a conduit or a reservoir as can be seen in the figure below.
Objective	At the end of the session, the participants will be able to: <ul style="list-style-type: none"> ▪ Identify the main components of spring chamber ▪ Describe the functions of the key components ▪ Carry out spring chamber and its appurtenant maintenance
Outputs	Awareness created to carry out operation and maintenance
Timing	Session should take approximately two hours excluding the site walk
Target Group	Woreda maintenance staff, operator and WASHCO members
Methodology	This is intended to be a PRACTICAL session. The components will be taught by demonstration on the system itself. The flip chart can be used to illustrate details if necessary. Reinforce the learning by allowing participants to handle components and describe their functions to each other.
Materials	<ul style="list-style-type: none"> ▪ Valve key/wheel ▪ pipe wrench ▪ Tools – shovel, rake
Session Guide	
Step 1: System Identification	<p>1. Catchment Area Maintenance (This part is covered in Module – A of Water Safety Plan in depth)</p> <p>Discuss why vegetation is important to the catchment area:</p> <ul style="list-style-type: none"> ▪ Vegetation holds soil in place and so reduces erosion/siltation ▪ Vegetation slows down runoff and helps water to soak into soil ▪ Inspect the catchment area for signs of harmful activities (charcoal burning, over-grazing, de-forestation, etc). ▪ Discuss how the catchment area could be improved; ▪ Discuss which other institutions should be alerted in regard to catchment degradation and lobbied for collective action. <p>Note: WASHCO that rely on a catchment that extends beyond the boundary of the community will need to recognize that catchment conservation activities require a multi-stakeholder approach. WASHCO should link up or form Water resources</p>

user associations to develop a platform for collective action on catchment conservation.

2. Spring Intake Components

(See Attachment 1 for typical spring chamber)



Part	Function	Operation	Maintenance
1 Over Flow	To keep the maximum pressure balanced, in order to protect the spring protection	Over flow will withdraw automatically	No maintenance required
2 Valve Box	To protect the Outlet Valve	Open and Close by steel cover with padlock	Always keep it locked. Keep Children away <hr/> Clean the sediment
3 Outlet Valve	Controls the water flow which goes in to collection chamber/users	Always stay open, should be closed only when collection chamber is going to be cleaned up	Don't force the valve to be opened to the maximum or closed tight
4 Washout End Cap	To extract the sediment from the spring protection	It should be opened at least once a month to clean spring protection	When tighten the cap, clean up the screw by water

5 Strainer	It filter the water which goes into the collection chamber/users from sand and other external substance	Strainer operates automatically	Wash the silt on the strainer by water, when it's needed
6 Manhole	An entrance, to check and clean the spring protection when it's needed	Open the lock to enter in the spring protection to clean and maintain	Always keep it locked. Keep children away from it.

Step 2: Intake Specific O & M tasks

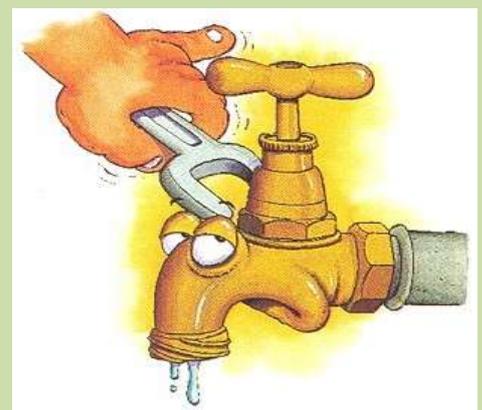
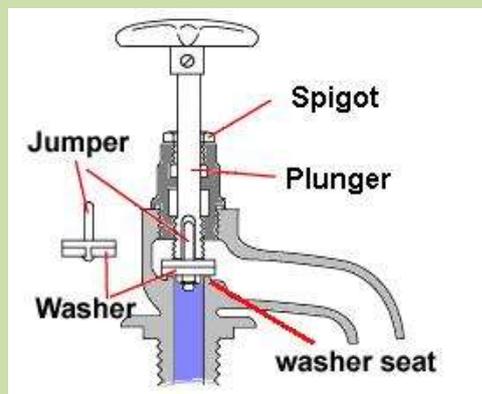
Discuss the tasks relevant to the operations and maintenance of the system components. These may include:

- Patrol catchment area for damage/harmful activities;
- Report catchment degradation to WRUA and WRMA;
- Patrol perimeter fence and repair;
- Clear weir wall and screens of any debris;
- Check walls or supports for any damage, undercutting, bypassing and repair;
- Open washout on weir wall and remove accumulated silt;
- Open washouts to clear out silt from chambers;
- Clear screen of any material and replace if damaged;
- Disinfect spring box if someone has entered;
- Read master meter.

Step 3: Routine Maintenance of Spring Box

You should do **ROUTINE MAINTENANCE** to identify and solve problems before they become big and expensive. This means replacing tap washers, repairing broken taps and pipe joints and fixing any leaks in the spring box or reservoir.

5. How to Change a Tap Washer



Box 2: Procedures for Routine Maintenance of Spring Box

- Turn off the water supply from the reservoir using the gate valve
- Open the tap to release any water pressure and release the force on the tap plunger and spigot
- Using a spanner, undo the tap spigot and remove the plunger and spigot assembly, with the washer
- Replace the washer with a new one
- Replace the plunger and spigot. Tighten gently with the spanner. **DO NOT OVERTIGHTEN**
- Open the gate valve at the reservoir to turn on the water flow
- Check the tap for leaks. If the tap still leaks, then the whole tap may need to be replaced.

Every month you should do a general inspection of the whole system. This includes:

A. The Spring Box

- Check the general condition. Are there cracks in the concrete or signs of leaks?
- Is there wet ground around the spring box? This may indicate a leak.
- Is water flowing out of the overflow pipe? If so this may indicate a blocked outlet pipe.
- Is there stagnant water around the spring box? If so proper drainage must be provided,
- Is the spring box having algae? If so clean and disinfect the spring box
- Is the spring box properly protected from external pollutants? If so properly protect the spring box.
- Open the manhole cover and look inside. Does it look clean and in good condition? Is there anything in there such as leaves, sticks or other vegetation?

Table 4-1: Summary of O&M Requirement for Spring Protection

Activity	How Often	Who by	Materials & Spare Parts	Tools & Equipment
Clean Spring surroundings	Weekly	Community		Broom, bucket, hoe, machete
Repair fence and clean surface drains	Monthly	Caretakers & Community (as necessary)	Wood, rope, wire	Machete, axe, knife, hoe, spade, pickaxe
Repair pipes and taps	As needed	Caretakers & Contractor (as necessary)	Spare pipes, valves, joints, taps, washers, cement, sand, gravel	Bucket, trowel, spanner (wrench), flat spanners
Check water quantity	Monthly	Caretakers		Bucket, watch
Check water turbidity	After each heavy rain or flood	Caretakers		
Check water quality	Annually or after repair	Contractor &/or Woreda	Laboratory supplies	Laboratory
Wash and disinfect spring	Annually or after repair	Contractor &/or Woreda	Chlorine	Bucket, wrench, brush
Repair faucets	When the need arises	Caretakers	Spare faucet and thread.	Wrench
Repair cracks	When the need arises	Caretakers	Cement, sand gravel	Bucket, trowel, hoe, spade, wheel barrow

Step 4: Troubleshooting

Discuss the potential unexpected problems, what might be the causes and the solutions.

Problem	Causes	Solution
Leaking gate valve	Worn out valve	Replace stuffing box packing in gate valve or replace entire valve
No/ little water flowing into intake chamber	Inlet pipe blocked	Inspect source and unblock pipe
Overflow from intake chamber	Gate valve blocked Blockage in pipeline (e.g. airlock) Damaged strainer Clogged strainer	Remove and clear valve (replace if necessary) Check/open nearest air Valve Replace strainer Clean strainer
Dirty water	Silt in chamber	Clean out chamber

<p>Step 5: Spares, Tools, & Technical Assistance</p>	<p>Tools - See Module D3.</p> <p>Spares – include:</p> <ul style="list-style-type: none"> ▪ Mesh for screens; ▪ Valves ▪ Masonry materials <p>Supply Chain – most intake materials can be purchased at a well provisioned hardware store.</p> <p>Technical Assistance – technical assistance should be sought if the spring source diminishes without explanation. It is important that no back-pressure is placed on the source in a spring intake otherwise the eye of the spring may shift.</p> <p>Technical assistance may be required in a spring intake if excessive or repeated erosion takes place around the chamber or sump to determine a more durable solution to the problem.</p> <p>Technical assistance should be obtained to determine a robust solution if the spring chamber frequently blocked.</p> <p>Technical assistance can be offered by the Woreda Water Office or Zone Water Office depending on the magnitude of the problem.</p>
<p>Review</p>	<ul style="list-style-type: none"> ▪ What are the main risks to the proper operation of the spring chamber? ▪ Is the WASHCO able to confidently handle the O & M tasks that are required? ▪ Are there clear issues that should be forwarded to the Woreda Water Office, Agriculture and relevant offices in regard to catchment management?
<p>Session Attachments</p>	<p>Attachment 4: Diagram of typical spring chamber</p>

Attachment 4: Diagram of typical Spring Chamber

Figure 4-1 Schematic section of spring development with spring box

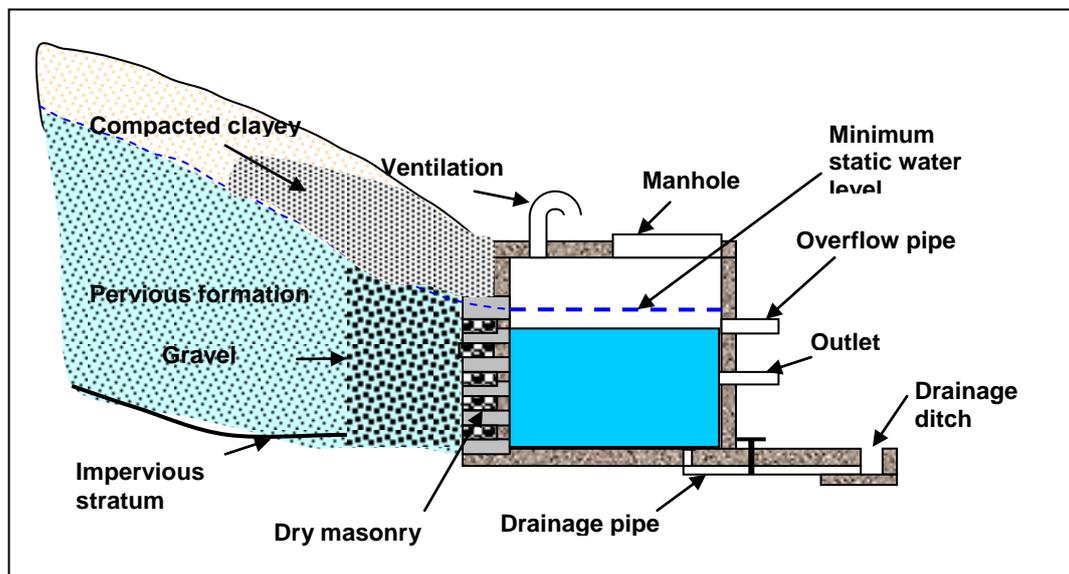
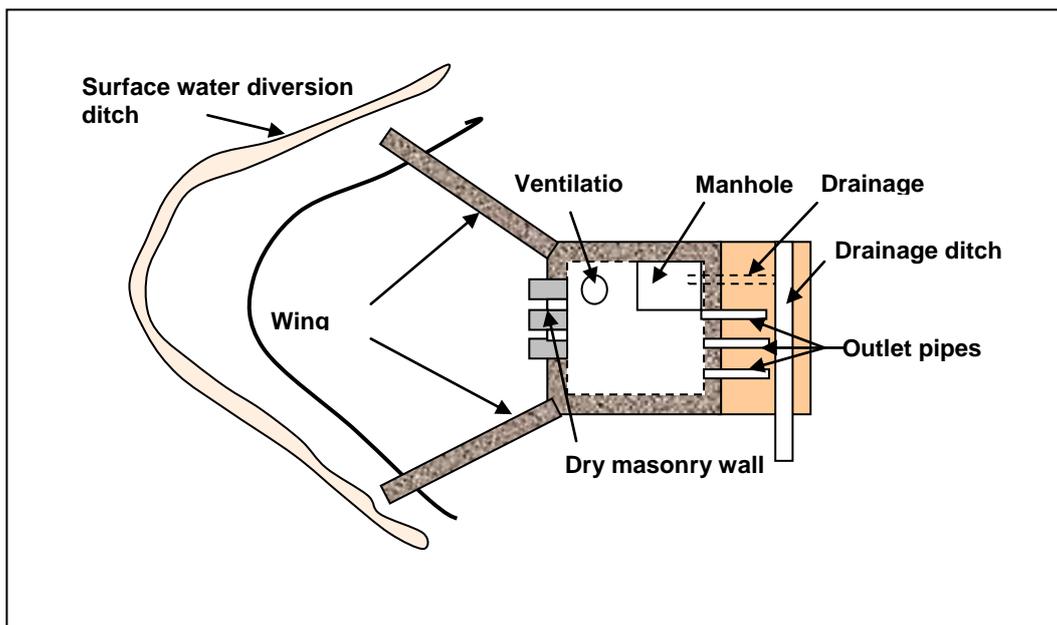


Figure 4-2: Schematic plan of spring development with spring box



4.9 Session – C6: O&M of Hand Pumps - Afridev

MODULE – C	TECHNICAL OPERATION AND MAINTENANCE REQUIRMENTS
SESSION – C6	HAND PUMP - AFREDIVE
Appropriate Facilitator Background Introduction	Water technician with experience in the operation and maintenance of the handpumps in use within the community
Introduction	<p>Many handpumps are designed to be village level operated and maintained (VLOM). Despite this, evidence shows that 25 – 35% of handpumps at any one time are not operational. This indicates that while village level maintenance is possible, there are still significant issues in the implementation of this practice.</p> <p>There are many different kinds of handpumps commonly used in Ethiopia, namely Afridev and India Mark 2 are the main pumps. This session is describes the process of preparing the Woreda Water Offices and WASHCOs to understand the importance of preventative maintenance of the two kinds of hand pump.</p>
Objective	<p>At the end of the session, the participants will be able to:</p> <ul style="list-style-type: none"> ▪ Describe the key components of the handpump and explain how it works ▪ Assemble and disassemble the hand pump without assistance ▪ Identify maintenance requirements on the hand pump ▪ Carry out routine maintenance of the key parts of the pump ▪ Recognize how poor maintenance of a handpump can reduce water yield
Outputs	An Operation and Maintenance Plan
Timing	Session should take approximately 4 hrs
Target Group	Woreda Water Office, WASHCO members and Operator
Appropriate Venue	Village handpump
Methodology	<p>This session is intended to be PRACTICAL sessions. The components should be taught by demonstration on the system itself. Reinforce the learning by allowing participants to handle parts and describe their function to each other.</p> <p>A CASE STUDY can be told as a STORY or acted as a ROLE PLAY. The purpose is to stimulate a discussion about how maintenance can keep the pump working. The story can be adapted to be more appropriate to a particular community.</p>
Materials	<ul style="list-style-type: none"> ▪ Bucket ▪ Spanner ▪ Sample handpump for demonstration purposes ▪ Fishing tool

Session Guide																	
<p>Step 1: Understanding System components</p>	<p>Start by explaining how the whole system works from aquifer to delivery spout.</p> <p>Describe the following parts and explain their purpose:</p> <table border="1" data-bbox="440 450 1422 1420"> <thead> <tr> <th>Item</th> <th>Purpose</th> </tr> </thead> <tbody> <tr> <td>Aquifer</td> <td>Source of water</td> </tr> <tr> <td>Hand dug well</td> <td>Hole that is excavated by hand to a depth sufficient to penetrate the water bearing soil/rock.</td> </tr> <tr> <td>Drilled well or borehole</td> <td>Hole that is excavated by mechanical means to a depth sufficient to penetrate the water bearing soil/rock</td> </tr> <tr> <td>Handpump</td> <td>Equipment that allows someone at the surface to manually work the pump which is lower in the well</td> </tr> <tr> <td>Apron</td> <td>Provides a firm base and foundation for the pump stand, a clean and convenient place for users to draw water and prevents waste water from re-entering the well from the immediate vicinity of the well by providing a sanitary seal around the well.</td> </tr> <tr> <td>Drain/soak away</td> <td>Drainage channel or pipe which takes excess water away and so prevents water from stagnating near the handpump</td> </tr> <tr> <td>Fence</td> <td>Prevents uncontrolled access to the well area. This is important to stop livestock polluting the well area and children from playing with the handpump</td> </tr> </tbody> </table> <div data-bbox="443 1435 1299 1509" style="border: 1px solid black; border-radius: 10px; padding: 5px; margin-top: 10px;"> <p>Allow participants to discuss the system and ask questions.</p> </div>	Item	Purpose	Aquifer	Source of water	Hand dug well	Hole that is excavated by hand to a depth sufficient to penetrate the water bearing soil/rock.	Drilled well or borehole	Hole that is excavated by mechanical means to a depth sufficient to penetrate the water bearing soil/rock	Handpump	Equipment that allows someone at the surface to manually work the pump which is lower in the well	Apron	Provides a firm base and foundation for the pump stand, a clean and convenient place for users to draw water and prevents waste water from re-entering the well from the immediate vicinity of the well by providing a sanitary seal around the well.	Drain/soak away	Drainage channel or pipe which takes excess water away and so prevents water from stagnating near the handpump	Fence	Prevents uncontrolled access to the well area. This is important to stop livestock polluting the well area and children from playing with the handpump
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<p>Step 2: About Afridev HandPump</p>	<p>The Afridev Hand Pump is suitable for lifting water up to depth of 45 m very easily. Though, it also works as more as up to 60m but it needs then more maintenance and care.</p> <p>It is suitable for boreholes with casing size of nominal 100mm, 127mm or 200 mm of internal diameter and hand Dug Well</p> <p>The AFRIDEV is a true Village Level Operation and Maintenance (VLOM) pump. All the internal moving components can be withdrawn without the necessity of removing the rising main.</p> <p>Pump Caretakers are trained to remove the internal components and replace fast wearing parts</p>																

Step 3: About Indian Mark – II HandPump

Indian Mark – II capable of drawing water from 5 to 90 meters operating depths, Long and heavy handle provides adequate mechanical advantage to reduce pumping effort, enabling even a child to operate with easy.

Easy available of spare parts.

To service an Indian Mark II, higher skills and special tools are needed which require help from qualified mechanics at village.

Step 4: Understanding the Pump Mechanism



- 1) Remove the handpump from the well (including rods and plunger and foot valve) and explain the main parts (see Attachment 7 & 8: for Afridev and Indian Mark-II Handpumps).

Above-Ground Components	1) Pump Head assembly
Below-Ground Components (also called “Down-the-Hole components)	2) Pump stand assembly
	3) Rising Main assembly
	4) Cylinder assembly
	5) Pump rod assembly
	6) Riser Main support Rope

- 2) Explain the basic components of the cylinder and how it works.
- 3) Explain how the pump rods and rising main work
- 4) Explain how the pump head works.

Reassemble pump head showing how the parts connect together. Demonstrate how moving the handle moves the rods and the foot valve up and down.

1. Components of Afridev Hand Pump and Its Functions

Components	Features
Pump Head	<ul style="list-style-type: none"> ▪ The mechanism above pump stand ▪ Sturdy mild steel box containing the handle pivot ▪ Spout length option of 580 mm to 300 mm ▪ Pump handle made from telescopic handle (hot dip galvanized) pump with special hexagonal bolt. Adjustable T-bar handles to reduce pumping effort. ▪ Welded and hot dip galvanized removable steel cover to protect bearing and object from falling in ▪ Tamper-proof, captive fasteners. Prevents loss and unauthorized interference
Pump Stand	<ul style="list-style-type: none"> ▪ Three pump stand options <ol style="list-style-type: none"> 1. Pump stand with bottom flange 2. Pump stand with 3 legs

	<p>3. Pump stand with ISO flange arrangement</p> <ul style="list-style-type: none"> ▪ Provides hygienic seal and robust design
Rising Main Pipe	<ul style="list-style-type: none"> ▪ uPVC rising main Lightweight, corrosion ▪ uPVC rising main diameter 63 mm OD with bell sockets in 3 m lengths ▪ Other option is uPVC rising main with “Bell end” in 2.9 m lengths ▪ Carries water from cylinder to the water tank ▪ The uPVC pipes are solvent cement joint ▪ Rubber stabilizer to centralize Rising main ▪ Rubber Centralizer to Cement pump rod in rising main reduces wear of rising main ▪ Rope to hold up riser pipes to the steel cone
Cylinder Arrangement	<ul style="list-style-type: none"> ▪ Brass plunger with brass foot valve or brass plunger with plastic foot valve ▪ Plastic plunger with stainless steel fitting for corrosive resistant ▪ uPVC cylinder with brass liner to provide resistance to wear ▪ Foot valve. Easily removable without disturbing the pump head cylinder, cylinder or rising main
Pump Rod Arrangement	<ul style="list-style-type: none"> ▪ The pump rod made from three option pipe materials – mild steel, stainless steel or fibre reinforced plastic ▪ Mild steel pump rods with threaded connection ▪ Stainless steel pump rods with threaded connectors ▪ Large bore suction tube reduces inlet velocity and intake of sand

2. Components of Indian Mark - II Hand Pump and Its Functions

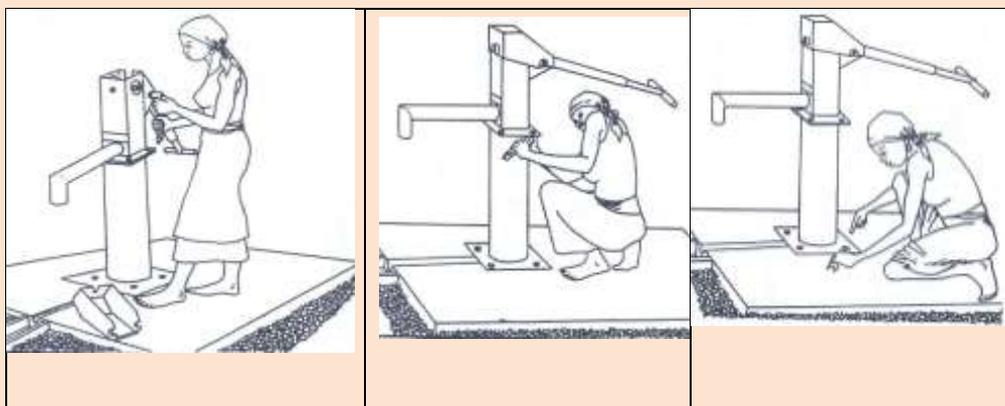
Components	Features
Head Assembly	<ul style="list-style-type: none"> ▪ The mechanism above ground level and operating the plunger ▪ Sturdy mild steel box containing the handle pivot ▪ Heavy duty handle stop ▪ Simple inspection cover secured by a single bolt ▪ Flange mounts to water tank with third plate
Handle Assembly	<ul style="list-style-type: none"> ▪ Solid bar handle to counter-balance connecting rods ▪ Ball bearings ▪ Chain linkage for gravity return of the piston
Water Tank	<ul style="list-style-type: none"> ▪ Angled spout makes ingress of debris to water tank difficult ▪ Heavy duty riser pipe holder raised above the spout to prevent ingress of debris to cylinder ▪ Flange mounts to pedestal

Pedestal (Stand)	<ul style="list-style-type: none"> ▪ 150 mm B.B. pipe pedestal fits over borehole ▪ 125 mm B.B. casing pipe ▪ Angle iron legs to ensure firm bound to a concrete base ▪ Sanitary seal created between OD of well casing and pedestal to prevent infiltration of polluted water to well
Connecting Rods	<ul style="list-style-type: none"> ▪ Provided linkage between pump head and cylinder ▪ Mild steel brighter bar, electro-galvanized for surface protection ▪ Threaded rods with hexagonal coupling and check nut ▪ 3 meter length for ease handling
Cylinder Assembly	<ul style="list-style-type: none"> ▪ Contains plunger, valves, etc lifting water upward in each stroke ▪ Cast iron case for low cost and to protect brass liner ▪ Brass liner with smooth finish to prolong Nitrile Rubber bucket washer life ▪ Nitrile Rubber seated valve poppet's for effecting sealing
Riser Pipes	<ul style="list-style-type: none"> ▪ Carries water from cylinder to the water tank ▪ 32 mm NB medium grade galvanized pipe in 3 meter lengths to facilities ▪ Installation and repair using hand tools

Step 5
Preventive, Breakdown and Curative Maintenances

Explain the difference between:

- ☞ **Preventive Maintenance (Planned Maintenance)**
- ☞ **Corrective Maintenance (Breakdown Maintenance)**
- ☞ **Crisis maintenance (unplanned maintenance)**





Preventative (Planned) Maintenance:

1. Undertaken while the system is in operation;
2. Scheduled at an interval to pre-empt any failure of parts;
3. Involves the replacement of parts before they have completely worn out and exceeded their life span;
4. Intended to keep systems working without any unexpected breakdowns; it focuses on improving system reliability.

Corrective (Breakdown) Maintenance:

1. Undertaken only after the system has broken down/defected;

Crisis (Unplanned) Maintenance:

1. Un-planned responses to emergency breakdowns and user complaints to restore a failed supply.
2. It demanding additional financial budget (contribution from the community)

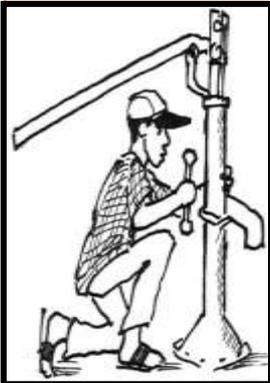
Allow participants to discuss the advantages and disadvantages of each type of maintenance service.

The steps in preventive maintenance are:

- Understand if a pump is functioning properly. If it is not, then understand the nature of the problem and identify the solution required.
 - Checking the discharge of the pump: This is done by observing whether the discharge rate of water from the pump is adequate and timely. This gives a very good picture of the condition of the Below ground components of the pump – the cylinder, the riser pipe and connecting rod assemblies.
 - Checking the physical condition of the pump: This is done by observing the movement of the handle, looking for external signs of wear and tear, rusting, condition of components such as nuts & bolts, flanges, handle and handle bracket, chain, etc. These observations give the condition of the Above-ground components of the pump.
- Dismantle the pump for maintenance, if necessary and reassemble it after replacing the defective components or the components that have reached their serviceable life span;

	<ul style="list-style-type: none"> ▪ Maintain a record of the maintenance history and observations of pump condition for each pump in a given area (See Attachment 2: Handpump Maintenance Record).
<p>Step 6: Operation and Maintenance Tasks</p>	<p>Explaining the following 10 points are the major tasks of the Caretaker of their wells and pumps:</p> <div style="border: 1px solid black; border-radius: 20px; padding: 10px; margin: 10px 0;"> <ul style="list-style-type: none"> ☞ ORGANISING THE WORK. Talk to and work with the other caretaker(s) so that you help each other and share the work load. ☞ WORKING WITH THE WaSHCO, so that your work and theirs help keep the pump operating ☞ INSPECTING THE PUMP every week and every month ☞ CONDUCTING ROUTINE MAINTENANCE – tightens nuts and replaces worn out parts such as the U-seal, the O-ring and the bearings. </div> <div style="border: 1px solid black; border-radius: 20px; padding: 10px; margin: 10px 0;"> <ul style="list-style-type: none"> ☞ IDENTIFYING AND SOLVING MINOR PROBLEMS. ☞ GETTING HELP FROM THE WOREDA WATER RESOURCE OFFICE TO SOLVE MAJOR PROBLEMS ☞ KEEPING TOOLS IN GOOD CONDITION, AND BUYING & STORING SPARE PARTS ☞ KEEPING RECORDS – of parts and repairs ☞ ENSURING THE PROPER USE OF HAND PUMP and WELL ☞ INITIATING AND OR ORGANISING THE COMMUNITY FOR GENERAL SITE MAINTENANCE. </div>

Step 7: Operation and Maintenance Schedule



In discussion with the community members, formulate an O & M Schedule for all the handpumps within the community.

1. Maintenance of Pump Surroundings

The hand pump platform should offer good protection to the water source because; it seals off the well from surface contamination. However, contamination can still occur, if:

- ☞ the platform and drain are cracked or broken,
- ☞ the pump stand had become loose in its foundation,
- ☞ waste water accumulates in the close vicinity of the well,
- ☞ solid waste is disposed near the well in a garbage dump,
- ☞ animals (and humans) defecate close to the well,
- ☞ the well is in the natural drainage path and the platform is prone to flooding during rains

All of the above should be prevented/ corrected/ repaired.

1.1 Weekly Inspections

Every WEEK you should check the parts on the head of the pump

- Check that the flange bolts and nuts are tight.
- Check that the Fulcrum Pin nuts and Hanger Pin nuts are tight
- Check that the handle moves smoothly, moves for its full arc, and water comes out when the handle is operated.

1.2 Monthly Inspections

- Check if any nuts, bolts of parts in the pump head are missing. Replace any missing parts.
- Check if there is any unusual noise when the pump is operated. Refer to the Trouble shooting Chart and correct the problem.
- Check if the pump is loose in its foundation (or foundation bolts even if the bolts are tight), this can allow contaminated waste water to enter the water source. Repair the platform, allowing time for the cement to set properly, before the reusing the pump.
- Check if the pump is yielding adequate water. This is done by conducting the Discharge Test.
- Check if there is leakage in the pump. If more than 5 strokes are required before the pump begins to yield water, it means that the water level is dropping in the riser pipe due to a leakage.
- Reduction of discharge and leakage in the pump could be due a number of reasons such a leak in a pipe joint, a small perforation in the riser pipe wall, worn out bobbin valves or a leakage at the “O” ring in the foot valve. The procedures for conducting the Discharge Test and the Leakage Test are described in details in Step 4 above.
- Repairs to the rising main require a skilled mechanic with the proper equipment. It should not be attempted by the Caretaker alone.

1.3 Annual Maintenance Tasks:

- Replace fulcrum/hanger bearings
- Replace plunger seal and plunger bobbin
- Replace foot valve bobbin and foot valve “O” ring.

To reiterate, it is important for the handpump caretaker to:

- regularly check all nuts and bolts are tight and that the movement of the handle is smooth, complete and yields water,
- perform the Leakage and Discharge Tests and records the results,
- check the platform and drain for cracks and breaks, the pump stand should be firm,

- eliminate collection and stagnation of waste water near the pump by keeping the drain clean, by filling with earth and draining,
- maintain the fence, if any, around the pump to prevent animals from coming close to the pump,
- keep the pump surroundings clean at all times,
- instruct and motivate users to keep the pump surroundings clean and dry and to use the pump properly
- Check perimeter fence and repair as required
- Assist in taking water quality samples for analysis
- Assist in disinfecting the well
- Assist in de-silting the well

Step 8: Testing Hand Pump Performance

1. Demonstrate the Leakage test and the Discharge Test

- Explain the purpose of the two tests which is to determine whether there is a downhole problem with the pump and the nature and extent of the problem.
- Leakage in the rising main indicates worn bobbin or O-ring on the foot valve, disconnected rising main joints or cracked riser pipes;
- Low discharge indicates a problem with the bobbins or the cup seal.



STROKE/LEAKAGE TEST

Do this test early in the morning before anyone has used the pump. Count the number of full strokes before water comes. If the number of strokes increases from last month, or it takes longer than a few minutes for water to come, you should check the foot-valve.

Procedure of Leakage Test:

1. Operate the pump handle until water is flowing from the spout
2. Stop operating the pump handle for approximately 30 minutes
3. Then operate the handle and count exactly how many strokes required until the water is starting to flow again.

If more than 5 full handle strokes are required to make the water flow again, there must be a leakage in the rising main or the footvalve.

Leakage mostly occurs because of worn bobbin or o-ring of the footvalve, disconnected rising main joints or perforated or cracked riser pipes.

- Leakage can be caused by a leak in a pipe joint, a small perforation in the riser pipe wall, worn out bobbin valves or a leakage at the “O” ring in the foot valve.
- The cause of the leakage then needs to be diagnosed and corrected. Proceed

with maintenance steps outlined in the Attachment 3: Trouble Shooting Chart for Afridev Handpump.

 **Report this problem immediately to the pump mechanic and ask for rectification!**

BUCKET/DISCHARGE TEST

Count the number of strokes to fill a bucket. You should always use the same size bucket for this test. If the number of strokes increases a lot, then change the U-seal.

- After completing the Leakage Test, the Discharge Test should start after the pump is producing water continuously when the pump handle is operated.

Procedure for Discharge Test:

- When water is flowing continuously, it should be collected in a container or bucket for 40 continuous and full strokes of the pump handle.
- Measure the quantity of water collected. Ideally, the water collected should not be less than 16 litres.
- If the discharge is less than 10 litres, then it has dropped to lower than acceptable limits and the pump needs to be repaired.

- Discharge can fall if the plunger U seal or bobbin valve are worn out, the foot valve “O” ring or bobbin valve are leaking or if there is a significant leak in the riser pipe.
- A leak in the riser pipe can be further confirmed by the Leakage Test.
- Proceed with maintenance steps outlined in the Trouble Shooting Chart.

Step 9: Trouble Shooting

Discuss the potential unexpected problems and what might be the cause. See Attachment below for Trouble Shooting Chart for detailed.

1. For Afridev

Trouble		Cause	Remedy
No Water	Handle operation is easy	▪ Pump rods are disconnected	▪ Pull out all pump rods and replace broken and corroded rods
	Handle operation is difficult	▪ Riser pipe disconnected,	▪ Pull out complete rising main repair/replace pipes (solvent cement) joints

	Handle operation is normal	<ul style="list-style-type: none"> ▪ U-seal or cup seal is defect ▪ Borehole is clogged (split or sand), ▪ Water level dropped below cylinder 	<ul style="list-style-type: none"> ▪ Replace seal, ▪ Rehabilitation of borehole (cleaning with compressed air or by bailing) ▪ Add riser pipes Bobbins (plunger and Foot valve)
Delayed water flow	Handle operation is normal	<ul style="list-style-type: none"> ▪ Leaking of valve Bobbins, ▪ Leaking of Foot valve O-ring ▪ Leaking in pipe joint or rising main pipe is perforated, 	<ul style="list-style-type: none"> ▪ Check and replace Bobbins (Plunger and Foot valve), ▪ Replace O-ring, ▪ Pull out complete rising main, repair/replace pipes (solvent cement joints),
	Handle Operation is difficult	<ul style="list-style-type: none"> ▪ U-seal or Cup seal is too tight 	<ul style="list-style-type: none"> ▪ Replace with seal correct size
Reduced Discharge	Handle operation is normal	<ul style="list-style-type: none"> ▪ Full stroke is not possible ▪ U-seal or Cup seal is worn ▪ Leaking or valve Bobbins ▪ Leaking of the cylinder (cracked) 	<ul style="list-style-type: none"> ▪ Check and adjust length of the top rod ▪ Replace seal ▪ Check and replace Bobbins (plunger and Foot valves) ▪ Pull complete rising main, repair/replace cylinder (solvent cement joints)
	Handle operation is normal	<ul style="list-style-type: none"> ▪ Pump rods rubbing on riser pipes ▪ Pump rod centralizer worn 	<ul style="list-style-type: none"> ▪ Check and replace worn pump rod centralizers ▪ Check and straighten bent pump rods, replace worn pump rod centralizers
Abnormal Operating Noise	Handle operation is inconvenient	<ul style="list-style-type: none"> ▪ Pump rods are toughing riser pipes ▪ Bearing are worn, handle fork touching the sides of pump head 	<ul style="list-style-type: none"> ▪ Straighten or replace ben pump rods, replace worn pump rod centralizers ▪ Check and replace bearing sets (4 off)
	Handle is shaky when operated	<ul style="list-style-type: none"> ▪ Bearing are worn ▪ Fulcrum pin is loose 	<ul style="list-style-type: none"> ▪ Check and replace bearing sets (4 off) ▪ Check Fulcrum pin (and Bearing sets tighten both nuts fully) ▪ Check hanger pin (

		Hanger pin is loose	and bearing sets) tighten both nuts fully
	Pump head shaky	▪ Flanges are loose	▪ Tighten all bolts and nuts of the flanges
	Pump stand is shaking	▪ Pump platform is cracked	▪ Repair pump platform or well cover (for dug wells)

2. For Indian Mark – II

Trouble	Cause	Remedy
Pump hand works easily but no flow of water	<ul style="list-style-type: none"> ▪ Water level gone down below the cylinder assembly, ▪ Worn out cylinder leather cup washer, ▪ Connection rod joint disconnected ▪ Valve seats worn out, ▪ Pump cylinder cracked 	<ul style="list-style-type: none"> ▪ Add more pipes and roads, ▪ Overhaul the cylinder and replace the leather cup washer, ▪ Pull out the pump and join the connecting rod where necessary, ▪ Replace valve seats
Delayed flow or small flow	<ul style="list-style-type: none"> ▪ Damaged/leaking rising main, ▪ Leaking in cylinder check valve or upper valve, ▪ Rubber cup washers worn out. 	<ul style="list-style-type: none"> ▪ Replace the damaged/leaking pipe or disconnect the affected rising main, ▪ Overhaul cylinder. Replace worn out rubber seats or bend check valve seats.
Folding of chain during return stroke	<ul style="list-style-type: none"> ▪ Improper erection. Top rod above water tank flange level (Top flange) ▪ Rubber cup washers getting jammed inside the cylinder, 	<ul style="list-style-type: none"> ▪ Adjust the length of top connecting rod suitably, ▪ Overhaul the cylinder and replace rubber cup washers if damaged or replace the cylinder body if deformed.
Noise during operation	<ul style="list-style-type: none"> ▪ Stand assembly flange not leveled properly, ▪ Bearing worn out ▪ Bent connecting rod, ▪ Hexagonal coupler welder offset 	<ul style="list-style-type: none"> ▪ Level the flange using spirit level, ▪ Replace ball bearing, ▪ Straighten the rod, ▪ Replace spacer
Shaky Handle	<ul style="list-style-type: none"> ▪ Loose handle axle nuts, ▪ Worn out ball bearing, ▪ Spacer damaged or short in length, ▪ Bearing loose in the bearing housing 	<ul style="list-style-type: none"> ▪ Tighten handle axle nuts, ▪ Replace ball bearings, ▪ Replace spacer, ▪ Replace the handle assembly

Step 10: Spare Parts, Tools and Technical Assistance

Discussion Questions:

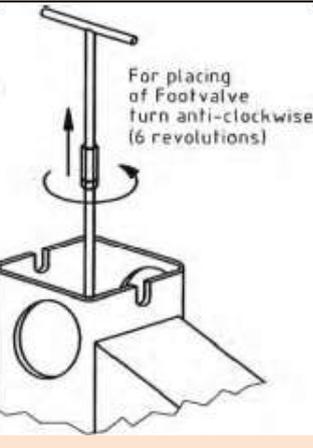
1. What spare parts are needed for routine maintenance?
2. What tools are needed for routine maintenance?
3. Where are these spares and tools available?
4. If the system requires major repairs where will they find a technician to repair the system?

The facilitators should discuss with the committee members about possible sources of spares and technical assistance if they are not familiar with all the possibilities.

Tools

The tools for Afridev and India Mark 2 are slightly different.

Afridev Tools:

		
24 size spanner for M16 hexagonal nuts	Fishing tool for retrieving foot valve	Connecting Tool

- Rod Resting Tool to be used when the cylinder installation depth is of the order 30 m to 45 m, the total weight of pump rods is heavy.

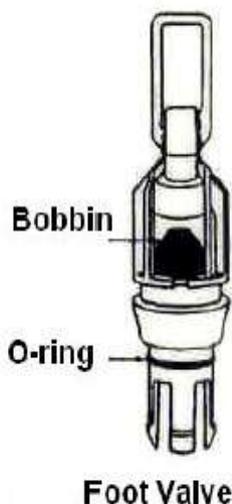
India Mark – II:

- 19mm spanner

Spares:

- Fulcrum pin
- Bobbin
- O-ring
- Pump Washer

2 Bearings		'U' Seal	
Bobbin		'O' Ring	



- Cup seals
- Bearing bushes

Supply Chain- You should buy and keep some of these FAST MOVING ITEMS in your village so that when they wear out or break you can replace them straight away without having to wait until someone can go and buy them. In addition, obtain contact name & phone number for handpump maintenance provider:

	Name and Contact of Local Service Provider/Technician (1)	Name and Contact of Local Service Provider/Technician (2)
Name		
Phone No.		

Technical Assistance: Technical assistance may be required if the well goes dry to ascertain whether the well should be deepened.

Rules of Utilizing of Schemes

Teach everyone, including children, how to use the pump properly. This will prevent the pump from becoming damaged and will save your community lots of money on parts and repairs.

Call a community meeting and agree on the rules for how the pump should be used.

Box 3: Rules of utilizing Schemes

The following is an example of some of the rules you should agree to:

- ☞ Operate the pump handle until a continuous water flow has been achieved (pump ratio approximately 40 full strokes per minute).
- ☞ When pumping, stand directly behind the pump
- ☞ Use full strokes, not short strokes
- ☞ Don't bang the handle
- ☞ Do not let children play on or around the pump
- ☞ Do not let animals near the pump. Fence around the pump to prevent animals getting near.
- ☞ Do not allow clothes washing at the pump. This should be done away from the pump.

- ☞ Do not allow people to wash themselves at the pump. This should be done somewhere else.
- ☞ If children are going to collect water, then put a block for them to stand on when pumping.
- ☞ If the pump is showing signs of a problem, stop using it until the problem is identified and solved.

These are just some of the rules you should discuss with water users community. Make sure everyone understands and agrees to the rules.

Everyone is a CARE-taker

The pump belongs to everyone in the community and so everyone is responsible for its care. If it breaks down, everyone suffers.

Everyone who uses the pump should help you care for it. They should do:

- ☞ Use the pump properly
- ☞ Inform the caretakers when they see a problem
- ☞ Help the caretakers solve the problem
- ☞ Help to clean and maintain the pump site

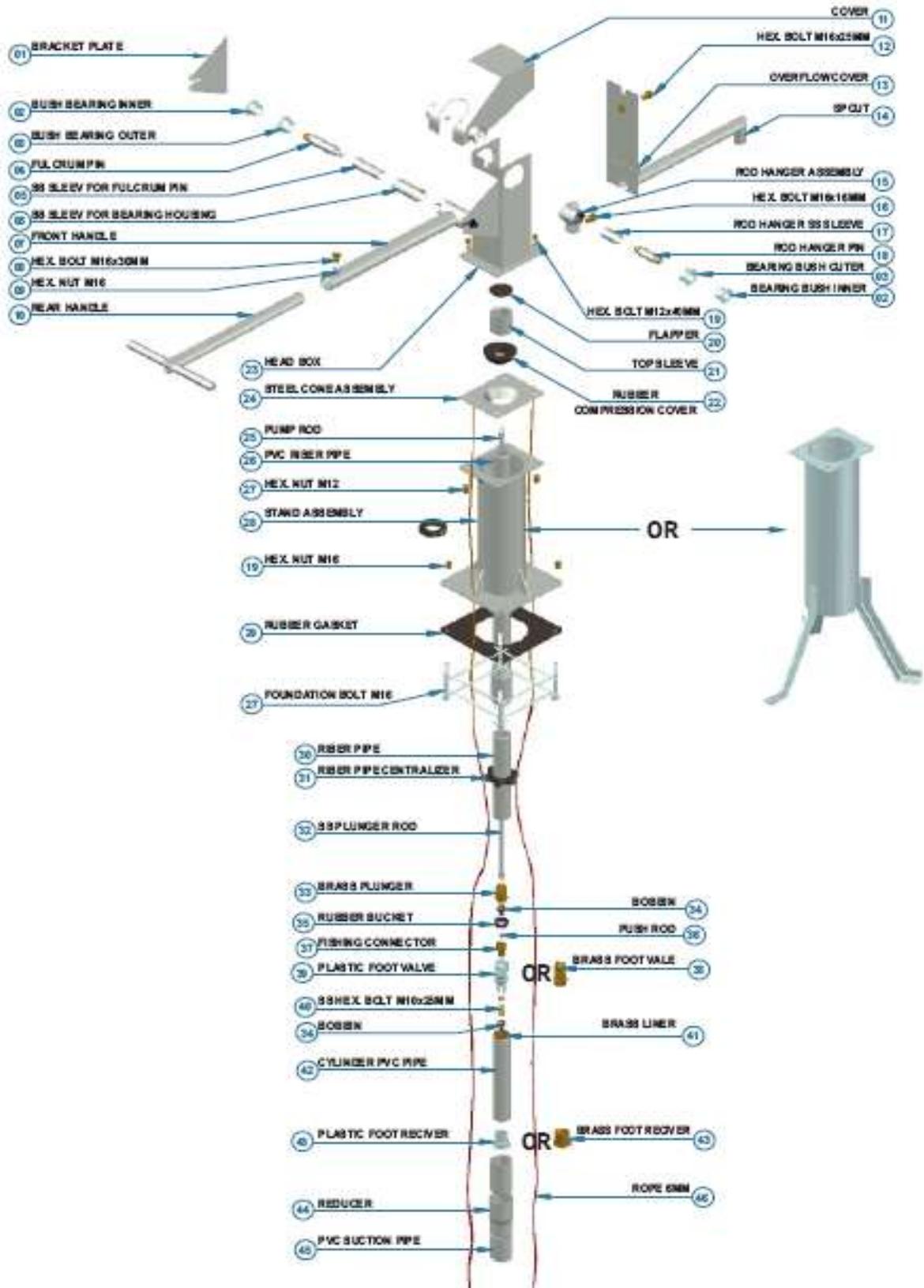
You can get the pump users – especially the women - to check the pump everyday when they collect water. Some things they can **LOOK** and **LISTEN** for include:

Everyone who uses the pump should help you care for it. They should do:

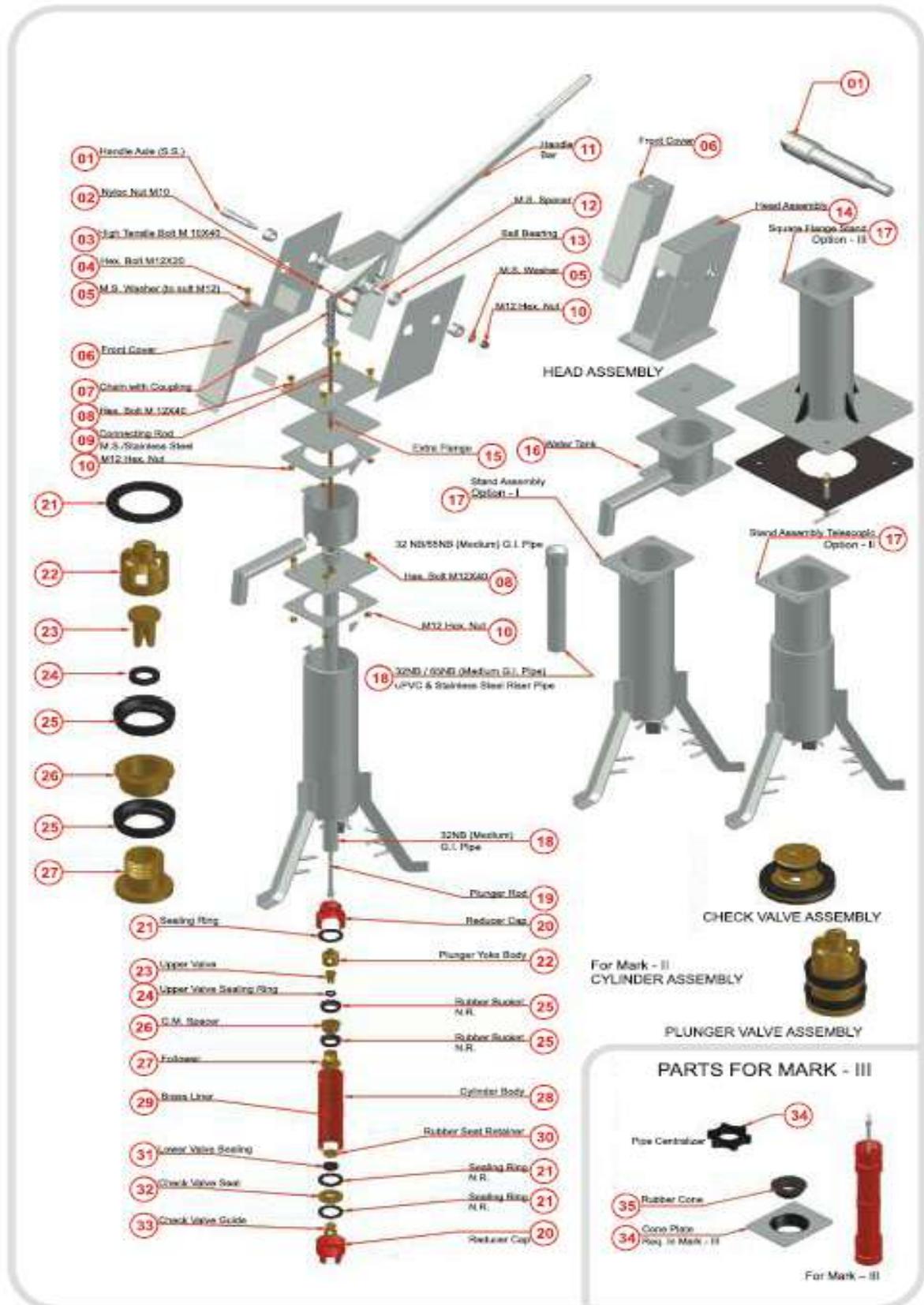
- ☞ REDUCED WATER FLOW
- ☞ DELAY IN WATER COMING FIRST THING IN THE MORNING
- ☞ LOOSE HANDLE
- ☞ PUMP DIFFICULT TO OPERATE
- ☞ LOOSE NUTS

Review	<ul style="list-style-type: none"> ▪ Are the participants familiar with how a handpump works and the need for ▪ Preventative maintenance? ▪ <input type="checkbox"/> Has the handpump caretaker or maintenance person demonstrated the ability to remove, examine, repair and re-install the handpump? ▪ Has the community established bylaws on proper use and care of the handpump?
Session Attachments	<p>Attachment 5: Diagram of Afridev Handpump</p> <p>Attachment 6: Diagram of Indian Mark – II Handpump</p> <p>Attachment 7: Handpump Maintenance Record</p> <p>Attachment 8: Trouble Shooting Chart for Afridev Handpumps</p>

Attachment 5: Diagram of Afridev Handpump



Attachment 6: Diagram of Indian Mark – II Handpump



Attachment 7: Handpump Maintenance Record

Village/ Community	
Location/ sub-location	
Division/ District	
GPS References	N/ S E
Handpump Type	<input type="checkbox"/> Afridev <input type="checkbox"/> India Mark II Other:
Hand Pump Code/ Serial No:	

Preventive Maintenance - Results of Discharge & Leakage Tests

Date	1 st Observation Leakage - Strokes	2 nd Observation Discharge - Litres	Remarks

Maintenance Interventions

Date	Complaints	Date repaired	Parts replaced	Costs & Remarks*

Attachment 8: Trouble Shooting Chart for Afridev Handpump

Problem	Indication	Cause	Corrective Steps
Reduced discharge, confirmed by the Discharge Test	Handle is difficult to operate	Cup seal is tight	Replace Cup seal
	Handle operation is normal	Complete stroke not available	The check for the correct length of pump rods has to be made every time the below-ground assembly is dismantled for repairs. Adjust the length of the top rod to get the full movement of the handle. Correct the stroke by adjusting the length of rod as described earlier
		Plunger seal defective/ worn out	Pull out rods, with plunger and foot valve. Examine the Plunger seal, Foot valve "O" ring and both the bobbins and sealing surfaces. Replace worn parts and reinstall rods.
		Bobbins worn out	
Leakage in the foot valve "O" ring			
Delayed flow, confirmed by the Leakage Test	Handle operation is normal	Complete stroke not available	Correct the stroke by adjusting the length of rod as described earlier
		Leaky valves or leaking foot valve "O" ring	Pull out rods, with plunger and foot valve. Examine the foot valve "O" ring and both the bobbins and sealing surfaces. Replace worn parts and reinstall rods.
		Leakages in pipe joints	Take out the riser mains and look for a leakage. This could be due to external abrasion of pipes if the bore hole is not fully cased and/or if pipe centralizers have not been used. Perforation of PVC pipe from inside is also possible if rod centralizers have not been used and rod couplings have cut through the pipe from inside. Cut off the riser at the point of leakage, examine the inside of the pipe carefully for signs of wear, replace/ repair the defective part/s of the riser main, following the pipe repair procedure.
Pump handle shaky	Handle is shaky when operated	Fulcrum Bushes are worn	Replace fulcrum bushes
		Fulcrum pin loose	Tighten nuts fully
		Hanger pin loose	Tighten nuts fully
	Pump head is shaking	Loose flange bolts	Tighten flange bolts and nuts
	Pump stand is shaking	Loose pump stand, cracked	Repair platform

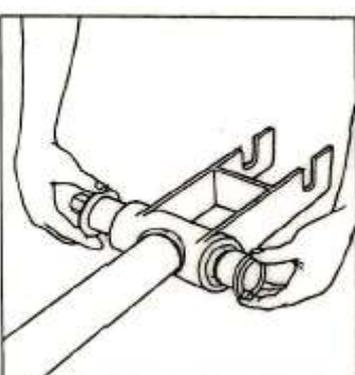
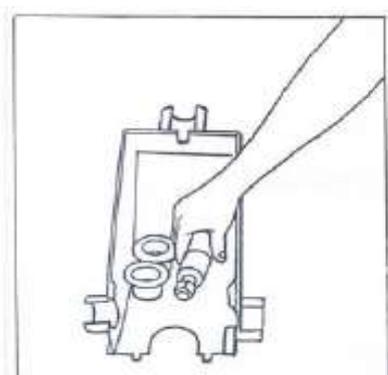
Problem	Indication	Cause	Corrective Steps
		platform	
Abnormal noise during operation	Handle operation is normal	Rods rubbing against pipes; centralizers worn out	Ensure that the rods are straight. Replace rod centralizers.
	Handle is rough/ uneven to operate	Rods bent and rubbing,	Replace rods with good ones. Straighten bent rods if replacement rods are not available.
		Worn out fulcrum bushes, handle fork touches pump head	Replace fulcrum bushes
No Water	Handle is very easy to operate, virtually free	Pump rods have disconnected	The rods feel very free to lift. Pull out all rods till the broken/ disconnected rod joint comes out. Insert a small rod fishing tool into the riser pipes to extract the remaining rods, till the plunger assembly comes out. Replace the damaged rod/s (or rethread rod joint/s) and reinstall the plunger and rods as described in the Installation manual.
			Alternative: If no rod fishing tool is available, pull out the rod till the broken joint. Counting the number of rods that have come out, pull out the riser pipes for at least the length of rods pulled out earlier. Then pull out the riser pipe for least 3 m more (one pipe length) to be sure that remaining rods can be reached. Cut off the riser pipe to expose the remaining rods. Then pull out all the remaining rods till the plunger comes out. Use a repair socket with solvent cement to join the cut riser pipes. Allow the join to cure and lower the riser pipes. Now replace the damaged rod/s (or rethread rod joint/s), and proceed to reinstall plunger and the rods.
	Handle is	Riser pipes have disconnected	Pull out the rods. The plunger should come up to indicate that the rod connections were intact. Remove the pump head and lift the cone flange. Carefully loosen the supporting ropes, keeping them taut. Lower the ropes a little to see if the tension on the ropes slacken – in which case the pipes have not disconnected. If the ropes go down and the tension remains on the ropes, then it indicates that the pipes have disconnected but is still hanging on the ropes. Anchor the ropes to bolts on the pump stand flange. Pull out the riser pipes that are attached to the cone. The length of riser pipes that come out would be shorter than the rods and the cylinder would be missing. A comparison of the lengths of the riser pipe and the rods will give an indication of the length of riser pipes that are now hanging by the support ropes. Pull out both end of the support rope evenly till the broken/ disconnected end of the riser pipes comes up. Then pull up all the remaining riser pipes. When the entire length of the rising main has been accounted for, examine the riser pipe

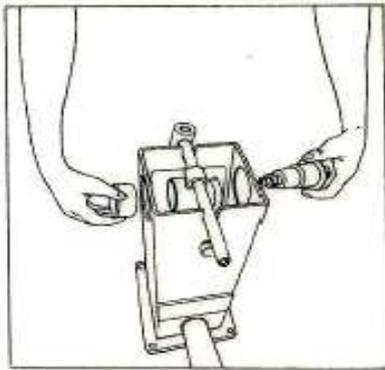
Problem	Indication	Cause	Corrective Steps
No Water (Contd.)	very easy to operate, virtually free (contd.)	Riser pipes have disconnected (contd.)	<p>thoroughly for any other damage. Cut off damaged parts and repair the rising main. Reinstall cylinder and riser pipes, taking care to repair the broken part carefully.</p> <p>A pipe fishing tool may have to be used in case the riser pipes do not come up with the support ropes. This may happen in case the upper end of the riser pipe fouls with the bore wall or the lower end of the casing pipe. Fishing will also be required if the support ropes have failed and the pipes have dropped to the bottom of the well.</p> <p>Alternative: If fishing is not possible or is unsuccessful, then consider installing new riser pipes and cylinder. This will be determined by the Static Water Level (SWL) in the bore well and the total depth of the bore. The bore should be deep enough and the SWL should be high enough to accommodate a new riser main and cylinder. Be sure to record these details on your repair work record.</p>
		Plunger seal defective Bobbins worn out	Pull out rods, with plunger and foot valve. Examine the Plunger seal, Foot valve "O" ring and both the bobbins and sealing surfaces. Replace worn parts and reinstall rods.
	Handle operation is normal	Riser pipes have disengaged	<p>Pulling out the rods does not reveal any problem.</p> <p>Remove the pump head and lift the cone flange.</p> <p>Untie the ropes very carefully and anchor them securely to the pump stand flange with anchor bolts. Lift the riser main out. As it comes out, the support ropes WILL NOT GO SLACK confirming that there is still weight suspended on the ropes. The final confirmation of a disengaged riser will be possible when only a short (in comparison to the rods) length of risers come out.</p> <p>After this, the support ropes have to be pulled out uniformly on both sides, to bring out the remaining length of rising main from the bore.</p> <p>When the entire length of the rising main has been accounted for, examine the riser pipe thoroughly for any other damage. Cut off damaged parts and repair the rising main. Reinstall cylinder riser pipes as per installation instructions, taking care to repair the broken part carefully.</p> <p>Fishing may have to be attempted as described earlier.</p>
		Water level has dropped below the cylinder	<p>Remove rods and plunger. Examination of plunger shows no defects. Remove riser pipes with cylinder. This assembly too shows no defect.</p> <p>Measure the SWL with plumb line. Also measure the total depth of the bore to judge if space is available for more riser pipes, i.e., a deeper cylinder setting.</p> <p>Compare the depth of SWL with the length of pipes pulled out. The pipes (including cylinder) should measure less than the SWL. This confirms that the water level has dropped below the cylinder level. Add at least one pipe to the riser mains and one rod or more, if the well depth can accommodate more riser pipes.</p>

Annexes

Annex A: Afridev Hand Pump Maintenance and Repair Sheet

A) Maintenance and Repair Sheet-1

 <p>1. Before starting, wash your hands and fill some buckets with clean water for cleaning parts.</p>	 <p>2. Loosen the pump head cover bolt</p>	 <p>3. Take off the cover</p>
 <p>4. Loosen both hanger nuts</p>	 <p>5. Loosen both fulcrum nuts</p>	 <p>6. Put spanner through hanger eye</p>
 <p>7. Raise and withdraw handle. Take care! As you remove the handle make sure the bush bearings and pin do not fall out as they may break on the floor.</p>	 <p>8. Remove fulcrum pin and bush bearings.</p>	 <p>9. Place all parts in cover for safe keeping</p>



10. Remove hanger pin and bush bearings



11. Pull up the hanger and first rod.



12. Slide the rubber centralizer where the rods join.

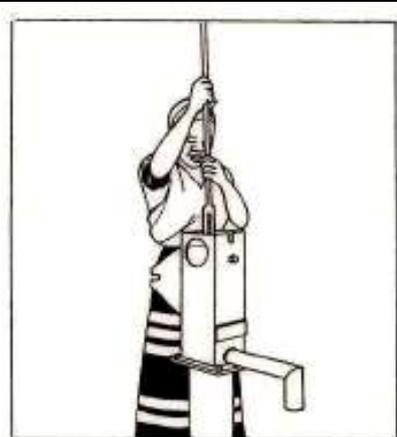
B) Maintenance and Repair Sheet-2



13. Disconnect and remove all rods. Remember to keep the rods in the same order. The last rod taken out should be the first rod put back..



14. Remove the plunger



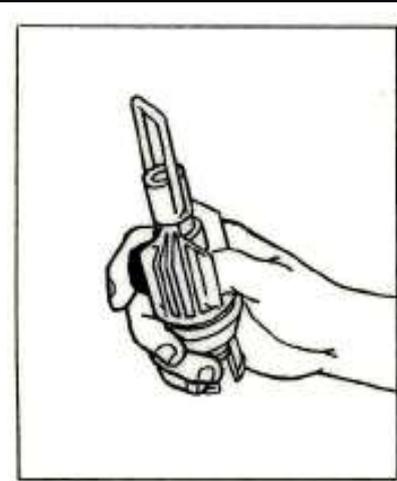
15. Lower the fishing tool and connect to the rods



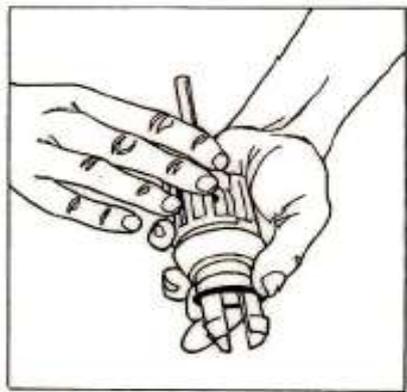
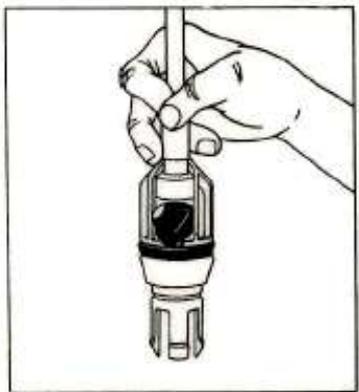
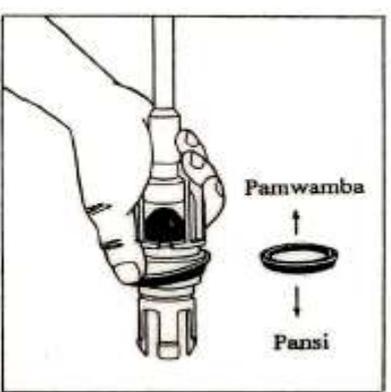
16. Gently lower the last rod and hanger until you feel that you have caught the foot valve



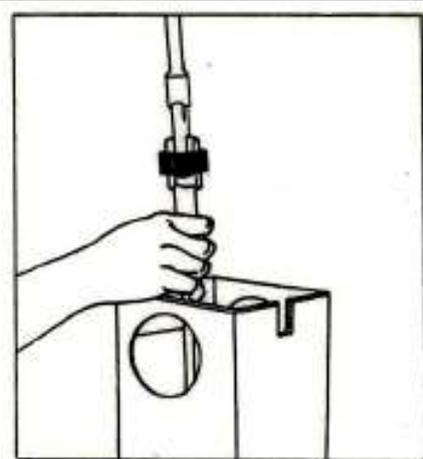
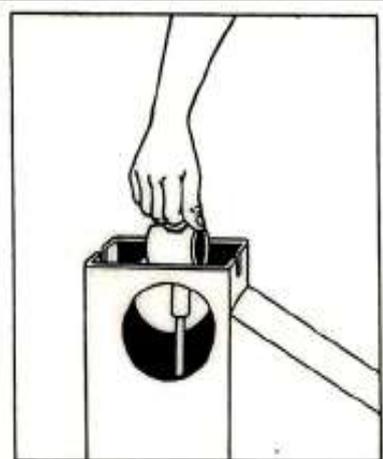
17. Remove all the rods, the fishing tool and the foot valve

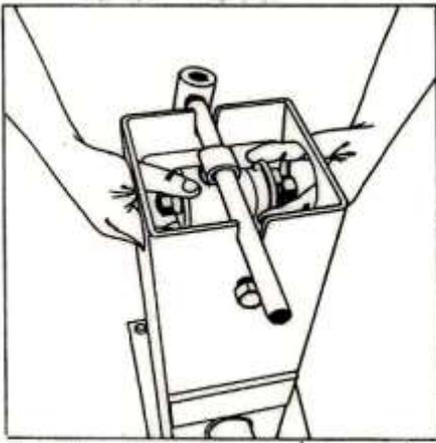


18. Push out the bobbin from the foot valve with your thumb. If the bobbin is damaged, replace it with a new one.

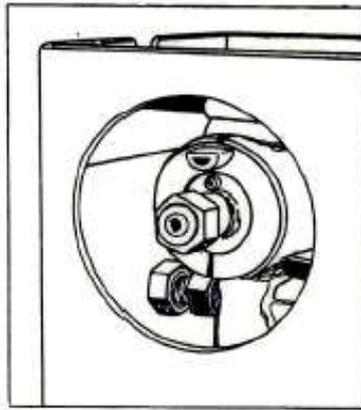
		
<p>19. Remove the O-ring from the foot valve. If the O-ring is damaged, replace it with a new one</p>	<p>20. Push out the bobbin from the plunger with your thumb. If the bobbin is damaged, replace it with a new one</p>	<p>21. Carefully remove the U-seal. If it is damaged, replace it with a new one. Make sure the groove faces upwards</p>
		
<p>22. Wash the foot valve, plunger and rods. Use only clean water</p>	<p>23. To reassemble the pump, first drop the foot valve down the borehole. Make sure the hook is upwards</p>	<p>24. Put the plunger and pump rods back together and lower them down the borehole</p>

C) Maintenance and Repair Sheet-3

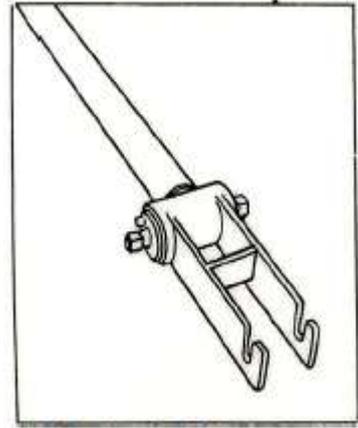
		
<p>25. Make sure the rubber centralizer is slid down over each joint on the pump rods.</p>	<p>26. Join all the rods together until the hanger rod is connected</p>	<p>27. Make sure the foot valve is in place by pushing the rods at arms length down the borehole.</p>



28. Put the spanner through the hanger eye to support the rods and then replace the hanger pin and bush bearings. If the bush bearings are worn out or damaged, replace them with new



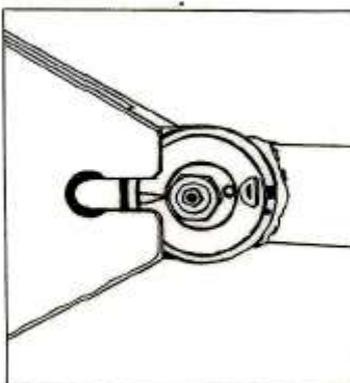
29. Turn the hanger pin and bush bearings so that the small projecting lugs are at the top



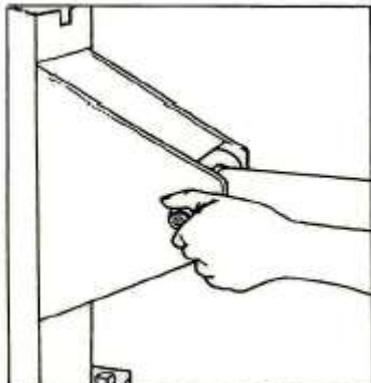
30. Put back the fulcrum pin and bush bearings in the handle. If the bush bearings are worn out or damaged, replace them with new ones.



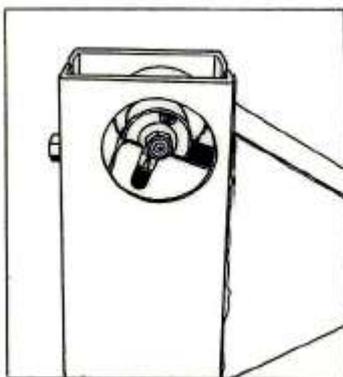
31. Put the handle back



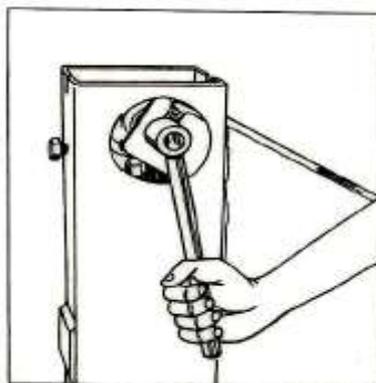
32. Make sure the projection lugs on the pin and bush bearings will fit into the slots on the pump body. Ensure that the pin is pushed right to the back of the slot.



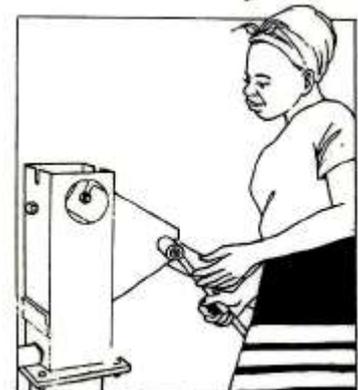
33. Tighten the fulcrum nuts by hand.



34. Push the handle down so that the slots engage in the hanger. Ensure that the hanger pin has slid to the bottom of the slots. Remove the spanner.



35. Tighten the hanger nuts with the spanner. Tighten alternatively on both sides



36. Tighten the fulcrum nuts with the spanner. Tighten alternatively on both sides.

D) Maintenance and Repair Sheet-4 (Re-assembling “Above Ground Components”)



37. Put the cover back on



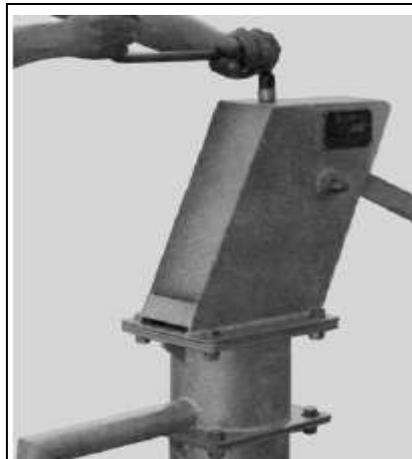
38. Tighten the cover nut



39. Pump water until clear water comes out before using for drinking

Annex B: Indian Mark-II Hand Pump Maintenance and Repair Sheet

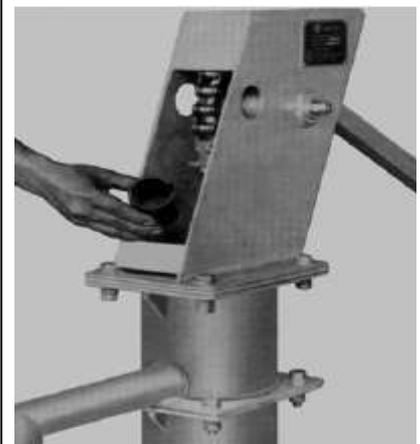
a) Maintenance and Repair Sheet-1(Dismantling the “Above Ground Components”)



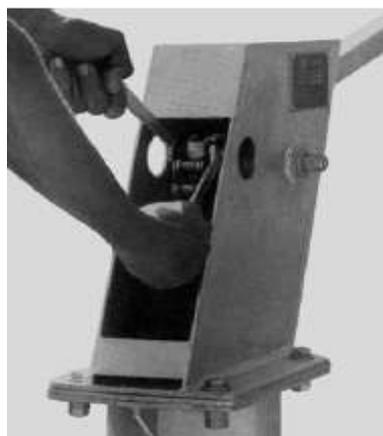
1 Loosen Front cover bolt



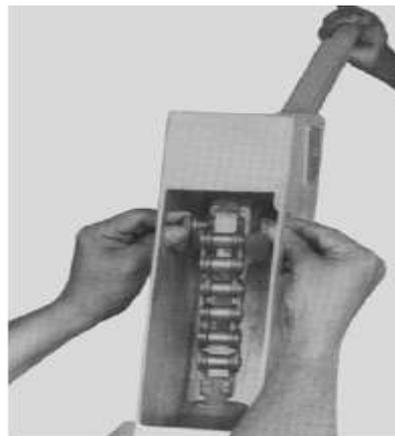
2 Remove Front cover from Pump head



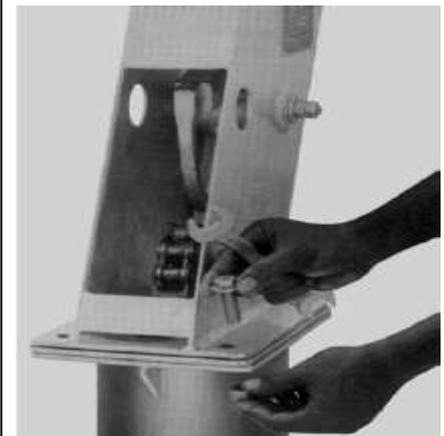
3 Lower Pump handle, put Chain below the Chain assembly



4 Lift Pump handle to top position and loosen “Nyloc” nut with spanners



5 Remove the “Nyloc” nut from bolt and remove Chain from the Handle



6 Loosen and remove bolts and nuts connecting Head and Water tank



7 Lift and remove Head assembly (chain passes hole in Head flange)



8 Lift Third plate with Pumprod assembly and insert Rod vice



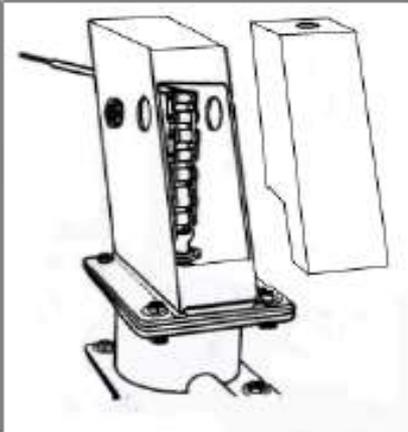
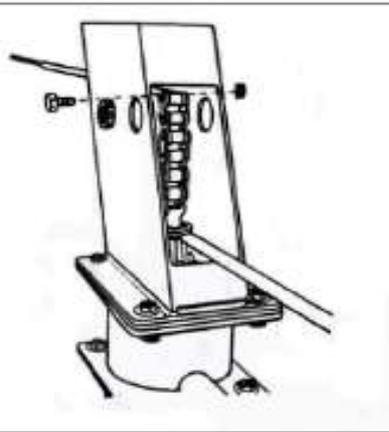
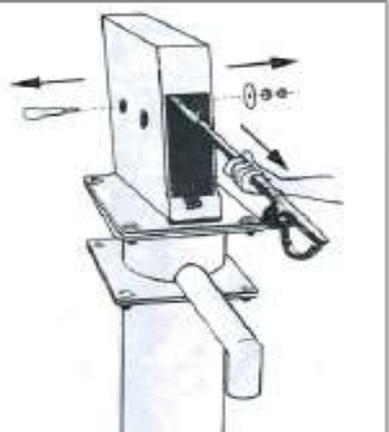
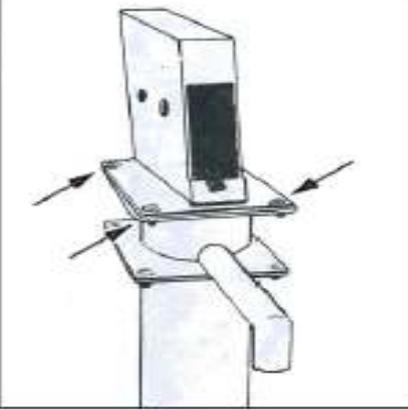
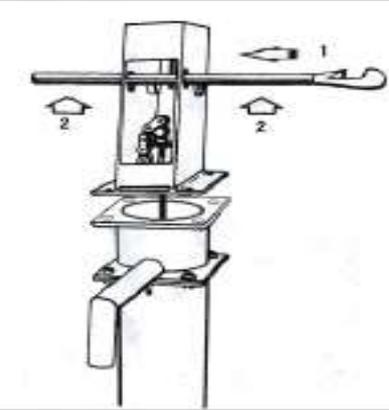
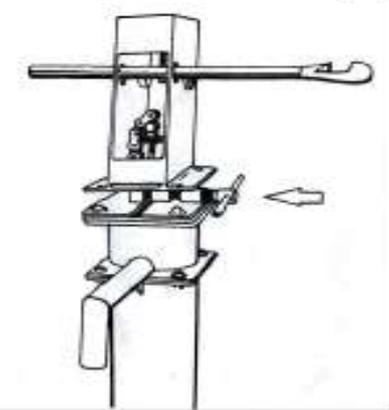
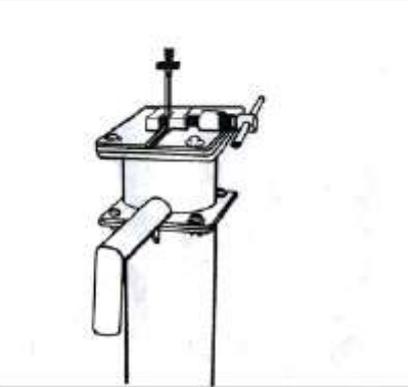
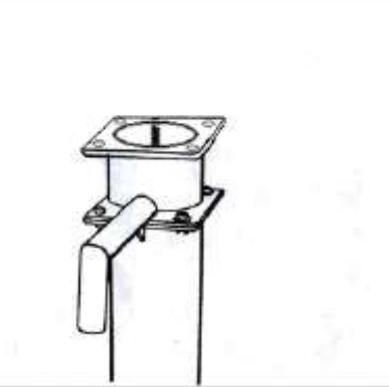
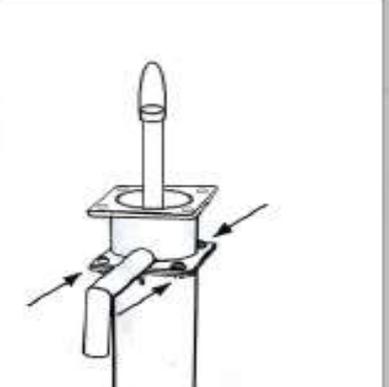
9. Place Third plate on Rod vice, take off the Chain support and remove

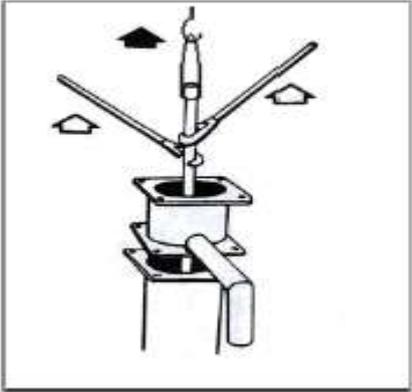
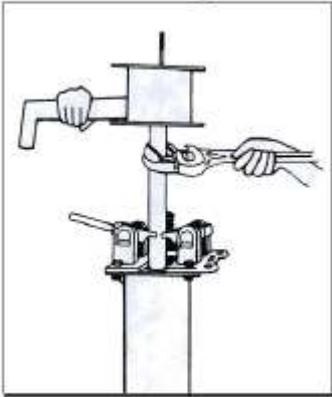
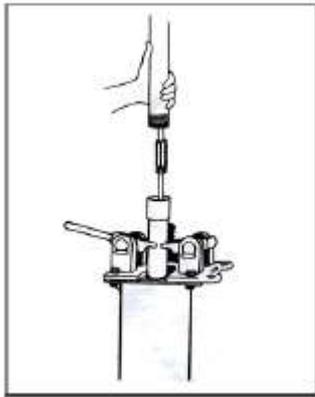
the Chain assembly



**10 Unscrew check nut and remove
Third plate assembly**

b)

		
<p>1. Remove inspection cover from head assembly</p>	<p>2. Disconnect handle from chain by removing the lock nut and bolt</p>	<p>3. Take out handle-axle. While removing, use axle punch to protect axle thread and remove handle from head assembly.</p>
		
<p>4. Remove flange bolt from head assembly</p>	<p>5. Insert one pipe lifter into the holes provided in the head assembly and lift up</p>	<p>6. Fit the connecting rod vice onto the water chamber top flange</p>
		
<p>7. Remove chain & chain lock nut and remove head assembly</p>	<p>8. Support connecting rod with connecting rod lifter, loosen connecting rod vice and remove. Gently lower connecting rod. Remove connecting rod lifter</p>	<p>9. Remove water tank bottom flange bolts and set pipe lifter</p>

 <p>10. Lift water tank by using water tank lifter and pipe lifters or chain block</p>	 <p>11. Fit self locking clamp or clamp and remove water tank</p>	 <p>12. Disassemble rising main and connecting rods. Remove connecting rod lengths, one at time</p>
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Maintenance and Repair Sheet-1(Dismantling the “below Ground Components”)

 <p>1 Attach Rod lifter to Top rod, hold Rod lifter and remove Rod vice</p>	 <p>2 Lift Pumprod assembly by hand until next connection is about 30 cm above the Water tank. Introduce Rod vice and clamp Pumprod securely in this position</p>	 <p>3 Open the connection with two spanners and remove the rod</p>



7 Lift and remove Head assembly (chain passes hole in Head flange)



8 Lift Third plate with Pumprod assembly and insert Rod vice

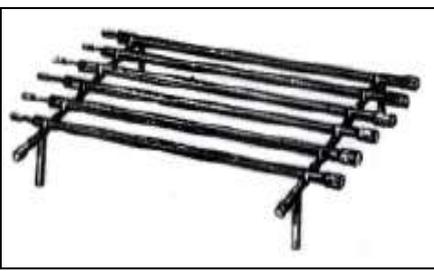


9. Place Third plate on Rod vice, take off the Chain support and remove the Chain assembly

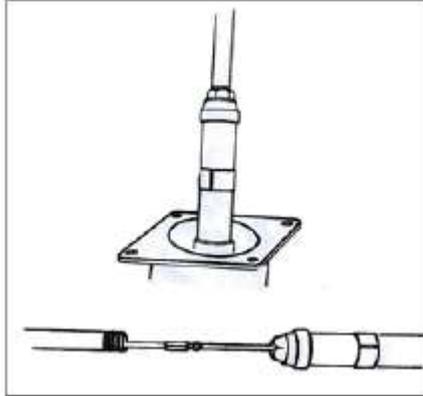


10 Unscrew check nut and remove Third plate assembly

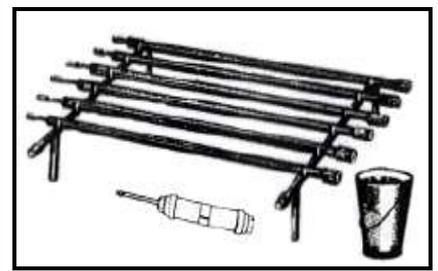
c) Maintenance and Repair Sheet-2



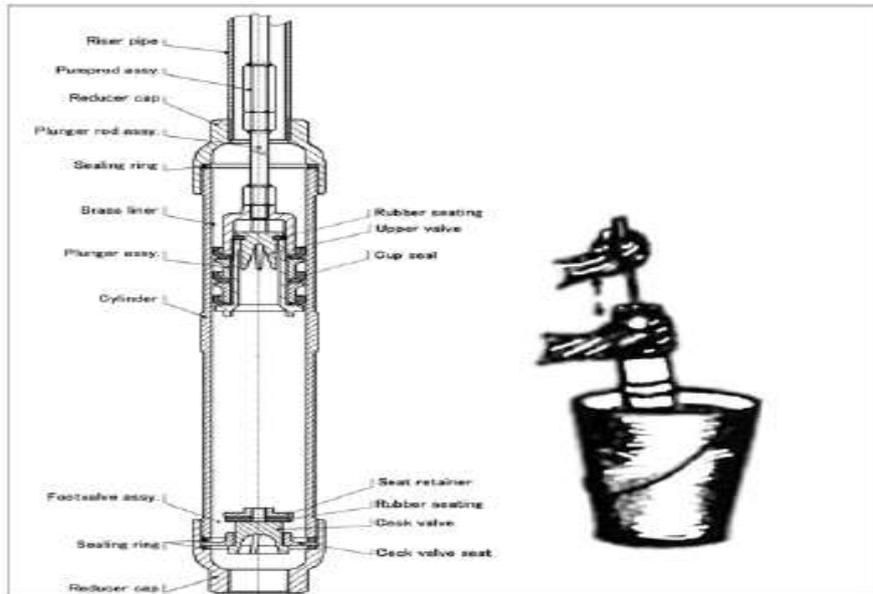
13. While removing the pipes and rods, ensure that you place these on the pipe stands. Continue doing so until the entire below-ground assembly has been removed from the tube-well



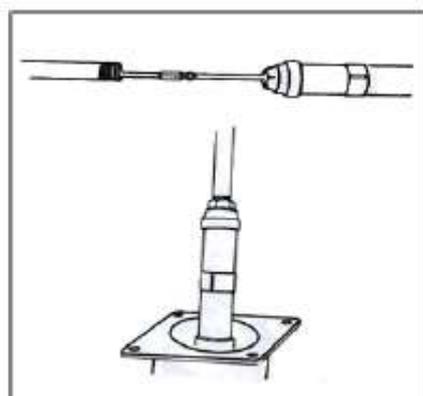
14. Disconnect cylinder from the last pipe



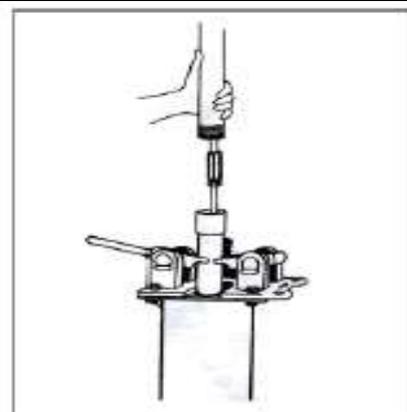
15. Check all the pipe thread; clean out the threads by using wire brush. Remove any dirt and rust from the pipes by using wire brush or sandpaper. If any pipe is damaged, replace. Ensure that all pipe couplings are intact and fit properly



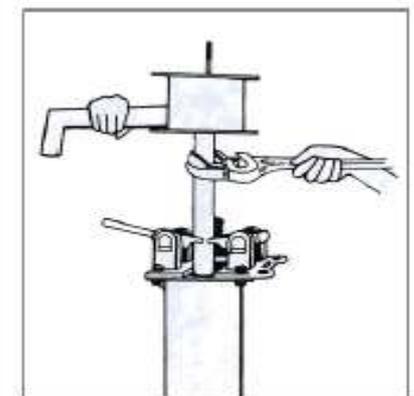
16. Open cylinder with the help of pipe wrenches and check that plunger and footvalve are tight and properly assembled. Test cylinder in a bucket of water. If check-valve leaks replace it.



17. Joint first connecting rod to plunger rod. Screw first pipe into cylinder. Lower cylinder



18. Lower pipe and connecting rod into tube-well using pipe lifters/chain block and clamp with self-locking clamp. Continue to



19. Screw water tank to last pipe. Tighten fully

last pipe

d) Maintenance and Repair Sheet-3

<p>20. Remove clamp. Carefully lower water tank on to pedestal with the pipe lifters or chain block. Spout must face drain</p>	<p>21. Bolt and fit check nuts</p>	<p>22. Fit the connecting rod vice onto the water chamber top flange</p>
<p>23. Screw chain onto rod. Use two spanners-tighten check nut fully against chain coupling</p>	<p>24. Remove rod clamp. Lower head onto water tank. Bolt and fit check nuts</p>	<p>25. Insert handle through head. Adjust handle, then insert axle. Tap lightly, but do not use</p>
<p>26. Fit chain to handle</p>	<p>27. Fix inspection cover on the head</p>	<p>30. Put back the fulcrum pin and bush bearings in the handle. If the bush bearings are worn out or damaged, replace them with new ones</p>

e) Maintenance and Repair Sheet-4 (**Special Installation & Maintenance Kit**)

