

## Rehabilitation of hand-dug wells: diagnostic and technical solutions

### Introduction

Within the frame of the maintenance projects Inter Aide is conducting in Sierra Leone, the team was rapidly confronted to a high demand for rehabilitation of hand-dug wells, beyond the sole issue of the pump maintenance. In this context, the following tool was designed to propose practical advices for the rehabilitation of hand-dug wells.

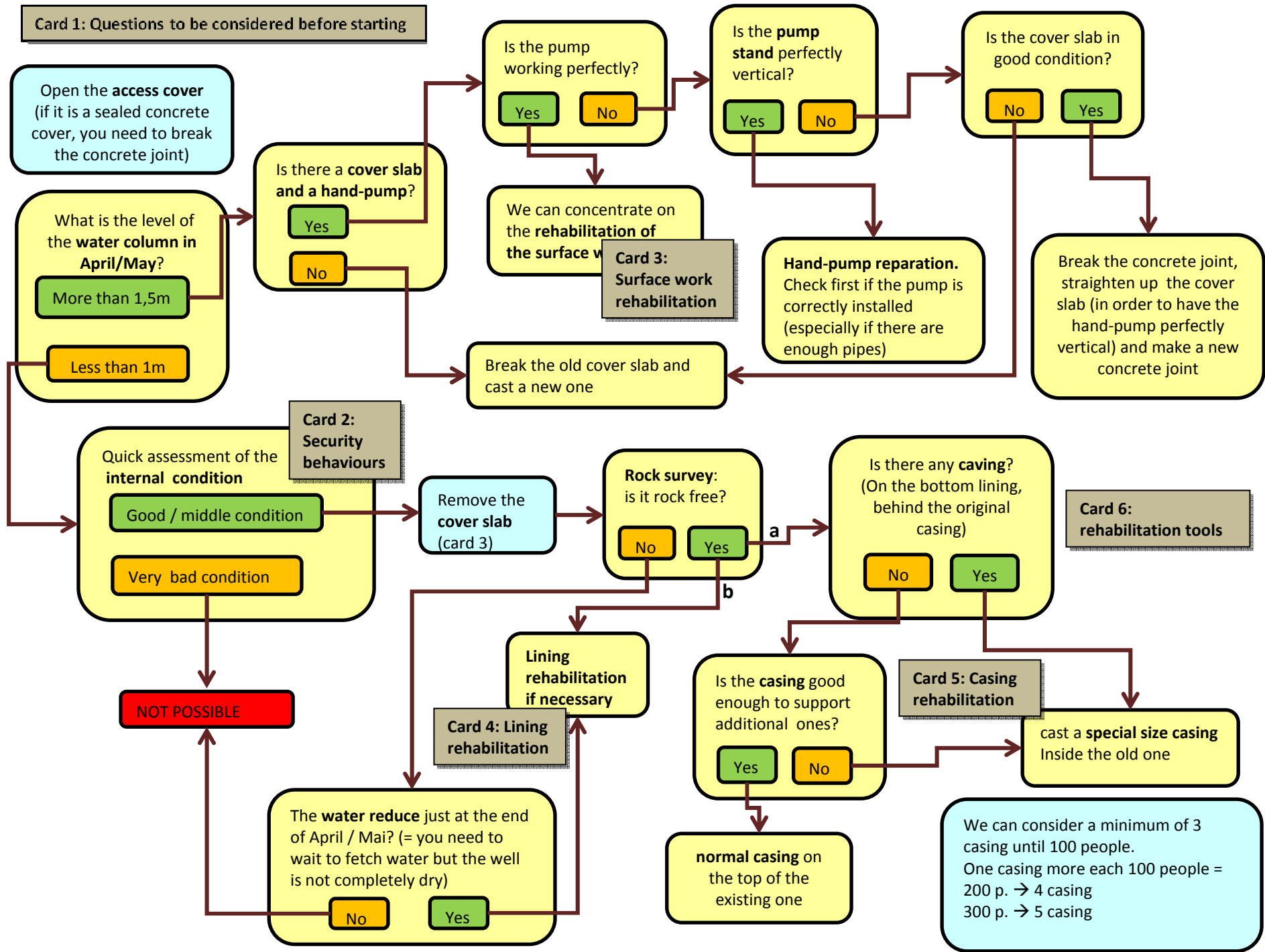
Starting from practical cases observed on the field, the idea was to break down the different steps of a diagnosis of a well in order to set up a protocol, and to help appropriate decision-making concerning technical solutions. Of course, the main question in the background remains whether it is relevant to rehabilitate an existing well versus the construction of a new well. Indeed, in some cases, the rehabilitation may appear inappropriate because it is too costly as compared to a new construction, or too risky or because of a too low feasibility to put the well back into a working state.

### Presentation of the tool

Starting from a decision-making tree, the tool proposes 6 explanatory cards to be used depending on the situation observed during the diagnosis of the water point (gray boxes - slide 1):

- Diagnostic decisional tree
- Card 1: Questions to be considered before starting
- Card 2: Security first!
- Card 3: Rehabilitation of the surface work
- Card 4: Rehabilitating the lining
- Card 5: Rehabilitating the casing
- Card 6: Rehabilitation tools

A last slide presents a reference scheme of a hand-dug well and a borehole.



## Card 1: Questions to be considered before starting

Question	Purpose
When was it done?	To know if it is an old construction (which usually requires more rehabilitation)
By whom?	To know the “construction strategy”: every operator has its own methodology and particularities. Also, the quality of the intervention may vary from one operator to the other, and specific particularities can be observed depending on the operator.
In which month did the operator finish the casing/sinking?	To know if they completed the well before, during or after the rainy season. If the well was not completed in April/May, the risk of facing water availability problems is high.
How many casing did the operator cast?	To calculate how many casing were sunk (comparing to the number of casings observable from the access cover)
Background of the pump status	To know if it has been broken for a long time (it can be a bad installation: not enough pipes, pump stand not straight, clay that is immobilizing the cylinder) or if it is just a matter of maintenance

### Key elements to take into account to decide whether or not to do a rehabilitation:

#### 1. Security:

if you think that it is not safe to work inside this well, it is better not to do it (major risk: mould or concrete collapsing)

#### 2. Cost of the rehabilitation versus a new construction

Take into account the well depth, the construction you have to break (before starting the intervention) and the construction you have to do

→ Is it too much time spending?

→ Is it too complicated? Or you do not feel it is safe enough to do it?

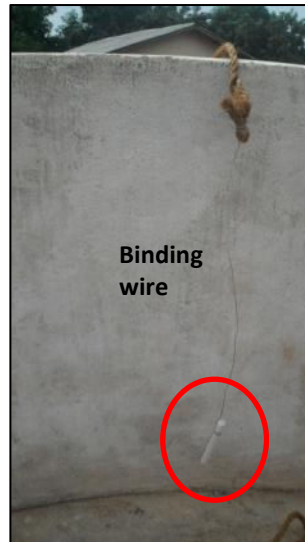
## Card 2: Security first!

### Before going down into the well

1. Open the access cover
2. Leave it open for 4-5 days
3. Make some air circulate by moving up and down a branch linked to a rope



4. Make the **candle test** (as you see in the picture you tie a candle to a rope and you put it down lighted into the well: if the light goes off, it means there is not enough oxygen, you need to wait)



**Rescue rope:** in case the person has a problem this rope is used to rescue the siteforeman

**Main rope:** it is used to lower (and bring out) the siteforeman inside the well

**Safety rope:** the siteformane uses this rope as support to go down and to come up



a. Be sure that the body harness is strong enough

b. Take your time to explain to the team what you are going to do

c. Explain clearly to the team what they have to do: each one must have a **clear understanding of his role**

d. Explain clearly who is going to give the instruction (just one person!)

### Card 3: Rehabilitation of the surface work

Before starting any intervention, be sure that the site is **well fenced and organised**



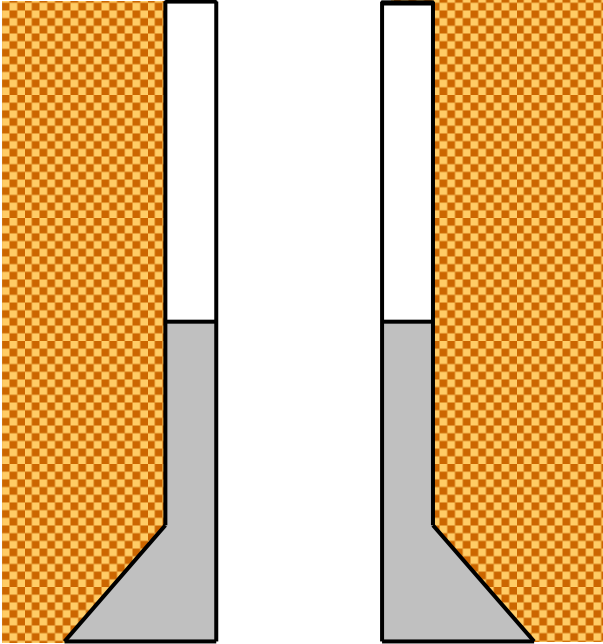
If the surface work was done with **no reinforcement** (soak away pit on the top) or with a **poor mixture** (apron on the right), after few months, several cracks will progressively appear.  
→ If the damages are minor, a simple plastering is enough.  
→ Otherwise, it is necessary to break everything and redo the surface work.

#### Cover slab rehabilitation


- ✓ Break the concrete joint
- ✓ Use some sticks to lift it
- ✓ You can also use a rope handled to the pump stand to assist
- ✓ Break the concrete
- ✓ If the reinforcement was well done, you can use it again



## Card 4: Rehabilitating the lining



The diagram shows two cross-sections of a pipe. The left section shows a pipe with a concrete lining that is anchored into the surrounding soil, indicated by a grey trapezoidal shape at the bottom. The right section shows the same pipe with a crack in the concrete lining, and a grey trapezoidal shape representing the soil behind the pipe.

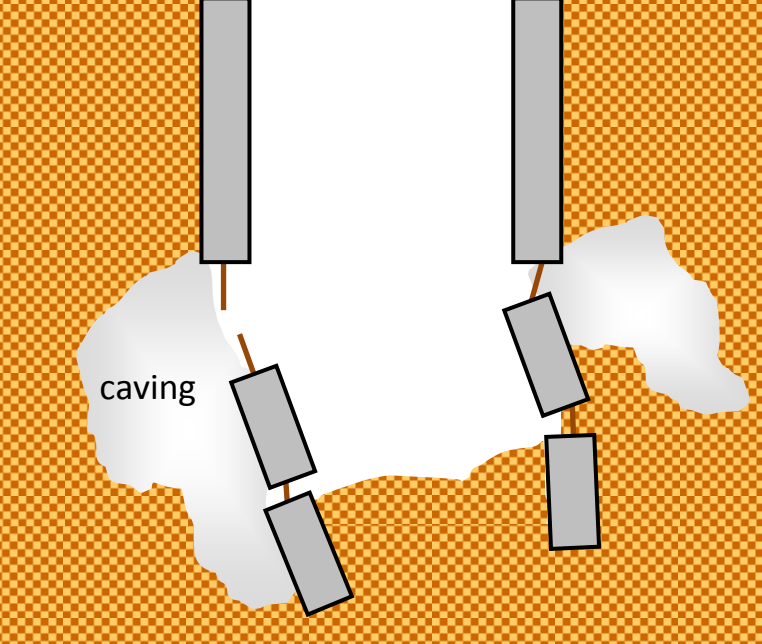


**Assessment:**  
Minor problem. With the age, the concrete may have started to crack. Some iron rods can then be exposed.

**Rehabilitation:**  
The concrete needs some plastering (especially to cover the iron rods that are exposed)

**Easy rehabilitation**

**1. Lining with anchorage**  
→ Essential to avoid any lining movement



The diagram shows two cross-sections of a pipe. The left section shows a pipe with a concrete lining that is not anchored into the surrounding soil. A large white area labeled 'caving' is shown behind the pipe, indicating soil collapse. The right section shows the same pipe with a crack in the concrete lining, and a grey trapezoidal shape representing the soil behind the pipe.

**2. Lining without anchorage**  
→ Possible movements, especially in the first lining if it is in contact with water  
→ The lining starts to break and soil collapse behind (caving)



### Assessment:

- Some lining rings are completely damaged
- Deep caving observable

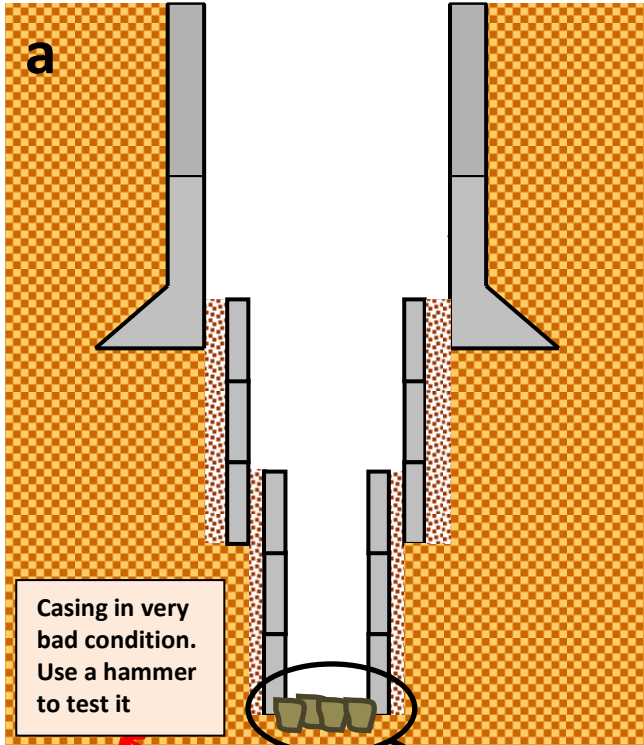
### Rehabilitation:

- feel the holes as much as possible with stones and seal it with concrete

**It is necessary to evaluate if there is any risk of collapsing. If it is the case the REHABILITATION is too dangerous and SHOULD NOT BE DONE.**

## Card 5: Rehabilitating the casing

The original casing is in very bad condition: it cannot support a new construction



### Case a:

- Original casing too difficult to break OR
- There is caving behind (risk of collapsing) OR
- There is just the need to add just 1 or 2 casing, → It is better to make a **special casing** (smaller size)

**SPECIAL CASING is MORE SAFE and avoids any risks of collapsing**

### Case b:

The sediments behind the lining fall into the well and cover the original casing.

- In this case, first of all it is necessary to rehabilitate the lining (to avoid any collapsing) and then to dig until the casing, break it and build up a new one

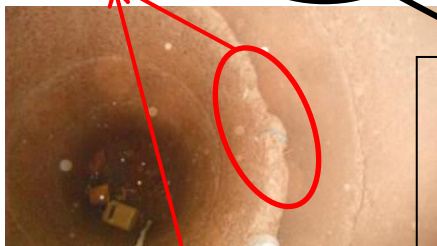
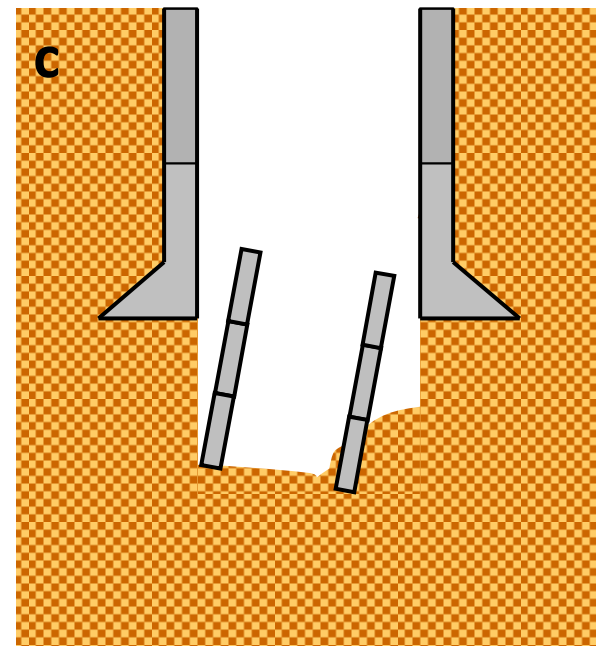
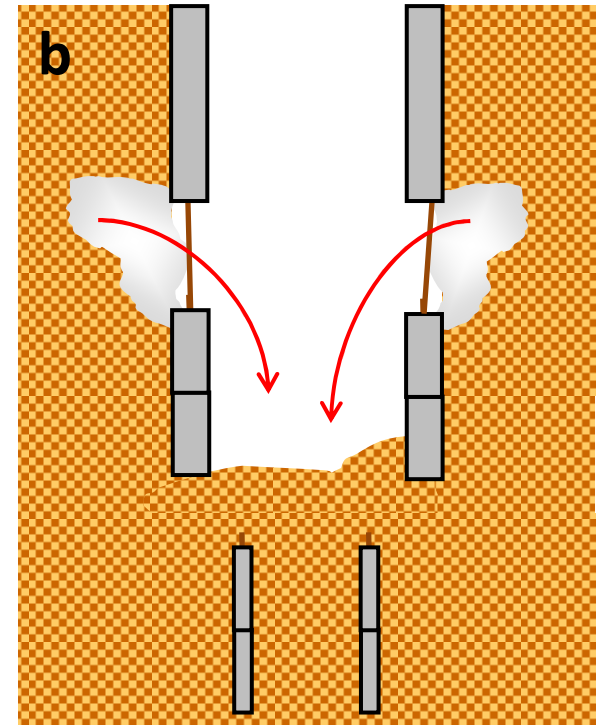
**You must decide whether it is relevant (and safe) to make all this work, or if it is better to dig a new well.**

### Case c:

The casing is not perfectly straight .

- If it is in bad condition: it needs to be broken (**risk of collapsing behind**).

If it is in good condition: dig at the bottom and use at least 8 spacers to assist it going down perfectly straight



**Put stones at the bottom:** to avoid any clay to come into the well  
 →Risk of pump breakdown and clogging  
 →Reduction of the water column



## Card 6: Rehabilitation tools



### Tripod (locally made)

Useful to cast the casings outside (0,5 meter to have less weight)

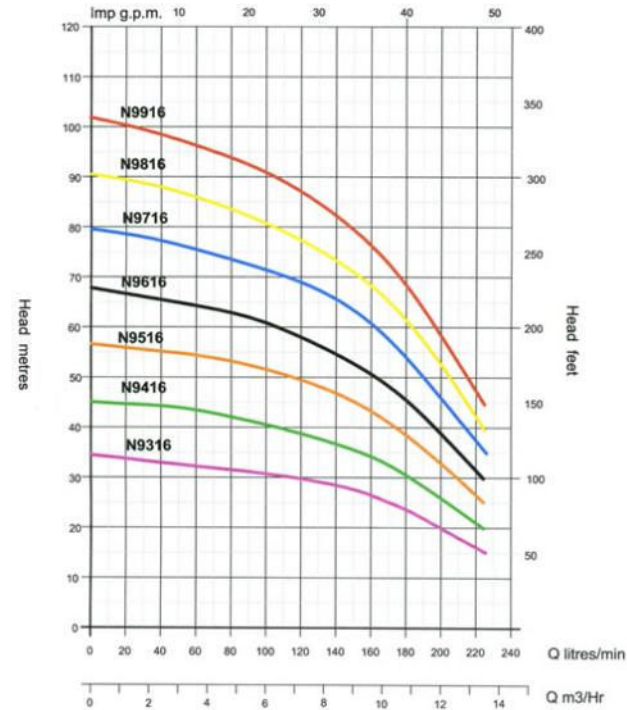
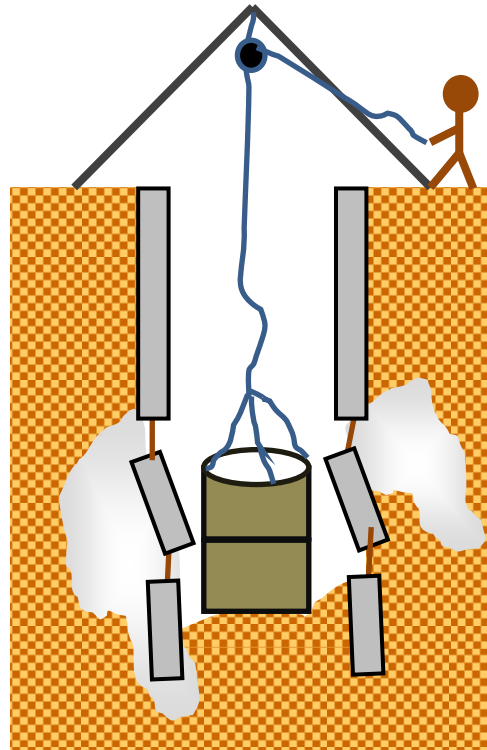
→ It is possible to work even if there is some water inside the well (as the curing is done outside)

→ It is possible to work in rainy season

*[possibility to look for the imported tripod: ask to the Lunsar vocational center]*

Why to cast the casing outside?

- For rehabilitations with collapsing risks, it is safer
- To spend less time inside the well
- The casing protects from the collapsing behind



### Dewatering pump

The chart at left indicates the pump to be chosen based on the yield:

The different lines correspond to different models. Usually, at 15m deep, we need a machine that can pump about 50 l/min

→ A pump allows working when there is water inside the well, and being more efficient in sinking the casings



Giant curter → to cut the iron rod of the lining / casing that needs to be broken



### Special casing

Out to out 120 cm  
In to in 100 cm



