

**Draft
Short Manual
On
Baptist Well Drilling Methodology**



First trials in Chimoio Mozambique, June 2006

Arrakis & Agua para todos
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1 Introduction

This Short Manual is based on an extensive manual prepared by Terry Waller May 23, 2003 with modifications based on experiences by Henk Holtslag and Jan de Jongh of Arrakis, while drilling in Africa.

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The Baptist well drilling methodology is a low cost, manually operated well drilling methodology, developed by Terry Waller while working as a Baptist community development missionary in Eastern Bolivia and Central Africa. By the end of 2006 around 2000 wells have been drilled in Bolivia of 20-70 m deep and the technology is spreading to other countries. These guidelines are meant as a reference for the trainees and not as a learn it yourself book. It needs to be combined with proper training.

“Our goal was and is to make this technique a shared common knowledge in the culture, along the lines of digging a ditch, or planting a tree.

Water is too important to only be left in the hands of specialist. Too often specialist aren't around when needed or else have to charge so much for their services that the poor can't afford them! To solve the water problem for poor rural people of the world, the people themselves have to be empowered to get water for themselves, if at all possible.”

Terry Waller.

2 The Baptist well drilling technology

Limits

Baptist drilling is limited to non cemented, sedimentary deposits of sand and clay (it will not drill through solid bed rock). Soft rocks can be drilled through, slow if manually drilled and faster if a motorised rig is used. Larger stones may cause problems. Manual drilling requires time, 1- 8 days per well depending depth and soil conditions and 4-8 people.

How it works

Ground water exist between particles of either soil, sand, clay or rock. And can be reached with hand dug or drilled wells. A manual drilling technique is the Baptist method which drills without a casing, an open hole down into the aquifer, the layer of sand that is saturated with water. The hole is made via hydraulic percussion of drill pipe and a drill bit with drilling fluid consisting of water and bentonite , clay or cow dung. After the hole is completed cleaned a casing is installed.

The drill bit tool is a ball and dart point mounted on the end of the drill pipe. As drilling proceeds 1.5 meter or 3 m lengths of PVC drill pipes are added as needed. The drill bit acts as a foot valve. Drilling fluid and cuttings enter the drill pipe through the valve. The cuttings are suspended in the fluid, forced up the drill pipe and discharged at surface. This via inertia and displacement of the drilling fluid, on each stroke.

The drilling fluid and cuttings flow into the settling pit. The heavier parts stay in the pit and the cleaner fluid enters again in the borehole. In the settling pit one can see what type of material is being drilled through. The hole is kept completely full of fluid through entire drilling process. If permeable loose layers, such as sand are encountered, clay or cow dung must directly be added. The function of the drilling fluid is to seal off the hole, to keep it from collapsing and bring up the heavy particles as sand, gravel or small stones.

The drilling fluid must be heavy enough to maintain a higher pressure on the inside of the hole than the water pressure pushing in from the aquifer. If not, the hole will collapse with a probable loss of drilling tool and some of the drill stem, so don't skimp on the drilling mud especially as you are learning.

3 Materials an tools needed (well of 20 m deep)

1. 1 pipe, 1¼ " (inch) 3mm thick, galvanized. Of 6 m Can also be plain steel pipe.
2. 1 pipe, 1¼ " (inch) 3mm thick, galvanized. Of 3 m
3. 2 pipes 1¼" PVC (schedule 40 mm), Wall Thickness 4 mm, lenght 1.5 meter**
4. 6 pipes 1¼" PVC, length of 3 meters
5. 2 Tools to make 1 ¼" thread on pipes
6. 8 PVC 1¼" couplings, (sockets with inside thread)
7. 2 drill bit (one for spare)
8. 2 reamer drill bits - to increase the drilling hole from 2" to 4"
9. Fishing tools , hook of 6 mm welded to a metal 1 ¼ inch coupling
10. 20 Kg or more of bentonite, fine clay or 2 –3 bags of cow dung
11. 3-5 drums of water (200 liter drum), depending soil conditions. Clay soils require little water
Make sure not to use water contaminated with pesticides.
12. 10 meters of rope. 10 - 12 mm thick
13. An outlet handle (see below). This is a 1¼ " galvanized elbow fitting.
14. A pulley (type used to haul up buckets of cement or water in construction, 3 or 4" in diameter)

15. 2 poles of 4 meters with a cross piece to form a 3-meters tall structure (above ground level). (This is called a “derrick”) See pictures below.
16. Two pipe wrenches (2 inch) and a water pump pliers (big enough for the couplings)
17. A shovel, stakes, rope and rubbers trips cut form inner tube to fix poles and “derrick”
18. An step auger ("soil drill") of 2 ”
19. Buckets or containers to pour water from barrels to the drilling hole
20. Eight people to pull rope and do the work. (less people can do it, but it will take more days)
21. Good spirits, music, stories, refreshments, etc. Optional - but the result is faster progress.



The original Baptist drill bit, see drawing below.



Plastic Threaded 1 1/4 inch PVC “Drill Stem” plus reamer, Auger and most of the material that you will need to drill.

** In some cases thick walled PVC pipe may not be available. For instance in Nicaragua thinner pipe was used with glued couplings. Material there was:

- 2 pipes 1 1/4" PVC pipes (SDR 26), 2-2.5 mm thick. length of 1.5 meter. 6 lengths of 3 meters
- 10 sets (male and female) PVC 1 1/4" couplings - one side for inside glueing, one outside thread
- PVC glue (fast drying). Buy the small size to avoid drying up

4 Drilling step by step.

1. Cut the poles and make the “derrick”
2. Bring water and all tools to the site
3. Make holes for the poles, install derrick, mount pulley and rope
4. Make a start hole using a spade or auger ("soil drill"). Make this hole as deep as possible, one meter or more .
5. Dig the settling pit 40 cm in front of the poles. Size around 60 cm by 100 cm wide and 40 cm deep.
6. Make a small canal, 15 cm deep between settling pit and hole.
7. Mix clay and water and fill pit and hole with water. Add clay if soil is sandy.
8. Put 3 meter steel drill pipe in hole with drill bit and drill handle and connect rope to handle
9. With helpers pulling the rope, start drilling by jumping the drill pipe up and down till circulation begins.
10. At all times, keep the hole and pit filled with water and add clay or cow dung if needed
11. If the hole is 3 m deep, add PVC pipe of 1.5 meter. If hole is 4.5 m deep, take off PVC pipe and install the 6 m steel pipe.
12. If the holes is 6 m deep add length of 1.5 m PVC pipe.
13. If hole is 7.5 m deep take off 1.5 m PVC pipe and mount 3 m PVC pipe.
14. If hole is 9 m deep mount 1.5 m PVC pipe, etc until hole is deep enough
15. Keep a drilling log noting the depth of the drill bit every time soil materials changes
16. **Add clay or cow dung as soon as you notice loss of water** in the hole
17. Continue drilling for at least 3 meters after the water bearing layer is reached
18. Prepare filter screen, cutting slots with a hack saw every 1 cm on 3 sides of the casing pipe watch out not to cut slots to long to avoid weakening of pipe. Length of filter depends on type of aquifer and normally is between 2 to 6 meter long.
19. Put filter/screen in the hole and if needed fill with water for counter weight
20. Continue to add sections of casing, adding water as needed till casing hits the bottom of the hole. Cut pipe at height of 1.5 meter above ground level
21. Back wash the well pouring clean water in the pipe until water coming from the well is relatively clean. Also a hand piston pump, EMAS model, can be used for backwashing.
22. Swab the well if needed, Going up and down with a cloth fixed to a thin pipe or round bar.
23. Cut casing pipe at height of 0,5 meter high
24. Install hand pump and pump till water clears up.
25. Pray and thank God for the water!! Dedicate the well and family, roast a goat and have a party!!!

5 The well.

Casing

In case of using a rope pump the size of the casing depends of the lowest depth of the water table. For levels

- 23 meters or deeper, 2 inch casing (Inside 55 mm)
- 6 till 23 m 3 inch casing (Inside 80 mm or more)
- 1 – 6 m 4 inch casing (Inside 110 or more)

To case and finish the well you will need;

1. X meters of PVC 2 or 3 inch casing.

2. A filter screen 2 to 6 meter
3. Good quality PVC Glue that dries up quickly.
4. Gravel to make a gravel; pack in the water bearing layer.
5. Clay to make a stopper above the water layer, to prevent dirt to get into the waterlayer.
6. A pump that fits into a 2" or 3" casing
7. cement and sand to make a well slab.

When a pre determined depth has been reached (determined by talking to well drillers in the area, or just drilling blind, (called being a "wild catter"), the entire drill string, is removed and an open hole full of mud is left. The filter/screen is closed at the lower end. This is shoved down into the open hole. Water is added to counter weight the buoyancy caused by the mud in the hole. Another length of casing is glued on to the top of the filter and this placed (shoved) on down the hole. More water is added, then another length etc. until the bottom of the hole is reached. The casing is then tied off to keep it from shooting out of the hole (because of the buoyancy of the mud that is being displaced).

6 Backwashing

Clean (as clean as you can find easily) water is poured (or pumped) down the casing, out the filter, and up the back side of the casing to back wash the well and remove the mud drilling fluid. This comes to surface until the fluid pressure decreases in the hole enough for the aquifer water pressure to cause sand to collapse around the filter. Then the well is hand pumped until water begins to clear up. The well is "swabbed" (see below) if need be, to condition the sand around the filter. That is it! Then the hand pump can be permanently installed and the well is pumped until clean. You are done!

7 Most common problems

Drilling does not advance,

Check the outflow with a bucket. Fill up with 5 to 10 strokes, leave for 10 sec and see amount and type of settlings. If there are no settlings, drilling fluid may be too thin. Add clay or cowdung

Drill hits hard layer, drilling does not advance,

Try a more heavy steel drill pipe. For instance weld a 1.5 inch pipe around the 1 1/4 " pipe

Use a drill bit id 1,25 inch, see Drawing below.

Drill stem breaks

Use fishing tool connected to PVC pipes

Drill bit needs to have a pin welded in side

Foto

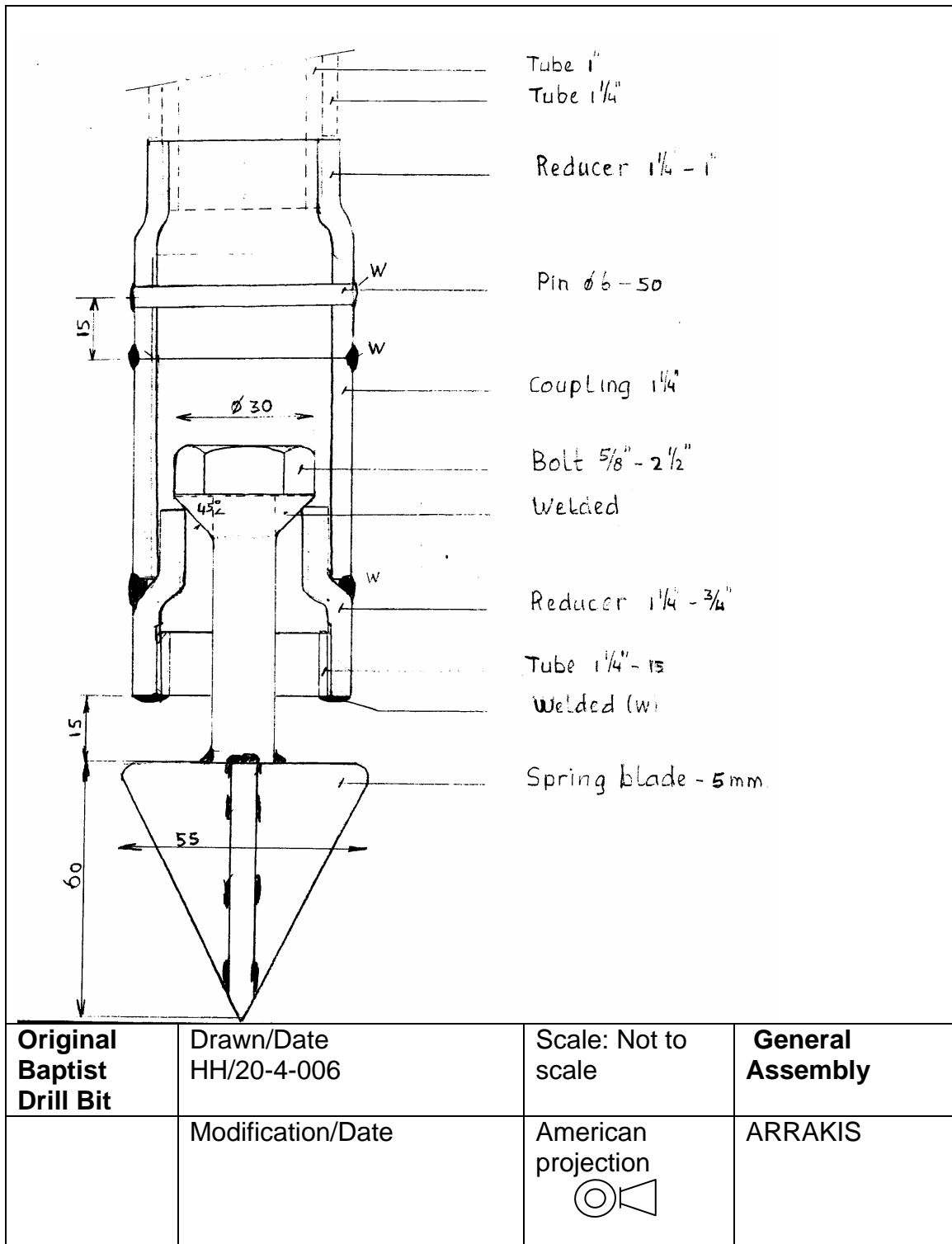
Tips for fabrication

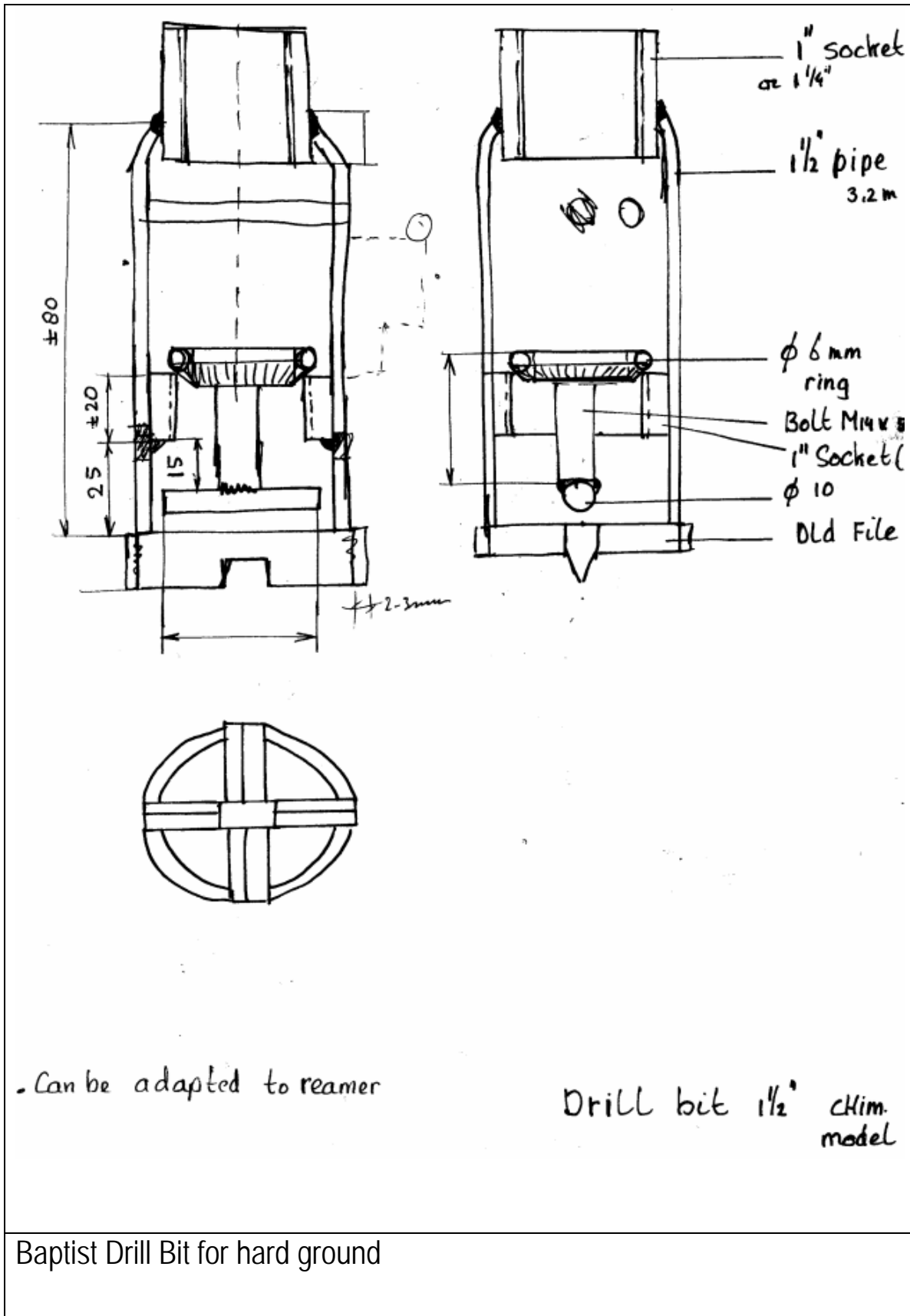
Don't use steel couplings in PVC pipes

PVC couplings should be mounted on PVC pipes as far as possible preferably until thread on pipe is completely inside. To achieve this PVC treat PVC couplings, by hesating one end and mounting them on a treaded pipe.

In case 1 ¼ inch pipe is not available, the drill stem can also be made with 1 inch pipe
 In that case the drill bit should be adjusted, also see drawing under

8 Drawings





9 Material list Baptist drill Blad 1 Borehole Materials Blad 2

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One (1) set of pipes for Baptist Drill ; 1" tubes. For holes to 30 m deep.

Material	Unit	Amount	Observations
Gi Tube 1 1/2 "	Lenght 6 m	1	Wall thickness 3.2mm
Gi Tube 1 1/4"	Lenght 6 m	2	Wall Wall thickness 2.5 mm
Gi Tube 1 1/4 " outlet	Length 0.3 m	1	
Gi Tube 1 " handle	Length 0.3 m	1	
PVC Tube 1 1/4"	Lenght 6 m	5	Wall thickness min. 2mm
PVC Coupling 1 1/4" Male		10	including reserves
PVC Coupling 1 1/4" Female		10	
PVC Glue	Litres	0.11	Or smallest size available
1 1/2 " Baptist Drill Bits & Tools for 2 sets.			
Gi Tube 1.1/2 "	Lenght 0.5	1	Wall thickness 3.2mm
Sockets 1"		4	
Round bar 10 mm	Length 50	2	
Round bar 6 mm	Length 1 m	2	
Bolt Steel M14 x50	Nr	2	
Spring blade	55 mm x 60 mm	8	Steel of springblade of a truck

Auger (1 auger)			
GI Tube 3/4"	length 6 m	2	
Gi Tube 3 "	Lenght 0.5	1	Wall thickness 3.2mm
Angle 25x25x3 for steps	length 6 m	1	
Gi Tube 1/2"	Lenght 1 m	1	Wall thickness 2.5 mm

Derrick & Tools (for 1 set)

Derrick poles	Length 4 m	2	verticals
Derrick poles	Length 3 m	3	2 stuts and 1 horizontal
Drums	Nr Oil barrels	2	
Buckets	Nr.	4	
Pulley, round 10 to 15 cm		2	Fit for 15 mm rope
Rope 15 mm	Meters	10	Polypropylene or other
Pipe wrenches 2 Inch	Nr.	2	
Round bar 6mm	m	2	
Round bar 10 mm	m	2	
Fine Clay	buckets	6	

Borehole materials for Baptist drilled Tube Wells of 15 m.

PVC Tube 3" (casing)	Lenght 6 m	3	Wall Thickness min 2 mm (No of tubes dep on Depth)
PVC Glue	Litres	0.11	Or smallest size available
Gravel	bags of 50 kg	4	
Clay	""	2	