INFORMATION
on the construction of

"LOW COST" RURAL WATER SUPPLIES

facts on "sufficient, safe and clean" drinking-water

in 1995 the total world population is over 6.000.000.000 people
5.000.000.000 of them without sufficient, safe and clean drinking-water
required amount 50 litres/person/day → 20 m^3/person/year → 100 m^3/family/year
quality of groundwater becomes poorer, more aggressive; its treatment more expensive
cost of treated piped water is already more than \$1 per m^3 and will be over \$2 per m^3 in 2000
total cost of "sufficient, safe and clean" piped drinking-water will then be \$200/family/year
"low cost" water is the only alternative for more than 80% of the world population

CALORAMA
Rural Development Service

P.O. Box 88
8080 AB Elburg, The Netherlands

phone 31.5250.81717 fax 31.5250.85303

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

LOW COST WATER SUPPLY

BACKGROUND

The population of the developing countries grows at such a rapid rate that their shortage of drinking-water has taken alarming proportions. The people suffering most of this shortage are those in the rural areas, because the governments tend to pay attention primarily to the urban areas. But even there, drinking-water is often in short supply, because the equipment is either of poor quality or too sophisticated to operate. Indeed much sophisticated equipment installed ten or twenty years ago is now worn out or has broken down. Rehabilitating those water systems is often not possible due to lack of finance, skills, electricity, transport, communications, fuel, roads, etc.

Take electricity. In the developing countries its supply is often interrupted, causing a vacuum in the distribution system which sucks in polluted waste water. Another common mishap is lack of spare parts for the generator. Operators may then supply water by truck, at a high price and of poor quality.

THE PROBLEM

Where sophisticated water supply systems brake down, it would make sense to return to shallow wells as a cheap and reliable source of good quality water, but often the population has lost its skills of making them. As a result most people in the developing countries now fetch their drinking-water from dirty ponds, streams, rivers and other kinds of surface water. No wonder that many people are suffering from water-borne diseases.

The number of people affected by this water shortage is huge. The governments of the developing countries seldom cover the water need of more than 25 % of the population. Another 25 % usually manages to establish its own dug or drilled well. This leaves the other half of the population without a proper water supply. In Africa alone an estimated 400 million people are presently without proper drinking-water.

THE SOLUTION

During the 1970's and 80's CALORAMA re-developed the technique of hand-dug and hand-drilled wells down to a depth of 25 metres. Hand-drilling has proved to be much quicker than hand-digging. In fact a hand-drilled well costs less than half the price of a hand-dug well and can be established in just a few days.

In the 70's CALORAMA started the manufacturing of handpumps specially designed for the rural area's of Africa. After many years of experience and quality improvement, the SWN handpump is now considered to be the most suitable handpump for Africa; it is long lasting and available at a reasonable price.

Last, CALORAMA has trained local contractors to provide maintenance. Thanks to these contractors more than 13,000 SWN pumps are presently providing clean drinking water to more than six million people in Africa.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

NECESSARY INFORMATION
to be gathered before constructing a new water supply

THE EXISTING SITUATION

1 **- number of people**
- what is the size of the project area in km^2 and how many people are living there ?
- how many of them have access to clean drinking-water ? What are the complaints ?
- for how many more people do you have financial means to build additional water supplies ?

2 **- number of dug wells**
- how many dug wells have been constructed in the area during the last 20 years ?
- how many of these wells are still used ?
- how many additional dug wells are you planning to make ? What will be their costs ?

3 **- number of handpumps**
- on how many of the existing wells has a handpump been installed ? What manufacture ?
- how many of these handpumps are still in working condition ?
- are qualified "caretakers" and "mechanics" available for their maintenance ?
- who is responsible for the handpumps and who is paying for the spare parts ?

DUG WELLS

4 **- well siting**
- have the new well sites already been chosen and who will be (act as) the owner ?
- what is the estimated depth of the groundwater level ? Has that been checked ?
- is there sufficient groundwater and how is the expected recharge into the new well(s) ?
- will digging through rock be necessary and do you have the equipment for that ?

5 **- water quality**
- how is the quality of the groundwater in the area and how has that been checked ?
- has the quality become poorer during the last 5 years ?

6 **- digging and dewatering**
- are well diggers available in the area and do they have digging equipment ? (see diary)
- how will dewatering be done, when digging (3 metres) below groundwater level ?

7 **- lining of dug wells**
- what will be the diameter of the dug wells and what will be the ring size under water?
- what size of concrete rings are used for deepening (rehabilitation), if the well goes dry ?
- are moulds available for that diameter of concrete rings ? How are the rings transported ?

8 **- covering of the wells**
- do you intend to install handpumps ? What make and type ?
- is a mould available for making concrete well covers with a special pump base onto it ?
- do the users want a man-hole with cover in case the handpump is out of order ?
- will a special gutter and/or animal trough be foreseen ?

DRILLED WELLS

9 **- tube wells**
- how many tube wells have been drilled in the area and how many are still being used ?
- what will be the average depth required ?

10 **- hand drilled wells**
- can one use a hand drill? (no rock or big pebbles; shallow groundwater available)
- can you dispose of PVC plain and slotted pipes of the right diameter and quality?

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

POSSIBILITY FOR FINANCIAL ASSISTANCE

for the construction of "low cost" family-owned rural water supplies

SITUATION

Although in most African countries rural water supplies have been constructed for many years, the major part of the rural population still has no access to clean drinking water. Many new water supplies are constructed but their number only keeps pace with those that went out of order again.
This situation will not improve in the near future for lack of financial means.

As the government can not fulfil all water needs many people started building their own supply. But lack of tools, materials and know-how hamper these activities. Calorama is receiving requests for assistance almost daily.

Calorama is quite experienced in constructing "low cost" hand dug and hand drilled wells in Africa.
It is ready:

- to assist in solving specific water supply problems and
- to look for donor organisations, willing to assist financially.

CONDITION

The most important condition for constructing and operating a private water supply successfully is the presence of a respected person living in the area, who:

1) will be responsible for the preparation and the execution of the project and who will later on act as the owner of the construction and to be responsible for its maintenance.
(Too many constructions in Africa have gone out of order due to the owner's lack of responsibility)

2) is informed about rural water supplies in general and the existing rural water supply constructions in the area in particular.
(Before we take any action we need to have all relevant information necessary to find the most appropriate, and financially feasible solution. Please answer our questionnaire point by point. See info sheet A-01)

3) is well aware of the costs involved. Our financiers are prepared to assist small scale rural water supply projects which will stay within the limits of $ 3,000 to $ 6,000.
Requests for drilling equipment suitable for depths to 200 metres, costing around $ 200.000 or other needs for constructing sophisticated pipe supply schemes are out of the reach of these assistance programmes. Make sure that cost estimates are realistic. For "cost estimates" see Info sheet E-04 and E-07)

Look for a honest man or woman, living in the area, who has sufficient prestige to fulfil the above described obligations. We are not interested in a "coordinator" sitting in an office hundreds of miles away from the project area.

THE FUTURE

Clean drinking-water is a basic need which every family can organise for itself, just like growing food in its own garden and transporting its products to the market in its own wheelbarrow.
Thanks to modern technology, an appropriate "low cost" water supply can be built by only a few people within just a couple of days.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

THE Ø 4" HAND SURVEY DRILLING SET,
an appropriate tool set for:

1) INVESTIGATING GROUNDWATER

Survey drilling for investigating of availability of groundwater can easily be done by means of our ø 4" light weight hand drilling set, suitable for drilling to depths of 20 to 25 metres. A variety of drilling augers and pointed chisels make it possible to penetrate rather hard, compacted layers as calcrete and laterite. As long as there is no rock or big boulders, it is possible to drill 10 to 15 metres per day with a crew of 2 unskilled people only.

The handle and the rods of this drilling set are made of thin walled (Ø 25/22 mm), high quality steel pipe and are joined together by conical thread connectors. Special rod catchers/spanners are supplied with the standard drilling set.

Survey drilling starts with the Ø 100 mm auger. If the borehole collapses, which can happen below groundwater level, a Ø 90/76 mm ABS (high impact plastic) drilling pipe is then lowered into the borehole and the drilling is continued (through the drilling pipe) by using the Ø 70 mm augers.

Pointed chisels, connected to the drilling rods, will break the harder compacted layers. The bailer, fixed either to the rods or to a rope, will remove the soil below groundwater level. Our standard drilling set contains all tools required to drill to a depth of 20 metres. Additional tools can be supplied for drilling deeper or larger diameter bore holes.

Seasonal fluctuations of the groundwater level can sometimes be more than 4 metres. For that reason it is advised to drill to a depth of 6 metres below groundwater level. The quality of the water must be tested as soon as the water is reached. At full depth the capacity of the well must be tested. Both tests should be performed before deciding whether a well will be constructed at that particular site or not.

The complete Ø 4" hand survey drilling set, suitable to drill down to 20 metres, is packed in 2 steel boxes, size ± 1.30 m x 0.50 m x 0.50 m and can be transported in any type of 4W drive pick-up or even in a big size personal car.

2) CONSTRUCTING (VERY) SMALL DIAMETER TUBE WELLS

A small diameter 63/58 mm PVC filter can be installed into the ø 90/76 mm drilling pipe giving sufficient space for a Ø 40 mm pump cylinder. After installing a simple direct action pump on top, as for example, the Afya pump, this very small tube well will supply a maximum of 200 to 400 litres per hour, sufficient water for one extended family of about 50 people. However, this set-up is only feasible if a good sandy aquifer is available. In clay the recharge into the small diameter filter will be not enough to operate such a special handpump successfully.

In clayey soils, with a low permeability, a special reamer can be used to enlarge the borehole diameter from Ø 100 mm to Ø 150mm or even to a wider diameter borehole. This wider borehole offers ample space to install a ø 110/103 mm PVC casing, which has a 3 times bigger water storage than the small Ø 63/58 mm filter.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

SOME GENERAL OBSERVATIONS CONCERNING DUG WELLS.

For centuries village people have been digging their own water wells. Many of these wells have been operational for decennia because they were properly maintained.

But when the local population starts to move from one village to another or to towns it loses the attachment to traditional customs and responsibilities. Their wells are no longer kept in proper condition. Most community owned dug wells are not maintained at all. They are polluted by dirty buckets and ropes and many times the village water well is the main source of infections.

There is no way back. Community wells are no longer a viable proposition. The dug well should either be privately owned and situated at someone's backgarden where it will be maintained, or covered and fitted with an indestructible handpump sothat it will hardly be possible to damage or pollute it.

Digging a well is often considered to be an easy operation. In practice however the sinking of a good dug well may be complicated and rather expensive. The following problems may be faced:
- what to do if rock is hit. In case it can be penetrated, will there be water under the rock?
- what to do if the well wall starts collapsing during construction?
- what to do if a dug well with a good yield goes dry after some time? Can it be reactivated again?

These questions could have been solved if a proper survey had been carried out before starting to dig. Too often wells are constructed at the wrong sites, indicated off-hand by ignorant officials, instead of at sites where the chances for a successful well are optimal.

A hand survey drilling set is suitable for checking the sub-soil to depths of more than 20 metres. It indicates where the rock fractures are, so that one can avoid the use of compressors or ammunition during construction. For that reason alone the investment in a hand survey drilling set is already worthwile. Besides checking the existence of rock, the set gives full information on the composition of the sub-soil and the availability and quality of groundwater.

Suitable, strong and safe digging tools are indispensable. Small sledge hammers of 1 to 2 kgs, hardened chisels (preferably chisels with a collar to protect the left hand), pick-axes, shovels, a tripod, rope and pulleys and some strong buckets are the most important items of **a digging set**

Lining of dug wells is needed for safety of the diggers during construction and for protecting the wall when water is taken out by means of rope and bucket. Every time a heavy bucket hits the wall of the well some soil will be scratched from it. Within a short time the bottom of the well is full of mud.

Most dug wells are not deep enough! The groundwater often fluctuates more than two metres depending on the season. Therefore digging should be continued to more than one metre below the lowest water level to three metres below water level at the end of the rainy seaon. Lack of good **hand operated dewatering equipment**, (allowing the well-sinker to work below the water level), is the main reason that many dug wells are not deep enough and have dried up.

When a handpump is going to be installed, a dug well may prove to be too expensive. The construction of a 15 metres deep dug well, properly lined with concrete rings, may take more than 3 months and may be very expensive. A hand drilled (tube) well to the same depth can be made in one week at a fraction of these costs.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

DIGGING A WATER WELL

A well should be dug where the survey indicates the availability of at least 200 l/h of potable groundwater. Mark a circle Ø 150 cm (5 cm wider than the diameter of the biggest concrete ring, Ø 145/125 cm) and erect a small tripod h = 4 m.

Start digging, keep the bottom of the well round and its wall vertical. The soil is removed by special heavy duty plastic buckets, a Ø 25 mm rope and a Ø 300 to 500 mm well wheel.
Digging without a lining is continued in hard clay or in other compacted soils (laterite or calcrite) where there is no fear that the well wall collapses. Use sledge hammers, chisels and small pickaxes. When the survey drilling has been executed correctly, digging must be possible without the use of dynamite or compressors. (expensive and dangerous)

When the survey drilling indicates the presence of sandy layers, well lining (concrete rings) will have to be installed. Manufacturing these rings requires the following materials:
- cement which is resistent against salty groundwater.
- washed granitic sand of a size between 0.5 and 3 mm, without clay or dust.
- washed hard gravel from 5 to 25 mm, no crushed stones, no laterite or other compacted compacted material.

The moulds must be placed flat and horizontally on a firm floor. Solid concrete is made out of a mix of 1 volume cement, 2 volumes sand and 3 volumes gravel. Keep the mix rather dry!

Place the under-ring (rabbet or cutting edge) and pour the concrete mix between the inner and the outer mould in layers of about 15 cm. Compact the concrete with a wooden beam the exact size of the opening. Not a stick, not a bar, not a spade, but a big wooden beam! Compact each layer and finally place the upper rabbet ring.

Remove the upper rabbet ring after one hour, the outer mould after 3 hours and the inner mould after 12 hours. The fresh concrete ring, now standing on the lower rabbet ring only, must cure 5 days at least. Keep the ring wet and covered with plastic.

When digging has come at ground water level, the well wall may lose its stability and collapse, especially in sandy soils. Lower the biggest diameter concrete ring Ø 145/125 cm (or Ø 115/100 cm), without cutting edge, to the bottom of the well. Use a 2 tons tripod and special lifting tools for this rather complicated and sometimes dangerous job.
Place the other rings on top of each other until the lining has reached the top. The last ring should be made to a special height so that it reaches 50 cm above ground level.

Lower now the smaller ø 115/100 cm (resp 93/80 cm) filter ring (1 volume of cement and 4 volumes of gravel without any sand) with cutting edge, through the bigger rings, on the bottom of the well and place on this one 3 filter rings of h = 1 m or 6 filter rings of h = 0.5 m.

Dig underneath and all around the cutting edge so that the pipe of concrete rings will sink slowly. Continue digging till approximately 3 meter below water level to be sure there will be sufficient water in the well during the dry season. Use hand operated dewatering equipment for digging under the ground water level. Suction (membrane) pumps are only useful when the total depth to the bottom of the well is less than 7 metres. For deeper wells use the SWN dewatering handpump set.

Note: The amount of drinking-water for 250 people is ca. 5000 litres per day. Of this amount ca. 50% or 2500 litres may be stored during the night and will be used during the first hours of the day. This means that at sites where the inflow is 200 l/h only, a dug well can serve a community of 250 people.
A drilled (tube) well, without any storing capacity, constructed at the same site, will supply 2400 litres during the day-time, which is sufficient for 120 people only.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

TWO (FOUR) HAND DRILLING SETS FOR CONSTRUCTING WATER WELLS :

type	**first auger**	**drilling pipe**	**casing/screen**	**suitable for:**
4" set (too small)	*100 mm*	*ø 90/76 mm*	*ø 63/58 mm*	*40 mm cylinder*
6" set	150 mm	ø 125/108 mm	ø 75/69 mm	50 mm cylinder
8" set	180 mm	ø 160/140 mm	ø 110/103mm	75 mm cylinder
10"set (too heavy)	*240 mm*	*ø 220/200 mm*	*ø 125/117mm*	*75 mm cylinder*

Experience with hand drilling equipment.

In the early seventies 10" hand drillings sets were used in handpump water supply programmes. These heavy sets required truck-mounted cranes and trailers for their transport. Later on the smaller 8" hand drilling set was introduced, and it became more or less the standard set for rural water supply projects in Africa.

With the 8" drilling set it is possible to make a tube well for a 110/103 mm PVC casing and screen which is suitable to install the 75 mm (outside ø 98 mm) pump cylinder. With larger bore hole diameters it is the handpump itself that limits the yield, not the bore hole size. Drilling 10" or wider diameter boreholes in good aquifers, for handpump supply only, makes no sense at all.

The 8" hand drilling set is capable of penetrating in rather hard soils, is made out of high quality materials, light weight, easy to handle, durable and reasonably priced. It is capable of drilling to a depth of 20 metres, can be packed in 4 steel boxes, sizes 1.3 m x 0.5 m x 0.5 m, and be transported in a car the size of a Landrover. For drilling shallow wells, down to maximum of 10 metres, a tripod is not even necessary.

The 6" hand drilling set.

The light weight 6" hand drilling set is a combination of a survey set and a well construction set. Everywhere a good aquifer is found within 20 metres, a 600 to 800 litres per hour yielding well can be constructed, suitable to serve approximately 250 people.

In clayey material, where the subsoil is stable, the 150 mm borehole can be enlarged by means of a 300 mm reamer. This gives more water storage in the well and the possibility to install a 110/103 mm, a 125/117 mm or even a 160/150 mm PVC casing and screen.

It is also possible to drill **latrine holes** of 450 mm diameter to a depth of 10 metres by means of some special reamers. (The cost to build a standard V.I.Pit latrine is more than 50 times higher).

The standard 20 metres set is packed in 3 steel boxes and can be transported on every pick-up or a big size personal car (station wagon). A tripod is not necessary, even not for depths to 25 metres.

Note:
When the first hand drilling programmes started in Tanzania in 1972, the total cost of a well fitted with a hand pump (of poor quality) was around **US $ 6000**. At the moment (with the 6" hand drilling set) it is possible to construct good yielding tube wells, fitted with an almost maintenance free handpump, for **US $ 600 per well.**

P.O. Box 88
8080 AB Elburg

PRICE LIST FOR Ø 150 MM (6") HAND DRILLING EQUIPMENT
suitable for ground water investigation or the construction of tube wells.
(US $ = ± NLG 1.75)

A)	**Minimum set, suitable for drilling water wells to a max depth of 20 m in clayey soils only.**					
1	toolguide, detachable	ø 200 mm			NLG	192.00
1	kelly, crosspiece with lockpins, 4 handles	sq 40/30			NLG	225.00
2	drilling rod, L = 1.00 m, incl. lockpin	sq 40/30	NLG	68.00	NLG	136.00
9	drilling rod, L = 2.00 m, incl. lockpin	sq 40/30	NLG	90.00	NLG	810.00
10	spare lockpins for connectors	sq 40/30	NLG	6.00	NLG	60.00
2	rod catcher, rod lifter and auger cleaner		NLG	45.00	NLG	90.00
1	river-side auger	ø 150 mm			NLG	185.00
1	river-side auger	ø 100 mm			NLG	150.00
1	flight auger, conical, pointed	ø 150 mm			NLG	425.00
1	chisel, flat and pointed				NLG	120.00
1	fishing tool for drilling rods and pebbles				NLG	125.00
1	set of tools for installation and repair				NLG	60.00
1	steel box (1.5 x 0.5 x 0.5) m, with padlock				NLG	390.00
	Total for the minimum set (when casing (drilling pipe) is not required)				**NLG**	**2,968.00**

A1)	**Hand drilling set for the construction of Ø 450 mm bore hole latrines, in clayey soils only**					
	The minimum hand drilling set, see A) plus following additional equipment				NLG	2,968.00
1	reamer for widening ø 150 mm bore holes to ø 300 mm				NLG	460.00
1	reamer for widening ø 300 mm bore holes to ø 450 mm				NLG	490.00
1	mould (detachable) for concrete latrine covers, incl concrete foot steps				NLG	960.00
1	steel box (1.3 x 0.5 x 0.5) m, with padlock				NLG	390.00
	Total for constructing bore hole latrines (when casing is not required)				**NLG**	**5,268.00**

B)	**The complete (economical) set, for drilling to a max depth of 20 m, mostly in clayey soils.**					
	The minimum set, A), plus equipment (incidentally) needed for sandy equifers				NLG	2,968.00
1	ABS casing, L = 1.00 m, LHT, w. protect.	ø 125/108			NLG	165.00
2	ABS casing, L = 1.50 m, LHT, w. protect.	ø 125/108	NLG	235.00	NLG	470.00
8	ABS casing, L = 2.00 m, LHT, w. protect.	ø 125/108	NLG	295.00	NLG	2,360.00
1	casing head on drilling pipe	ø 125/108			NLG	60.00
1	casing shoe, notched, LHT, for	ø 125/108			NLG	190.00
2	casing clamp for pipes	ø 125/108	NLG	170.00	NLG	340.00
1	bailer, for rope and rod connection	ø 90 mm			NLG	325.00
	Total for this economical set (when casing may be required incidentally)				**NLG**	**6,878.00**

C)	**The heavy duty set** (all items packed in boxes) for mostly drilling in sandy aquifers.					
	The same as the economical set, see B), plus following alterations:				NLG	**6,878.00**
	In stead of the 9 drilling rods L = 2.00 m, which do not fit in the steel boxes, add the **price differences** for					
18	drilling rods, L = 1.00 m, incl. lockpin	sq 40/30	NLG	68.00	NLG	414.00
	In stead of full ABS casing (1x L=1.00 m, 2x L=1.50 m, 8x L=2.00 m) add the **price differences** for					
20	ABS/steel casing L = 1.00 m, LHT, w. prot.	ø 125/108	NLG	275.00	NLG	2,505.00
2	steel boxes (1.3 x 0.5 x 0.5) m, with padlock		NLG	390.00	NLG	780.00
	Total for the heavy duty set (when casing will most probably be required)				**NLG**	**10,577.00**

CALORAMA
P.O. Box 88
8080 AB Elburg

EX FACTORY PRICES FOR Ø 150 MM (6") HAND DRILLING EQUIPMENT

a) The minimum set, suitable for drilling to depths of 20 metres **in clayey soils only.**

1	toolguide, detachable	ø 200 mm			NLG	192.00
1	kelly, crosspiece with lockpins, 4 handles	sq 40/30			NLG	225.00
2	drilling rod, L = 1.00 m, incl. lockpin	sq 40/30	NLG	68.00	NLG	136.00
9	drilling rod, L = 2.00 m, incl. lockpin	sq 40/30	NLG	90.00	NLG	810.00
10	spare lockpins for connectors	sq 40/30	NLG	6.00	NLG	60.00
2	rod catcher, rod lifter and auger cleaner		NLG	45.00	NLG	90.00
1	river-side auger	ø 150 mm			NLG	185.00
1	river-side auger	ø 100 mm			NLG	150.00
1	flight auger, conical, pointed	ø 150 mm			NLG	425.00
1	chisel, flat and pointed				NLG	120.00
1	reamer for widening boreholes to	ø 300 mm			NLG	450.00
1	fishing tool for drilling rods and pebbles				NLG	125.00
1	set of tools for installation and repair				NLG	60.00
1	steel box (1.5 x 0.5 x 0.5) m, with padlock				NLG	390.00
	Total for the minimum set (when casing (drilling pipe) is not required)				**NLG**	**3,418.00**

b) The standard set, for drilling to depths of 20 metres, **mostly** in clayey soils.

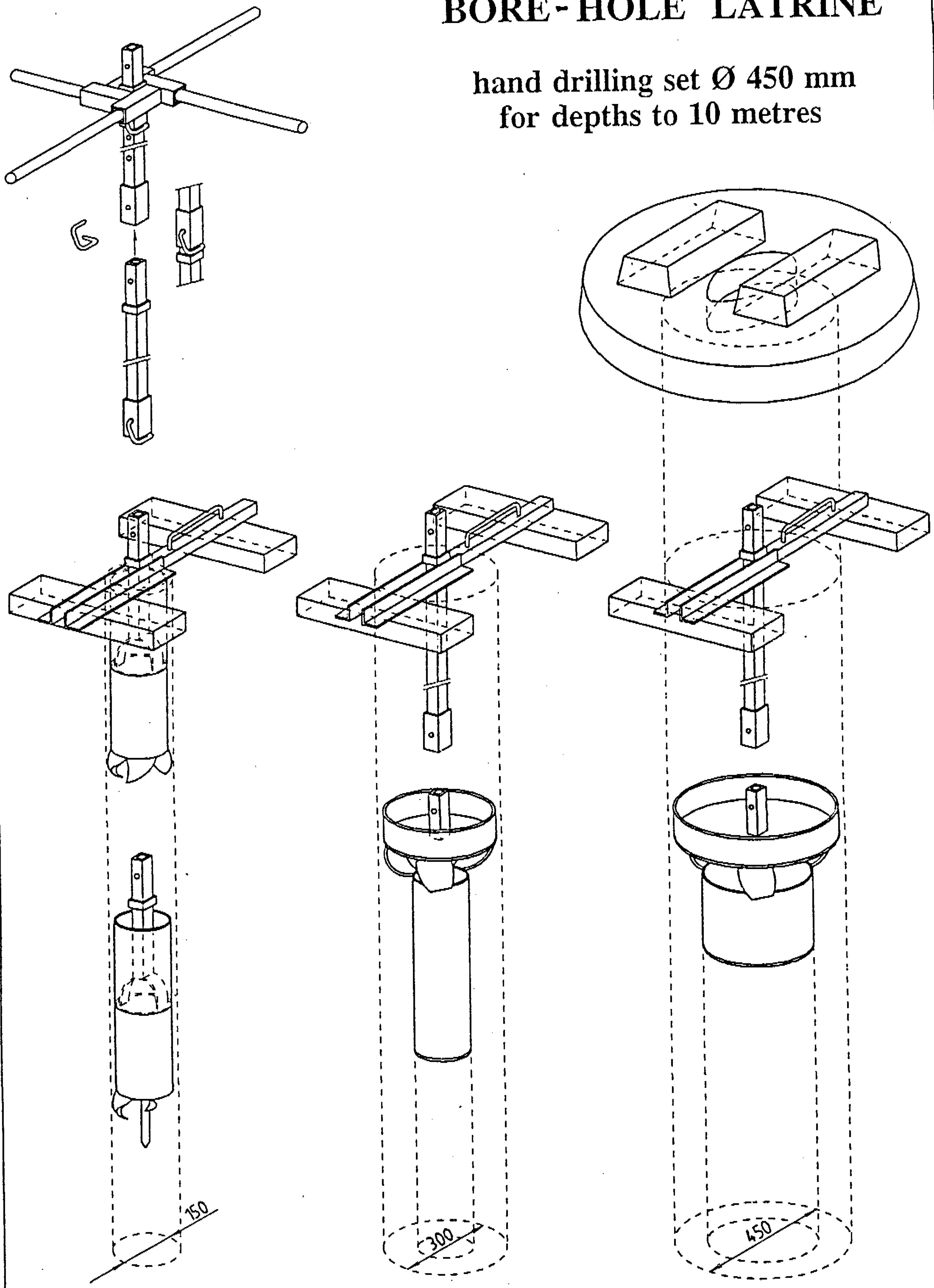
	All the above mentioned equipment from **the minimum set**				**NLG**	**3,418.00**
	plus the equipment needed for (incidentally) drilling in sandy aquifers:					
1	ABS casing, L = 1.00 m, LHT, w. protect.	ø 125/108			NLG	165.00
2	ABS casing, L = 1.50 m, LHT, w. protect.	ø 125/108	NLG	235.00	NLG	470.00
8	ABS casing, L = 2.00 m, LHT, w. protect.	ø 125/108	NLG	295.00	NLG	2,360.00
1	casing head on drilling pipe	ø 125/108			NLG	60.00
1	casing shoe, notched, LHT, for	ø 125/108			NLG	190.00
2	casing clamp for pipes	ø 125/108	NLG	170.00	NLG	340.00
1	bailer, for rope and rod connection	ø 90 mm			NLG	325.00
1	steel box (1.3 x 0.5 x 0.5) m, with padlock				NLG	390.00
	Total for the standard set (when casing may be required incidentally)				**NLG**	**7,718.00**

c) The universal set for frequently drilling in sandy aquifers.

	The same as the standard set no b)				**NLG**	**7.718.00**
	plus the costs of the following alterations. In stead of the 9 drilling rods L = 2.00 m, which do not fit the boxes, add the **price differences** for					
18	drilling rods, L = 1.00 m, incl. lockpin	sq 40/30	NLG	68.00	NLG	414.00
	and i.s.o. full ABS casing (1x L=1.00 m, 2x L=1.50 m, 8x L=2.00 m)					
20	ABS/steel casing L = 1.00 m, LHT, w. prot.	ø 125/108	NLG	275.00	NLG	2,505.00
1	steel box (1.3 x 0.5 x 0.5) m, with padlock				NLG	390.00
	Total for the universal set (when casing will most probable be required)				**NLG**	**11,021.00**

BORE-HOLE LATRINE

hand drilling set Ø 450 mm
for depths to 10 metres



Calorama, Box 88 Elburg, Holland

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

IMPORTANT INFORMATION ON LOW COST "HANDPUMP" WATER SUPPLIES

General
- In 1990 more than 75% of the total world population had no access to clean drinking-water.
- The number of people in the world without access to clean water is increasing every year.
- Poverty and poor health are mostly related to an insufficient and/or poor water supply.

Hydrological situation
- Surface water is contaminated and often not available during the whole year.
- Spring catchment can serve not more than 5% of the rural population in Africa.
- Rainwater catchment is financially not feasible for a rural population.
- Groundwater is mostly the only reliable water source.
- Most of the rural population is living there where the shallow groundwater is available.

Water lifting
- The use of bucket and rope is cheap and reliable, but requires a wide diameter (shallow) well. As buckets may pollute the well, this system should always be privately owned. A community owned open well will be a mess in no time, wherever this construction may have been built.
- Shallow well handpumps (locally manufactured) are cheap and may last more than 10 years.
- Deep (tube) well handpumps are more expensive, need regular maintenance and a spare parts supply organisation.
- A piped water supply system with a submersible pump, a water storage tank and a distribution nettwork, requires an adequate organisation and a sufficiently large (foreign currency) budget.

A handpumping unit consists of the following parts:
A cylinder (the pumping unit) of various diameters (minimum PVC casing ø 3" (75/69 mm)) with: - top connector to the 1½" plastic riser,
- bottom connector with footvalve and connection to a suction pipe or hose,
- piston, with valve and pumprod connection.

Pumping rods of stainless steel to move the piston up and down and to lift the water column.
Riser pipes, made from High Impact PVC, to transport the maximum yield of 1 m^3 per hour.
A pumpstand with spout, to be fixed to the concrete base (foundation).
A pumphead fixed on the pumpstand, with handle (bearings), connected to the pumprod.

Handpumps can be installed on
Hand dug wells, which are mostly shallow wells, which have been constructed
- in clayey soils, where the permeability is low and a 1-2 m^3 storage is required.
- in harder materials where hand drilling is not possible.

Hand drilled wells, constructed to a maximum depth of 25 metres
- as small diameter tube wells, when constructed in good aquifers.
- as wide diameter (reamed) tube wells when constructed in clayey soils (6 m below water level)

Boreholes, in which the water level is not deeper than 60 metres and which have been abandoned for a piped supply system for reason of insufficient yield. A small pipe supply system for e.g. 5000 people will require 10-20 m^3 per hour; the maximum yield of a handpump is 1 m^3/h only.

Costs:
- Depreciation, operation and maintenance costs of a piped supply system may vary from $ 5.00 to $ 10.00 per person per year.
- The total costs for deep well hand pumps fitted on boreholes are $ 0.50 to $ 1.00 p.p.p.y.
- Those for Direct Action handpumps on shallow wells $ 0.20 to $ 0.40 per person per year.
- The yearly costs to supply the 400 million people in the rural areas of Africa will be around $ 3,000 million, $ 300 million and $ 120 million respectively.
- The "least cost" solution is the only realistic approach to solve this drinking-water problem.

CALORAMA
Rural Development Service
P.O.Box 88
8080 AB Elburg, The Netherlands

THE AFRICAN HANDPUMP
and its related construction equipment

In the early seventies in East Africa, some donor organisations started "Water Master Plan Studies" for the rural areas where the drinking water situation was very poor. They found that most existing water supplies were out of order. They concluded that the best solution was the implementation of "low cost" handpump programmes. In those days however, the "Water Authorities" focussed on the rehabilitation and extension of existing diesel or electrically driven piped water supply systems.

It was only towards the end of the seventies that this focus shifted to low cost (hand operated) systems. But the technology of making low cost constructions had almost been forgotten. Special hand operated survey and construction equipment, together with suitable operating and maintenance systems, had to be re-developed, re-designed and field tested in order to find the most suitable solution. With modern materials such as stainless steel and technical plastics, Calorama developed a full range of special equipment suitable for the rural areas.

Special attention was given to the development of a handpump suitable for rural Africa, i.e.:

- **Easy** : to install, operate, maintain and manufactured.
- **Economical** : maintenance free during its full lifetime of 10 years.
- **Reliable** : as sturdy and strong as possible.
- **Cheap** : both for buying and maintenance (spare parts).

During the eighties Calorama developed and field-tested a complete range of new SWN hand and foot pumps, suitable to lift the water from both shallow and deep wells.
In 1980 the SWN 80 became the standard handpump in Tanzania for wells with a water level down to 40 metres. More than 8000 of these pumps have been installed in East Africa and another 5000 in other African countries. The SWN 80 has thus become **The African Handpump**.

A complete range of special equipment and materials for the construction of rural water supplies (hand dug and hand drilled wells) is available. All aspects of "low cost" have been taken into consideration, from the early stage of the survey of ground water (survey drilling equipment) to the maintenance and local manufacture of the hand pumps (spare parts).

Technical and logistical problems, are relatively easy to solve. Maintenance on the contrary tends to be difficult because it's a social problem. It will have to be organised before the end of a project construction period. Experience shows that the maintenance is best put into the hands of the beneficiaries, organised at the lowest possible level.

Special maintenance equipment has been developed, together with simple and clear instructions for mechanics and care takers. Even local assembly or manufacture of handpumps is now possible thanks to a set of welding jigs, some special tools and a short training. These aids suffice for a manufacture of minimum one hundred SWN handpumps per year.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

THE (EXPENSIVE) DEEP WELL HANDPUMP
and its requirements

More than 80% of all handpumps installed anywhere in the world are or will become out of order within a few years. Remarkably, many donor organisations believe that training of care-takers and/or mechanics is all that is needed to ensure that the water supply remains operational.

If a number of handpumps has to be installed in a remote (project) area (where local authorities can't organize maintenance for it), these handpumps have to meet the following minimum requirements:

1) A lifting device (lever system),
capable of lifting around 150 kgs. This is possible by a pushing force of 20 kgs on the handle and a lever ratio of 1 to 7½. This means the capability to lift water from a depth of 50 metres by means of a ø 50 mm (2") pump cylinder. For the availability of the correct parts it's important to have all pumps installed in a certain project area to be of the same make and type.

2) A pumphead, which supports the lever mechanism,
has to be sturdy and strong. Maintenance will not be necessary during its lifetime of at least 10 years. The bearings, the wearing parts of a handpump, should even have a bearing capacity up to 10 tons.
(A handpump will never be too strong!)

3) A pumpstand, which is fixed to the concrete base,
should be stable and strong, not only to withstand all pumping forces, but also forces caused by improper use of the pump, as by children playing around, or by cows or camels tied to the pump. Besides that, the pumpstand should be extremely well coated (inside and outside) to be protected from corrosive water for more than 10 years.

4) A string of riser pipes, between the pumpstand and the cylinder,
exists of a number of pipes of various lengths, so that the cylinder can be set at every depth with an accuracy of 25 cm. The pipes have to be joined together by means of cylindrical (not conical) thread connectors. A rubber ring prevents leakage and make the use of tape superfluous. Risers should be made out of thick walled "High Impact" PVC and must be suitable to withstand rough treatment during transport and be resistant to ultraviolet sun radiation. Never use the ordinary PVC pipe! The pipes should be light-weight and suitable for installion by hand to a depth of 50 metres.
(Galv.Iron Pipes are heavy, expensive and will deteriorate quickly. Useless for rural water supplies).

5) A string of pumprods, between the handle and the piston in the cylinder,
consists of a number of rods of the same length as the riser pipes. They should be packed and transported inside the risers. A pump rod should be inoxidable. Its diameter should be sufficient to withstand forces of 4 x the maximum pumping load (appr. 600 kgs) which occurs during juddering the pump-handle. The rods should be put into PE hoses to prevent damage to the PVC riser pipe.

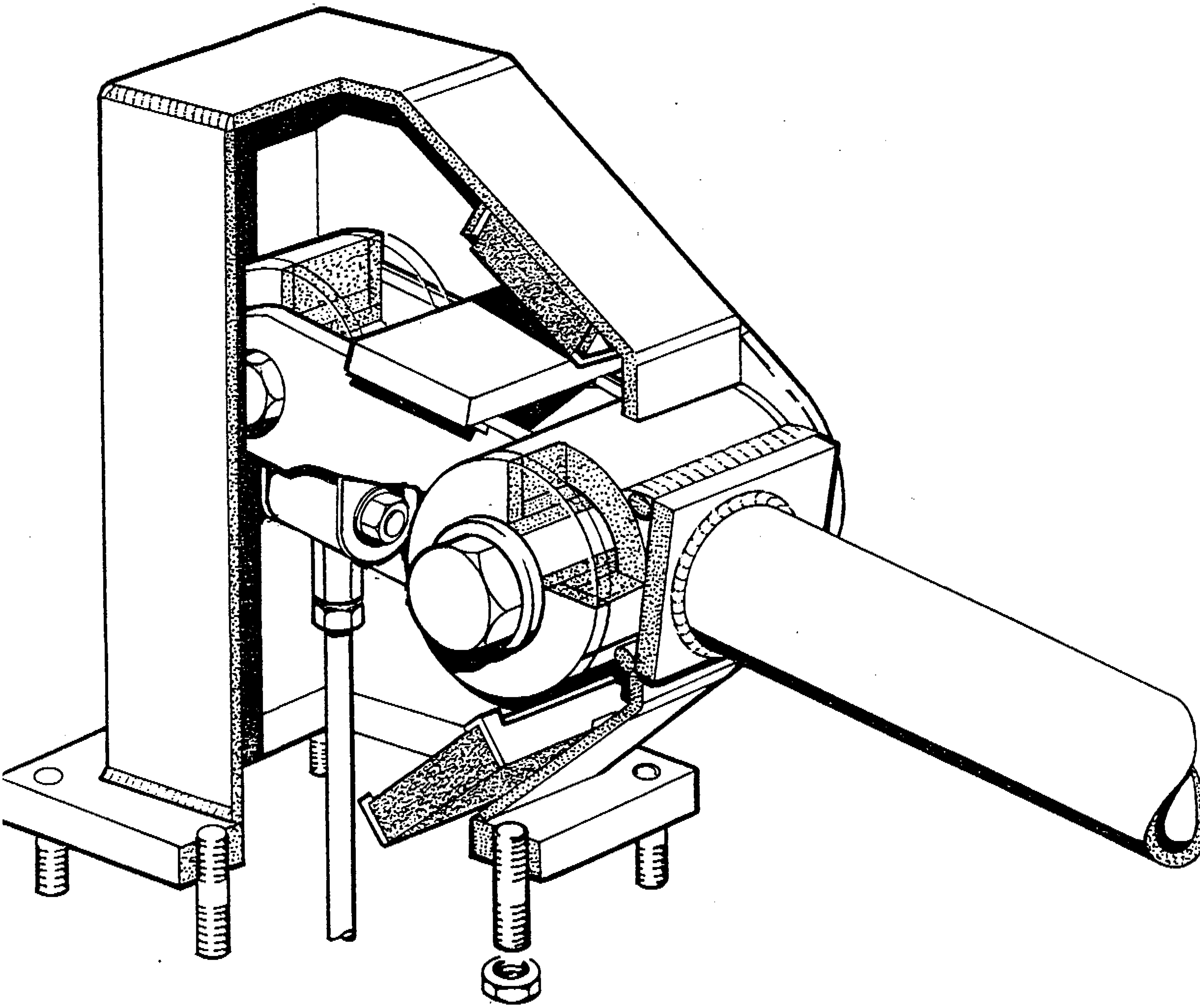
6) A pump cylinder, fitted underneath the riser and the rod,
has to be made out of inoxidable materials such as neoprene, rubber, stainless steel and brass. The high quality neoprene piston cup (no leather!) should be of a double acting type, so that sand will be removed from the cylinder wall during the downward stroke. The piston valve and the footvalve should have a thick rubber disc closing on an inoxidable seat.
A "plastic" riser installed to a depth of 50 metres, may creep 20 to 40 cm during a period of 10 years. In that case the piston may hit the inside of the cylinder. A deep well pump cylinder should therefore have a length of 100 cm at least.

7) A concrete pumpbase.
Many handpumps have gone out of order due to a poor fixation to the concrete base. When the base surface is not flat and horizontal, strange forces may affect and damage the pump. A thick rubber layer underneath an oversized base plate of 400 x 400 x 8 mm may overcome this problem.

SWN 90 PUMPHEAD

suitable to lift the water from 60 meter

- heavy-duty steel construction
- hot dip galvanized
- heavy rubber stops
- laminated phenolic bearing bushings
- high quality steel bearing shafts
- designed for local production



CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

THE "LEAST COST" SOLUTION TO SUPPLY CLEAN DRINKING WATER TO A CONCENTRATED NUMBER OF 30,000 PEOPLE (Encampment)

Assuming:
- the average ground water depth at 8 metres in a subsoil without rock and/or boulders,
- good yielding aquifers of 500 litres per hour or 6000 litres per day of potable water,
- required amount of drinking-water to be 20 litres per person per day.

This means that:
- wells can be hand drilled, by means of augers ø 150 mm, to a maximum depth of 15 metres,
- ø 75/69 mm permanent PVC casing must be installed to an average depth of 12 metres,
- ø 50 mm (2") pump cylinders will have to be set at an average depth of 10 metres,
- Direct Action hand pumps can be used for these depths,
- the number of people to be served by one well will be approximately 300 and that
- **all materials and equipment to construct 100 wells can be loaded in one 20ft container.**

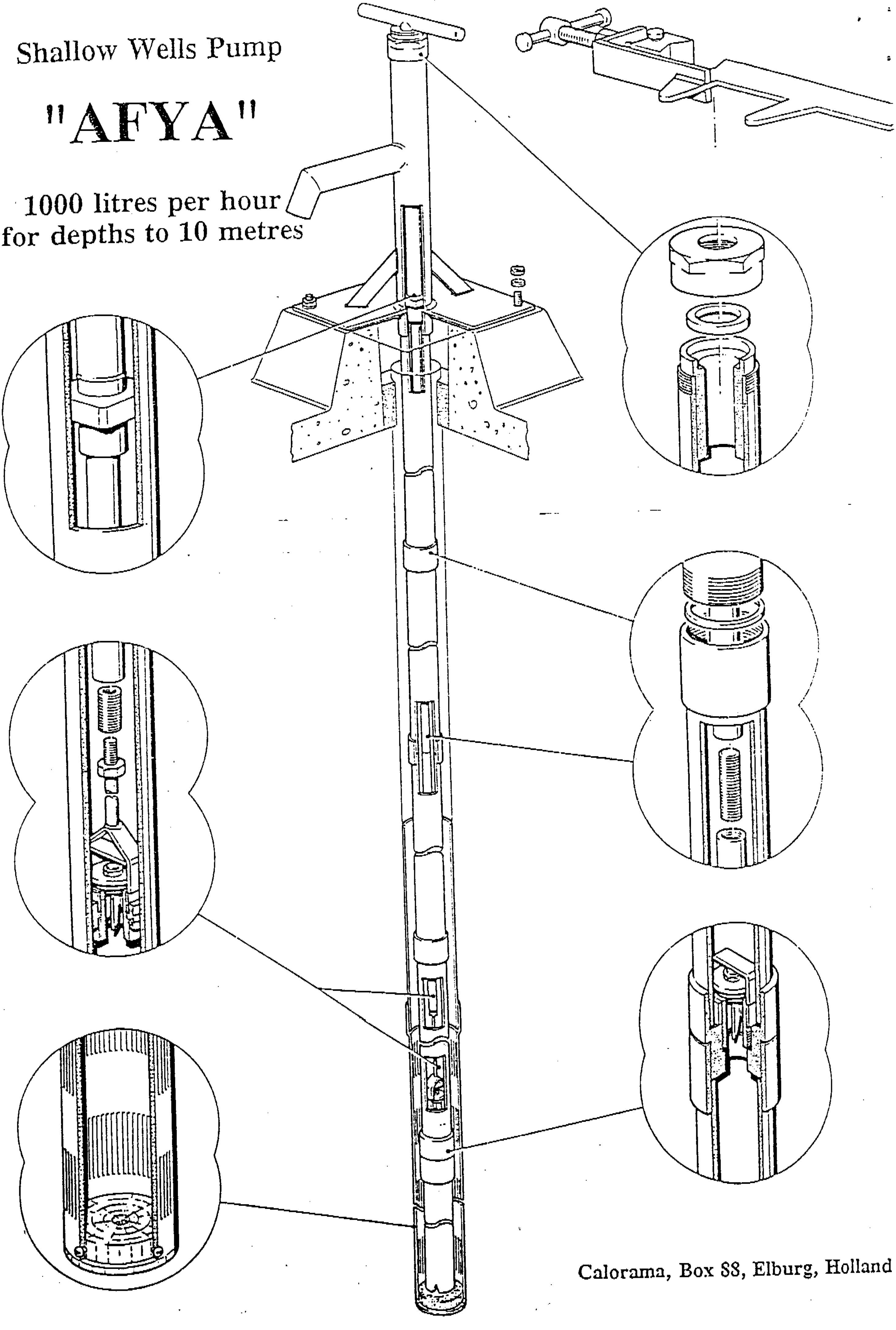
(excl. labour and transport)	**INVESTMENT**	**COST/WELL**
1) Well drilling		
6" hand drilling set, suitable to drill a total number of 200 wells, at a rate of 2 wells per week,	NLG 12,000.00	
depreciation over 200 wells		NLG 60.00
maintenance of the drilling set		NLG 5.00
2) Well materials,		
3 PVC casing ø 75/69 mm, plain, l = 3 metres	NLG 20.00	NLG 60.00
1 PVC casing ø 75/69 mm, slotted, l = 3 metres	NLG 33.00	NLG 33.00
1 wooden bottom for ø 75/69 mm PVC	NLG 2.00	NLG 2.00
3) Concrete works (local materials not included)		
mould for concrete pump base	NLG 540.00	
mould for concrete slab and gutter	NLG 1,800.00	
depreciation over 200 wells	NLG 2,340.00	NLG 12.00
4) Pump installation,		
direct action pump type "Afya"	NLG 320.00	NLG 320.00
4 riser PVC 60/50/rod PVC 21/14 mm, l = 2 m	NLG 40.00	NLG 160.00
1 cylinder PVC 50 mm (2") l = 2 m	NLG 190.00	NLG 190.00
1 universal spanner for "Afya" pumps	NLG 100.00	NLG 100.00
TOTAL MATERIAL COSTS, ex factory		**NLG 942.00**
Packing and transport,		
sea container, 20 ft, 2nd hand overhauled	NLG 3,200.00	
packing and transport in the Netherlands	NLG 2,200.00	
Total packing and transport costs for 100 wells	NLG 5,400.00	NLG 54.00
TOTAL COSTS PER WELL, FOB Rotterdam		**NLG 996.00**

(This is about US Dollar 600 per well or US Dollar 2.00 per person only).

Shallow Wells Pump

"AFYA"

1000 litres per hour
for depths to 10 metres



Calorama, Box 88, Elburg, Holland

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

LOW COST PIPED WATER SUPPLY SYSTEMS
for domestic use, cattle watering or small scale irrigation.

All SWN lever pumps (SWN 80, 81 or 90) can be modified into pressure pumps, capable of pumping the water into an overhead tank. by fitting a special pressure unit is installed in the SWN pumpstand.

The pressure unit consists of a galvanized iron flange fixed to a 50 mm PVC cylinder and a 50 mm piston which is at one side connected (via a ball joint) to the pump handle and at the other side to the pump rod. The piston moves up and down in the cylinder (as a movable plug) and prevents water from entering the pumphead. When the spout is closed, the water in the pump stand is compressed and conducted to a higher level.

A SWN hand pressure pump normally operates a 2" pump cylinder and is capable to supply a maximum of 750 litres per hour to a height of maximum 30 metres. At an average pumping time of 6 hours per day, the daily production will be 4500 litres, which is sufficient for about 225 people using 20 litres per day or for the population of a small hospital say 100 people using 45 litres per day.

In case a hand pressure pump is used for one family only (using a maximum of 1000 litres per day) the extra capacity may be used for cattle watering or for a small vegetable garden. Special porous poly-ethelene irrigation hoses, connected to a small (100 litres) overhead tank, may irrigate plots up to one acre.

The SWN hand pressure pump can be used in combination with a solar energy system. Two 60 watt solar panels can supply ample energy to operate a 24 volt DC sub-mersible pump, installed underneath the handpump cylinder. The water is pumped via the valves of this cylinder into the riser of the handpump.

With the spout closed by a cock tap, the solar pump will supply ca 300 litres per hour to a total height of about 30 metres via a 1" poly-ethelene riser.

Water storage can be obtained by connecting together a number of water drums, which may be installed in the attic of a building or on a special support. All kind of maintenance free poly-ethelene containers are presently available, up to a capacity of 5000 litres or even more. A water storage of just 2000 litres is already sufficient for dispensaries, small schools or private houses.

The handpump/solar-pump combination is particularly suitable for the rural areas. There is no need for a complicated DC-AC adapter, there are no batteries required (to be checked and maintained continuously) and there is hardly any other maintenance involved.

The electric supply from the panels is directly connected to the 24 Volt DC submersible pump motor, via a maintenance-free pump controller. The submersible pump starts and stops automatically and no daily caretaker needs to be appointed.

The water supply will always be operational. At night or when the storage tank is empty, water can be obtained from the handpump.

Provided there is sufficient groundwater it is well worth to install this small handpump/solar system for one's building, cattle trough or irrigation site. Compared to all other solar options, this syatem costs very little.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

THE RURAL WATER CHAIN

Checklist on information, materials and equipment required for a successful handpump installation

no	description	yes	no
01	information on the problems (diseases, complaints) caused by the existing water supplies	x	x
02	information on the willingness of the users to have the situation improved or not	x	x
03	information on the availability of groundwater in the area from existing dug or tube wells	x	x
04	information on the costs of the various possibilities to improve the existing situation	x	x
05	information on the contribution the villagers are willing to pay for the improvement	x	x
06	ø 4" hand drilling survey set (drilling pipe 90/76 mm) for depths to maximum < 25 metres	x	x
07	means of transport, repair facilities (as welding) and spares for the survey equipment	x	x
08	(field) water testing set for chemical analyses and the training of staff to use it	x	x
09	hand operated well capacity testing set, to be sure there is enough recharge into the well	x	x
10	discussion with the villagers on the results of the survey and on the final site of the well	x	x
11	reaming tools to enlarge survey borehole (in clay) from ø 100 mm to ø 150 mm	x	x
12	ø 6" hand drilling set (drilling pipe 125/108 mm) for wells < 20 m, where there is no rock	x	x
13	reaming tools to enlarge boreholes (in clay) from ø 150 mm to ø 300 mm	x	x
14	ø 8" hand drilling set (drilling pipe 160/142 mm) for wells < 20 m for harder soils, no rock	x	x
15	means of transport, repair (welding) facilities and spares for the drilling equipment	x	x
16	permanent PVC casing ø 75/69 mm, plain, slotted and bottom, (in 125/108 mm drilling pipe)	x	x
17	permanent PVC casing ø 110/103 mm, plain, slotted and bottom, (in 160/146 mm drilling pipe)	x	x
18	roofed (as a sun protection) PVC store and a lockable store for the equipment	x	x
19	washed (clean) coarse sand and gravel from a riverbed; means to transport it to the well site	x	x
20	sieves for (round) gravel pack (1-3mm) and for concrete: sand (max 2mm), gravel (5-25mm)	x	x
21	10 bags of (dry) cement for slab and gutter and a covered and locked place to store the bags	x	x
22	mould for making the concrete pump base, a slab and a gutter on drilled wells	x	x
23	hand digging set for sites where the depth of the water is > 20 m and/or there is hard sub-soil	x	x
24	moulds for making concrete well rings, ø 115/100 x 50 cm (350 kgs hoist in digging set)	x	x
25	moulds for making cylindrical or conical (in situ) concrete well rings ø 145/125 cm	x	x
26	hoisting set (2 tons), complete with lifting tools, for handling ø 145/125 cm concrete rings	x	x
27	1 bag of cement per meter lining ø 115/100 cm; 2 bags per meter for ø 145/125 cm rings	x	x
28	dewatering set, suction pump type (spares!), where the water level is less than 7 metres	x	x
29	dewatering set, lift pump type (spares!), where the water level is more than 7 metres	x	x
30	mould for well cover, pump base and man hole of ø 115/100 cm or ø 145/125 cm well rings	x	x
31	mould for the concrete slab and gutter on dug wells and a soakpit to avoid standing water	x	x
32	special pump installation toolset, including pump spares, bolts, nuts and washers	x	x
33	60/50 mm PVC riser (l=2m), 21/14 mm PVC rod (l=2m), 2" cylinder (l=2m) for Afya pump	x	x
34	2" pump-cylinder, outside diam. 63 mm, fitting in ø 75/69 mm permanent PVC well casing	x	x
35	2½" or 3" pump-cylinder, both fitting in a 110/103 mm casing, for medium depth wells	x	x
36	1½" high impact PVC riser / ø 10 mm st/st rod, in different lengths, for deeper wells	x	x
37	1½" threaded coupling, between the PVC riser and the stand, when installed on a tube well	x	x
38	anti swing construction, between the PVC riser and the stand, when installed on a dug well	x	x
39	retainers to prevent the PVC riser/rod from swinging and hitting the concrete dug well lining	x	x
40	installation of the "Afya" direct action pump on shallow wells to 10 metres	x	x
41	installation of a high pumpstand (on a tube well) or a short pumpstand (on a dug well)	x	x
42	installation of a built-in pressure unit (in the pumpstand) and piping to an overhead tank	x	x
43	installation of pumphead SWN 80 for depths to 40 m or pumphead SWN 90 for depths to 60 m	x	x
44	fencing and protecting the well site against pollution and vandalism; appointing "care takers"	x	x
45	via government: organizing "users water committee"; appointing/training "village mechanics"	x	x
46	for maintenance: organizing "fund raising", a "dealer" for spares and local manufacture of parts	x	x
47	stimulate "private ownership" and "productive use" as for irrigation, cattle watering, selling	x	x
48	for the reference: meeting with users to be informed if water situation has been improved or not	x	x

If only one item out of this list has been forgotten or neglected (as a shackle in a chain) the water supply can not be successful and the total investment will often be a waste of time and money.

ÇALORAMA
Rural Development Service
P.O.Box 88, Elburg, The Netherlands

COST ESTIMATE FOR CONSTRUCTION EQUIPMENT AND MATERIALS

1) Well construction in sandy aquifers to a maximum depth of 20 metres

Qty	Item	Unit price	**price indication**	**estimated for equipment, materials and transport**
	a) Hand drilling and construction equipment (suitable to drill 100 wells):			
1	(6") hand survey/construction drilling set including reamers		$ 8.500.00	$
1	wooden mould for concrete pump base		*(can be made locally)*	$
1	wooden mould for concrete slab/gutter		*(can be made locally)*	$
	Total estimated costs for hand drilling equipment			$
	b) Well materials for tube wells (casing/screen/filter packing/concrete mixing materials etc.)			
2	PVC 75/69 mm, tulip end, slotted, 1 = 2.00 m	$ 8.50	$ 17.00	$
1	wooden bottom for 75/69 mm pipe		$ 2.00	$
	(per well: 50 litres of washed round gravel, Ø 2-5 mm)		locally available?	$
x	PVC 75/69 mm, tulip end, plain 1 = 2.00 m		$ 6.50	$
	cost of concrete mixing materials for pump foundation and slab		locally available?	$
	Total estimated material costs per well			$
	Total estimated costs for well materials		(number of boreholes)........	$

2) Well construction in hard and clayey subsoils with poor aquifers.

Qty	Item	price indication	estimated
	Well digging equipment, needed when hand drilling is not possible:		
1	well digging set, including tripod h = 4 metres	$ 2,200.00	$
1	conical mould for in situ lining (may not be required)	$ 2,250.00	$
1	dewatering set for digging under water	$ 1,100.00	$
1	mould for concrete well rings diam 115/100 cm, h = 50 cm	$ 4,000.00	$
1	mould for concrete well cover/pump base, (if required)	$ 1,200.00	$
	Total estimated costs for well digging equipment		$
	for lining per metre: 50 lt cement, 120 lt washed sand, 180 lt gravel,	*locally available?*	$
	Total estimated costs for well materials	(number of dug wells)..........	$

3) Handpump installation

Qty	Item	Length	Unit price	price indication	estimated
	a) for lifting the water from a depth of 10 metres maximum:				
1	type "Afya" direct action handpump			$ 135.00	$
3	riser/rod combination for Afya pump,	1 = 2.00 m	$ 20.00	$ 60.00	$
1	pump cylinder diam 50 mm	1 = 2.00 m		$ 125.00	$
1	suction pipe diam 50 mm	1 = 2.00 m		$ 12.00	$
	Total estimated costs per Afya shallow wells pump			$ 332.00	$
	Total estimated costs for Afya pumping equipment			(number of pumps).......	$
	b) for lifting the water from depths of more than 10 metres:				
1	pumphead SWN 90 for water depths to 40 m (incl. counterw. 60 m)			$ 165.00	$
1	pumpstand, h = 600 mm (tube wells) or h = 375 mm (dug wells)			$ 120.00	$
2	riser/rod unit for deep wells	1 = 3.00 m	$ 38.00	$ 76.00	$
	(for deeper wells extra riser/rod units are required)				
x	riser/rod unit for deep wells	1 = 2.00 m	$ 30.00	(number).....	$
x	riser/rod unit for deep wells	1 = 1.50 m	$ 25.00	(number).....	$
x	riser/rod unit for deep wells	1 = 0.75 m	$ 20.00	(number).....	$
1	cylinder D = 63 mm,	1 = 1.00 m		$ 130.00	$
	Total estimated costs per SWN 90 deepwell pump				$
	Total estimated costs for deep well pumping equipment			(number of pumps).....	$

4) Summary of costs

Estimated total investment costs	(for all equipment and materials)	$
Total number of wells to be constructed	(drilled and dug wells together).....	
Total estimated costs per well......		$

Constructing a number of hand-drilled or hand-dug wells can always be done att a unit-price of less than $ 2,000.00

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

A FEASIBLE APPROACH FOR THE MAINTENANCE OF RURAL WATER SUPPLIES

The conditions for having drinking-water in the rual areas are the following:

1) Responsibility
Every head of a family must be personally responsible for the water supply to its members.
(No government in the world is so rich that it can supply drinking water, food, shelter or health facilities to all its citizens, free of charge. The responsibility for these basic needs is with the people themselves).

2) Ownership
Every family or group of families should build its own water supply on its own land, as close as possible to their houses (but at least 10 metres away from a latrine). The well should be protected and maintained. Nobody outside this family should be allowed to fetch water without permission.
(A few years after their constitution more than 80% of all government owned rural water supplies in rural Africa were irreparably out of order).

3) Well materials
The materials for building the water supply must be the personal property of the owner. These materials could be:
- lining for a dug well. In case concrete lining can't be made available, the top part of an unlined well could be made from an old plastic drum.
- PVC permanent casing for a small diameter tube well.

(Local Governments and donor organisations should make these materials available on the condition that the construction can be built by the people according to standard specifications and conditions.)

4) Water lifting equipment
Depending on the financial capability of the owner, the water lifting equipment can be
- a rope and a bucket for dug wells
- a simple and cheap poly-ethelene water bailer with a rope for tube wells
- a low cost direct action handpump

(Also these items should be made available by the local governments, donor organisations and churches at reduced prices.)

5) Assistance
Local government authorities, assisted by the donor organisations and churches, should inform the rural people:
- that Government cannot supply water (and other facilities) free of charge,
- that low cost constructions exists which can be built by individuals,
- that construction equipment can be borrowed and rented,
- that well materials and water lifting equipment can be bought at reduced prices,
- that well builders, pump mechanics and caretakers can be trained,
- that local private assembling/production plants for hand pumps can be set-up.

(Informing the rural population about self help is a responsibility of political, charity and clerical officials.)

6) Conclusion
When people are not constructing their own wells, despite all encouagements, it means that:
1) the message, (as under 5 Assistance), has not been understood,
2) the reduced prices for materials and equipment are still too high,
3) the people put a very low value on improving their water supply.

(There is no shame in abandoning one's effort to improve the water supply if the villagers show no interest themselves.)

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

THE "INDISPENSABLE" VILLAGE WATER SUPPLY CONTRACTOR

At the beginning of this century some 300,000 handpumps had been installed in Holland, **one for every 10 people**. Every village had its own contractor for well construction, pump installation and repair. All materials, equipment and tools were available at the local market.

In Tanzania there are at present some 15,000 handpumps in operation for a rural population of 30,000,000 people, **one handpump for every 2000 people**, a situation similar to that in most African countries. But there are almost no village contractors who can earn a living from the water supply.

If rural Africa sincerely wishes to have its own supply of potable water, it would be well advised to start training its own well sinkers and water mechanics.

At present most rural water supply projects are still executed and managed by donors in cooperation with the government. It would be far better if they would be undertaken by the rural population with local governments and foreign donors assisting equally.

Every district should have its own private water supply contractor. All activities necessary for ground water survey, well construction and pump installation and repair should be undertaken by this local contractor.

A donor pre-financed investment of some hand drilling equipment, a mould for the concrete pump base and some tools would be sufficient to put a self supporting district water supply contractor in business. The local governments could support by buying goods or services from him, but they should never undermine the independence of such contractors.

An experienced consultant will be indispensable for setting up a profitable water contracting business. Aside from technical training the contractors must be tought how to link up with rural organisations, such as schools, hospitals, churches and local agricultural cooperations which are often able to raise funds necessary for constructing small scale supplies of potable water.

"Calorama" is an experienced service organisation capable of assisting the small donor organisations as well as the local contractors in their efforts to supply potable water to the rural population.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

MAINTENANCE ON SWN PUMP CYLINDERS, PVC WELL CASING AND SCREENS

THE CYLINDER PARTS

SWN handpump **cylinders** are manufactured for five different piston diameters and are suitable to be installed at the following maximum depths:

to 5 m	*diam 100 mm*	*(4")*	*od/id 117/100 mm,*	*fitting PVC screen*	*140/125 mm*
to 15 m	**diam 75 mm**	**(3")**	**od/id 93/ 75 mm,**	**fitting PVC screen**	**110/110 mm**
to 25 m	**diam 63 mm**	**(2.5")**	**od/id 75/ 63 mm,**	**fitting PVC screen**	**90/ 83 mm**
to 40 m	**diam 50 mm**	**(2")**	**od/id 63/ 50 mm,**	**fitting PVC screen**	**75/ 69 mm**
to 60 m	*diam 40 mm*	*(1.5")*	*od/id 55/ 40 mm,*	*fitting PVC screen*	*63/ 58 mm*

The piston seal is of a double acting type: perfect sealing during the upward (delivery) stroke and *cleaning the cylinder wall during* the downward stroke. Both the piston and the bottom valve have a thick natural rubber disc, which is closing on a nylon seat. All parts of the cylinder are made from high quality, corrosion free materials. If only clean water is pumped, the manufacturer could guarantee a maintenance-free life time of 10 years.

However, many tube wells are poorly constructed or have not been developed at all. In many tube wells the screen is just an ordinary galvanished steel pipe, in which wide slots have been cut with a oxy-acetylene cutter. Therefor fine sand is coming through the slots causing wear of the rubber piston seal, the rubber puppet valves, the nylon valve seats and even the PVC cylinder wall. Under these circumstances also a stainless steel cylinder will wear out very quickly.
The wear and tear of the cylinder parts can be observed by a decrease of the yield. The well should be cleaned, "developed" and cleaned again.

THE PVC CASING AND SCREEN

The permanent casing should be a thick-walled PVC pipe. For easy installation its length should be 3 metres as a maximum and be fitted with a tulip end at one side. The slots in the screen should be cut in longitudinal direction (never in cross direction) to a width of 0.7 mm. After a few months the remaining slot opening (width) will be decreased to approx. 0.4 mm due to material stresses.

The PVC screen has to be cleaned regularly. By means of a set of special brushes fixed to e.g. the survey drilling rods, or together with a steel weight to a rope, one can scratch all clay and iron crustration out of the slots. The iron particles can be removed from the well by means of a bailer.

Better positioning of the gravel pack can be obtained by pushing and pulling a well fitting plunger up and down in the PVC casing (developing). The gravel should be of a size between 1 and 3 mm, washed and cleaned, round granitic material. Never use crushed stones! The permeability of the gravel pack may become very poor. And most of the crushed stones are too soft. Specially lateritic and calcareous stones. They will clog the slots in a rather short period.

In case the water, pumped out of a tube well, keeps on being sandy, even after "developing" the well several times, the only conclusion is that the well has been wrongly constructed, having too wide *screen slot openings and/or too big a diameter gravel size.* The well has to be abandoned.

The PVC casing and screen of shallow tube wells (down to maximum 15 metres) can be pulled out by means of a tripod, a chain tackle and a special puller. Removing the PVC casing from very deep wells is not possible. The only way to reduce the sand intake of such wells consist of installing a smaller diameter PVC casing and screen inside the existing one.

CALORAMA
Rural Development Service
P.O. Box 88
8080 AB Elburg, The Netherlands

"RE-USE" OF OLD SEA CONTAINERS IN RURAL DEVELOPMENT PROGRAMMES

Big quantities of equipment and materials for rural development projects are usually shipped being in 20 ft sea containers. After a long sea-voyage, a lenghty stay at the port and an expensive trip by truck over-land, the container finally reaches its destination at the project site. There sufficient lockable stores are often missing.

In that case the container itself is the best place to keep the goods.
Indeed, all over Africa, thousands of containers are used as a store, a workshop, a garage, an office, a class-room, a maternity centre, a dispensary or even a house.

A moveable partition can divide the container in two compartments. This is particularly necessary for maternity centres which need:
- one compartment for medical examination of mother and child, fitted with 2 convertible beds, a balance for babies and a cupboard for medicines and dressings.
- one compartment for consultation and vaccinations, fitted with 2 desks and a cupboard.

The heat is kept out of the container with a second (sun) roof, a (lockable) side door as entrance and a sunshade curtain at the end the container, very useful when the main doors are open.

New 20 ft sea containers are expensive. 2nd hand however are rather cheap and will last at least another 10 years, when fitted with an extra (sun) roof and are placed on small supports which keep the bottom dry.

2nd hand transport containers can be fitted with:
- a detachable single pitch roof or a saddle roof
- windows with bars and shutters
- racks with 4 shelves of 3, 4, or 5 metres length
- second floor construction to store long pipes, bars, angle iron etc
- a lockable steel side door
- a work bench with vices, tools etc
- all furniture as tables, office desks, benches, chairs, cupboards etc, etc.

Many of the container workshops are kept operational after the completion of the project. In rural areas these workshops can be very useful as repair shops for knives, axes, hoes, sickles, pitch forks, wheelbarrows, bicycles, carts etc. Such repairs are often not undertaken simply because no one in the village can afford to buy a well equipped repair shop.

For the same reason most rural communities are unable to maintain the handpumps which donor organisations have installed. Therefore every water project that uses containers for shipping equipment would be well advised to transform them into workshops before shipping them to the project area.