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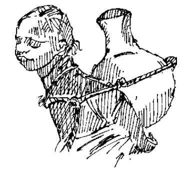
INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION



Integrated self-financing drinking water projects

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ADVANCED TECHNOLOGIES NOW available enable integrated rural distributed drinking water projects to be self-financed by most rural communities provided the initial seed or investment capital is made available to them. Even the very poorest communities in the world should be able to contribute a part of the investment costs, and at least and in any case cover all the on-going administration and maintenance costs of a modern drinking water supply project.

This paper suggests that the relative lack of monetisation of a local economy need not necessarily imply that the community be forced to beg for "gifts" from the international community or driven to accept technologies which are culturally and technically inappropriate for that community. The traditional, also mostly non-monetised, costs to a community of inadequate or unsafe drinking water supply must also be borne in mind when assessing what the community itself is able and willing to contribute towards the cost of its drinking water supply system.

Principles and goals

The principles and goals behind the projects and the ways in which the local community would typically be involved, are for reasons of space not mentioned in detail in this paper. For more information please see (ref. 3).

Short description of the projects

A solar distributed drinking water system where relatively few wells are dug or boreholes drilled, each well or borehole subject to its capacity containing several (up to 10) solar pumps each such solar pump dedicated to a water tank serving about 200 users and placed near the users' houses at a distance which can if necessary be several kilometers away from the water source. Reserve backup multiple handpump groups placed NEXT TO the well or borehole. Communal washing place near the well or borehole. PV ultra-violet or other water purification systems inside water tanks reserved for clinics or schools.

The parties to the projects

Depending on size, the projects can, subject always to appropriate insurance guarantees granted by international agencies or foreign aid ministries of industrialised nations, be financed by private groups such as pension funds, "green banks", or NGO's on an interest-free basis or eventually at a very low rate of interest. Since drinking water supply projects of the type here foreseen are usually carried out amongst communities with substantially non-monetised economies, often in areas of political instability, the communities are unable to sustain the financial consequences of loss of or damage to the project assets through Act of God or war or political or subversive activities and a viable form of insurance is therefore required.

The proponent and executing agency will usually be a well-established local NGO which enjoys the full confidence of the local population, and will have access to locally responsible political and administrative authorities to obtain the necessary approvals to the execution of the project. The executing NGO will often operate through a partner NGO in the country sourcing the funds for the project, but may operate in direct liaison with the project funder(s) or where applicable through materials suppliers.

Work will wherever possible be executed by local operators and/or members of the communities themselves at the standard locally applicable rates. The executing NGO will obtain recovery of its reasonable out-of-pocket expenses for the project execution and of the subsequent on-going costs for administration and maintenance.

The executing NGO will be supported by well commissions and tank commissions.

Tank commissions will be elected by the (indicatively 200) users of each tank installation. They are responsible for supervising the use made of the structures, the collection of the users' monthly contributions and the carrying out of minor operations such as keeping its tank area and dedicated solar array clean. The tank commission collectively receives a small monthly payment for its services which it is free to spend as it wishes. Since women enjoy the greatest benefits from the execution and the continuation of the project, it is desirable and expected that the members of the tank commission be mostly women.

Well commissions are usually but not necessarily chosen amongst the members of the tank commissions. They are responsible for the safety, control and maintenance of the well itself, the security of the PV arrays, the back-up handpump systems placed near the wells, and the washing place. They also regulate the flux of users to the well in emergency situations and receive a freely disposable monthly payment for their trouble.

The question of ownership

The executing agency retains, until all debts have been repaid by the responsible user groups, the ownership (on behalf of the users) of all project structures, and therefore the right to recover pumps, PV panels, tanks and other structures in case of failure by the respective well or tank commissions to meet their obligations. The loan repayment time will usually be ten years. The executing NGO is therefore also responsible for the administration and the maintenance of the system during the loan period. After repayment has been completed, ownership in structures, is, with the consent of the interested local political and administrative authorities already obtained at the start of the project, vested in the tank and well commissions themselves. The executing NGO has at inception offered to continue with maintenance, training of maintenance operators, and administration of the system against cost price.

The main components of the project

The project comprises:

- Structures based on the Dutch developed "Beosite" technique.
- Solar pumps.
- Back up handpumps.

The "beosite" technique.

The basic material for the production of items using "Beosite" is what is known as "cheap gypsum" (CaSO4+H2O) or anhydrite (CaSO4+ 1/2H2O). Beosite technology (see ref. 6) is the result of some 30 years of advanced research and it is available for transfer to bona fide partners in developing countries practically free of charge. Anhydrite is one of the most widely available materials in nature and can be readily sourced in practically every region of every country. When very carefully mixed with certain additives (mostly recovered waste products such as discarded coconut or flax fibers) it can attain half the resistance of steel and can be made with the technical and physical properties demanded by the application in question. It is 100 per cent ecological. It is SANITARY and can where necessary be finished to the perfection of polished marble. When an item is no longer needed it can be ground to dust and re-utilised to make something else even stronger than the original item. It can usually be surface "mined" by putting a loader bucket in front of a truck or tractor.

"Beosite" is ideal for the setting up of small, local, production facilities because the capital cost of the production units is extremely low, and the labour content very high, which makes it a perfect solution for developing countries. Typical products which can be made by local production units with 100 per cent local value added are well-linings (with lateral stabilisers to block displacement in case of ground subsidence!), sanitary water tanks, san-plats, handpump platforms, washing places. There are innumerable further potential applications in the building industry (weather-proofing of the walls of mud houses, support structures for roofs, tiles etc)., for the manufacture of furniture etc.

A typical installation for the production of items made from "Beosite" would cost about US$60.000, and seed loans to set up such units within the framework of a solar drinking water project would be repayable over a maximum period of five years. In normal circumstances business deriving directly from the project of which it is part would alone be sufficient to enable the unit to pay back part of the original seed money.

The first moulds for a given application have to be purpose designed and tested and can cost a few thousand US$. Subsequent copies of the initial moulds cost just a few hundred US$ each.

Since the anhydrite material available varies in quality from site to site, and planned applications and ruling climatic conditions also vary widely, an initial first phase of analysis lasting several months is required to adapt the material available to the product required. This basic research work is carried out by the executive project partner with the (free) guidance of the technology owner.

The well/borehole

The well or borehole is dug or drilled by local operators, and is lined by locally made "Beosite" products which can be manufactured with stabiliser arms to help counteract earthquake or ground subsidence in general. The technical solutions proposed do not call for verticalisation of boreholes. The size and the capacity of the well/borehole is fundamental to the reduction of project costs, especially where boreholes have to be drilled, as, if they are adequate, anything up to ten solar pumps plus a triple back-up handpump system can be fitted down the one hole. The well-cap is a half-sphere made from "Beosite" which is easy to remove for access to the well and to the pumps in the well for maintenance purposes.

Solar pumping technology

The technology recommended is the solar submersible horizontal axis piston pump technology (see ref. 4), involving highly efficient (up to 59 per cent global subsystem efficiency) new generation solar pumps with two large counterbalanced 40mm diameter sealed pistons placed horizontally in the pump body and operating over a stroke length of between 0.9mm and 1.5mm with a frequency of up to 3000 cycles per minute. They differ substantially from the traditional "diaphragm" solar pumps in that the pistons move inside the pump body. The work load is therefore on the piston themselves rather than on a rubber diaphragm, and the piston groups are practically free from maintenance requirements. The sealed piston technology enables pumps with just 200W nominal motors to run at elevated heads up to 150m and more, at submerged up to 50m and more to take into account daily and/or seasonal draw-down in the water level, in conditions where other technologies cannot be used. They are able, for instance, to force water from, say, 30 meters down a well or borehole, over several kilometers if necessary, then up a hillside to a tank near the users' homes.

Depending on variable factors such as head, distance, and the number of users supplied by a given solar pumping unit, the installed power of the photovoltaic array would range from 300Wp to 400Wp. The pump is run by a specially developed controller and the system is optimised to run at about 2000rpm corresponding to 48V at about 10.45am and 13.15pm so as to ensure the best average hourly pumping capacity throughout the solar day. Since the pump is a positive displacement pump, it will produce water so long as there is enough power for the motor to turn the pump, and will continue to work in conditions of low insolation.

The photovoltaic arrays can be mounted on locally made panel supports. They must be placed in a carefully fenced off area near the well or borehole. In case of risk of theft or damage by vandalism it is the responsibility of the well commission to make sure the site is kept under adequate supervision.

The pumps are connected to dedicated water storage tanks by way of continuous lengths of embedded flexible polytehylene or other suitable feed pipe.

The water tanks

The water tanks are locally made from "Beosite" and are spherical in shape with an upper and a lower hemisphere each made from three segments. Because of their shape, the tanks are highly resistant to shock and simply rest on locally made "X" shaped "Beosite", wooden, or other supports. Because they are made from "Beosite" the tanks are hygienic and can easily be repaired in case of damage. Their volume is typically 15000 liters (15m3) corresponding to about 3 days' supply for 200 users. They can be accessed for water-testing and cleaning purposes. Each tank is fitted with two double stainless steel ball-valve groups so that two users can collect water at the same time. The handle of the inner valve of the double ball valve group is removed and fitted only when the outer valve needs to be removed for the replacement (on site) of its seal.

Water tanks serving clinics and schools can be fitted with solar UV purification lamps INSIDE the tanks themselves.

Overflow outlets allow excess water to escape "constructively" from the top of the storage tank in such a manner that the water can be drained off for instance to a vegetable plot.

Back-up handpumps

The bore-hole or well may contain anything up to eight or nine solar pumps plus the back-up hand pumps and, after a number of years, access to the well/borehole will be required for maintenance purposes. The handpump group is therefore placed near the well/or borehole, adopting the advanced spring rebound inertia handpump technology (see ref. 5) which uses just one continuous length of flexible feed pipe for each pumping unit to exploit the physical characteristics of oscillating water columns to obtain their pumping effect. Spring rebound inertia pumps do not require a vertical borehole and can operate even with bends in their feed pipe. They operate at a rhythm of oscillation of about 80 strokes a minute, which is the rate of the human heart beat. Force input IS VARIABLE as it depends on the length of each stroke, and this feature makes it ideal for use by women and particularly by children. As they have a very large above-ground piston and no parts in relative movement below ground level, spring rebound inertia pumps are free from all the maintenance problems associated with traditional handpumps. They can be pulled, put to pieces, reassembled, and reinstalled on site within one hour by one person.

The triple back-up handpumps group is required as back-up for situations where:

- climatic conditions have for several days been insufficient to enable the solar pumps to produce their design yield.
- where one of the dedicated solar pump and tank systems is under maintenance.
- in cases of an unexpected or irregular flux of users to the project area.

The spring rebound inertia pumps technology is available for transfer practically free of charge to countries whose internal markets are large enough to warrant local manufacture.

The washing places.

A washing place for communal washing is placed near each well or borehole and designed according to the cultural preferences of the women in the project area. The washing places can be built from locally made "Beosite" element blocks. It will be decided within the framework of each project whether to dedicate a solar pump to the washing place or whether to use the nearby handpump group for the purpose.

Typical system costs

A general estimate of the total costs for the global system described comes to about US$55 per user. (See ref. 3). This can be lower in the presence of usable existing structures and/or according to the extent of local manufacture, and higher where extra boreholes need to be drilled. Repayment of 100 per cent with interest at 3 per cent over ten years with full cover for on-going costs and maintenance calls for a monthly contribution of about US$3 PER FAMILY (see ref. 1). If this were to be reduced to just US$1.50 per month per family, then a part (about 70 per cent) of the capital cost would need to be contributed by donor agencies. See ref. 3 for a detailed analysis of the works and an itemised indicative budget for such a project.

Associated health aspects

The project ensures that clean water reach the users' recipients. A good drinking water water project calls for liaison with persons primarily responsible for users' health and sanitation, so that water samples from the well, the tanks, and users' recipients can be regularly taken and checked. Health operators may feel the need to spread information and offer suggestions for the correct use of clean household utensils and above all, the recipients used for temporary water storage. In this respect, the use of the SODIS-Solar Water Disinfection system (ref. 2) may be recommended in case of evidence of contamination after water collection.

References

HTTP://www.sodis.ch/synthesis_e.html (A useful reference concerning solar water Disinfection (SODIS) once the water has left the water tanks and is put into users' containers).

HTTP://www.flowman.nl/engpro1.htm and /engpro2.htm (For expanded details and itemised budget for a project of the type described).

HTTP://www.flowman.nl/solspri.htm (For details including photos and drawing of the solar submersible horizontal axis piston pump).

HTTP://www. flowman.nl/infvill.htm (For details including photos and drawing of the spring rebound inertia handpump).

HTTP://www.flowman.nl/beosite.htm (For more details on the "Beosite" process).

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