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Prethodno saopćenje

APPLICATION OF APPROPRIATE TECHNOLOGY FOR RURAL WATER SUPPLY

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Key-words: Rural Water Supplay (RWS), Appropriate technology, Water source, Drilling, Well, Ground water, Aquifer, Safe water

The supply of safe water to all population is a basic need to improve health, quality of life and prosperity of people in the region. The paper gives an overview of low cost RWS intermediate technology experienced by UNICEF operations in developing countries.

Ključne riječi: Vodoopskrba seoskog pučanstva, Odgovarajuća tehnologija, Izvor vode, Bušenje, Zdenac, Podzemna voda, Vodonosnik, Pitka voda

Opskrba cjelokupnog pučanstva pitkom vodom nužna je osnova za zdraviji i kvalitetniji život te uspješan razvoj regije. U radu je izložen pregled ekonomičnijih tradicionalnih metoda vodoopskrbe seoskog pučanstva iskušanih radom UNICEF-a u zemljama u razvoju.

Introduction

The *International Drinking Water Supply and Sanitation Decade (IDWSD)* 1981–1990 proclaimed by the General Assembly of the United Nations on 10 november 1980 had a primary goal to achieve universal access to water supply and to sanitation for all inhabitants in the world by the 1990.

After 10 years of intensified global effort only 50% of the rural population in developing countries will have potable water in 1990, but approximately 1,000 million people in thise countries are without access to adequate safe water supply source (WET/628,1989). It is clear that goals of the IDWSD-Decade are not being achieved by the target year the 1990. Consequently, both the developing countries and External Support Agencies have reached a broad consensus to continue the existing thrust of the International Water Supply and Sanitation Decade beyond 1990. The achieving of universal access to water supply and sanitation is now re-targeted for the year 2000 (Delhi Conference, Sept. 1990).

Application of appropriate RWS methods is an important precondition to achieve the universal access to safe water for all. This paper gives an overview of low cost traditional techniques experiences by UNICEF operations in developing countries.

Low-cost technology of the rural water sources implementation

Rural water sources like rain-water household tanks, shallow dug and drilled wells, communal ponds, filtration wells, gravity and pumping water-supply systems using adequate pipes have long tradition of use in Asian and African countries. These water sources are spread out in all other continents including Europe extensively. In addition to these artificial water sources people use numerous canals, rivers, ponds and lakes with surface water. The available hydro-geological data of aquifers may prove feasibility of use of ground water to supply majority of population in some regions.

In spite of availability of numerous type of water sources, only a relatively small part of rural population is adequately supplied with safe water all year round, because the mentioned types of water sources may be easily polluted at many places and occasions. The quality of water collected from roof rainwater house-hold tanks of relevant volume can be considered good during the rainy season, but during the dry season its quality may decline too. Due to limited volume of rainwater tanks, this sources are used only for drinking and cooking, for all other purposes water is taken from polluted sources.

During the last twenty years UNICEF has supported mainly the development of shallow ground water formations in many developing countries using usually the locally produced hand pumps installed in the drilled wells and/or dug wells. Hundred thousands hand pumps have been installed in rural areas making the ground water accessible to many millions of users. Fig. 1. shows an often utilized manual drilling JET-boring technique applicable to drill wells up to 120 m depth in soft formations at a very low cost (less than 300 US$/well). This method has some similarities with »Simple jetting method« (NWWA, 1982). Fig. 2. shows SLUDGER drilling method adopted from Bangladesh (UNICEF, 1990) rapidly mastered by local drillers and proven as appropriate for large areas in Asia. These rigs are really inexpensive, they have similarities with »Hollow rod drilling« rigs (NWWA, 1982).

The water well should be designed with chief aim to achieve the most economic and effective water supply system using appropriate drilling technology. Drilling rig to develop ground water source on a low-cost has special characteristics, different from

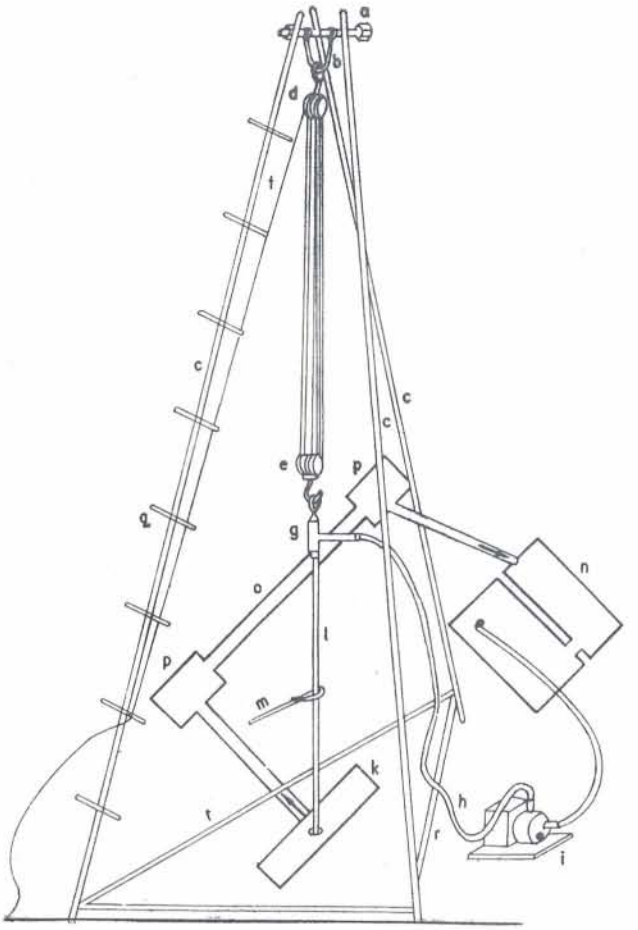

Fig. 1 Jet drilling rig

Legend

a – Bolt 1 ∅ MS; b – Bail 1 ∅ MS; c – Tripod 3″ ∅; d – Pulley (Crown block); e – Pulley (Travelling block); f – 1 ∅ Manila rope; g – Swivel Assembly; h – Delivery hose 1.5″ ∅; i – Centrifugal pump assembly; j – Suction hose with foot valve at the suction end; k – Wooden guide 2.5 m × 0.4 m for drill pipe; l – Drill pipe MS 1.5″ ∅; m – Chain tong to rotate drill pipe; n – Sunction pit; o – Flow line; p – Settling pits; q – Ladder; r – Cross members

Fig. 2 Sludger drilling rig

drilling equipment other applications. Rigs for exploration of coal and mineral resources are often available in many regions, for site investigation in the civil engineering works too. Core drilling is the most reliable method to get undisturbed sample of formation for relevant analyses in these applications, but these rigs are not drill-rig of choice to drill water wells (Zelenika, 1989). Water well should have larger diameter (200 mm at least) to accommodate adequate motor driven pump, opposite to slim-hole which is the most convenient to provide smooth running and maximum ability to produce core.

Main technical characteristics of a rotary drilling rig may be summarized in: speed of rotation, thrust on the drilling bit, torque-capacity, mud pump capacity, winching capacity and transport arrangement with/without air compressor. Designer of drilling rigs for water wells should provide technical solutions to assure economical development and use of ground water.

Beside manually and mechanically drilled wells, rehabilitated and new dug wells equipped with pumps, UNICEF is supporting capacity building of local Project counterpart in design, implementation and maintenance of low-cost gravity and pumping piping flow systems (Fig. 3), slow sand filters, iron removal plants, rain water harvesting (Fig. 4), etc.

In the meantime some other kinds of water sources may be developed and proved as more appropriate for rural water supply in some areas, than the above mentioned techniques.

Criteria to select an adequate water source for rural population

First priority in the RWS of each country is to define Level-I of access to safe water and support it technically and financially. Level-I for the Vietnamese circumstances is specified by maximum distance of 500 meters from dwelling-place to the source of safe water. which is shared among 60 to 80 families. Such a water source should assure at least 40 lit/day/capita of safe water. The water-supply of Level-I will be achieved for all population of Vietnam at least 1995.

Dug wells have limited depth, tube-wells drilled by manual methods have more limited depth and diameter comparing with wells drilled by appropriate mechanical drilling rig (Rotary drilling with the reverse circulation of fluid for soft alluvial formations and Down the hole hammer drilling method for hard formations). Safe yield, water-quality and price of the ground water source could constrain to its

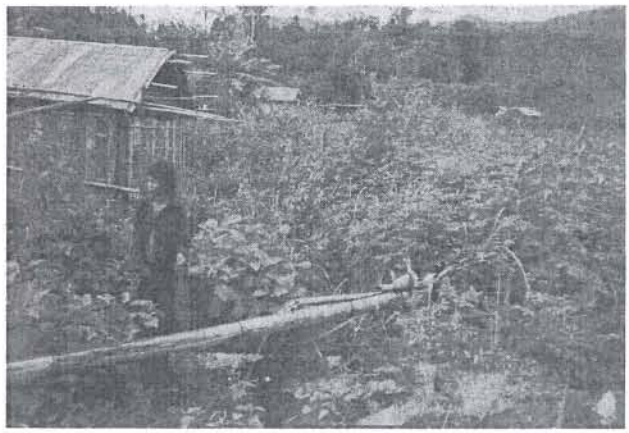

Fig. 3 Bamboo gravity flow system

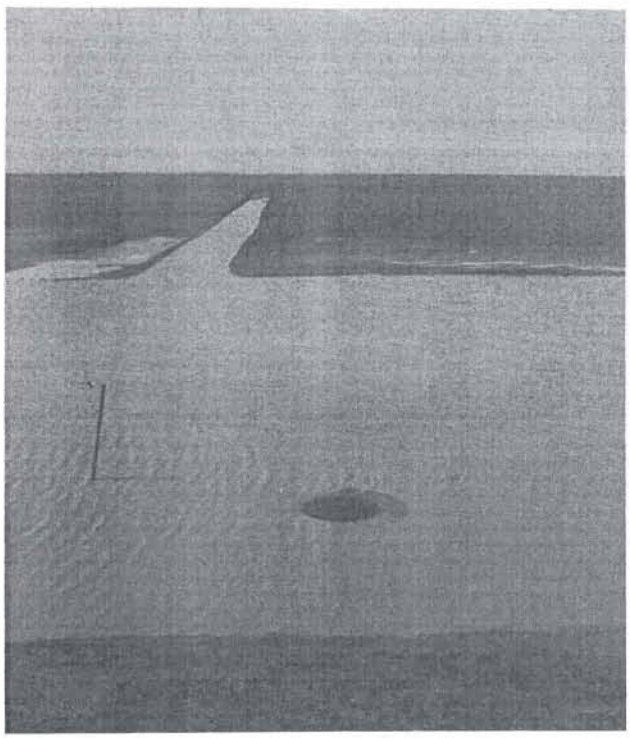

Fig. 4 Rain water harvesting

wider use and be a good reason for an easy elimination of wells from the list of appropriate techniques for water supply in some areas. Many populated areas may have more than one possibility to get safe water. The choice among manual and mechanical drilling technique to construct tube-well; among dug well, pumping-, gravity- flow system, slow sand filter, rain water harvesting (dam, subsurface dam, water tank etc), and additional possible technique may not be an easy one.

With the above definition of the adequate water sources and possible choises, the most relevant criteria to select the appropriate RWS technique should be its TOTAL COST (US$/capita) of design and implementation cost having in mind (in calculation) technical and financial feasibility and low cost of maintenance. The decision should be made after detailed analyses of the capital costs and running costs for each applicable technique in order to select the most appropriate one for each district, comune, village or hamlet (Table 1). Figures in Table 1. should be estimated and analyzed after field survey of available water sources, theirs distributions, qualities and quantities in all seasons, sometimes even additional hydro-geological investigations, drillings and pumping tests may be required too.

To assure a reliable quality of this analyses a computerized mathematical model based on operational research – linear programming (Zelenika, 1986) may be useful. To enable utilization of this model, relevant parameters characterizing standard designs of each applicable water source and its cost in defferent hydrogeological and environmental field circumctances should be determined.

Conclusion

The supply of safe water to all population is a basic need to improve health, quality of life and prosperity of people in a region. This opinion is globally accepted by inaugurating the goals of International Water Supply and Sanitation Decade beyond 1990 (New Delhi, Sept. 1990). In order to provide access to safe water to all, there must be adopted a strategy based on correctly surveyed data, analyses of relevant parameters and decisions made

Table 1 Summary of application of appropriate technology in water regions – drainage basins

Commune Village (all)	Rural population (000)	Rural population (000) covered by appropriate technology WS (J) (D) (GF) (P) (RC) (SS) (MD) (..)	Remarks
Total population in region			
Percent			
Water sources requirement			
Cost of water source (US$)			
Total investment (US$)			

(J)	manual drilling	(RC)	rain catch rez.
(D)	dug wells	(SS)	slow sand filter
(GF)	gravity flow	(MD)	mechanical drilling
(P)	pumping system	(..)	. . . . .

according to Government policy. One of the most difficult problem to provide safe water is the budget requirement to achieve the programmed objectives, so the assigned professional institutions and officers should profoundly study all aspects of water source construction techniques to select the most appropriate and effective method for each area. Required funds and all sources of RWS investments: beneficiaries, national and regional budgets and possible loans should be estimated and analyzed. The natural environment should be improved – it must not be degraded by any selected technique or operation.

Water Supply Master Plan at national level should be prepared with analyses of each drainage basin (water region) with all relevant aspects, including financial, particularly to provide safe water at Level-I. In the Table 1. a summary coverage of all rural population by appropriate techniques to supply safe water may be exercised to achieve the lowest cost of implementation. The RWS system should be sustainable, design and all decisions should be based on relevant data for each area. Prices of drilling and other operations, equipment and required material to accomplish appropriate water sources should be analyzed accordingly. The master plan for water-supply and sanitation should consider more an analytical treatment of appropriate technology that yet has been done using traditional skills in relevant communities like an academic exercise. Beneficiaries should participate financially and share essential informations to avoid frustrations later.

Costs of implementation, use and maintenance of each type of water source should be calculated for all typical field conditions. This calculations could be possible after accomplishment of designs for each water source and implementation of necessary number of pilot projects. Such basic data could be utilized to define necessary parameters for use of a mathematical model and thus, develop an effective water supply policy and building of appropriate capacities for design and inplementation of all required RWS sources.

Development of reliable and fresh water supply system as it does exist in most developed countries, depends on huge financial expenditures. Many of developing countries, especially in Asia and Africa, do not have or are not able to get necessary funds for fresh water supply systems alike those in the developed world. Developing RWS might be a useful practice for a temporary, somewhere also a longterm solution for a number of developing countries or some of their areas.

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Primjena odgovarajuće tehnologije za vodoopskrbu seoskog pučanstva

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U cilju vodoopskrbe i ekološke sanitacije cjelokupnog pučanstva na Zemlji, a na temelju rezultata prve internacionalne dekade usvojene na zasjedanju Generalne skupštine Ujedinjenih naroda 10. studenog 1980. koja je završena s polovičnim uspjehom 1990. godine, odlučeno je (Delhi conference, 1990) produžiti ovu važnu svjetsku akciju do 2000. godine. S tim u vezi preporučeno je vladama svih zemalja da revidiraju ranije planove opskrbe pitkom vodom i načine realan program dekade (1991–2000) u kojoj treba biti opskrbljeno cjelokupno pučanstvo, koristeći se pri tom iskustvima stečenim u prvoj dekadi.

Financijska sredstva su najčešća prepreka raliziranju planova vodoopskrbe pa je preporučen izbor odgovarajuće ekonomičnije tehnologije izrada bunara gdje god je to moguće. Spominjani vodoopskrbni objekti mogu se bez većih troškova projektirati, izvoditi i održavati. Osnovni parametar rentabilnosti vodoopskrbe je cijena opskrbe korisnika pitke vode (novčana jedinica/osobi). Proračun cijene vode i opskrbe treba biti osnovan na točnim podacima hidroloških i hidrogeoloških značajki, gustoći naseljenosti i iskustvima komunalnih vodoopskrbnih institucija u datom slivu ili regiji. Nužno je novčano participiranje pučanstva kojemu se rješava vodoopskrba. Pučanstvo treba biti odgovarajuće informarano kako bi se izbjegli kasniji nesporazumi. Pri izvođenju svih radova posebnu brigu treba voditi o zaštiti okoliša.

Troškove izvedbe, korištenja i održavanja svakog od tipskih vodoopskrbnih objekata potrebno je izračunati za date uvjete nakon projektiranja te međusobno usporediti ukupne troškove u cilju izbora optimalnih tehničkih rješenja koja će biti sigurna i najekonomičnija u upotrebi.