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Technology transfer of hand pumps in rural communities of Swaziland: Towards sustainable project life cycle management

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ABSTRACT

The research summarised in this paper explored the reasons behind the high failure rates of hand pumps from a technology transfer perspective, by examining the existing hand pump technology transfer practices and procedures in Swaziland where over 3000 hand pumps were installed and about 60% are not working. The research determined that there is a lack of proper, structured and sustainable knowledge sharing practices among the main stakeholders, suppliers, providers, users, and the government. It was observed that operations and maintenance, knowledge management, and the integration of a project life cycle management approach were crucial elements for the sustainability of hand pump-based rural water supply projects. Users have little involvement throughout the project life cycle; they do not know where and how to access parts, the majority of the areas do not have trained technicians, and government does not have stock for parts. There is poor communication between the users and suppliers, which is critical for product improvement and product support. It is therefore necessary to have a balanced focus on resource allocation for a hard and soft technology transfer process. A maintenance model resulting from the study aims to provide for practical co-ordination involving all the major stakeholders. Its objective is to establish a sustainable institutional support system through a public/private partnership.

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1. Introduction

Hand pumps are mostly utilised to supply water in rural areas of Africa, and over 350,000 hand pumps have been installed for this purpose. However, the United Nations Children's Fund (UNICEF) data show that at least 40% (about 150,000) of these hand pumps are abandoned. In dry and remote areas the hand pump failure rate is over 80% [1]. In 2005 it was estimated that 35% of all rural water supplies in sub-Saharan Africa were not functioning [2]. In a survey conducted in 2009 by International Relief and Development (IRD), a Non-Governmental Organization (NGO), on 425 boreholes in southern Swaziland, 39% were not operational, while 19% were partially operational [3]. Statistics across the world, especially in developing countries, indicate that rural water supply facilities are falling out of use at an alarming rate [4]. This therefore requires a different approach to viewing the challenges affecting the sustainability of borehole pumps. A central aspect in the management of technology is the appropriate transfer of that technology to the users through a process known as technology transfer. In order to address the low sustainability of hand pumps in Swaziland, it was imperative to analyse the gaps in the process of transferring the technology from the manufacturers of the hand pumps to the

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user communities. The research explored the reasons behind the high failure rate of hand pumps in the context of technology transfer by examining the existing hand pump technology transfer practices and procedures in southern Swaziland, where hand-pump fitted boreholes are the main, if not the only, drinking water supply sources in most of the rural communities.

1.1. Technology transfer

Technology transfer is a process by which a technology supplier communicates and transmits the technology through multiple activities to the receiver, and this will ultimately enhance the technological capability of the receiver [5]. Technology transfer encompasses far more than equipment and other so-called “hard” technologies, for it also includes entire systems and their component parts, ‘know-how’, goods and services, equipment, and organizational and managerial procedures [6]. Technology transfer thus involves both ‘hard’ and ‘soft’ technology. Largely, the narrow definition in terms of hard technology transfer has been adopted in developing countries and hard technology has subsequently overshadowed training, institutional capacity and infrastructure; all of which are prerequisites for sustaining hard technology [7]. In the context of hand pump technology transfer, appropriate technology selection through suitable participation of users, knowledge management, maintenance and operation plans, technology improvement through feedback, and research and development (R&D) are all important factors for sustaining hard technology.

The sustainable use of hand pumps in rural communities has been hampered by factors from both the supply and demand side. There is little or no incentive for the private industry to invest in innovation, design, development and technology improvement of hand pumps due to the low return, since most of rural African communities do not have the capacity or means to purchase hand pumps on their own. From the demand side, contributing factors include: lack of adequate institutional support for operation and maintenance; lack of financing mechanisms, often being dependent on donor funding; inadequate provision of technical assistance for training in maintenance; and the lack of community participation ([8–13]). The lack of technology management plans and project management skills have also been detrimental to project success [7].

To improve the flow of credible information between technology developers, providers and users, information to support technology transfer should be demand driven and results oriented, supporting key activities in the transfer process, such as selecting a specific technology and making an investment decision [6]. The relationship and the interaction among stakeholders (see Fig. 1) in the hand pump technology transfer are often not consistent. They are rather brief, with the relationship ending up with the closure, or completion, of the projects, which are usually short term in nature. There is often an unbalanced focus and resource allocation towards borehole drilling, supply and installation of hand pumps in rural communities and the aspect of its management, service, maintenance, and

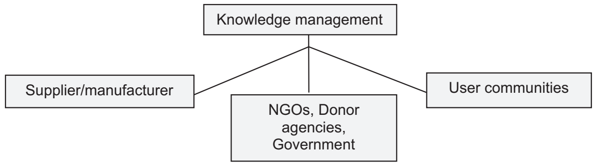

Fig. 1. User–Supplier relationship in hand pump technology (Adapted from UNEP, 2003).

product improvement. While a great deal of attention is paid to the former, little or no support is given to the latter.

Since technology transfer is a process by which both the hard and the soft components of the technology are transferred from the supplier to the user, it requires a proper approach for the transfer to be successful. The life cycle management concept is one such approach.

1.2. Sustainable life cycle management (LCM)

In current literature, sustainability is (typically) defined in three dimensions: *environmental*, *social*, and *economical*. Therefore, sustainability means to be able to keep human development in all these dimensions, which is often referred to as sustainable development [14]. Life Cycle Engineering approaches evaluate the environmental implication of a product, process or service in the design phase, while Life Cycle Management is an extension of the Life Cycle Engineering (LCE) concept, namely the life cycles of products, processes and services that are managed beyond the design phase [15]. Labuschagne and Brent further argue that a holistic LCM approach requires an effective integration of the three life cycles (projects, assets and products), for organisations.

1.3. Sustainability of hand pumps

Hand pump-equipped boreholes are one of the most common water supply technologies adopted in rural Africa, but often demonstrate low levels of sustainability. The primary reason for these high failure rates, and hence low sustainability, is insufficient attention to operation and maintenance of the pump [8]. Other reasons include poor financial management [9], a mismatch between the technology, the water environment, and the capacity of users to maintain the systems [11], and borehole failure [16]. There are a variety of rural water supply sustainability frameworks, approaches and initiatives in the literature. Montgomery et al. [12] proposed three foundational sustainability components: (1) effective community demand, (2) local financing and cost recovery, and (3) dynamic operation and maintenance. For each of these components, enabling factors along with the main obstacles and trouble-shooting approaches were presented.

Harvey and Reed [8] identify eight main sustainability factors. These factors (or building blocks) are: policy context, institutional arrangements, financial and economic issues, community and social aspects, technology and natural environment, spare parts supply, maintenance and monitoring. Each of these factors was extensively

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