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Sustainability of tunnel wells in a changing agrarian context: A case study from South India

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ABSTRACT

We analyze tunnel wells (*surangams*), traditional water harvesting systems, which have been innovated and nurtured by farmers in the Enmakaje panchayat in the state of Kerala in South India for decades. We show how the genesis and design of the indigenous knowledge-based water harvesting systems are shaped by agro-ecological conditions. We also identify issues that affect the sustainability of tunnel wells in the changing agrarian context in this region. The significance of tunnel wells is declining, even though the smallholders, who dominate the agricultural landscape, are highly dependent on tunnel wells to meet their water requirements. Grass roots efforts are needed to revive this traditional water harvesting system.

1. Introduction

Water scarcity, due partly to the seasonal variation of rainfall in India, imposes limits on agricultural production. To overcome this problem, the Indian National Water Policy, 2002, recommends the revival of traditional water harvesting systems to increase usable water resources (Ministry of Water Resources, 2002). This need is also emphasised by multilateral organizations, non-governmental organizations (NGOs) and academia (Narain, 2000). Indigenous knowledge-based water harvesting systems enhance the water status of a country and contribute to achieving sustainable agricultural production. They are expeditious and cost-effective methods of water harvesting, and they are appropriate for the local conditions in terms of ecological, technical and institutional feasibility. Several studies from India (e.g., Agarwal and Narain, 1997; Balooni et al., 2008; Iyengar, 2007; Kumar, 2003) and elsewhere (e.g., Christensen, 1998; Enfors and Gordon, 2008; Farshad and Zinck, 1998; Hill and Woodland, 2003; Mbilinyi et al., 2005; Motiee et al., 2006; Mvungi et al., 2005; Wessels and Hoogeveen, 2002) have highlighted the importance of conservation of traditional water harvesting systems at the grass roots. Such systems, which have proved to be more stable than large-scale irrigation systems (Christensen, 1998), when adapted to the biophysical and socio-economic environments in which they function, contribute to sustainable resource development. Research inputs are essential to complement efforts of the government and NGOs to sustain the indigenous knowledge-based water harvesting systems. This is important in the Indian context, where several of these systems have been declining (Agarwal and Narain, 1997).

We analyze 'tunnel wells' innovated and nurtured by local people in Kasargod district in the state of Kerala in India. Tunnel wells, called *surangams* or *thurangams* in local parlance, are instrumental in overcoming the water shortage experienced in some parts of this district and the neighbouring Dakshin Kannada district in the state of Karnataka. The agro-ecology of this region is a crucial determinant of cultivation practices and irrigation water requirements. The topography of Kasargod district is highly uneven with steep hills. In addition, 75% of the area of Kasargod district is covered by laterites (Balakrishnan and Saritha, 2007), which makes the digging of open dug wells, the major means of groundwater extraction in the state of Kerala, an arduous and expensive task. Tunnel wells, which are carved horizontally through the hills to tap a subterranean water course and are usually constructed at the base of hills, following a water bearing formation (see Fig. 1), are a better alternative, both technically and economically. The distance to be traversed horizontally, to obtain water from the aquifer, is much less than the vertical distance in

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Fig. 1. Tunnel wells constructed at the base of hills in the Enmakaje panchayat.

the case of an open dug well. The water flows out of a tunnel well by gravity and is a perennial water source if the well is built at an appropriate location. Although the water from tunnel wells falls in the category of private property, the technology (tunnel well construction) is common, indigenous knowledge, which has been disseminated in this region over time. There are a few instances of water from tunnel wells being shared by a small group of users, as we find in this study.

In the above context, we show how the genesis and design of indigenous knowledge-based water harvesting systems and water extraction technologies are shaped by agro-ecological conditions. This is shown by Parajuli (1999) while analyzing the elements of social and agro-ecological conditions in farmer managed irrigation systems in the mid-hills of Nepal and examining their relationships with irrigation infrastructure, especially water division structures. In general, literature supports the fact that agro-ecological based technology, relying on indigenous knowledge, is the most practical way of realizing sustainable development (e.g., Adeel, 2008; Agarwal and Narain, 1997; Alteiri, 2002). There is also a growing realization of the relevance of the agro-ecological approach to food production and security (Bullock, 1997; Enfors and Gordon, 2008).

Two earlier studies (Nazimuddin and Kokkal, 2002; Prasad et al., 1991) have examined tunnel wells in Kasargod district – our study area, conducted by the Centre for Water Resources Development and Management (CWRDM), Kozhikode, India. Prasad et al. (1991) claim there was no prior systematic documentation of the existing tunnel wells in this region. Those authors focussed on the technical and operational features, including the hydrological and hydro-geological parameters, of tunnel wells, and suggested that this traditional water harvesting system deserves the attention of water planners, geologists and engineers. Prasad et al. (1991) found 570 tunnel wells in two *taluks* (*taluk* is an administrative unit) in Kasargod district. The results of that study were published by Basak et al. (1997) in a widely popular edited book '*Dying Wisdom, Rise Fall and Potential of India's Traditional Water Harvesting Systems*' (Agarwal and Narain, 1997).

Another, more comprehensive, study by Nazimuddin and Kokkal (2002) documented all existing tunnel wells in the Kanhangad Block panchayat, Kasargod district. The authors also examined ownership patterns, hydro-geological status, water resources potential, water quality, land use, and socio-economic aspects of tunnel wells. Both studies cover large administrative areas (panchayats) in the Kasargod district.

The scope of our study includes only one panchayat in Kasargod district and our sample includes only 40 farmers. While investigating the features of tunnel wells, we first provide an overview of the changing agrarian context in the region that affects the sustainability of tunnel wells. We analyze farmers' dependency on tunnel wells for meeting water requirements. We also examine the labour needed to construct tunnel wells, the diminishing water supply from tunnel wells, and the emerging forms of ownership and management in view of fragmentation of landholdings. We show that the importance of tunnel wells is declining in the fast changing agrarian context, even though this traditional water harvesting system is the lifeline of the smallholders.

The tunnel wells in our study area in South India are similar technically to *qanats*, the ancient underground irrigation systems found in arid regions of Iran (Farshad and Zinck, 1998; Motiee et al., 2006), Syria (Wessels and Hoogeveen, 2002), and in other parts of the world (see http://www.qanat.infor the website of Centre of Qanat Information (CQI)). According to the CQI, the construction of *qanats* expanded from Persia eastward along the silk route to China and subsequently spread to India, Saudi Arabia, North Africa, Cyprus, the Canary Islands and Spain (CQI quoted in Motiee et al., 2006). *Qanats* are long-distance water transfer systems and spread over a large area, each with a group of users, and managed by a