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Buried clay pot irrigation for horticulture in arid zones: a case study

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This study presents technical, environmental and socio economic benefits under some case studies carried out by using buried clay pot irrigation for establishing small orchards in Rajasthan, India . Feasibility of treating saline water locally by multi effect distillation and using product water mixed with saline water for irrigation in clay pots has also been studied.

Keywords: Arid zones, Buried clay pot irrigation, Horticulture

Introduction

Arid region is a fragile eco-system, which encounters deficit and erratic rains (annual rainfall, 180-300 mm), leading to droughts and famines. Arid lands suffer from a vicious cycle of low investment, low productivity, poor natural resources and poverty. Presence of excess salt in ground water (60% area in Thar desert) restricts soil utilization for raising crops/ vegetables /fruit plants. High animal population causes severe grazing stress, denuding pasture lands. With economic conditions deteriorating, survival of people and livestock has become difficult in arid zones, resulting in forcing residents to migrate to other places for livelihood. On the other hand, Arid zone agro-climate offers a great potential for production of high quality arid fruits [ber (*Zizypyus mauritiana)* and lasora or gunda (*Cordia myxa*)]. This study presents some case studies, targeted at economic uplift of rural poor, on growing vegetables in backyards and establishing small ber orchards through efficient utilization of rain water harvested in a storage tank. This stored water mixed with saline water from a local bore well was used for clay pot irrigation.

Experimental Section

Irrigation System

An underground water storage tank (Fig. 1), also called Tanka / Kundi / Kund (storage capacity, 25,000-30,000 l) was constructed for rain water harvesting and storage of surface runoff from a clean catchment around it. Catchment was made by spreading excavated material around the structure. A second layer of bentonite was spread and overlaid by 5-6 cm thick tank bed soil. The mass was compacted to make a smooth and semi-impervious surface. A uniform slope (2-3%) towards the tank in-let was provided for harvesting maximum possible rain water runoff.

Pitcher (earthen or clay pot) irrigation (PI) was used to provide self regulated water flow correlated to change in soil tension[1]. Locally fabricated pitchers (capacity, 5-6 l; ht, 30 cm) (Fig. 2a) were buried during rainy season for enhancing rain water harvesting and reinstalled after the soil on both sides of plant saplings (Fig. 2b) to cater to their irrigation water requirement on demand. Buried pitchers were removed during rainy season for enhancing rain water harvesting and reinstalled after monsoon receded in October/November for supplementing irrigation need till onset of ensuing monsoon. Water from these pitchers is drawn into the soil through pores of wall. The system was used for growing vegetable/fruit plants around the pitcher. Initial establishment of arid fruit saplings (2-3 y) could successfully be done through PI, saving water (> 70%) compared to the conventional basin irrigation method. It was observed that saline water (electrical conductivity, 15 dS/m) could be used to grow salt tolerant vegetable crops.

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Fig. 1—Rainwater harvesting

Fig. 2—Clay pot irrigation

Results and discussion

Case Studies

IIT, Delhi pilot tested PI technology at Navodaya Vidyalaya Schools in Jhunjhunu, Rajasthan, India under projects supported by Department of Land Resources, Ministry of Rural Development, Govt of India (GOI) and Engineering & Physical Science Research Council (EPSRC), UK through Aston University, UK. PI technology proved successful for initial establishment of ber plants in arid areas even with saline water (Fig. 3). In parallel, URMUL an NGO, with financial assistance from Oxfam UK, had initiated development of small scale orchards in 1600 ㎡ area (1 bigha) each at Gram Panchayat-Krishnanagar, Kulu Pabbuji, Tehsil-Phalodi in Jodhpur district, Rajasthan, India. Generally, 64 ber plants with 20-24 plants of lasora (*Cordia myxa*) at the border, were established. To protect from stray cattle, earmarked area was fenced with barbed wires, as there is no other vegetation in surrounding areas. Selected below poverty line (BPL) beneficiaries were small and marginal farmers belonging to scheduled caste and minority communities. Pre-condition for monetary support

Fig. 3—A ber tree laden with fruits

Fig. 4—MED unit set up

under the project was to transfer ownership of such horticulture plantation land in favour of housewife so as to provide a regular source of income and social security to poor farm women. Trainings were imparted to these farm women on sapling transplanting, plant protection measures, pruning, post harvest technologies etc. at Krishi Vigyan Kendra (KVK), Bikaner and Agricultural Research Station (ARS), Mandor – Jodhpur, Rajasthan, India. During initial establishment, women could harvest fodder from sewan grass, tumba (*Citrulus colocynthesis*) fruits and seed of *kharif* pulses, which were intercropped. From fourth year onwards, beneficiaries started getting handsome returns in the form of ber fruits, dried leafy fodder for sheep & goats and also fuel obtained by pruning trees during April or May every year. Looking into economic viability of these orchards, some farmers came forward to develop such orchards from their own resources. In 4-5 years, many farmers with one bigha mini-orchard unit could earn Rs 15000-20000 per annum from fruits, fodder and fire wood from trees and other green / dry fodder produced in fenced area. Ber fruits found ready markets in the local schools as mid day meal. Ber, being nutritious, helps children in improving their health.

Considering that PI technology would help in utilizing naturally occurring saline ground water, IIT Delhi in collaboration with ARS, Mandor decided to undertake further work in establishing small orchards using this technology, giving some technical inputs. Since evaporation from soil is essentially from top soil layers (15 cm), it was proposed that neck length of pot should be increased from 7.5 to 22.5 cm so that less water flows laterally into top layer. Also, to accommodate higher volume of water, overall pitcher height was increased from 30 cm to 45 cm. Other technical inputs include *in situ* rainwater harvesting from the area surrounding plant and providing soil and vegetative mulch to check surface evaporation. As reported earlier, moderately saline water can be used through PI. Highly saline water can be partly diluted with rain water. Bore well water in this area has a high TDS (3000-4000 ppm). Further, a Multi effect distillation (MED) unit was set up (Fig. 4) for production of distilled water locally from saline water. The product water was mixed with brackish water for use in PI. In collaboration with IIT Delhi, URMUL, Phalodi, and School of Desert Science, Khejerli, Jodhpur, Rajasthan, India are implementing this technology at several sites. Considering its impact on improving livelihoods of poor people (BPL), Zila Parishad, Jodhpur has sanctioned a pilot project under MGNREGA scheme to propagate this technology in 3 Gram Panchayats of Luni Tehsil (Jodhpur) for BPL families.

Conclusions

Buried clay pot irrigation is found to be useful in arid areas, where vagaries of climate keep the people poor due to inadequate availability of rain water for raising crops. Setting up orchard units with poor quality irrigation water suitably tailored to the plant brings new hope for economic uplift of people in the desert. Mini orchard units have been made functional by using PI system designed for poor farmers with very small land holding.

Establishment of such units could help local people, especially farm women, in getting additional income by producing nutritive arid fruits, which are in good demand in the local markets. Raising of biomass also improves soil and environment. PI technology, besides providing economic returns with local value addition and environmental benefits, has lead to women empowerment and has given nutritional support to children.

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Reference

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