

## Termites as ecosystem engineers and potentials for soil restoration

Kachchh, the 2nd largest district in India (45,652 km<sup>2</sup>) and located in the north-western region of Gujarat, experiences tropical arid climate (13 average rainy days in a year) with high evapotranspiration rate<sup>1</sup> resulting in degradation of land. Higher dependence on groundwater for agricultural and industrial activities has accelerated the salinity ingress, as the district shares its boundary with the Gulf of Kachchh from three directions. This type of salinity ingress is seen in Banni region in particular, which is infested by exotics such as *Prosopis juliflora*<sup>2</sup>. Further, expansion of crusted soils, a result of higher accumulation of Na ions<sup>3</sup>, one of the prime chemical constituents in Banni soils in Kachchh, is a major problem in agricultural lands of this district. Low infiltration capacity of crusted soils results in increased surface runoff and further aggravates the problem of groundwater recharge. Thus, rehabilitation of crusted soils is required to reduce runoff from affected areas. No rehabilitation effort has been made for crusted soils in the Kachchh region barring efforts that contemplate increasing nutrient status of soils in the form of increased application of agro-inputs such as organic manure and vermicompost at individual level. However, rehabilitation has to be accelerated, economically affordable, cheap and easily accessible for sustainable land management. Increasingly, it is being recognized globally that termites are an important component of agro-ecosystems, particularly in developing economies, where they are an alternative to expensive agro-inputs. Termite-mediated processes are used to improve the soil-water balance.

Termites, one of the highly successful groups of social insects, coevolving for over 300 million years and constituting an integral component of the ecosystem, are successful in invading new habitats. Due to their wide range of distribution across the world, termites have severely disrupted the ecological system causing considerable economic damage. Nevertheless, they are the most important soil fauna in the semi-arid tropics as they bring about significant physical and chemical modifications in soils<sup>4</sup>. They are known to play an important role in detritus decomposition and maintaining

soil structure<sup>5</sup> thereby modifying soil chemical characteristics as a result of upturn of soil. Termites can be used and managed, together with locally available organic resources, to counteract land degradation. The soil crust is destroyed by the galleries dug by the termites. Three types of burrows are seen: type 1 burrows which are subsurface ones, type 2 burrows which are channels and type 3 burrows which result from the construction of the nests<sup>6</sup>.

In arid and semi-arid regions of India, predominantly in the Kachchh region, so far termite-mediated processes have not been used in land management, particularly soil rehabilitation. It seems that termite activity can be triggered by application of various mulches to the crusted soil surface. Their bioturbating activities accelerate the soil rehabilitation process by (i) breaking up of surface crusts, (ii) reducing soil compaction, (iii) increasing soil porosity, (iv) improving water infiltration into the soil and (v) enhancing water holding capacity of the soil, thereby reducing surface runoff. These activities are conducive for (a) root penetration, (b) vegetative cover regeneration and (c) primary productivity restoration. Termites improve vegetation growth first by improving certain physical properties of soil (soil structure, water infiltration and water storage capacity, and soil rootability<sup>7</sup>) and second by improving the chemical cycling in soil (nutrient release from the mulch into the soil). In semi-arid conditions, termites play a key role in nutrient cycling, especially through comminution and the turn-over of organic material<sup>8</sup>, both processes being critical for land rehabilitation.

Use of termites for land rehabilitation is an ecologically sustainable approach as it requires only an initial investment in organic matter. Tillage is an unsustainable mechanical method in controlling crusting as a few rainfalls result in building up of a new crust<sup>9</sup>. An increasing number of researchers show interest not only in taxonomic details of these insects, but their role as ecological engineers is also on the rise due to increased recognition of the role of these lesser known soil invertebrates in rehabilitation. Future research questions on a diversified eco-agricultural gradient should be on the role of termites in

increasing the carbon sequestration potential of soils in view of the recent deliberations in Copenhagen and elsewhere. Bearing the local scenario in mind, the response of termites on usage of *Prosopis* plant parts for the purpose of mulching would help enhance soil quality and also contain the problem of *Prosopis* invasion. Understanding the role of these species in restoring saline grasslands of Kachchh, for which it is renowned, would provide a solution in controlling the land degradation and pave ways for maintaining the ecological sustainability in the region.

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