ABSTRACT

A bare salt-affected land was selected in the vicinity of a remnant grove of thorn forest community at Harappa archaeological site with the objective of rehabilitating minimum viable populations of thorn forest species. Monitoring of previously planted trees revealed spatial differences in species establishment with sites showing good, moderate and poor survival and growth. In order to successfully restore the site a complete set of experiments was designed, that based on in-depth analysis of microclimatic factors, species tolerance limits and fertilizer amendments. The results revealed that restoration of native plant community required the identification and modification of environmental factors that were impeding or restricting ecosystem development at this site. They also showed that the area is not uniformly saline but can be divided into sites of low (EC_e < 60 mS cm^{-1}), moderate (60-85 mS cm^{-1}) and high (> 85 mS cm^{-1}) surface salinity. Analysis of replaced soil showed accumulation of salinity in plant pits at all the sites in general and at high salinity site in particular resulting in greater plant mortality at that site. Difference in micro-topography was causing greater salinity built-up in the pits at high salinity site especially by monsoon overflows resulting in high plant mortality. A pot experiment designed to check the response of individual species to salinity and fertilizers showed a negative linear relationship between plant growth and biomass characters as they decreased with increasing salinity levels and were enhanced with increasing fertility. All tree species seemed to be salt tolerant to varying degrees. EC_e value at which dry matter production would be reduced to 50% as compared to un-fertilized control plants was highest for *Salvadora oleoides* followed by *Prosopis cineraria*, *Tamarix aphylla* and *Capparis decidua* under low fertility and this sequence of decreasing salt tolerance was maintained when plants were supplemented by fertilizers.

An *in-situ* experiment was conducted using soil replacement, gypsum and inorganic fertilizers as amendments on the three salinity sites. Three years monitoring suggested that enhanced Nitrogen and Phosphorus nutrition had a positive effect on all growth variables as availability of both in the soil was limiting. The effect was more pronounced at site of low salinity and in more tolerant *S. oleoides* and *T. aphylla* as compared to the other two species. Moreover remedial measures for the

revegetation of highly saline patches were experimented with nutritional amendments in combination with surface modification at high salinity site. Incorporation of farmyard manure (FYM) with physical barriers generated the greatest revegetation success in all species and was not only found to be biologically sound but also economically feasible restoration treatment. A total of 705 trees have been successfully established out of that 481, 132, 57 and 35 are of *S. oleoides*, *T. aphylla*, *P. cineraria* and *C. decidua*, respectively. After initial fertilization and two years of supplemental irrigation the plants are now not required to be nurtured. Three out of four tree species have started producing seeds and many trees are now acting as nurse plants and are facilitating the establishment of other species under them. With the arrival of avian dispersers natural recruitment can now be seen at many places. Ecosystem function parameters are indicating that this restored area is on a trajectory towards a self-sustaining ecosystem. Recommendations derived from this study have been incorporated in the site management plan and have been successfully implemented for the rehabilitation of adjacent area. With the accumulation of both above and below-ground biomass as well as litter and other woody debris this juvenile forest is now sequestering carbon and is contributing towards building viable populations of thorn forest species at Harappa archaeological site. The populations of both *S. oleoides* and *T. aphylla* have now attained a safe number while increasing the number of individuals of *P. cineraria* by reclaiming more area and initiation of seed formation in this species will also assure its population viability.