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“Development on the margin”

Suitability of Tree Species for Afforestation of Marginalised and Abandoned Croplands in Uzbekistan

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Abstract

Marginalisation of irrigated croplands due to salinity, resulting in abandonment of degraded parcels, negatively impacts agricultural production and peoples' livelihood. This study focused on the afforestation of abandoned croplands, as an (irrigation) water saving alternative land use in the lower reaches of the Amu Darya River, Uzbekistan. To this end, the survival and early growth of six tree species considered for non-timber production and carbon sequestration were field-tested on two deserted cropping sites. To identify areas which can be potentially targeted by afforestation, spatial delineation of degraded croplands was implemented based on time series analysis of normalised difference vegetation index (NDVI) images from the Moderate Resolution Imaging Spectroradiometer (MODIS).

Both study sites were characterised by the presence of salts in soil ($10\text{--}12\text{ dS m}^{-1}$) and groundwater ($2\text{--}5\text{ dS m}^{-1}$), and deficiency in soil nutrients. The sites differed in depth to the groundwater table (GWT), which fluctuated between 0.4 and 0.9 m and 0.6 and 1.8 m from the soil surface. Tree establishment was assessed at the end of the first growing season in September 2010. Under deficit irrigation of about 150 mm, five of six tested species showed survival rates ranging from 65 to 99%. Thus, shallow, moderately saline groundwater satisfied the initial tree water demand. Moreover, the deeper GWT was not associated with a lower tree survival, indicating that afforestation could be potentially expanded to such areas.

Ulmus pumila performed best among the species, demonstrating survival rates of $>98\%$ and $>92\%$ and above-ground biomass increment of 70.4 and $172.0\text{ kg ha}^{-1}\text{ year}^{-1}$ in the presence of the shallow and the deeper GWT, respectively. *Populus euphratica* failed to establish, underlining its limited suitability.

The spatial assessment showed that 85,213 ha of the study area experienced a lowered NDVI for 2001–2009, indicating land degradation trends. This area defines a potential scope for afforestation intervention in the region and will be analysed for its suitability for tree planting.

The feasibility of tree plantation establishment on marginalised croplands that can be detected with the remote sensing technique lays a promising ground for remediation of land degradation in the region.

Keywords: NDVI, plantation forestry, salinity, shallow groundwater table, spatial land assessment