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## Technology for rehabilitation of Yamuna ravines – cost-effective practices to conserve natural resources through bamboo plantation

A. K. Singh<sup>1,\*</sup>, S. Kala<sup>1</sup>, S. K. Dubey<sup>1</sup>, V. C. Pande<sup>2</sup>, B. K. Rao<sup>2</sup>, K. K. Sharma<sup>1</sup> and K. P. Mahapatra<sup>3</sup>

<sup>1</sup>Central Soil and Water Conservation Research and Training Institute, Research Centre, Chhalesar, Agra 282 006, India

<sup>2</sup>Central Soil and Water Conservation Research and Training Institute, Research Centre, Vasad 388 306, India

<sup>3</sup>CAR Research complex for NEH Region, Shillong 793 001, India

The present study evaluated bamboo (*Dendrocalamus strictus*) based resource conservation in the Yamuna ravines at Central Soil and Water Conservation Research and Training Institute, Research Centre,

Agra, Uttar Pradesh, India. Ravine lands are highly degraded dry lands and 3.97 m ha area is affected by ravines in India. One ravine micro watershed of 2.8 ha area was planted with two rows of bamboo in staggered manner as vegetative barrier for the analysis of hydrological and economic aspect of bamboo plantation. Hydrological results showed that runoff has been reduced from 9.6% to 1.8% and soil loss from 4.2 to 0.6 t/ha/year in the last 4 years. Based on bamboo growth performance, average value of culm height and culm collar diameter have been recorded as 3.80 m and 22.50 mm, the value of average crown size and number of culms per clump being 3.93 m and 18 numbers respectively. Further, the soils under bamboo plants improved in terms of decreased pH and enhanced soil organic carbon. The economic analysis suggested a cash outflow of Rs 48,000 ha<sup>-1</sup> from 7th year onwards to the stakeholders in the region, in addition to the benefits accrued to society at large in terms of value of nutrient (Rs 2125–5555 ha<sup>-1</sup>) saved through soil conservation. This study recommends bamboo plantation for productive and protective utilization of such degraded lands. It also suggests that the high cost of establishment for individual stakeholders can be met through subsidies and banks' financial inclusion programme in developing countries such as India. Further, public funding can also be routed through appropriate budgetary provisions in development plans of corporate entities involved in the rural development in the country.

**Keywords:** Bamboo plantation, degraded land, economic analysis, financial analysis, ravines.

RAVINE lands are highly degraded dry lands and 3.97 m ha area is affected by ravines in India. In Uttar Pradesh alone, 1.23 million ha (33.5%) of land is occupied by ravines, which are mainly found along the bank of river Yamuna and its tributaries. The severity of water erosion is found at the peak along the banks of Yamuna and Chambal rivers in the districts of Agra, Etawah, Kanpur, Fatehpur, etc. where terrain has completely deformed into ravines. Rao *et al.*<sup>1</sup> reported that stream bank erosion is a major cause of land degradation, leading to deteriorated drainage systems, which ultimately govern natural calamities in terms of floods, and non-point source pollution in ravine lands of India. Vegetation in these ravine regions suffers from a variety of unfavourable conditions such as nutrient deficiency, moisture stress and biotic interference. The inclement weather conditions coupled with very high summer temperature further aggravates the problem and makes farming uneconomical. In such situations, less water and nutrient demanding technologies hold a good promise to sustain the productivity and provide alternative source of income to the farmers. This vast tract of existing ravine lands poses potential threat to nearby productive lands because of overexploitation and degradation. The