Nutrients Economics (NPK) in Different Forest Ecosystems

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Abstract: The study was carried out in three forest types i.e., Holoptelea integrifolia (tropical region), Anogeissus latifolia (sub-tropical region), Quercus leucotrichophora (temperate region) forests and a control site (non-forest) were selected to know the amount of nutrients produced by each forest type and compare with control to differentiate the actual production of nutrients in terms of money. The nutrients generated by all three forest types were calculated for market costs and compared with control. The total estimated market cost of nutrients (NPK) was rupees 1780 ha⁻¹, 2495 ha⁻¹, 1383 ha⁻¹ and 887 ha⁻¹ for Holoptelea integrifolia, Anogeissus latifolia, Quercus leucotrichophora, forests and control respectively. This study has proved that forests types generated higher nutrients as compared to non-forest site and among the forests, Anogeissus latifolia has the highest nutrients generating capacity. The study suggests that ecosystem services provided by these forests in the form of nutrients should be enhanced through management techniques.

Key words: Economics analysis • Forests • Nutrients • Market value

INTRODUCTION

Ecosystem services are defined as services generated due to the interaction and exchange between biotic and abiotic components of an ecosystem [1]. Ecosystem services are generated by ecosystem function such as production and nutrient cycling. The common ecosystem services are carbon sequestration, purification of water and air, soil formation and renewal of fertility, regulation of water and nutrients movement from one ecosystem to another. Soil fertility can be viewed in an economic framework, in the context of derived demand emanating from owner objectives for utilizing forest products for sales and other consumption purposes. The services provided by the forest ecosystems are largely dependent upon the productivity of soil, the management of resources and its sustainable use.

The demand from soil services is derived from marketed outputs. The level of market access and associated transfer and transactions costs will influence that demand, as well related process of outputs, factors and inputs. Every location will have particular market access characteristics that are associated with distances to demand and supply centers and quality of transport infrastructure. Soil nutrient depletion is the main biophysical factor limiting increases in per capita food production for the majority of small farms [2].

Despite the obvious importance of understanding soil nutrient value in forest land and water management, there has been little focus in the literature on methods for its economic assessment. As a result, the true value of nutrients and nutrient change remains unclear, making the provision of practical and cost effective nutrient management solutions to foresters and governments more difficult and complicating the targeting of research for resource conservation and development. In order to value soil nutrients, it is essential to be able to measure either the nutrients themselves or their change over time. This Paper outlines the main economic techniques which could be used to value soil nutrients.

MATERIALS AND METHODS

The study area is situated in Tehri Garhwal, lies in state of Uttarakhand located between 30°18' 15.5" to 30°20' 40" N and 78°40' 36.1" to 78°37' 40.4" E. The climate of the area is represented by three main dominated seasons, winter, summer and rainy. The mean maximum temperature ranges between 12.8°C (December) to 32°C (June) and mean minimum between 4°C (December) to 16°C (June). The mean relative humidity varies from 35% (May) to 92% (August). Soil samples were collected by the method used by Sheikh et al. [3] for Garhwal Himalayan forests. For the soil analysis, the samples were air dried and mixed well individually before use.
The Nitrogen (%) was measured using the standard Kjeldal procedure. Exchangeable phosphorus (P) and available potassium (K) was determined by Jackson [4].

The study was carried out in the preliminary level for the economic valuation of major soil nutrients (NPK), its availability in soil produced by forests and compared with market price of nutrients as available form in market. Three forest types Holoptelea integrifolia (tropical), Anogeissus latifolia (sub-tropical), Quercus leucotrichophora (temperate) and control (non-forest) sites were selected to estimate the amount of nutrients produced by each forest type and compare with control to differentiate the actual production varies with the forests.

RESULTS AND DISCUSSION

Economic valuation of NPK in different sites is shown in Table 1. The economic analysis of nutrients in term of money have been analysed with current available market value. Nitrogen, phosphorus and potassium in market was available in the form of urea, diammonium phosphate (DAP) and potash respectively with market price of rupees 6.10 kg⁻¹ (urea), 12.50 kg⁻¹ (DAP) and 6.00 kg⁻¹ (potash).

The amount of nutrients in Holoptelea integrifolia the 1133 ha⁻¹ respectively. In control site (non-forest) forest was 13 kg ha⁻¹ (N), 14.40 kg ha⁻¹ (P) and 238.96 kg ha⁻¹ (K) and the estimated market cost for these NPK was rupees 166.40 ha⁻¹, 180 ha⁻¹ and 1434 ha⁻¹ respectively. Similarly in Anogeissus latifolia forest the NPK was 10 kg ha⁻¹ (N), 13.49 kg ha⁻¹ (P) and 366.96 kg ha⁻¹ respectively and the market cost was rupees 128 kg ha⁻¹ (N), 169 ha⁻¹ (P) and 2198 ha⁻¹ (K). The amount of nutrients in Q. leucotrichophora forest was 1.96 kg ha⁻¹ (N), 17.99 kg ha⁻¹ (P) and 188.92 kg ha⁻¹ (K) and the estimated market cost for these NPK was rupees 25.0 ha⁻¹, 225 ha⁻¹ and 125.3 kg ha⁻¹ respectively and the estimated market cost of these nutrients was rupees 9 ha⁻¹, Rs.127 ha⁻¹ and Rs.751 ha⁻¹ for N, P and K respectively (Table 1).

The total value generated by Holoptelea integrifolia, Anogeissus latifolia, Q. leucotrichophora and control site in terms of money of market cost was rupees 1780 ha⁻¹, 2495 ha⁻¹, 1383 ha⁻¹ and 887 ha⁻¹ respectively. All the three forest types generated more nutrients than control site. This may be due to high input of litter in these soils, which releases nutrients on decomposition which consists of living and dead plant and animal residues of different age, activity and resistance. SOC contributes to soil structure, soil water-holding capacity, soil nutrient content and nutrient exchange capacity and thus soil fertility and yields in general [5, 6, 7]. The higher concentration of nutrients (NPK) in forest sites than non-forest site.

![Fig. 1: Total values of NPK in different sites](image)

Table 1: Economic valuation of nutrients (NPK)

<table>
<thead>
<tr>
<th>Forest Type</th>
<th>Nutrient</th>
<th>Available market form</th>
<th>Market rate (Rs kg⁻¹)</th>
<th>Kg ha⁻¹ available in soil</th>
<th>Approximate value (Rs ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holoptelea integrifolia</td>
<td>N</td>
<td>Urea</td>
<td>12.60</td>
<td>13.00</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>DAP</td>
<td>12.60</td>
<td>14.40</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>Potash</td>
<td>6.00</td>
<td>238.96</td>
<td>1434</td>
</tr>
<tr>
<td>Anogeissus latifolia</td>
<td>N</td>
<td>Urea</td>
<td>12.60</td>
<td>10.00</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>DAP</td>
<td>12.50</td>
<td>13.49</td>
<td>169</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>Potash</td>
<td>6.00</td>
<td>366.34</td>
<td>2198</td>
</tr>
<tr>
<td>Quercus leucotrichophora</td>
<td>N</td>
<td>Urea</td>
<td>12.60</td>
<td>1.96</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>DAP</td>
<td>12.50</td>
<td>17.99</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>Potash</td>
<td>6.00</td>
<td>188.92</td>
<td>1133</td>
</tr>
<tr>
<td>Control (Non-forest)</td>
<td>N</td>
<td>Urea</td>
<td>12.60</td>
<td>0.70</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>DAP</td>
<td>12.50</td>
<td>10.17</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>Potash</td>
<td>6.00</td>
<td>125.30</td>
<td>751</td>
</tr>
</tbody>
</table>

Note: Urea Containing only 46(%) of nitrogen, so the value of urea is converted as per the % of nitrogen available in urea.
had also reported by Sheikh et al. [8]. The ecosystem services provided by forest in the form of these nutrients depend upon species composition, developmental stage and spatial pattern of forest species. In western Himalaya, oak forest serve most effectively in soil development, nutrient portion, water retention and connected watershed springs [9, 1]. Omamo et al. [10] has carried out a study in Kenya on soil fertility management, show that fertilizer use is significantly related to market access costs as well as the real price of fertilizers or soil nutrients form the market to be applied on forest land.

CONCLUSION

Among the sites it has been observed that all three forest types has higher NPK producing capacity compared to control site, which might be due to dense canopy forest which produces thick litter production on ground. In the Garhwal Himalaya all the three forest types are equally important. These nutrient services of soil can be enhanced through proper management by reducing excess exploitation of forest litter especially for fodder, branch lopping for fuel, surface burning through use of leaf litter input for decomposition in forest floor. Although further studies need to be taken on the volume estimation of each forest type produced through the available nutrients on the forests. Clearly the use of economic methods for assessing soil nutrients in developing countries is filled with many challenges. To address them, research aimed at finding better ways to apply theoretically valid methods.

REFERENCES