ASSESSMENT OF SOIL CARBON STORAGE IN SAXAUL FORESTS IN THE BUIN ZAHRA DESERT OF IRAN.

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Abstract- Deserts cover about one-fifth of the Earth's surface and most of them have a considerable amount of specialized vegetation which is important for soil conservation. Two species of Saxaul (Haloxylon ammodendron and Haloxylon aphyllum) are the dominant plants in the vast deserts of Iran and both of them are the major plants for afforestation in the desert area. Due to the large area of land planted with Saxaul, the importance of these lands as carbon storage, become more and more. This study carried out in Booen Zahra desert region of Iran in order to evaluate carbon storage in Saxaul Forests. Study area is located in the south of Qazvin province. Sampling was done in Saxaul (Haloxylon aphyllum) stands and the native vegetation of adjacent area (Control area). In both areas, the amounts of aboveground and underground biomass of the species were calculated by cutting and weighing the aerial parts (leaves, stem), roots, and soil. Sampling was carried out to a depth of 30 cm. The comparison of the carbon content of H. aphyllum in the unit of the measuring surface and control areas showed the difference of this ability between two areas. (p<0.01). The results indicated that the total soil carbon content of H. aphyllum (1453.2 kg/ha) was significantly (p<0.01) more than the control area (314.3 kg/ha).

Keywords: HALOXYLON APHYLLUM, DESERT VAGATATION, ORGANIC CARBON, IRAN

1. Introduction

The world’s drylands, 6.31 billion hectares (Bha) or 47% of the earth’s land area, are found in a wide range of climates spanning from hot to cold (Lal, 2001). Although deserts and so-called dryland habitats are indeed largely waterless and parched, they are able to support a great variety of life. Most deserts have a considerable amount of specialized vegetation, which is important for soil conservation and herbivores. Canopy in most deserts is very rare and plants are mainly ground-hugging shrubs and short woody trees. As these types of plants grow, they sequester carbon in their tissues, and as the amount of tree biomass increases, the increase in atmospheric CO₂ is mitigated. Nowadays, there is much concern that the increasing concentration of greenhouse gases (GHGs) in general, and carbon dioxide in particular, in the atmosphere contributes to global warming by trapping long-wave radiation reflected from the surface of the earth Carbon sequestration, i.e. capturing and sequestering carbon that would otherwise be emitted and remain in the atmosphere might be a suitable alternative to control atmospheric emission of carbon (Kumar et al., 2009). There is a strong link between desertification of the drylands and emission of CO₂ from soil and vegetation to the atmosphere (Lal, 2001). Planning at a scale of conservation reserves aims to maintain or improve the ecological condition of the targeted biological or environmental feature of these areas or mitigate the threats to them (Groves et al., 2002). In some part of Iranian Desert, vegetation is suffering from livestock overgrazing, mining development, road construction, and other human activities. Two species of Saxaul (Haloxylon ammodendron and Haloxylon aphyllum) are the dominant plants in the vast deserts of Iran and both of them are the dominant plant for afforestation in the desert area. Besides functioning as a C-sink, the vegetation of the Iranian Desert and semi-deserts takes on a multi-functional key role in offering additional benefits to the ecosystem. Afforestation in desert regions is one of the most practical and advantageous methods of desert management. The carbon stock of the Saxaul vegetation is low compared to other ecosystems of the Iran, but restoration and conservation of Saxaul vegetation is one way to sequester carbon through vegetation for Iran, which do not have much other woody vegetation. Nowadays due to the large area of land planted with Saxaul, the importance of these lands as carbon storage, become more. The purpose of this study is to evaluate carbon storage in Saxaul stand in the desert area of Iran.

2. Materials and Methods

2.1 Study Area

The study area (35°44′04″N 50°11′00″E, 35°45′05″N 50°13′17″E) covered 339 ha of (237 ha Haloxylon aphyllum and 102 ha control area) Buin Zahra plain. This area is a desert region with a temporal saline river (Rud-e-Shor in Persian) located in the south of Qazvin province near by Buin Zahra city (Figure 1). The mean annual temperature and mean annual rainfall during 1995-2015 were 17.4°C and 210 mm. This region has the arid and desert climatic condition and almost 70% to 80% of the annual precipitation is concentrated in the months from September to March, while less than 5% occurs in the summer. The average elevation of study area is roughly 1100 meters above sea level. Much of study area covered by native halophyte, e.g., Halocnenum strobilaceum M.B. and non-halophyte species Artemisia sieberi Besser. Some Part of the studied area has been planted with Saxual trees. It has been a program to combat desertification during the three past decades.

Fig. 1 Geographical position of study area in Qazvin province of Iran

2.2 Methods

For soil and plant sampling, study sites were established in the desert region of Buin Zahra in an area planted with Haloxylon aphyllum (Minkw.) Iljin, as well as adjacent native vegetation (control area) (Fig. 2). The age of the H. aphyllum stand in the study area is about 35 years. This stand is used as a park for local live
grazes weekend by people but native vegetation (control area) stock e.g. Camels and sheep. Totally 90 quadrants (2m × 2m) in the H. aphyllum stand and control area were established along ten 500m transects which were selected randomly. All plant and soil samples were collected within these plots. For both sites, the amounts of aboveground and underground biomass of the species were calculated by cutting and weighing the aerial parts (leaves, stem) and roots with 30 repetitions. Regarding the goal of the study, effective depth for root sampling in H. aphyllum stand and control area was 30 cm. Following Rayment and Higginson (1992), the ash method was used to determine the carbon sequestration coefficient of the studied species. Soil sampling was conducted randomly at each site. For each of the selected sites representing vegetation type, 30 sampling ditches were dug. Soil bulk density was determined using a soil corer. 30 soil samples at each site were taken and Soil organic carbon (SOC) was measured using Walkley and Black’s method (Nelson and Sommers, 1982). In order to determine the amount of sequestered carbon by the gram per square meter, Formula (1) was employed: Cc = 1000.C (%). Bd.e. (1)

\[ Cc = \frac{1000 \times C}{Bd \times e} \]

This formula, Cc refers to the amount of sequestered carbon weight per square meter. C signifies the percentage of the accumulated carbon in the calculated depth of soil. Bd represents the bulk density of the soil and e denotes the thickness of the soil depth by the centimeter. Total system carbon was defined as the sum of the woody biomass, herbaceous biomass, root and litter and soil carbon. All data were analyzed using the SPSS version 16 for Windows software package. Means of carbon stock in different parts were conducted by paired-samples T test.

3. Results and Conclusion

The comparison of the carbon content of H. aphyllum in the unit of the measuring surface and control areas (table 1) showed the difference of this ability between two areas (p<0.01). The results indicated that the total soil carbon content of H. aphyllum (1453.2 kg/ha) was significantly (p<0.01) more than the control area (314.3 kg/ha). While the amount of carbon stored in the plant for both forested areas and the control area is 35% and 11.2% respectively, much of the organic carbon is stored in the soil in both areas. According to the results; the H. aphyllum stand presented significantly higher carbon storage compared to the adjacent control area.

4. References


Schlesinger, W. H., & Lichter, J. (2001) argued that living wood is the dominant sink for atmospheric CO2 within regrow forests; consequently, in arid and semi-arid rangelands, this function belongs to some plants that have sufficient woody stems and roots for releasing carbon.

<p>| Table 1: Carbon distribution (kg/ha) between the H. aphyllum stand and the control area |
|---------------------------------|-----------------|------------------------|--------|</p>
<table>
<thead>
<tr>
<th>Parts of C storage</th>
<th>H. aphyllum stand</th>
<th>Control area</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial parts</td>
<td>279.7</td>
<td>12.3</td>
<td>2.29</td>
</tr>
<tr>
<td>Roots</td>
<td>228.8</td>
<td>27.9</td>
<td>2.36</td>
</tr>
<tr>
<td>SOC</td>
<td>1453.2</td>
<td>314.3</td>
<td>2.60</td>
</tr>
<tr>
<td>Total</td>
<td>1961.7</td>
<td>349.5</td>
<td>2.36</td>
</tr>
</tbody>
</table>

*significant: <0.01

Fig. 2 Carbon ratio in the H. aphyllum stand (A) and the adjacent control area (B)