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Estimation above ground biomass by using a diameter and density parameters (case study: district one of Darabkola forest)

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Abstract

Vegetation biomass is a crucial ecological variable for understanding the evolution and potential future changes of the climate system and is a larger global store of carbon than the atmosphere. One of the issues of major global concern is the increase in atmospheric carbon dioxide and its potential to change world climate. The study area is located in the Hyrcanian forests and sample plots were selected in the *Fagus* stands. The logging is done using a method of selecting individual trees. The method presented here is based on existing volume per ha data and volume-weighted average wood density. The total amount of biomass was equal to 421 ton per hectare. The results showed that the rate of deforestation in natural forests in Hyrcanian forest is high. Biomass estimates are critical for many landscape analysis questions. Measurements for biomass should be conducted at least every 5 years. and remote sensing inference should be repeated at least on an annual basis.

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Introduction

Biomass is the mass of living plant organic material, and it is often proportional to volume and basal area at the stand level, and diameter and height at the individual plant level. Biomass is also related to water, nutrient, and energy requirements of individual plants and stands. The carbon content of vegetation is directly related to biomass as discussed in the following section (Sandra and Ariel, 1992).Vegetation biomass is a crucial ecological variable for understanding the evolution and potential future changes of the climate system. Vegetation Biomass is a larger global store of carbon than the atmosphere, and changes in the amount of vegetation biomass already affect the global atmosphere by being a net source of carbon, and having the potential either to sequester carbon in the future or to become an even larger source (FAO, 2009). One of the issues of major global concern is the increase in atmospheric carbon dioxide and its potential to change to change world climate. Most of contribution to atmosphere carbon dioxide is from burning of fossil fuels and cement production by the industrial nations (Sandra and Ariel, 1992).

The CO2 concentration in the atmosphere has increased by 31% since 1750 AD and is predicted to increase considerably in the next hundred years (Sofia *et al*, 2005). As a consequence is the temperature expected to increase (Anonymous, 2000). Thus, additional to various goods and services being provided to human beings, forests act as a natural storage for carbon at the global scale, contributing approximately 80% of terrestrial aboveground, and 40% of terrestrial belowground carbon storage (Kirschbaum, 1996). Deforestation in the recent decades has increased and has proposed as one of the critical issues around the world.

Identify resources available, monitoring the changes and access to update information are the keys factors for planning, decisions and management in any field. Estimation biomass is important in estimating the amount of carbon stored and assessment of structure and condition of forest. Also, in estimating the amount of biomass and study fertility habitats is important (Navar, 2009). Accurate estimation of biomass is necessary for Greenhouse gases measurement (Muukkonen and Heiskanen, 2006).Finally, study and comparison of these data with other areas and consider of potential of the region are very effective in the management of forest.
Remotely sensed data have become the primary source for biomass estimation. A summary of previous research on remote sensing based biomass estimation approaches and a discussion of existing issues influencing biomass estimation are valuable for further improving biomass estimation performance (Dengsheng, 2006). The Hyrcanian forest (north of Iran) has a large ecological and economical value, but so far researcher has not been a study on estimation of above ground biomass by using a diameter and density parameters.

The aim of this study is estimation above ground biomass by using a diameter and density parameters in of Darabkola forest (Hyrcanian forest), north of Iran

Material and methods

The study area

The study area is located in the Hyrcanian forests, district 1 of Darabkola's forests, northern Iran. Darabkola's forest, with an area of about 2500 ha, is a natural and mature forest with uneven-aged and dense to semidense stands, comprising mixed hardwood types including *Fagus* dominant, mixed *Fagus*, *Carpinus–FagusFagus–Carpinus*, *Carpinus–Tilia* and so on. The elevation ranges from 140 to 920 m from free sea level and the general aspect of the study area is northern, but with some fine different slope aspects. However, the sample plots were selected on the northern slopes and only in the *Fagus* stands. The logging is done using a method of selecting individual trees, so as to be close to a natural silviculture. The investigation was carried out in only a part of Darabkola's district 1, about 1224 ha, where Persian beech (*Fagus orientalis*) is a dominant species (*Fagus* dominant type). The volume of *Fagus*

stands based on our plot measurements ranged from 131 to 643 m3 ha–1.

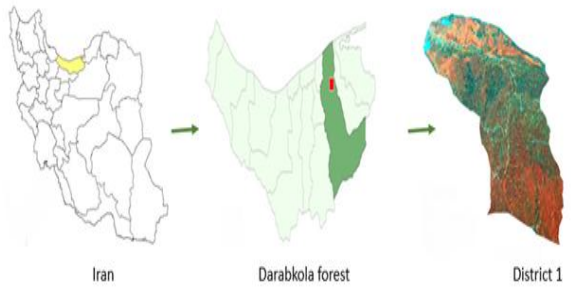

Fig. 1. location of study area in Mazandaran province (north of Iran).

The method presented here is based on existing volume per ha data and is best used for secondary to mature closed forests only, growing in moist to dry climates. It should be used for closed forest only because the original data base used for developing this approach was based on closed forests. The primary data needed for this approach is VOB/ha, that is inventoried volume over bark of free bole, i.e. from stump or buttress to crown point or first main branch. Inventoried volume must include all trees, whether presently commercial or not, with a minimum diameter of 10 cm at breast height or above buttress if this is higher. If the minimum diameter is somewhat larger, the VOB/ha information can be used with some adjustments as shown below. However, such adjustments to the primary data introduce larger errors in the estimate.

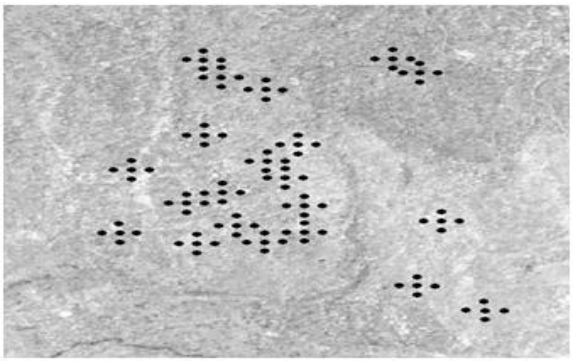

Fig. 2. inventory net in this study.

General equation

Biomass density can be calculated from VOB/ha by first estimating the biomass of the inventoried volume and then "expanding" this value to take into account the biomass of the other aboveground components as follows (Brown and Lugo 1992):

Aboveground biomass density (t/ha) = VOB × WD × BEF

Where:

WD = volume-weighted average wood density (1 of oven-dry biomass per m^3 green volume)

BEF = biomass expansion factor (ratio of aboveground oven-dry biomass of trees to oven-dry biomass of inventoried volume).

The total amount of biomass was equal to 42107/74747 ton per 100 hectare and mean of biomass per hectare was 421 ton per hectare.

Results and discussion

More of the Hyrcanian forests are affected by human activities in the surrounding landscape, and all may be influenced by global changes in climate or sea level. To assess the health of these forests, or to evaluate the environmental impacts of specific management actions, it is often necessary to develop monitoring systems that address fundamental ecosystem characteristics such as diversity, structure, or productivity. Ideally, sampling methods should be applicable in forests in all stages of development, and across the entire range of site variability *(*Michael *et al, 2001).*

Although the rate of deforestation in natural forests in Hyrcanian forest is high, As a long-term political commitment to stopping illegal logging, and legal over-logging, slowing deforestation, and managing and protecting remaining natural forests (natural production forests and protected areas) and plantations is required as a high priority. Reducing or eliminating illegal logging will have significant impacts not only on growing stocks, but also on wood harvest and wood production, as well as the government revenues (Nophea, 2004).

Biomass estimates are critical for many landscape analysis questions, including carbon stock accounting and evaluating biomass potentially available to bioenergy projects (Xiaoping, 2009).

Land utilization statistics and using field methods to quantitative determination of parameters such as volume, density, basal area and biomass can be done with high precision but collection and update data is costly and time-consuming. Moreover, large extent of forest area, difficult access to some parts because of the mountainous areas, the efficiency of these methods is faced with serious questions. Due to these limitations in recent decades, the necessity of using other methods of data collection is quite evident (Holmgern, 2000).

Table 1. plot number and biomass (t/ha) in study area.

plot	Biomass /ha	plot	Biomasst /ha	plot	Biomasst /ha	plot	biomasst /ha	plot	Biomasst /ha	plot	Biomasst /ha	plot	Biomasst /ha	plot	Biomasst /ha	plot	Biomasst /ha	plot	Biomasst /ha
1	401	11	401	21	188	31	402	41	408	51	436	61	587	71	563	81	404	91	436
2	497	12	490	22	355	32	527	42	496	52	580	62	459	72	450	82	348	92	180
3	634	13	469	23	352	33	596	43	345	53	403	63	457	73	473	83	628	93	483
4	366	14	360	24	404	34	348	44	226	54	387	64	655	74	743	84	440	94	504
5	457	15	316	25	230	35	233	45	451	55	460	65	397	75	442	85	363	95	667
6	447	16	368	26	362	36	353	46	277	56	433	66	462	76	368	86	391	96	333
7	328	17	364	27	376	37	235	47	256	57	342	67	352	77	483	87	400	97	649
8	498	18	461	28	365	38	141	48	423	58	603	68	536	78	449	88	364	98	459
9	403	19	376	29	354	39	299	49	620	59	503	69	477	79	364	89	433	99	353
10	437	20	364	30	499	40	359	50	398	60	484	70	532	80	485	90	523	100	490

Recommendations

Measurements for biomass should be conducted at least every 5 years, and remote sensing inference should be repeated at least on an annual basis. The annual basis should be focused on incorporating natural disturbance effects as an update to existing biomass estimates. Promote the development of new standards for biomass products used in biomass estimation and mapping over large geographic areas. Current different methodologies for data collection and analysis of continuous, standardized and geo-referenced forest biomass inventories should be harmonized. Extend forest biomass inventories to tropical forests, non-commercial forests, mangroves, dry woodlands and under-represented regions, and increase the number of permanent plots and the periodicity of data collection. Develop new or improved algometric functions (in a range of vegetation types, climate zones, and fertility classes) with associated description of the site chacteristics (e.g. soil, climate, etc.) where the allometric functions were derived in order to make them of independent value and applicable to wider geographic area, along with an analysis of the error propagation effects that may occur during the scaling process. For a more comprehensive picture of the total biomass in a stand, below ground biomass, coarse woody debris, fine woody debris and litter mass should be also considered, and new soil carbon measurement techniques and sampling strategies should be developed. Measurements for biomass should be conducted at least every 5 years, and remote sensing inference should be repeated at least on an annual basis. The annual basis should be focused on incorporating natural disturbance effects as an update to existing biomass estimates (FAO 2009).

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