Journal of Plant Production

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Assessment of Structural Value for Atrush Forest

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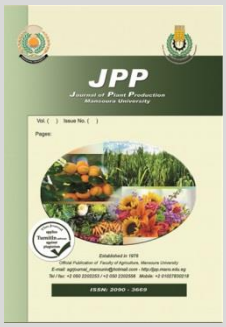

ABSTRACT

Using of Atrush forest as study site, to quantity the forest structure, environmental services and economic returns from the forest, located in the northern part of the Kaliqeyamat mountain range and the eastern part of the heights of the kaneMazi, while it is bordered by the western part of the center of Sub-District Atrush and the southern part is bordered by the Sheikhan District (Ain Sofni), which is within latitude (36°49'), (36°53'), south and longitude (43°17'), (43°27') north and at a height ranging from (669-1017) m, above sea level. The total area of forest (1415) km², and content more the trees of (*Pinus brutia*), (*Pinus pinea*), (*Quercus ajelops*), *(Quercus infectoria*), (*Platanus orientalis*) and (*Ficus carica*) as well as shrubs *(Crataegus saligna*), *(Junipours occidentalis*), (*Salix babylonica*) and (*Prunus amygdalus*), species grown naturally, the pine species most common type of coverage of these species is estimated at approximately (27.58%). Assessing the forest structure provides a picture of current extent and condition of Atrush forest. The data collected for forest sent to the United States Forest Service (USFS) to utilized in the i-tree Eco-program (http://www.epa.gov/airquality/benmap/index.htm). The result of this study indicated that carbon storage with in tree species were varying. In addition to that only seven have stored (20.51) tons of carbon, all other tree species had less than the amount. Understanding the species grown in the site, number of per hectare and fast-growing species provides the information needed for management and utilization of Atrush forest.

Keywords*: economic; assessment; i-tree program; structure value; Atrush forest.*

INTRODUCTION

Forest provide environment with oxygen and carbon dioxide absorption but this depends upon the tree species composition, tree size, leaf area and number of trees per hectare. Different structure results variation in the level of interest of the forest. Atrush forest land cover an average of (16.049%) hectares of land area of Atush region, there are a few studies on the ecology of forest because is not managed for its environment benefits. The structural value of forest land tends to increase with a rise in the number and size of trees also, through proper forest value can be increased (Nowak *et al*.,2002). Leaf Area defined as the surface area of leaves in the unit of land area (Midori *et al*., 2003). But another researcher defined that leaf area is the sum of paper tissue or the sum of leaves side by side per unit of land area (Jonckheere *et al*., 2009). In addition, forest land can provide us variety of productive and ecological control (Grewal *et al*., 2011). Many environment services can be providing society if forest land managed properly like important habitats for different species of plants, insects and birds (kamvasinou, 2011). Forest land provide different level of ecosystem services forest land infrastructure can be used to enhance environmental balance and better benefits. They evaluated different forest structures result in different ecosystem values and services among land uses (Kim *et al*., 2016). The leaf area of forest vegetation is an important ecological characteristic, influencing climate through shading and transpiration cooling and air quality through air pollutant deposition and accurate estimates of leaf area are fundamental such processes (Jenny *et al*.,2017). This paper aimed to study the differ in forest structure due to various interest of the forest for society and ecosystem services, the ecosystem of this study include carbon sequestration and storage and structure value of trees, and provides better understand how a Atrush forest land might be utilized to provide environmental of Atrush region.

MATERIALS AND METHODS

The forest manger have been used qualitative and quantitative methods, one of this the i-tree Eco-computer model was developed to qualify forest structure, this program can based on a sample of an inventory of trees forest, the result form it use to understand the forest structure, the data of this study were collected by random selected sample located (10.25) hectare. We are found there trees of *Pinus brutia, Quercus ajelops*, as well as shrubs *Crataegus azarolus, Juniperus occidentalis, Prunus amygdalus* and *Crataegus saligna,* and other character of local site by heavy soils, high clay content, brown soil that has a deep thick, un-flatted with rocky grounds and brown grounds that has medium thickness (Buringh 1960). Rain-fed locations with hot, dry climate in summer, cold winter rain. Field plots were measured, each plot measurements include species, canopy cover, leaf area, leaf biomass, leaf area index and basal area, the trees on each plot were also, measure for total height, diameter at breast height (DBH), crown ratio and crown width, the number of trees per plot. The data were collected during (24 May) year 2017, the field data were arranged and covered according to program requirement, diameter distribution of different species, Tables (1,3,4,5)

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DOI: 10.21608/jpp.2020.106200

Table 1. Individual trees data collected from Atrush forest

Plot ID	Tree ID	Longitude (X)	Latitude (Y)	Scientific name	DBH (cm)	Height (m)	Canopy Cover (m^2)	Leaf Area (m^2)	Leaf Biomass (kg)	Leaf Area Index
1	1	432127	365116	*Pinus brutia*	30	14.5	14.5	85.7	8.3	5.9
1	2	432124	365113	*Quercus ajelops*	11	11	2.3	6.8	0.7	3
1	3	432123	365112	*Quercus ajelops*	32	18	1.3	4.5	0.4	3.4
2	1	432122	365111	*Quercus ajelops*	14	14	2	6.4	0.6	3.2
2	2	432121	365110	*Pinus brutia*	32	20	17.3	81.5	7.9	4.7
3	1	432118	365108	*Pinus brutia*	29	21	3.1	14.8	1.4	4.7
3	2	432116	365106	*Quercus ajelops*	53	10	15.	47.8	4.7	3
4	1	432115	365105	*Pinus brutia*	11	9	16.6	60.7	5.9	3.7
4	2	432112	365103	*Pinus brutia*	59	13	14.5	82.1	7.9	5.7
4	3	432110	365100	*Pinus brutia*	53	12	12.6	70.1	6.8	5.6
5	1	432108	365059	*Pinus brutia*	16	10	4.5	19.6	1.9	4.3
6	1	432107	365055	*Pinus brutia*	54	20	21.2	99.7	9.6	4.7
7	1	432105	364958	*Quercus spp*	60	9	7.1	18.8	1.9	2.7
7	2	432103	364955	*Pinus brutia*	18	10	12.6	50.2	4.8	4
8	1	432100	364953	*Quercus ajelops*	25	10	2.5	8	0.8	3.1
8	2	432057	364950	*Pinus brutia*	52	15	5.7	25.6	2.5	4.5
9	1	432054	364948	*Pinus brutia*	14	9	4.2	17.8	1.7	4.3
10	1	432053	364945	*Quercus ajelops*	44	9	1.1	3.9	0.4	3.5
10	2	432052	364944	*Pinus brutia*	14	10	4.9	21.4	2.1	4.4
11	1	432050	364942	*Pinus brutia*	41	10	2.8	11.9	1.1	4.2
11	2	432048	364940	*Pinus brutia*	52	9	24.6	97.4	9.4	4
12	1	432045	364937	*Pinus brutia*	80	20	24.6	115.7	11.1	4.7
13	1	432044	364936	*Pinus brutia*	55	19	15.9	74.7	7.2	4.7
14	1	432041	364933	*Pinus brutia*	21	8	16.6	55.4	5.3	3.3
14	2	432039	364931	*Pinus brutia*	19	12	11.9	65.4	6.3	5.5
15	1	432037	364929	*Pinus pinea*	18	8	18.9	53.9	5.2	2.9
15	2	432036	364928	*Pinus pinea*	21	9	22.1	75.6	7.3	3.4
16	1	432034	364926	*Platanus orientalis*	105	27	18.1	107.6	4.9	5.9
16	2	432032	364924	*Crataegous saligna*	15	17	12.6	52.1	3.3	4.1
16	3	432030	364922	*Ficus carica*	20	15	23.8	104.5	7.8	4.4
17	1	432029	364921	*Platanus orientalis*	30	18	14.5	86.4	4	5.9
17	2	432028	364920	*Crataegous saligna*	19	9	11.3	52.4	3.3	4.6
18	1	432026	364918	*Ficus carica*	18	15	2.8	10.6	0.8	3.7
18	2	432025	364917	*Platanus orientalis*	100	23	5.7	30.3	1.4	5.3
19	1	432022	364914	*Platanus orientalis*	55	22	24.6	146.5	6.7	5.9
19	2	432019	364911	*Salix babylonica*	23	17	7.5	31.6	2	4.2
20	1	432017	364910	*Platanus orientalis*	150	20	14.5	77	3.5	5.3
20	2	432014	364909	*Salix babylonica*	25	12	1.3	5.5	0.4	4.2
21	1	432010	364907	*Platanus orientalis*	64	18	7.1	39.7	1.8	5.6
21	2	432007	364904	*Platanus orientalis*	75	15	3.5	17	0.8	4.9
21	61			Total			449	2036.4	163.9	

We were used a number of basic maps issued to determine of the study area and building the maps required for field surveys and geographical definition of target area, the Table (2) shows the maps used.

Table 2. Specifications of the topographic and basic maps of the Atrush region and their scale

1	Meroze	1:100 000	1981	Military Surveying
2	Shekhan	1:100 000	1984	Military Surveying

The study area and its location with in the northern region of Iraqi was also, identification by geographical maps as show in the Figure (1) below:

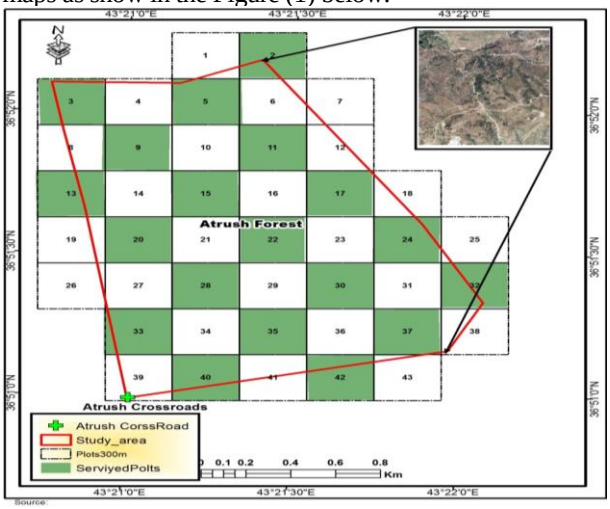

Fig. 1. The map of the Atrush forest region.

Source: KRG, Ministry of Planning, Data and Maps General Director-Duhok, 2010

This paper study the differ in forest structure due to various interest of the forest for society and ecosystem services, the ecosystem of this study included carbon sequestration ,carbon storage and structure value of trees and provide better understand how Atrush forest land might be utilized to provide environment of Atrush regions (Jonckheere *et al*., 2009). They are application Geographic Information Systems (GIS) helps cities manage forestry projects efficiently and reduce management costs. GIS brings together different types of data for intelligent planning. A city's tree database may include tree location, species, diameter breast height (DBH), canopy width, condition, and growth recordings.

RESULTS AND DISCUSSION

Forest Atrush land has a different forest structure, species composition, number of trees, the size and ground cover, this reflects the amount of environmental and economic services provided by forest land. (Wiseman and King 2012). They analysis many tree benefits are directly proportional to the healthy leaf surface area. In complexion to analytical structure for study forest Atrush region, it is through the Table (1) which include (64) trees, it's found that diameter distribution are varied, we found the diameter of (*Pinus brutia*) are range between (7.6-7.62 cm), they constitute the highest percentage of the sample, which was taken from the Atrush forest. The highest percentage in the selected number of the tree in this category was(15.2-22.9 cm) which is represented (22.2%).While the less proportion of the tree is more than one ratio category of diameter is (33.4%) percentage of the number of ratio

categories tree is a round (500 cm) and more. This is a good indication for the sepal of trees with a big ratio in the region which is reflected on the total contributions in the ecosystem. In regards the (*Pinus pinea*) all trees were ratio categories (15.2-22.9 cm) and repressed (100%) this an indicated that they are small sizes with less roles in the ecosystem. This condition has been repeated with (*Quercus* spp) and (*Salix babylonica*) trees, as the proportion of all trees (53.3-61.0)cm and(22.9-30.5)cm respectively, with an indication to the*(Quercus* spp) a logic, as they are trees present the region where it is original region, despite the bad circumstance of the trees in general and irregularly growth the (*Platanus orientalis*) represented the highest percentage for the number of trees with a ratio categories (99.1-106.7 cm), which is recorded (28.6%). Most of this type of trees were include within the big ratio categories and their role reflected in the ecosystem in the region. The highest of number of (*Crataegus saligna*) formed (108%) of total trees with the ratio categories (7.6-22.9 cm) which is indicated that they are small sizes trees and their impact is not as the level of the types of trees in the ecosystem. This can be seen in the diagrams of percentage, Fig (2,2(a-h).

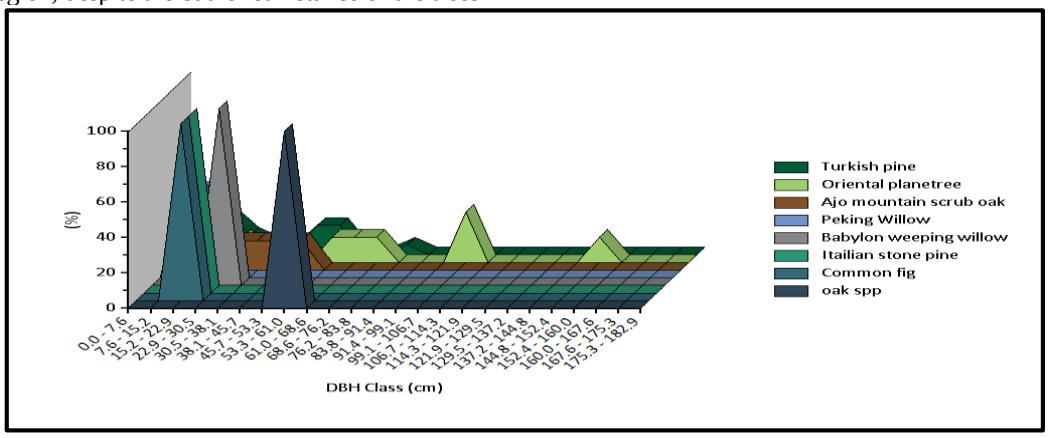

Fig 2. Diameter distribution of different species grown in Atrush region

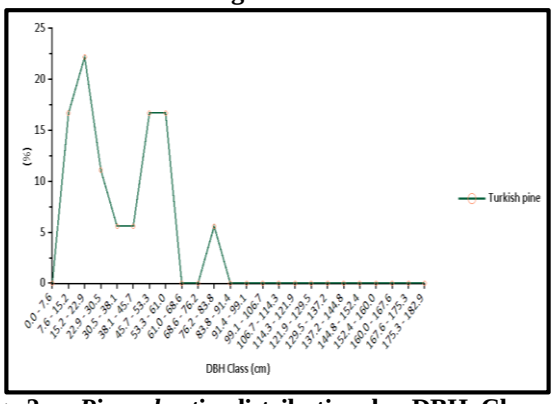

Fig. 2-a. *Pinus brutia* distribution by DBH Class (cm) in Atrush forest.

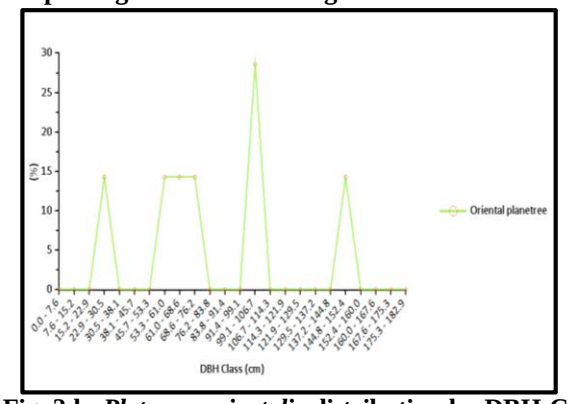

Fig. 2-b. *Platanus orientalis* distribution by DBH Class (cm) in Atrush forest.

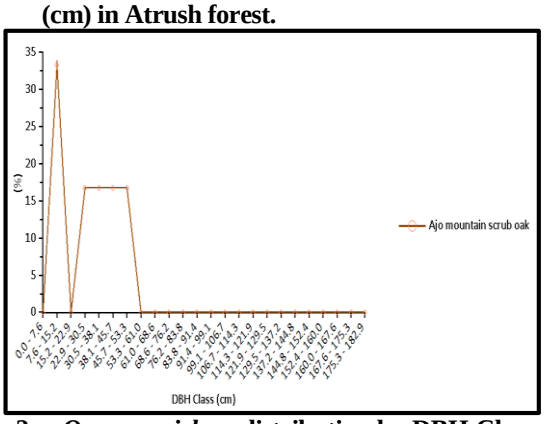

Fig. 2-c. *Quercus ajelops* distribution by DBH Class (cm) in Atrush forest.

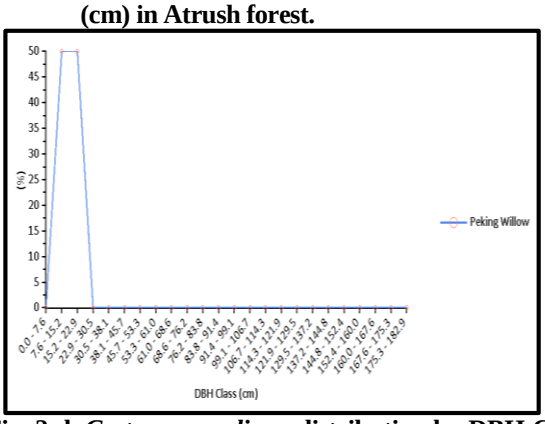

Fig. 2-d. *Crataegous saligna* distribution by DBH Class (cm) in Atrush forest.

The area covered by crown of trees and leaf area of the different types of trees as well as biomass of the leaves and basal area were analyzed. From that we see the percentage of these dominated trees (*Pinus brutia*) as the area of leaf areas of these trees arrived at (115.70) m² with a prevailed exception of the (*Platanus orientalis*) also, these area for other trees as trees are not regulated and are not in a good condition. The total area of (*Pinus brutia*) is around (2036.40 m²), these leaf areas are reflected in the amount of proportions leaf biomass. This proportions of (*Pinus brutia*) trees reached to (11.1 kg), the proportion of this type of trees were close within range (1.1-11.1 kg), which can be shown in the Tables (1,3,4 ,5)

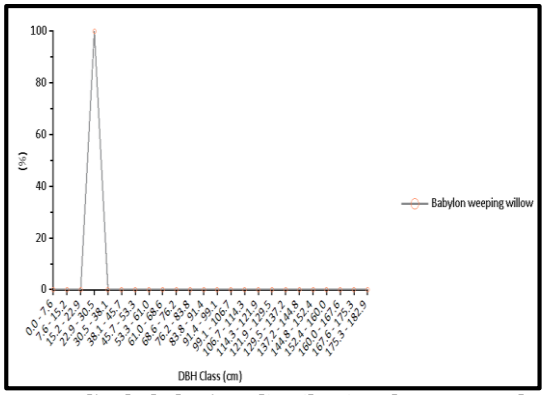

Fig. 2-e. *Salix babylonica* distribution by DBH Class (cm) in Atrush forest.

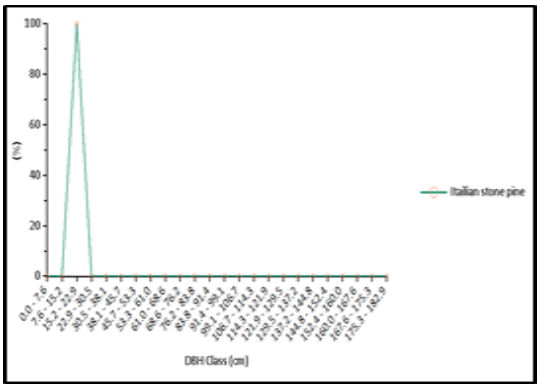

Fig. 2-f. *Pinus pinea* distribution by DBH Class (cm) in Atrush forest.

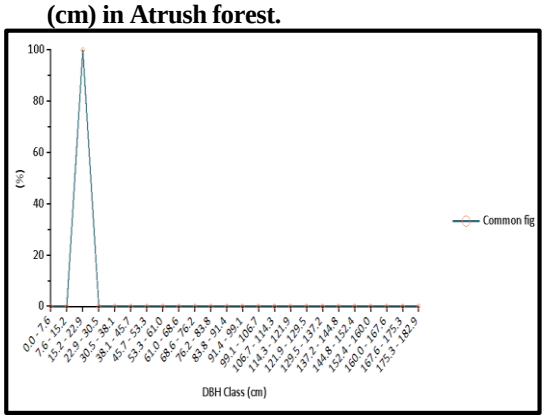

Fig. 2-g. *Ficus carica* distribution by DBH Class (cm) in Atrush forest.

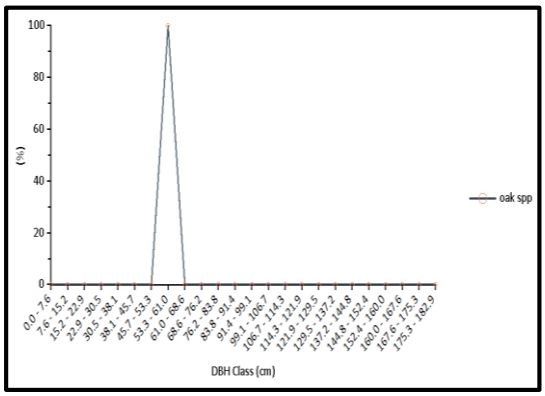

Fig. 2-h. *Quercus* spp distribution by DBH Class (cm) in Atrush forest.

Table 3. Measured Tree Details by Species in Atrush forest:

Scientific name	Tree Count		Canopy Cover (m²)		Leaf Area (ha)		Leaf Biomass (kg)	
	Value	%	Value	%	Value	%	Value	%
Quercus ajelops	6	15.00	25.20	5.60	<0.1	3.80	7.60	4.70
Salix babylonica	2	5.00	8.90	2.00	<0.1	1.80	2.40	1.40
Ficus carica	2	5.00	26.60	5.90	<0.1	5.70	8.60	5.30
Pinus pinea	2	5.00	40.90	9.10	<0.1	6.40	12.50	7.60
Quercus spp	1	2.50	7.10	1.60	<0.1	0.90	1.90	1.10
Platanus orientalis	7	17.50	88.00	19.60	0.10	24.80	23.20	14.10
Crataegous saligna	2	5.00	23.90	5.30	<0.1	5.10	6.60	4.00
Pinus brutia	18	45.00	228.40	50.90	0.10	51.50	101.20	61.70
Total	40	100	449.00	100	0.20	100	163.90	100

Table 4. Structure Summery by Species in Atrush Forest:

Scientific name	Trees		Leaf Area		Leaf Biomass		Tree Dry Weight Biomass		Average Condition
	Number	SE	Hectare (ha)	SE	Tone	SE	Tone	SE	%
Pinus brutia	19	±1	0.11	±0.005	0.10	±0.004	7.33	±0.391	82.50
Platanus orientalis	7	±0	0.05	±0.003	0.02	±0.002	41.03	±3.126	82.50
Quercus ajelops	6	±0	0.01	±0.001	0.01	±0.001	3.66	±0.332	82.50
Ficus carica	2	±0	0.01	±0.002	0.01	±0.001	0.34	±0.039	82.50
Pinus pinea	2	±0	0.01	±0.002	0.01	±0.002	0.14	±0.023	82.50
Salix babylonica	2	±0	0.00	±0.001	0.00	±0.000	0.51	±0.059	82.50
Crataegous saligna	2	±0	0.01	±0.001	0.01	±0.001	0.26	±0.030	82.50
Quercus spp	1	±0	0.00	±0.000	0.00	±0.000	2.29	±0.382	82.50
Study Area	41	±0	0.21	±0.005	0.17	±0.004	55.55	±2.979	82.50

Table 5. Structure Summery by Species and Strata in Atrush forest :

Strata	Scientific name	Trees		Leaf Area		Leaf Biomass		Tree Dry Weight Biomass		Average Condition
		No	SE	(ha)	SE	Tone	SE	Tone	SE	%
Urban	*Ficus carica*	2	±0	0.01	±0.002	0.01	±0.001	0.34	±0.039	82.50
	Pinus brutia	19	±1	0.11	±0.005	0.10	±0.004	7.33	±0.391	82.50
	Pinus pinea	2	±0	0.01	±0.002	0.01	±0.002	0.14	±0.023	82.50
	Platanus orientalis	7	±0	0.05	±0.003	0.02	±0.002	41.03	±3.126	82.50
	Quercus spp	1	±0	0.00	±0.000	0.00	±0.000	2.29	±0.382	82.50
	Quercus ajelops	6	±0	0.01	±0.001	0.01	±0.001	3.66	±0.332	82.50
	Salix babylonica	2	±0	0.00	±0.001	0.00	±0.000	0.51	±0.059	82.50
	Crataegous saligna	2	±0	0.01	±0.001	0.01	±0.001	0.26	±0.030	82.50
	Total	41	±0	0.21	±0.005	0.17	±0.004	55.55	±2.979	82.50

The i-tree program gives an indication of the analytical process of evaluation where, program was designed to find value and evaluation, the results were thus to evaluate the tree species with sample. Tree data (species, tree height, DBH, crown diameter, and height to the crown base) were used as intake parameters in i-Tree Eco to calculate the ecosystem services (Rocco *et al*., 2018**)**. The i-Tree Eco requires information concerning the species and the stem diameter at breast height (DBH) as the input data. Additional, data including land use criteria, total tree height, crown size (height to live top, height to the crown base, crown width, and percentage of crown missing (Westfall, 2015). The details confirm that the (*Pinus brutia*) presented the highest value of (18%) and counted for (45%) of the total sample trees in the area of Atrush. This is due to the number of trees of this type in the sample, where the program refers to the value of one tree, which is 2.5 for different types. This has also been reflected in the other analyze provided by the program in respect of both canopy cover, leaf area values and leaf biomass values. Which were also superior to (*Pinus brutia*) formed respectively (228.40,0.1,101.2), which confirm the predominance of the species of trees in the area and which can increase the numerical trees of this species that lead to an increase in the positive effect of these trees. While, the total sample tree species were (0.17) tones, which is relatively small compared to trees with good, the species of the small trees selected in the Atrush region were different in the amount of trees dry weight biomass and the bigger was in *Platanus orientalis*, where (41.03) represented only seven trees of this type compared to other species, where the difference was very large with other species. This indicates that these trees have the greatest effect in biomass due to high dry weight of the trees. This is also a good indicator of the trend towards the development of this tree in the area of Atrush which has reached a total of tree dry weight biomass for a sample (55.55) tones. It should be noted that the percentage of average condition of all trees species was high and equal and represented (82.50). Before making an assessment of tree species, we find that structure summery for the species of trees located in the area of Atrush to which the study referred. The total number of trees were (41) trees, while the common species of trees were the type of (*Pinus brutia*), which represented (19) trees, while (*Quercus* spp) trees the lowest number represented on one tree. This is an indication that the first mentioned species represents the predominated in Atrush. This was also, reflected in leaf area where we found that it represented the largest proportion and formed (0.11) hectares. While, the other percentage were less based on the number of trees in the sample and the total leaf area of the sample (0.21).This type also indicates that leaf biomass which was the largest natural one in the (*Pinus brutia*) trees, which amounted to (0.1) tones, while, the analysis of program i-tree did not show zero the size trees for some types of sample trees. The dominant of (*Pinus brutia*) is also a clear indication of amount per tree was (0.00526) tones compared to second species (*Platanus orientalis*) which amounted to (0.00285) tones.

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تقييم القيمة التركيبية لغابات أتروش

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استخدام غابات اتروش كموقع دراسة لحساب القيمة التركيبية و الخدمات البيئية والعوائد الاقتصادية من الغابات والواقعة في الجزء الشمالي لسلسة جبال (كلي قيامت) وارتفاعات كاني مازي من جهة الشرق,بينما تحددها مركز ناحية اتروش من جهة الغرب وقضاء الشيخان (عين سفني) من جهة الجنوب وتقع هذه الغابات ضمن دائرتي عرض (¯49 36° - ¯53 36°) وخطي طول (¯17 43º- ¯27 43º) وارتفاع عن مستوى سطح البحر بين (669 - 1017 م). المساحة الكلية لغابات اتروش (1415 كم2) والتي تحتوي على شجرتين هما (صنوبر زاويتا و بلوط الاكل) والشجيرات (الزعرور و العرعر و اللوز البري و كيرات) والتي نمت طبيعيا وانواع الصنوبر هي اكثر الانواع شائعا والتي تقدر تقريبيا بـ (27.58%). التقييم الاقتصادي لهيكلية الغابات تزود صورة للامتداد الحالي وظروف غابات اتروش. البيانات التي جمعت من غابات اتروش ارسلت الى خدمات الغابات للولايات المتحدة لاستخدامها في برنامج (i-tree Eco-program). كما أشارت نتائج هذه الدراسة إلى أن تخزين الكربون مع أنواع الأشجار كانت متفاوتة. بالإضافة إلى أن سبعة منها فقط قامت بتخزين (20.51) طن من الكربون ، وكانت جميع أنواع الأشجار الأخرى أقل من الكمية. من خلال فهم الأنواع المزروعة في الموقع ، يوفر عدد الأنواع لكل هكتار والنمو السريع لها المعلومات اللازمة لإدارة واستخدام غابة الاتروش.