Dynamics of Carbon Sequestration in Areas with Historical use of Agriculture in Northeastern Mexico

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Introduction

Economic-productive activities produce land use change according to the needs of society and of government programs, either for the exploitation of natural resources or agricultural land adaptation.

Objetive

The objective of the present study was to estimate the carbon content in the mezquital and in two areas with historical use of agriculture with a time of abandonment of 15 and 30 years.

Materials and methods

The study areas are located in the town of Linares, Nuevo Leon, Mexico. Comprising a mezquital vegetation type. The study areas are:

Primary mezquital

Mezquital of 15 years

Mezquital of 30 years

There was used a systematic sampling design to estimate the carbon content. Four sampling sites of 1,600 m² (40 x 40 m) divided into four quadrants were established in each area. In quadrant I, there was measured all trees and shrubs greater than 1 cm in diameter ($d_{0.10}$). In the quadrants II, III and IV, there were evaluated only individuals over 5 cm in diameter ($d_{0.10}$). The total height (h) and diameter ($d_{0.10}$) are the dasometric measurements that were made.

Carbon content was obtained from the relation of biomass for carbon concentration of tree and shrub species.

$$Carbon\ content = B * CC$$

where:
B = biomass (dry weight of trees and / or shrubs, kg)
CC = carbon concentration (%)

To determine biomass of tree and shrub species a local allometric equation was used and it was taken from Návar *et al.* (2004).

$$BT= (0.026884+0.001191D^2H+0.044529D-0.01516H)+(1.025041+0.023663D^2H- 0.17071H-0.09615lnH)+(-0.43154+0.011037D^2H+0.113602D+0.307809lnD)$$

where:
BT = total aboveground biomass (kg), D = basal diameter (cm), H = total height (m)

Carbon concentration was taken from Yerena *et al.* (2011) who recommends 45.4% for aboveground biomass of tree and shrub species.

Results
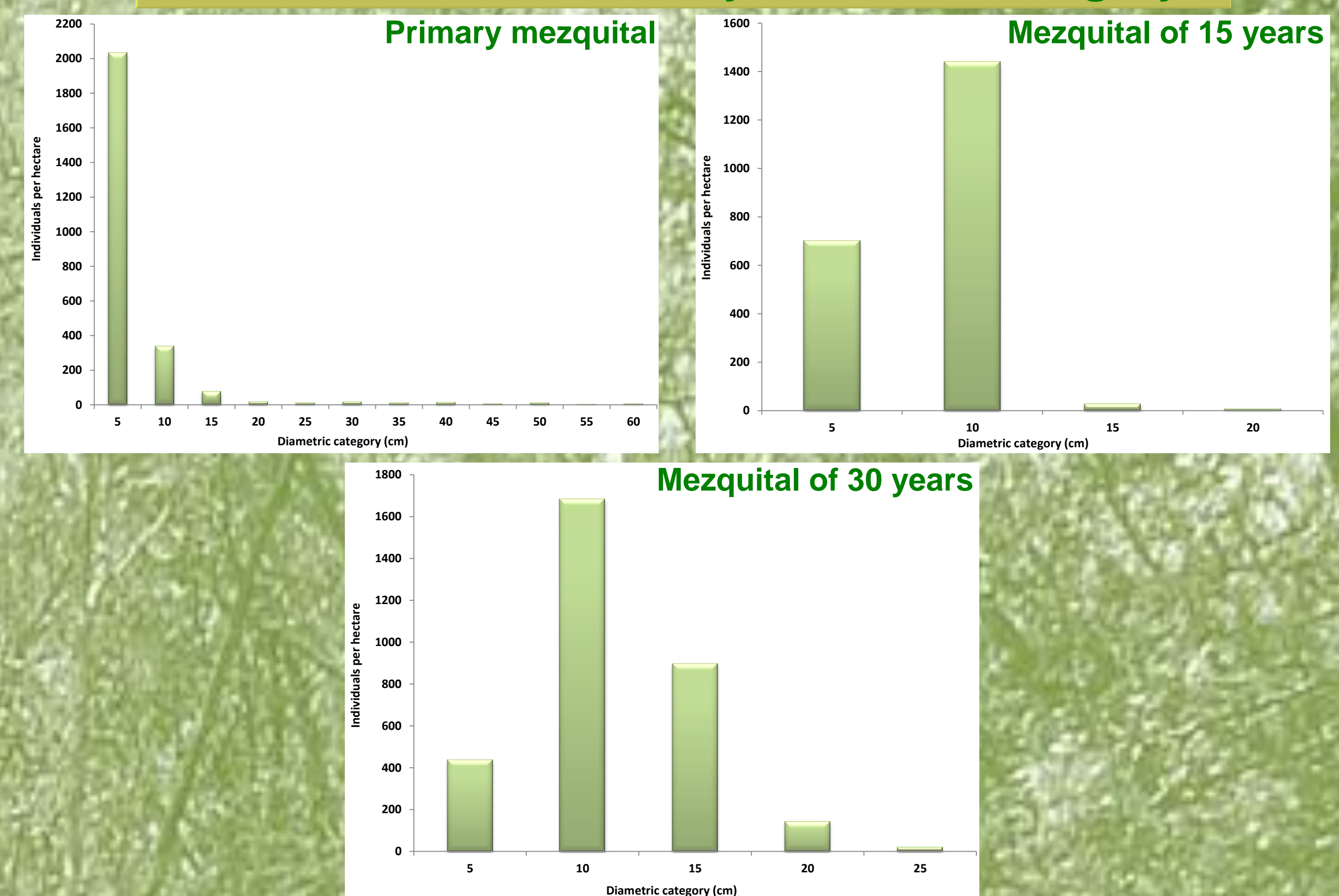
Number of individuals by diametric category

Primary mezquital

Mezquital of 15 years

Mezquital of 30 years

Table 1. Aboveground biomass and carbon content by diametric category

Diametric class	Primary mezquital MgB ha⁻¹	Primary mezquital MgC ha⁻¹	Mezquital of 30 years MgB ha⁻¹	Mezquital of 30 years MgC ha⁻¹	Mezquital of 15 years MgB ha⁻¹	Mezquital of 15 years MgC ha⁻¹
5	3.01	1.37	0.86	0.39	1.57	0.71
10	2.25	1.02	13.51	6.13	9.26	4.20
15	1.77	0.80	19.04	8.64	0.49	0.22
20	0.78	0.35	6.39	2.90	0.23	0.10
25	0.95	0.43	1.68	0.76	-	-
30	1.82	0.83	-	-	-	-
35	2.36	1.07	-	-	-	-
40	4.31	1.96	-	-	-	-
45	1.55	0.70	-	-	-	-
50	5.87	2.66	-	-	-	-
55	2.85	1.29	-	-	-	-
60	4.99	2.27	-	-	-	-
Total	**32.51**	**14.76**	**41.48**	**18.83**	**11.55**	**5.24**

Table 2. Carbon content and potential sequestration in the systems

Systems	Mean±SD*	Tukey's test[1]	Species richness	Potential Sequestration MgC ha⁻¹ año⁻¹	Potential Sequestration MgCO₂ₑ ha⁻¹ año⁻¹
Mezquital of 15 years	5.24±0.65	a	4	0.35	1.29
Primary mezquital	14.76±1.76	b	22	-	-
Mezquital of 30 years	18.83±1.56	c	12	0.63	2.31

[1]Similar letters are statistically similar ($P \le 0.05$), *SD = Standard deviation of the sample

Conclusions

It is possible to recover the initial state of primary mezquital in a geoform type of valley, as it can be seen with the mezquital of 30 years, that exceed the carbon content that the primary mezquital reserves had.

The abandoned areas with historical use of agriculture in a geoform type of valley with natural regeneration should be taken into consideration as important ecosystems for carbon storage, likewise to promote the location of forest plantation in this type of geoform.

References

1. Návar, J., E. Mendez, J. Graciano, V. Dale and B. Parresol. 2004. Biomass equations for shrub species of Tamaulipan thornscrub of northeastern Mexico. Journal of Arid Environments. 59(4):657-674.
2. Yerena-Yamallel J., J. Jiménez-Pérez, O. Aguirre-Calderón, E. Treviño-Garza. 2011. Carbon concentration in the above-ground biomass in the tamaulipan thornscrub. Revista Chapingo Serie Ciencias Forestales y del Ambiente. 17: 283-291.