ISSN: 2661-6831
Vol. 8 No. 1, pp. 58 – 71, January - March 2024

www.exploradordigital.org

Propuesta de un esquema de aprovechamiento para la producción subordinada del *Pinus maestrensis* Bisse caso de estudio Colón, Guisa

Determination of the potential for sustainable use of the biomass of Pinus maestrensis Bisse as a subordinate production of forestry exploitation case study Colón, Guisa

[1] Alexey Rosabal Quintana
Master in Environmental Management, Faculty of Agricultural Sciences, University of Granma. Km 17 Manzanillo Highway
arosabalq@udg.co.cu

[2] Yudemir Cruz Perez
PhD in Forestry Sciences, University of Havana. Emailcruzperezyudemir@gmail.com

[3] Alberto Vidal Corona
Ph.D. in Forestry Sciences UCTB Camagüey, Agroforestry Experimental Station, Ignacio Agramonte Ave. # 178, Los Coquitos Neighborhood, Camagüey
vidal56@nauta.cu

[4] Imilsi Virelles Espinosa
Master in Education Faculty of Agricultural Sciences, University of Granma. Km 17 Manzanillo Highway
iverellese@udg.co.cu

[5] Dayana Rosabal Gonzalez
Forestry engineer. University of Granma. Km 17 Manzanillo highway,
drosabalg@udg.co.cu

Scientific and Technological Research Article
Sent: 05/10/2023
Revised: 11/17/2023
Accepted: 09/12/2023
Published:05/01/2024
DOI:**https://doi.org/10.33262/exploradordigital.v8i1.2846**

Please quote: Rosabal Quintana, A., Cruz Pérez, Y., Vidal Corona, A., Virelles Espinosa, I., & Rosabal González, D. (2024). Proposal for a harvesting scheme for the subordinate production of Pinus maestrensis Bisse case study Colón, Guisa. Digital Explorer, 8(1), 58-71.https://doi.org/10.33262/exploradordigital.v8i1.2846

DIGITAL EXPLORER,*and*It is an electronic, quarterly journal, which will be published in electronic format, and has the mission of contributing to the training of competent professionals with a humanistic and critical vision who are capable of presenting their investigative and scientific results to the same extent that positive changes in society are promoted through their intervention.https://exploradordigital.org
The journal is published by Editorial Ciencia Digital (a prestigious publisher registered with the Ecuadorian Book Chamber with membership number 663).www.celibro.org.ec

ISSN: 2661-6831
Vol. 8 No. 1, pp. 58 – 71, January - March 2024

www.exploradordigital.org

Palabras claves:
producción subordinada, surtidos, tocón

Resumen

El trabajo se desarrolló en la comunidad de "Colón" perteneciente al municipio Guisa, provincia Granma, con el objetivo de Proponer un esquema de aprovechamiento para la producción subordinada del *Pinus maestrensis* Bisse. Que disminuirá las pérdidas de madera. Para ello se levantaron, parcelas rectangulares de (500m ^{2}), que se distribuyeron de forma aleatoria. Fueron medidos 101 árboles de ellos fueron objeto de tala 41 árboles, a los que se les midieron los parámetros dasométricos, se determinó el volumen de madera dejada en el campo y su utilización como diferentes surtidos las perdidas por concepto de tocón y trozas dejadas en el campo alcanzan un valor de 0,124m^{3} /*ha* y 11.06 m^{3} /*ha* respectivamente, de estos solo se aprovechó el fuste quedando en el campo madera que puede ser aprovechada como cujes, bolitos de madera, postes y rolliza. Por lo que se hace necesario proyectar medidas preventivas mediante un programa o un control periódico

Keywords:
subordinate production, assortments, stump

Abstract

The work was carried out in the community of "Colón" belonging to the Guisa municipality, Granma province, with the objective of Proposing a utilization scheme for the subordinate production of Pinus maestrensis Bisse. That will decrease wood losses. For this, rectangular plots of (500m 2) were raised, which were distributed randomly. 101 trees were measured, of which 41 trees were felled, to which the dasometric parameters were measured, the volume of wood left in the field was determined and its use as different assortments, the losses due to stumps and logs left in the field. field reach a value of 0.124m3 /ha and 11.06 m3 /ha respectively, of these only the stem was used, leaving wood in the field that can be used as cujes, wooden pellets, poles and logs. Therefore, it is necessary to project preventive measures through a program or periodic control

Introduction

Primary forest residues are the remains from the timber harvesting of forests and the silvicultural treatments carried out in them, such as: felling, pruning, clearing, opening of roads, actions for fire prevention, intermediate felling, sanitation, among others; these

forest residues can range from 10 to 18% in coniferous species and from 30 to 48% in tropical forest species (Carrillo et al., 2018).

Forest residues are a source of wood energy that can be used as firewood, charcoal, black liquor, methanol and pyrolytic oil. According to FAO, in 2017 more than 2 billion people depend on wood energy for cooking and/or heating, especially in households in developing countries.

According to García (2020), the use of this biomass source offers advantages such as: neutral emission of CO2 into the atmosphere during combustion, reduction of forest fires and the presence of forest pests. Despite the advantages of using forest waste, there are still drawbacks such as its high territorial dispersion and low energy density, which is why knowledge of its availability is a priority to determine the technical and economic viability of projects that intend to use it.

In order to make proper use of the forest, variables such as the amount of biomass, distribution in cutting fronts and areas with silvicultural treatments must be taken into account, without neglecting technical, ecological and economic criteria.

The extraction of forest residues is conditioned by the characteristics and existence of various variables, which directly influence the extraction logistics, economic costs and environmental impacts, one of them being the amount of forest biomass, which is related to the forest surface and the type of vegetation present (García, et al., 2021).

Given the growing interest in the use of biomass waste from forestry, it is necessary to conduct studies to determine its availability, distribution, and feasibility for its management.

Brañas, (2020) is of the opinion that all these circumstances have led to the fact that, in recent decades, the number and importance of studies on forest biomass production has grown continuously, reaching ever greater relevance, and covering a large number of different species and mass structures. From this perspective of possible use of tree biomass fractions, it is necessary to provide information that allows the development of sustainability criteria for our forest masses, especially with regard to fast-growing species managed intensively. Therefore, the objective of this research was to propose a exploitation scheme for the subordinate production of Pinus maestrensis Bisse.

Materials and methods:

Characterization of the study area

The community of Colón is located 53 km from the municipal capital, in the heart of the Sierra Maestra rising from 700 to 1200 meters above sea level, with irregular terrain its emergence dates back to the middle of the 19th century, from 1830, It is located between

the coordinates longitude: 76º 38´14" and latitude: 20º 8´7". It covers the entire area of the town of Colón.

The most abundant forests are pine forests of Pinus maestrensis Bisse and Pinus caribaea Morelet var. Caribaea Barret & Golfari and, on a smaller scale, natural forests composed of different species. Within the forest category, producers stand out.

According to Law 85 or the Forestry Law of Cuba, in Chapter 15, production forests are those whose main function is to satisfy the needs of the national economy for timber and non-timber forest products, through their rational use and exploitation.

Area evaluation

For the evaluation of the area, a detailed analysis of its own characteristics was carried out, such as its location and features (soil, relief, climate), the surface of the area, the existing vegetation, the volume of wood to be used. A topographic map of the area to be used was prepared, specifying the limits of the area, water courses, existing roads and other details of interest with the QGIS 3.26.3 software.

These results made it possible to determine the effective area of logging and the area not subject to logging.

Determining sample size

The sample size was calculated based on the standard error

$$n = \left(cv\frac{t}{E}\right)2$$

Where:

n = number of samples

t = is obtained from the Student table and its value from the sample size

E = sampling error

CV= coefficient of variation

Since there was no information available on population variability, either through variance or in relative terms through the coefficient of variation, a pilot sample was developed. One of the advantages of the coefficient of variation is that it allows for comparing the variability of populations that have different units of measurement.

Because the plantation is homogeneous in all its aspects (even-aged mass and single species) the sample size was 16 plots per stand significant for carrying out the research.

ISSN: 2661-6831
Vol. 8 No. 1, pp. 58 – 71, January - March 2024

www.exploradordigital.org

Sampling used

To determine the dasometric parameters of the trees within the stand, a simple random sampling was applied; in it, the sample is taken directly from the population, according to the randomness requirements. After the trees were cut down and the dasometric parameters were measured, the assortments were classified to determine, based on the preferred production, the uses of the subordinate production. For this, the assortment table of the work manual of the Cuban State Forest Service was used.

Table 1.

State Forest Service Work Manual Assortment Table

GROUPS OF SPECIES	ASSORTMENTS	LENGTH (m)	RABIZA DIAMETER (cm)	ASSORTMENT TYPE
All	Bowling	1.8 or more	25 and over	Thick
Hard, semi-hard, eucalyptus and pine	Posts	2.9 to 5.5 and more	14 to 24	Half
Hardwoods and Eucalyptus	Public service poles	5.5 to 11.5	12 to 32	Special Media
		more than 11.5		
Hard, coniferous	Sleepers	1.83; 2.13; 2.44	11 to 24	Half
All	Little buns	1 to 4	8	Half
Hard and semi-hard	Direct use rounds	1.8 to 10.0 and above	5 to 13	Fine
Hard and semi-hard	Tutor sticks	0.9 to 1.3	3	Fine
Hard and semi-hard	Cujes	1.4 to 3.6 and more	3 to 13	Fine

Table I. State Forest Service Workbook Assortment Table

In the cleared areas, all the usable parts of the trees that remained in the field were measured, as well as the height of the stumps that were greater than a third of the diameter taken at 1.30 meters. From this, the volume losses of wood were determined.

ISSN: 2661-6831
Vol. 8 No. 1, pp. 58 – 71, January - March 2024

www.exploradordigital.org

CHAPTER III.- ANALYSIS AND DISCUSSION OF RESULTS

Area evaluation

In the topographic map Figure 1 prepared with the QGIS 3.26.3 software, of the area to be used, the limits of the zone, the water courses, the existing roads and other details of interest are specified.

Figure 2. Map of the area

Source: own elaboration

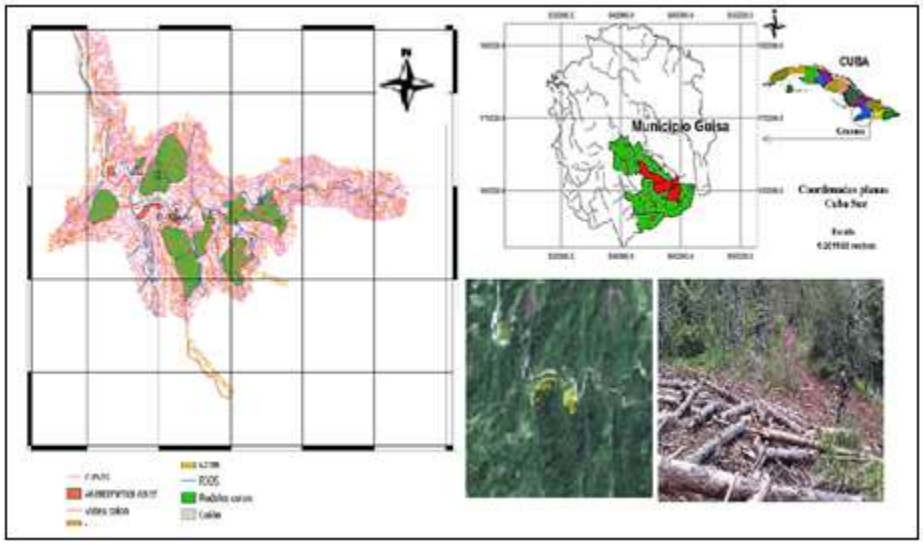


Figure 2. Area map
Source: Own Elaboration

Data collection was carried out in three stands where the number of trees measured for the study was 101, reaching various results such as the minimum diameter having a value of 0.1 cm and maximum diameter approximately 0.6 m, whose height varies from 8 m to 39 m the trees are in the stage of latizal (low) to fustal where there is a more accelerated growth depending on the characteristics of each species. These results are expressed in table 2. Similar values in terms of the dispersion of heights were found by Perez-Miranda, (2022)

ISSN: 2661-6831
Vol. 8 No. 1, pp. 58 – 71, January - March 2024

www.exploradordigital.org

Table 2.

Analysis of dasometric parameters

Tree Numbers 101		**height**		**volume**		**statistical variables**	
Average diameter (m)	0.350	minimum height (m)	8	volume m3/ha	168.01	variance (m)	0.01
Minimum diameter (m)	0.100	maximum height (m)	3 9	total volume of stands m3	521.22	standard deviation (m)	0.1
Maximum diameter (m)	0.650	average height (m)	2 6	average tree volume m3	0.998	Height diameter correlation	0.72
Diameter Width(m)	0.390	Lorey height (m)	2 6				

Source: own elaboration.

Table 2. Analysis of dasometric parameters
Source: Own Elaboration.

Analysis of wood losses due to stump height

According to Dourojeanni (2021), sustainable forest management would not be guaranteed if current regulations are respected, for this and other reasons it is necessary to propose new policies that bring about progressive change, which would imply drastic changes in forest management that are aimed at avoiding losses in production processes.

Stump height should be cut to one third of the tree diameter at 1.30m diameter at breast height (DBH). In small diameter trees, no less than 10cm of stump height should be left. Of a total of 41 trees that were felled, losses amounted to 0.12m3, the statistical analysis of the results of wood losses is reflected in table 3.

Table 3:

Statistical analysis of wood losses

Analysis of wood losses			
Volume left by stump cubic meters	0.124	V in logs left in cubic meters	11.620
maximum height cm	46.00	Largest log left in meters	5.280
minimum height cm	10.00	Minor log left 0	0.000
average height cm	24.44	average in meters	2.700

Table 3:

Statistical analysis of wood losses (continued)

Analysis of wood losses			
variance	77.74	correlation between heights and diameters	0.960
Standard deviation	8.82		
fashion	25.00		

Table 3: Statistical analysis of wood losses
Source: Own Elaboration.

Miranda (2022) is of the opinion that the abundance of trees in the smaller size categories (<9.9 cm DBH) present few or minimal valuable species.

The total volume lost in logs left in the field mentioned by Valdés, (2019) in Northern Bolivia is 2.5 m3, which is lower than that obtained in the table, where the volumes left in the field for this concept exceed 11 m3.

This shows that more trees are cut down to obtain a certain production. Moreno (2021) is of the opinion that the volumes of wood that accumulate are combustible materials that can be used to spread forest fires.

The largest log left on site was 5.28 m long and could be used for different purposes such as posts, sleepers or logs for direct use, which demonstrates the importance of reducing losses in forestry use.

Analysis of the losses of wood left in the rabiza

The stem is the part of the tree that remains, once it has been cubed and the volumes of supply of the trees have been used and that generally, in the plant, is what actually assumes this category, it depends on the diameter that it presents.

This portion of the tree is rarely (in our conditions) used from an industrial point of view. However, the uses that these portions can have are known, especially for industrial productions of small diameter and length.

However, the use that is generally given to the rabiza is for the production of firewood and charcoal, two lines that occupy an important weight within the economy.

Classify the total assortments of biomass produced in the harvest

In this study, the assortments of the Pinus maestrensis Bisse species remain in the field in the form of saplings and parts of the trunk, as well as the leaf mass that can have different uses. The non-utilization of these is often due to the fact that the truck used to transport

the wood only allows a certain amount of it, in addition to other causes such as wood that is cut down in places that make its extraction difficult, trees damaged by the felling of others.

In 35m trees, five six-metre logs were obtained, leaving five metres in the forest, which were not used because the capacity of the cart was less, resulting in five metres remaining that could be sold as posts.

Another assortment that remained in the field were the bolos or bolitos, which have a length of 1 to 4 m, classified as a medium assortment. These bolos that are lost could be used and given different uses such as firewood when cooking, without having to cut down pines unnecessarily and only use the wood in the bolo that is lost in the field.

The round wood is lost in the field since there is no specialized truck to transport it. This assortment is classified as a fine assortment and begins to be used when the diameter is greater than 5 cm and its length is greater than 1.8 m.

This type of assortment is little used in our country because farmers do not have the custom of collecting these parts of the trees after felling. Having important and different ways of being used, in figure 3 you can see structures for covers, structures for roofs, wooden roofs, porticos for wooden pergolas, wooden kiosks, wooden trusses, their unions are generally with metallic elements such as threaded rods, lag bolts and specialized screws.

Figure 3.

Uses of roundwood and cujes

The assortment of cujes is continuously affected since it has a length of 1.4 to 3.6m for its use, this is a type of assortment that is classified as fine which is wasted and lost, however it can be used mainly in buildings, roofs, cages, minor carpentry

Economic evaluation based on assortments

ISSN: 2661-6831
Vol. 8 No. 1, pp. 58 – 71, January - March 2024

www.exploradordigital.org

Economic analyses have tended to ignore environmental costs and the decline of natural resources. The economic justification for biological diversity can play a central role in debates about the use of natural resources. The economic benefits to humanity of biodiversity are difficult to value, and one of the goals of ecological economics is to develop methods for valuing the components of biological diversity.

In this study of wood loss of the Pinus maestrensis Bisse species, data were obtained which are reflected in Table 4. Economic values lost in unused wood.

Table 4.

Economic values lost in unused wood

Lost Volume of wood	volume average of the 41	trees Volume by hectare (m 3 /ha)	Loss economic ($)
Volume of cujes no taken advantage of	0.173	0.692	307.48
volume of bolitos no taken advantage of	0.222	0.888	100.34
volume of posts no taken advantage of	1.681	6.724	492.87
volume of roundwood not used	0.62	2.48	1463.72

Table 4. Economic values lost in wood
Source: Own Elaboration.

Schematic design

In the case of these places with an excessive slope where there is the presence of fragile soils and tropical forests with abundant species, it is proposed to avoid the hermetic sealing of fuel equipment or diesel equipment in these logging areas and to work only with the Dt-429 tractor, since it has the benefit of eliminating manual loading, its low soil compaction and the ease of extracting large logs over long distances.

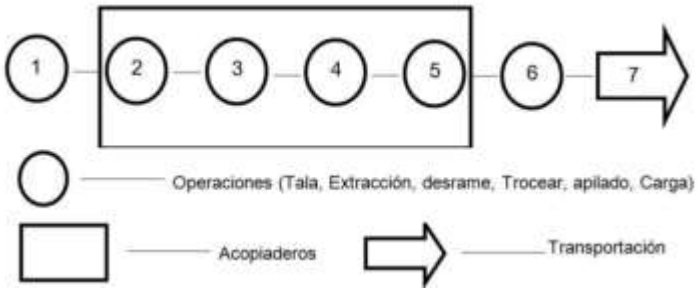
Figure 4 shows the tree felling process, where operations such as felling, extraction, limbing, cutting, stacking and loading are used. To start this, it is suggested that the trees must be felled in a safe manner, falling in the correct direction, this prevents the trunk from being damaged more than necessary.

ISSN: 2661-6831
Vol. 8 No. 1, pp. 58 – 71, January - March 2024

www.exploradordigital.org

Figure 4

Technological Variant using the OTIDA diagram



All of this is subjected to the loading operation, where it is taken from the upper stockpiles to the intermediate ones where some type of treatment can be carried out on the wood to then market it or to be transported to the consumption centers. In these stockpiles it is of utmost importance to carry out correct SST (Safety and health at work) due to the number of risks to which workers are subjected in these operations.

A procedure must be carried out for the identification, evaluation and control of risks, identifying the dangerous situations which are mainly located in the stockpiles where the high-risk operations are found, such as extraction, delimbing, cutting and stacking. There are risks when delimbing or cutting a pine tree, so you have to be careful with the chainsaw, axe or any means of cutting used. In addition, when stacking the wood it is necessary to use all means of protection such as gloves, helmets, rubber boots, overalls and goggles or face shields. This will prevent accidents from occurring or any worker from being seriously injured in all processes.

If all these risks can be assessed quantitatively through measurements or analysis, multiple consequences will be reduced, making it necessary to plan preventive measures through a program or periodic control.

Kometter, (2019) believes that an analysis of the exploitation practices are the basis for achieving sustainable management of the resource in forest concessions and are the foundation for avoiding accidents and increasing business profitability.

Conclusions

- Of a total of 101 trees that were inventoried in the study area, 41 were cut down, of which the cujes, wooden balls, posts and logs are not used; all of this is left in the field, which causes economic losses.

- The proposed scheme groups the operations of cutting, delimbing, stacking and loading into the collection center to group the assortments and avoid wood losses.

Conflict of interest

Authors must declare whether or not there is a conflict of interest in relation to the submitted article.

Literature

BRAÑAS, J.; GONZÁLEZ-RÍO, F.; MERINO, A. Nutrient content and distribution in Eucalytus globulus plantations in the Northwest of the Iberian Peninsula. Research. Agraria, 2020, (9): 316-335.

Carrillo-Ávila, N., Fuentes-López, M.E., Aguilar-Sánchez., P., Flores-Velázquez, R., Ordóñez-Prado, C., Buendía-Rodríguez, E. Use of forest residues in bioenergy production. National Institute of Forestry, Agricultural and Livestock Research. San Martinito Tlahuapan Experimental Field, Puebla. 2018. 30 p.

FAO. Dendroenergía. Available [Accessed on October 19, 2017] at: http://www.fao.org/forestry/energy/es/ http://www.fao.org/forestry/energy/ es/..

García, A., García, D., Pascual, J., De la Riva., Pérez, C.F., Montorio, R. Determination of suitable areas for the extraction of residual forest biomass in the province of Teruel using GIS and remote sensing, GeoFocus Magazine (Articles), 2021, No. 11. ISSN: 1578-5157. Spain. pp. 19-50

Moreno Ruiz, Juan Pablo. Adaptation of the hazard assessment to debris flows in burned forest areas: forest fires in Robledo de Chavela (2 and 29/08/2020) and, at the Valle de Lozoya forecast site, Community of Madrid. Thesis in the option of a Master's degree in Geological Engineering. 2021

Rodríguez García Encarna. Biomass, Biofuels and Sustainability. In c. TA and. A. ITAGRA.CT (Ed.) 2020, pp. 216.

Valdés. Residual wood in a harvested forest in Northern Bolivia. Evaluation of 6 species. Master's Thesis. 2019

Dourojeanni, M.J.; Malleux, J.; Sabogal, C.; Lombardi, I.; Tarazona, R.; Rincón, C.: Helmut, S. & Barriga, C.A. (2021). Foundations of a new forest policy for Peru. Peruvian Forestry Journal, 36(2), 118-17 Univ. Agraria La Molina http://dx.doi.org/10.21704/rfp.v36i2.1796

Caballero Miranda, Melina Lisbet. Statistical Analysis of Forest Use in the Structure and Floristic Composition of the Productive Forest of the Chamiriari Native Community, Peru Operational Research Journal Vol. 43 , NO. 1, 120-129, 2022

Kometter R. Analysis of management practices and resource sustainability in forest concessions for timber purposes. Project: USAID – US FOREST. 80 pp . 2019

Pérez-Miranda et al, Ramiro. Contingency analysis of the natural distribution of Mexican pines in the risk category. Terra Latinoamericana, vol. 40, , 2022, January-December.ISSN: 2395-8030

ISSN: 2661-6831
Vol. 8 No. 1, pp. 58 – 71, January - March 2024

www.exploradordigital.org