MULTIDISCIPLINARY SCIENCE JOURNAL

RESEARCH ARTICLE
Published Online: July 12, 2024
https://doi.org/10.31893/multiscience.2025038

Between nature and community: Local perceptions of local residents on the degradation of the Maâmora forest, Morocco

Elmassmari Fatima Zahra[a] | **Mostafa Slim**[a] ✉ | **Daiboun Thami**[a]

[a]Department of Geography, Faculty of Human and Social Sciences, Ibn Tofail University, Kenitra, Morocco.

Abstract The Maâmora is the largest cork grove in Morocco and even the world, home to flourishing biodiversity. It plays an important role as a natural heritage for the local inhabitants and offers many ecosystem services. However, there is deforestation caused by various factors, some caused by humans and others by nature. We aim to assess the degree of awareness of the surrounding population of the Maâmora forest regarding the impact of these factors on socioeconomic life as factors of forest degradation. To carry out this task, we used a questionnaire containing 17 items relating to the perception of the degree of degradation and overexploitation of the forest. The results of this survey indicate that more than 75% of respondents see a decrease in forest area, tree density and changes in water resources. While more than 70% of people confirm that the Maâmora forest has been overexploited due to the collection of firewood and construction, this leads to the disappearance of certain species of economic or ecological interest. Age and educational level were strongly associated with the choice of these answers, as well as the link with the forest. In response to this threat to our forest heritage, the Ministry of Agriculture, Fisheries, Rural Development, Water and Forests has recently taken actions by adopting bill 52.20 aimed at establishing the National Agency for Water and Forests (ANEF). This agency will play a crucial role in the implementation of the Moroccan Forests strategy 2020-2030.

Keywords: forest, degradation, overexploitation, surveyed, preservation, Maâmora, Morocco

1. Introduction

The Moroccan forests constitute a real treasure for the country to preserve. Their extent, biodiversity and multiple economic and social contributions make them essential elements for Morocco (Mesnildrey, 2021). The Moroccan forest occupies a vast area of approximately 9 million hectares, including 5.8 million hectares of forests and nearly 3.3 million hectares of alfa layers (Berkat & Tazi, 2006; Ahmed, 2023). This forest heritage site, according to Pramova and Locatelli (2012) and Miura et al. (2015), plays an essential role in both the protection of soil against erosion and the conservation of water resources, as well as at the economic and social levels. Indeed, it meets 30% of the country's needs in terms of timber for construction and industry, contributes 30% to the country's energy balance, and provides 17% of the food needs of the national livestock (Benbrahim et al., 2004).

Among the different forests of Morocco, the Maâmora forest is considered the largest cork grove and is widespread in the plain of Gharb. This formation is based on a Quaternary platform that extends from the Atlantic Ocean toward the interior of the country, with complex soils superimposed by sand on the red emerald of the Maâmora (Malki et al., 2022). It stands out for its rich and varied biodiversity (Slim et al., 2019). The cork oak is the essence of the Maâmora forest. The cork it produces is used in various sectors, such as the cork industry, construction and crafts (Adams, 2021). The main forest formations of Maâmora include cork oak, eucalyptus, acacia and pine reforestations (Malki et al., 2022). The reforestation of eucalyptus, acacia and pine also has significant importance in Maâmora forests (Malki et al., 2022). These plants provide timber and contribute to soil protection because of their developed root system (Benbrahim et al., 2014). However, as is the case for many forests around the world, the Maâmora forest continues to degrade. It is therefore essential to complete our knowledge of this biodiversity and grant it a status allowing it to be preserved to ensure the sustainable exploitation of this precious resource to preserve the forest ecosystem and its habitat.

Furthermore, forest degradation in Morocco is a crucial multifaceted problem. Indeed, many of these forests have suffered and are undergoing alarming degradation, which threatens their future and the balance of ecosystems. The causes of this deforestation are multiple and complex and vary from one forest to another. Thus, despite the efforts of forestry officials, forest degradation in Morocco remains a major challenge. However, estimating the state of forest degradation and raising

 Received: February 23, 2024 | Accepted: June 2, 2024

awareness among the human population of the short-term and long-term consequences could better contribute to the development of any strategy aimed at better controlling forest degradation.

Thus, the objective of this work is to estimate the state of degradation of the Mâamora forest according to the local human population or those neighboring the forest. We believe that this current estimate of the state of the forest and the degree of awareness among the population of this state and its consequences are very useful for taking measures to halt the degradation of the Mâamora forest and promote its reforestation.

2. Materials and Methods

2.1. *Study area*

The Maâmora forest is located in northwestern Morocco and extends over an area of 132,500 hectares, making it one of the most important cork groves in the Mediterranean basin. It is a rectangle 70 kilometers long from west to east and 40 kilometers wide from north to south. It is split into three homogeneous topographical units: western, central and eastern Maâmora (El Mostafa et al., 2015). Its relief is mainly flat, with altitudes varying from 6 to 8 meters along the Atlantic coast to 300 meters at its northeastern extremity (Figure 1).

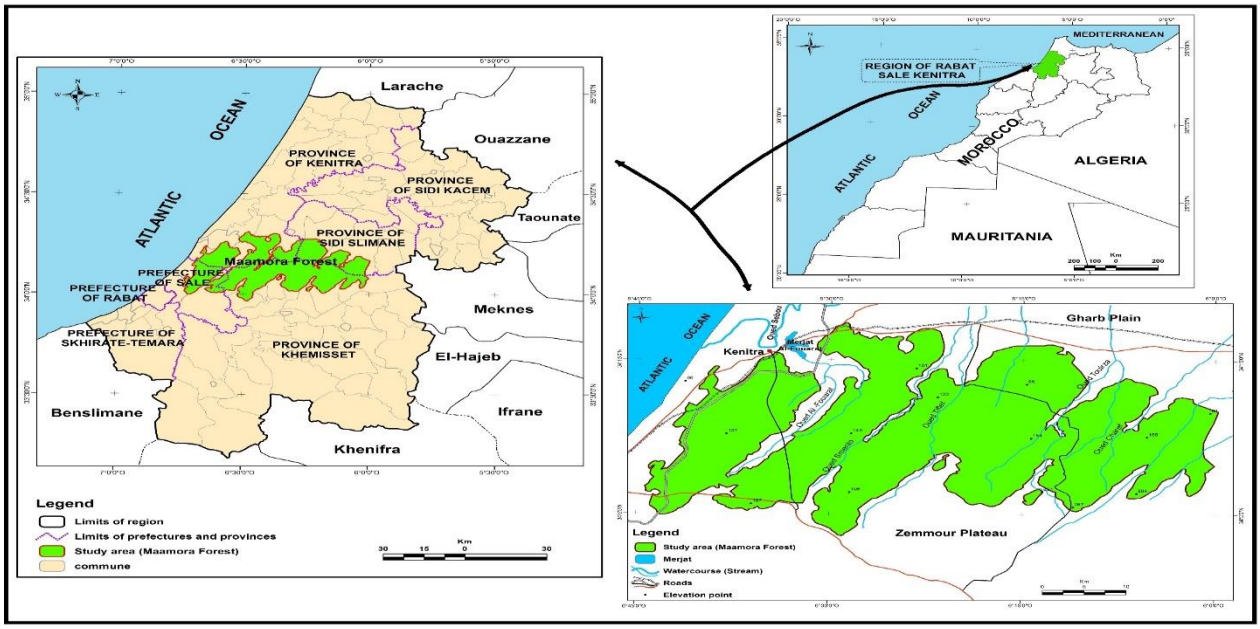

Figure 1 Location of the Maâmora forest.
Source: Laaribya et al., (2021)

The climatic conditions of the Maâmora forest are marked by a continental gradient that decreases from west to east. This situation gives the territory a subhumid bioclimate with warm winters in its northwestern part, while the eastern and southeastern parts have a semiarid climate. This is why we distinguished western Maâmora, which has more humid conditions, from eastern Maâmora, which is more arid.

The Maâmora forest plays an essential role in the region's ecosystem. It is home to a great diversity of flora and fauna, including plant species such as cork oak, holm oak, mastic and thuja. A variety of animals, such as wild boars, hare, foxes and many species of birds, are also found here. Thus, this forest plays an important socioeconomic and ecological role for the local and national populations (Fennane and Rejdali, 2015).

2.2. Study methodology

2.2.1. A questionnaire addressed to the population in contact with the forest studied

The questionnaire is composed of two parts. The first part concerns the sociodemographic characteristics of the respondents. This concerns, for example, the gender of the respondents, their age, their educational level and the type of link they have with the forest. The second part is more detailed, with 17 items divided into two dimensions. This second part allows us to collect more precise information. These dimensions are important because they deepen our understanding. They provided us with a more precise view of the attitudes and behaviors of the respondents.

The first dimension of the second part of the questionnaire concerns the attitudes of the respondents toward the forest. We ask them, for example, if they consider the forest to be a place of relaxation or if they perceive its exploitation as a threat to the environment.

The second dimension concerns the behavior of the respondents toward the forest. This involves knowing whether they participate in activities related to forest preservation, such as selective sorting or reforestation.

Dimension 1 assesses the state of forest degradation and includes the following items:

1: Reduction in forest surface area;
2: Reduction in tree density;
9: Forest floor degradation;
10: Destruction of the forest for agricultural purposes;
11: Degradation of the forest undergrowth;
13: Decrease in the amount of annual precipitation;
14: Deduction of forest water resources;
15: Disappearance of the dayas (temporary fed up);
16: sources that have disappeared;
17: Increase in depth of wells.

Dimension 2 assesses the degree of overexploitation of the forest and includes the following items:

3: Deterioration of tree health;
4: Collecting firewood;
5: Collection of construction timber;
6: Uncontrolled hunting of certain animal species;
7: Disappearance of certain species of economic or ecological interest;
8: Parasitic attack on trees;
12: Collecting medicinal plants.

The calibration of this scale is obtained by adding the corresponding scores of the items of each dimension (for the answer yes, we give the number 1, and for the answer no, we give the number 2). To obtain the categories based on the total score, we transformed them into Z scores.

$$Z = (XI - \text{population mean}) / \text{population standard deviation}$$

- Less than –Z: the respondents noted a major alteration of the forest (a significant degradation of forest products and its water ecosystem).
- Between -1 and 1 Z: the respondents had doubts regarding the state of the forest.
- Greater than +1: the respondents do not perceive any changes in the forest.

2.3. Sampling

In total, 543 people participated in this survey. The choice of participants was made randomly to guarantee the representativeness of the sample. The data were collected using a questionnaire that was validated through a test carried out with 20 respondents.

2.3.1. Reliability analysis of questionnaire

The validity of the questionnaire was verified by presenting it to a group of faculty members of professors who are conducting the Research Laboratory of “Territory, Environment and Development” to obtain their opinions and remarks on the extent of the questionnaire’s dimensions for this study and its suitability, as well as the clarity of each phrase. In light of this, some phrases were deleted, and other phrases were well modified and reformulated.

2.3.2. Validity analysis of the questionnaire

The Cronbach index, which measures the internal consistency of the questions, was 7.01. This indicates that the questions are reliable and consistent with each other, which reinforces the validity of the results obtained. The use of rigorous statistical methods will make it possible to analyze these data in a precise and relevant manner. The objective of this survey is to better understand the behaviors and opinions of those questioned on a specific subject. Through this study, we hope to obtain useful information and use the results to make informed decisions. The participation of 543 people in this survey is essential for obtaining statistically significant results. We would like to thank all participants for their valuable contributions. This survey will be able to provide relevant and enlightening information on the subject studied.

2.4. Statistical analysis of data

The collected data were entered and filtered in Excel and then transposed into SPSS software version 25.0. The qualitative variables are expressed as percentages, and the quantitative variables are expressed as the means ± standard deviations. The chi2 independence test was chosen for the hypothesis tests. The significance threshold was set at 0.05.

3. Results

3.1. Sociodemographic characteristics of the respondents

The study we conducted involved a sample of 543 respondents. Among these participants, 56.7% (n=334) were male. In addition, 75% (n=407) were under 25 years old, while 81.4% (n=457) had an educational level beyond secondary school. For the distribution according to the area of residence, 56.9% (n=309) of respondents lived in a forest environment. Furthermore, 16.2% (n=88) practiced pastoralism, while 26.9% (n=146) were forest visitors. This study highlighted several interesting trends. First, it is notable that the majority of respondents were under 25 years old, which may have affected the results obtained. Additionally, the fact that most participants have an education level above high school suggests that they possess a certain level of knowledge and education. Regarding the distribution according to the area of residence, it appears that the majority of those questioned live in a forest environment. This may indicate a particular interest in this environment and its issues.

3.2. Change in the state of the forest estimated according to the people surveyed

The research on the reliability of this questionnaire showed a Cronbach index of 0.639, with an eigenvalue of 2.507 and an average inertia of 14.7%. This value is acceptable and close to 0.7, which indicates the reasonable reliability of the questionnaire. The eigenvalue of 2.507 is also important to consider. This measure indicates the relative importance of each dimension of the questionnaire in the total variance of responses. A high eigenvalue suggests that a dimension is highly representative of response variations. In our case, an eigenvalue of 2.507 indicates that the questionnaire effectively covers the key aspects of the phenomenon studied. Finally, the average variance of 14.7% is a measure of the total variance explained by the dimensions of the questionnaire. The greater the average inertia is, the more representative the questionnaire dimensions are of the total variation in responses. In our case, an average inertia of 14.7% indicates that the questionnaire significantly explains a significant part of the variance of the responses.

3.3. Study of dimension 1

Table (1) presents the findings from the responses to the various items. In fact, more than 75% of the participants surveyed indicated that they were in favor of reducing the forest area and reducing the density of trees. However, a majority of more than 60% of the participants noted a significant degradation of the soil of the Maâmora forest, as well as a reduction in water resources, with the total disappearance of certain days and sources. Nevertheless, approximately 50 to 60% of the interview participants indicated that the forest had been subjected to massive destruction for agricultural exploitation or for the collection of undergrowth. This may be the cause of the low levels of annual precipitation.

Table 1 The responses to the different questions in this first dimension were classified as yes or no.

Item	Yes	No
1	431 (79.7%)	108 (20%)
2	417 (76.8%)	126 (23.2%)
9	340 (62.8%)	201 (37.2%)
10	280 (51.6%)	263 (48.4%)
11	296 (54.5%)	245 (45.1%)
13	321 (59.1%)	222 (40.9%)
14	331 (61%)	212 (39%)
15	341 (62.8%)	202 (37.2%)
16	365 (67.2%)	178 (32.8%)
17	298 (54.9%)	245 (45.1%)

To carry out a global analysis of this dimension, we used principal component analysis (PCA). The results showed that two principal components represented more than 51% of the total variance, and the projection of the elements allowed us to distinguish two groups (Figure 2).

- The first group of respondents is located on the positive side of axis 1. This group includes items 10, 13, 14 and 17. The people belonging to this group confirm the following propositions: the destruction of the forest for agricultural purposes, the reduction of the amount of annual precipitation, the reduction of the forest's water resources and the increasing depth of wells.
- The second group of respondents is located on the positive side of axis 2 and is defined by items 1, 2, 9, 15 and 16. The people interviewed in this group noted a significant decrease in the area of the forest, the density of trees, the soil, and water sources, namely, the dayas. This axis therefore reflects a reduction in the visible elements of the forest.

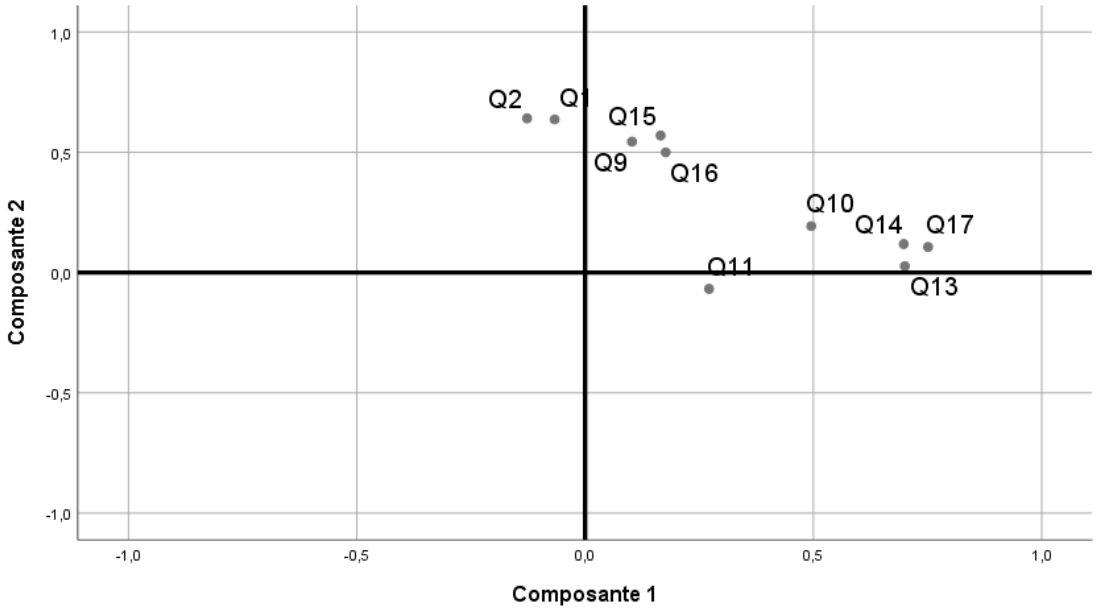

Figure 2 Presentation of dimension 1 items in PCA.

To deduce the forest condition service groups, we added the scores corresponding to each item. The total score of this dimension is the sum of the scores of the 10 items of dimension 1, where "yes" is assigned a score of 1 and "no" is assigned a score of 2. Furthermore, the average score was 13.62 ± 0.09, with a minimum score of 10, a maximum score of 20 and a median of 13. The distribution was symmetrical, with a skewness coefficient of 0.369 and a kurtosis of 0.136.

Figure (3) presents the results of the distribution of respondents "how do you see the ecological state of the Maâmora forest?". Indeed, 18.8% (n=102) responded that the forest has suffered from degradation and destruction of all the components of the forest (tree, soil, water), 19.5% (n=106) said the opposite (the Maâmora does not experience any changes), and 61.4% (n=331) did not have a clear declaration.

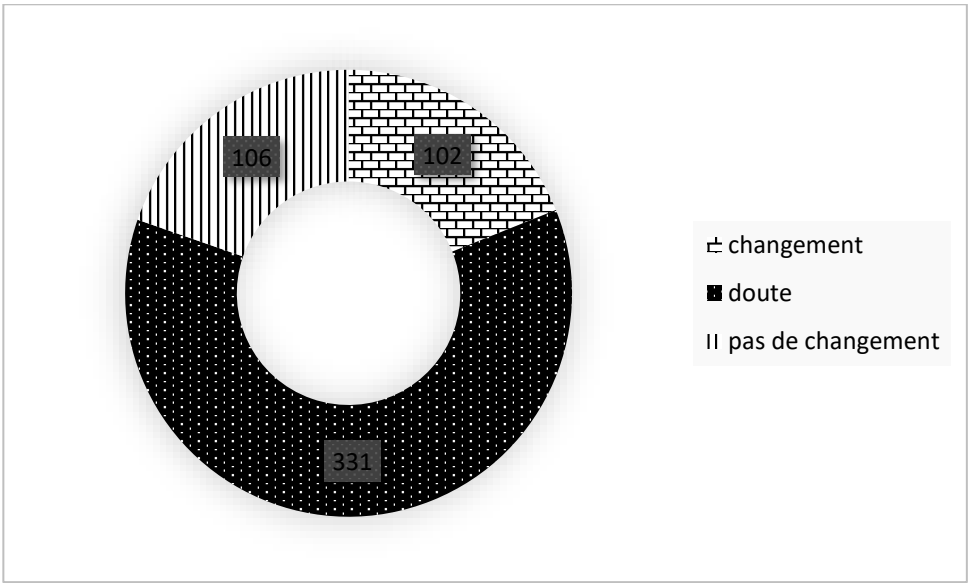

Figure 3 Distribution of respondents according to categories.

3.4. Study of dimension 2

Table (2) presents the results of the responses to the different items concerning the state of tree health and forest exploitation. According to the data collected, more than 70% of the respondents answered affirmatively to the question of whether the health of the trees had truly deteriorated. This demonstrates the scale of the problems our forests face.

Moreover, between 60% and 70% of respondents reported overexploitation of the forest, mainly due to the collection of firewood and construction wood. This destructive activity is responsible for the disappearance of certain species of economic or ecological interest. It is therefore essential to take measures to regulate this excessive exploitation.

Fewer than 60% of the respondents mentioned uncontrolled hunting of certain animal species. This practice leads to the destabilization of forest ecosystems and can have serious consequences on biodiversity. It is crucial to establish appropriate regulations to protect endangered species.

Furthermore, forest trees are often attacked by parasites. This situation is worrying because it harms the health and sustainability of forests. It is therefore necessary to intensify surveillance and prevention efforts to limit the devastation caused by these parasites.

Finally, the collection of medicinal plants was also mentioned by less than 60% of the respondents. This practice, if not managed sustainably, can endanger certain plant species and compromise the natural resources of the forest. It is essential to encourage the reasonable and respectful exploitation of these plants to preserve our natural heritage.

Table 2 The answers to the different questions in this second dimension were classified as yes or no.

Item	Yes	No
3	400 (73.7%)	143 (26.3%)
4	346 (63.8%)	197 (36.3%)
5	328 (60.4%)	213 (39.2%)
6	265 (48.8%)	278 (48.4%)
7	363 (66.9%)	180 (33.1%)
8	289 (53.2%)	254 (46.8%)
12	294 (54.1%)	249 (45.9%)

For an overall analysis of this dimension, we applied principal component analysis (PCA). The two components accounted for more than 53%, and the projection of the items made it possible to distinguish two groups (Figure 4):

- The first group is located on the positive side of axis 1, and it is composed of items 5, 6 and 12. The respondents in this group confirmed the overexploitation of natural resources in the region by the neighboring population. The activities to collect timber for construction, medicinal plants and the uncontrolled hunting of certain animal species have been identified as the main causes of this overexploitation.
- The second group is located on the positive side of axis 2. This group is characterized by responses to items 3 and 4. The participants in this group confirmed a deterioration in tree health as well as the collection of firewood.

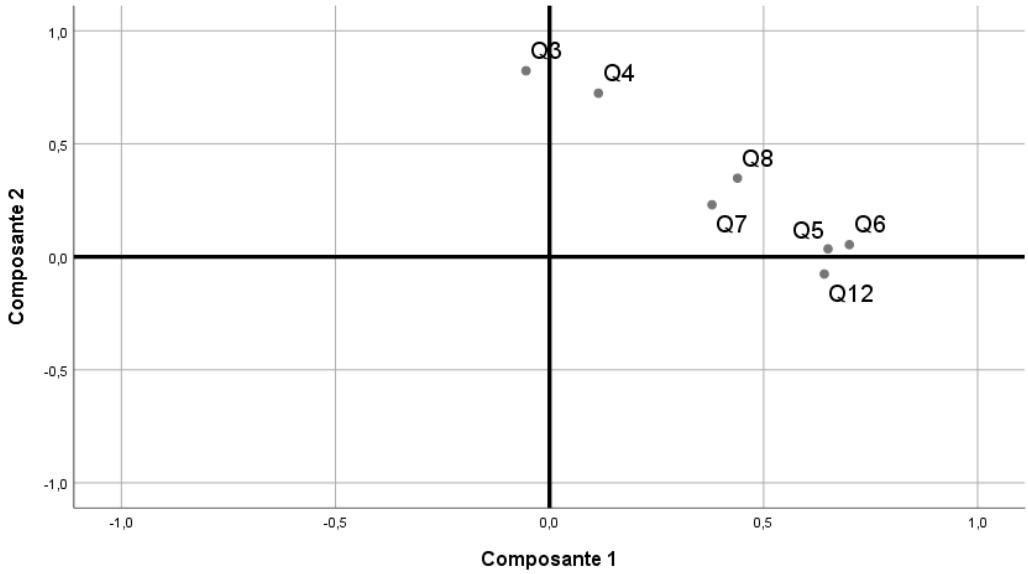

Figure 4 Presentation of dimension 2 items in PCA.

Figure (5) presents the results of the distribution of respondents according to “how they see the ecological state of the Maâmora forest. In fact, 11.4% (n=87) responded that the forest has indeed suffered from overexploitation, 13.6% (n=87) said the opposite, that is, the Maâmora is not subject to any overexploitation, and 74.9% (n=405) did not have a clear vision.

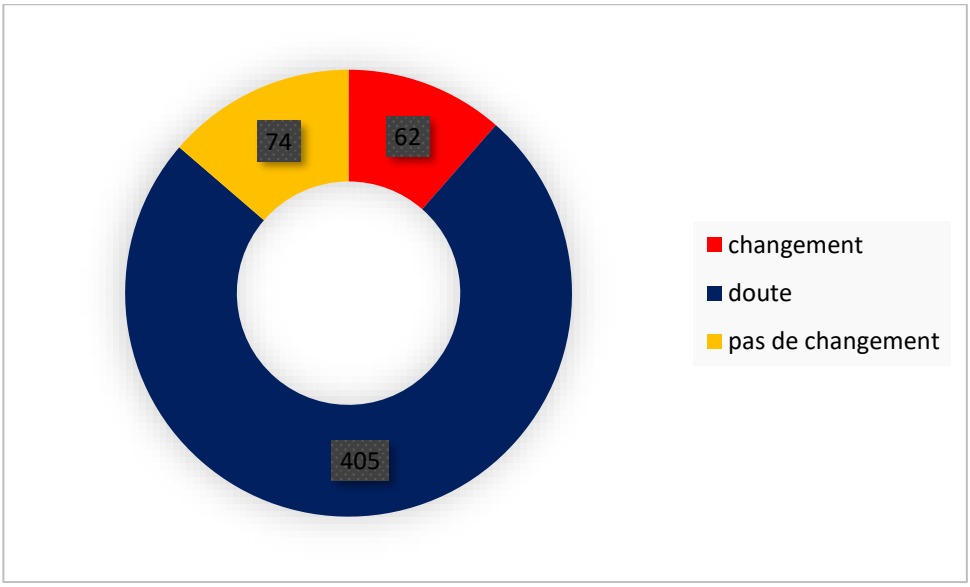

Figure 5 Distribution of respondents according to response categories.

4. Discussion

This study revealed a very significant correlation between the two dimensions studied (r=+0.326; p<0.000). Additionally, the participants who reported a change in forest condition confirmed several elements. First, there have been reductions in forested area as well as tree density. These findings indicate degradation of the forest floor following agricultural practices, a reduction in water resources during the day and an increase in the depth of wells. In addition, the deterioration of tree health, overexploitation of firewood and construction wood, unregulated hunting of certain animal species and excessive collection of medicinal plants have been confirmed.

These observations highlight the harmful consequences of human activity on forest ecosystems.

Indeed, among the causes of fires in the Mâamora forest, for example, the probability of intervention by human action is always present. Authorities noted that these fires have had a significant impact on the lives of local communities. They have led to the displacement of people and the loss of property and livelihoods. They have also contributed to an increase in health problems, such as respiratory diseases. It is therefore necessary to take this action to preserve and restore these fragile ecosystems. Therefore, actions such as implementing sustainable agricultural practices, protecting water resources, regulating hunting, and raising awareness of the importance of preserving biodiversity and natural resources are necessary.

It is essential that policymakers take these findings into account and implement effective environmental policies to protect our forests. Preserving these natural resources is crucial not only for biodiversity but also for the health and well-being of the communities that depend on these ecosystems. By working together, we can preserve our natural heritage for future generations.

In Morocco, the forest constitutes a pastoral reserve year round and produces, in a normal year, 1.5 billion fodder units, or 17% of the national fodder balance (Naggar, 2018). Indeed, the Mâamora forest is faced with a complex and multidimensional problem that threatens its balance and sustainability. According to the results of numerous studies, including those of Rapport (2016), pastoral pressure in the Mâamora forest arises mainly from the increase in livestock and the inadequacy of traditional pastoral practices with respect to the carrying capacity of the ecosystem. Thus, finding sustainable solutions to the pastoral problem in the Mâamora forest by banning goat breeding, for example, required a multidirectional approach that takes into account economic, social and environmental aspects.

For a long time, Morocco's forest ecosystems have been subjected to significant anthropogenic pressure depending on the region, and the natural balance has been disrupted for a large number of environments (El Mazi et al., 2018).

This is particularly the case for those that are ecologically fragile because they are located in marginal ecological conditions (Benabid, 1985).

The results obtained in our study are consistent with those of many research studies around the world. The factors that lead to deforestation are direct, such as the exploitation of firewood, unsustainable industrial exploitation, illegal exploitation (artisanal and/or industrial) and illegal artisanal exploitation, or indirect, such as demographic factors and climatic factors. This is an example of the forests of the Ivory Coast, the results of which are cited by Bnetd & Tera (2016). In addition, deforestation in Brazil and the Amazon is at its peak due to the development of industrial agriculture and particularly livestock breeding, which is responsible for approximately 70 to 80% of deforestation in the Amazon region (Piraux et al., 2018).

In Morocco, these official data revealed that the decrease in forest cover in Morocco is estimated at 17,000 hectares per year (El Kanabi, 2021).

In Africa, approximately 2 million hectares of forest disappear each year due to small farmers producing local subsistence agriculture (Karsenty, 2020).

According to a study conducted by Mehdioui & Kahouadji (2007), the massive use of medicinal plants in the forest resources of the Amsittène massif (province of Essaouira by the local population) has had an impact on the degradation of plant biodiversity.

Faced with this situation, which threatens our forest heritage, initiatives have been launched by the Ministry of Agriculture, Fisheries, Rural Development, Water and Forests. Recently, bill 52.20, which will play an important role in the implementation of the "Forests of Morocco 2020-2030" strategy, was approved by the National Agency for Water and Forests.

The preservation of the Moroccan forest is of capital importance. In addition to its ecological benefits, it plays a key role in maintaining the country's socioeconomic balance. It is therefore essential to promote sustainable forestry practices, strengthen forest management and increase public awareness of the importance of preserving this valuable natural heritage site.

However, the Moroccan forest experiences constraints, including the effects of human actions as users of the right to use goods and services and managers, which have contributed greatly to the process of this regression, including the succession of years of drought, overgrazing, overexploitation of forest resources by residents, the appearance of certain diseases and parasites and urban expansion, fires and excessive exploitation of fuelwood (Rapport, 2016).

Faced with these constraints, the national forestry program and the fight against desertification represent the most effective intervention tools for the sustainable development of the Moroccan forest, calling for certain objectives, such as soil protection against the degradation of vegetation cover and biological diversity and against the aging of trees and the overexploitation of forest property and the contribution to the socioeconomic development of rural populations.

5. Conclusion

Overall, this group highlights the importance of taking steps to preserve the forest and its resources. This highlights the need to promote sustainable forest management, encourage reforestation and increase public awareness of the importance of conserving these ecosystems. The protection of the forest surface, the preservation of tree density and the guarantee of fertile soil and abundant water sources are crucial issues to ensure a sustainable and balanced future for nature and human beings.

Ethical considerations

Not applicable. (The authors are committed to assuming full responsibility in this regard).

Conflict of interest

The authors declare no conflicts of interest.

Funding

This research did not receive any financial support.

References

Adams, M. (2021). *Trees of Life*. Princeton University Press.

Ahmed, I. A. (2023). Effect of Eucalyptus globulus trees on selected physico-chemical properties of soil, growth and yield of maize (Zea mays L.) At Hula Jannata in Girawa District, East Hararghe, Ethiopia.

Benabid, A. (1985). Les écosystèmes forestiers, préforestiers et presteppiques du Maroc : diversité, répartition biogéographique et problèmes posés par leur aménagement. *Forêt méditerranéenne*, *7*(1), 53-64.

Benbrahim, K. F., Berrada, H., El Ghachtouli, N., & Ismaili, M. (2014). Les acacias : des plantes fixatrices d'azote prometteuses pour le développement durable des zones arides et semi-arides [Acacia : Promising Nitrogen fixing trees for sustainable development in arid and semi-arid areas]. *International Journal of Innovation and Applied Studies*, *8*(1), 46.

Benbrahim, K. F., Ismaili, M., Benbrahim, S. F., & Tribak, A. (2004). Problèmes de dégradation de l'environnement par la désertification et la déforestation: impact du phénomène au Maroc. *Science et changements planétaires/Sécheresse*, *15*(4), 307-320.

Berkat, O., & Tazi, M. (2006). Country pasture/forage resource profiles. *MOROCCO: FAO*.

Bnetd, E., & Tera, R. (2016). Analyse qualitative des facteurs de déforestation et de dégradation des forêts en Côte d'Ivoire. Programme ONU-REDD, Abidjan.

EL Kanabi, M.J. (2021). «Forêts du Maroc 2020-2030» : Inverser la tendance de déforestation et d'épuisement des sols Hespress Français – Actualités du Maroc.

El Mazi, M., Er-riyahi, S., & Houari., A. (2018). Evolution spatio-temporelle des écosystèmes forestiers dans les massifs numidiens de la chaîne rifaine (Maroc): cas de Jbel Outka. *Geo-Eco-Trop*, *42*(1), 133-146.

El Mostafa, E. L., Brhadda, N., & Gmira, N. (2015). Bilan actualisé et facteurs impliqués dans le succès des reboisements du chêne liège (Quercus suber L.) dans la forêt de la Maâmora, Maroc. *Geo-Eco-Trop*, *38*(2), 325-338.

Fennane, M., & Rejdali, M. (2015). The world largest cork oak Maamora forest: challenges and the way ahead. *Fl. Medit, 25*, 277-285.

Karsenty, A. (2020). Géopolitique des forêts d'Afrique centrale. Hérodote, (1), 108-129.

Laaribya, S., Alaoui, A., Ayan, S., Benabou, A., Labbaci, A., Ouhaddou, H., & Bijou, M. (2021). Prediction by maximum entropy of potential habitat of the cork oak (Quercussuber L.) in Maamora Forest, Morocco. *Forestist*, *71*(2), 63-69.

Malki, F., Al Karkouri, J., Sabir, M., Ibijbijen, J., El Mderssa, M., Ikraoun, H., & Dallahi, Y. (2022). Assessment of the storage potential of organic carbon in Maamora forest soils: A strategic guidance tool for reforestation. *Soil & Environment*, *41*(1).

Mehdioui, R., & Kahouadji, A. (2007). Etude ethnobotanique auprès de la population riveraine de la forêt d'Amsittène: cas de la Commune d'Imi n'Tlit (Province d'Essaouira). *Bulletin de l'Institut Scientifique, Rabat, section Sciences de la Vie*, *29,* 11-20.

Mesnildrey, Leah. (2021). Picture a Pasture Open to All: Recognizing Community Conserved Areas and Territories in Morocco. *Journal of Public & International Affairs* (2021).

Miura, S., Amacher, M., Hofer, T., San-Miguel-Ayanz, J., & Thackway, R. (2015). Protective functions and ecosystem services of global forests in the past quarter-century. *Forest Ecology and Management*, *352*, 35-46.

Naggar, M. (2018). Méthodes de gestion de la forêt marocaine et les défis du développement durable. *Espace Géographique et Société Marocaine*, (22).

Piraux, M., Poccard-Chapuis, R., Le Page, C., Blanc, L., Cialdella, N., Coudel, E., ... & Assis, W. (2018). Accompagner les changements en Amazonie brésilienne : comment penser la transition des systèmes ruraux ?

Pramova, E., Locatelli, B., Djoudi, H., &Somorin, O. A. (2012). Forests and trees for social adaptation to climate variability and change. *Wiley Interdisciplinary Reviews: Climate Change*, *3*(6), 581-596.

Rapport, D. (2016). Améliorer la gouvernance des espaces boisés méditerranéens à travers la mise en œuvre de démarches participatives, Forêt de la Maâmora, Maroc.

Slim, M., Zouaki, N., & Fadli, M. (2019). A comparative study of the Coleoptera biodiversity of three areas of the Gharb plain: The biological reserve of Sidi Boughaba, the Mamora forest and the merja of fouarat. *Journal of Entomology and Zoology Studies*, *7*(1), 853-860.