

Review Article

Climate change and plant diversity in Mesopotamia

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Abstract

The “Mesopotamia”, well-known as a cradle of civilisations, is recorded as fertile crescent and an important geographical area. It is considered the place from which fruit trees like pistachio, pear, apple, plum, pomegranate and cultivated plants like pea, wheat, flax, lentil, chickpea, beet, and oat originated. In this study, mainly the provinces located in the Turkish Mesopotamian area have been evaluated. An attempt has been made to enlighten the potential impact of climate change on plant diversity.

Keywords: Fertile Crescent, Mesopotamia, Sacred Plants, Fragrant Plants, Sustainability, Climate change.

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Introduction

The name “Mesopotamia” means “between the rivers” or “the land between two rivers”, generally referring to the region between the Tigris and Euphrates rivers. It was the center of a culture that extended upto the the Indus Valley on the Indian subcontinent at the same time covering the Middle East, Egypt and the area near the Mediterranean Sea. This area served as the epicenter of various advancements in written language, science, economics, law, and religion. Furthermore, by providing fertile soil and

water, it supported a settled, agricultural way of life, enabling humans to abandon their nomadic lifestyle and transition to a settled life. Therefore, this area is counted among the few regions where agriculture originated [1 - 4]. Although a major part lies within the borders of Iraq and rest in the west and north of Syria and Türkiye, it generally refers to the area bounded by the Taurus Mountains to the north, the Persian Gulf to the south, the Zagros Mountains to the east, and the Syrian Desert to the west, extending upto the coasts of Arabia and Iran, reaching even further inland via the

Persian Gulf. This approximately 1,200 km long and 400 km wide area extends up to the Iranian plateau through mountain foothills and passes, Syria, Palestine, Anatolia, and the Mediterranean via the Middle and Upper Euphrates valleys; is bounded to the north and east by the Anatolian-Iranian high plateaus, to the southwest by the Arabian Massif, and to the west-along the Mediterranean coast-by the mountains of Palestine and Lebanon [5 - 9].

In southern Mesopotamia, around 5000-4000 BC first known written culture in history begins with the Sumerians, marking it as an early civilization, who settled in southern Mesopotamia around 5000 BC. Around 3200 BC, they introduced cuneiform writing, marking the beginning of the historical eras, and King Urukagina of Lagash established the first written laws in history. The important civilizations recorded from this area include: the Sumerians, who established the city-states like Ur, Uruk, Lagash, building at the same time Ziggurat temples. They ruled in what is now Iraq and Kuwait, establishing the first irrigation canals in southern Mesopotamia and establishing the first city-states like Uruk. The Mesopotamian Marshes discuss about the land of biodiversity as a story of the last Sumerian civilization. The cities of Maysan, Zi Kar and Basra in southern Iraq, always threatened by winter floods, were built on this land [10].

These were followed by the Akkadians, who established the first empire in history around 2300 BC, uniting Mesopotamia under one roof; followed by the Babylonians, when King Hammurabi established a centralized kingdom and advanced legal systems known as Hammurabi's Code. The Assyrians, who established a powerful military empire in Northern Mesopotamia, followed them. During this period, important advancements were made in mathematics (base 60), the lunar calendar and the use of

the wheel, irrigation techniques, and medicine. Due to its constant exposure to invasions, the region was in constant cultural interaction, and mudbrick architecture was widespread. The history of this area maintained its unique structure until the Persians conquered it in 539 BC. By 2300 BC, an empire of the Akkadians ruled southern Mesopotamia alone [11 - 12].

According to some Iraqi researchers, the story of the draining of swamps and the destruction of the environment is tragic not only for animals but for everyone. The early Sumerian legends have been found inscribed in cuneiform on 11 tablets in the Uruk swamp. When Gilgamesh wanted to learn the secret of immortality, he went to the rice fields in an unknown region to achieve victory against Humbaba, who represented evil, which is recorded as the "Secret of Immortality in Sumer Records". The earliest epic of human history dates back to the 3rd Dynasty of Ur, where in the 18th century BC, the journey of King Gilgamesh and his brave Sumerian-born friend Ankido is mentioned to have jointly undertaken a journey [11].

From its ecological and cultural background, this region comprises Lower and Upper Mesopotamia; the southern part was later known as Sumer, then Babylonia due to the city of Babylon, while the north was referred to as the land of Assyria [6, 7, 12]. Lower Mesopotamia was divided into 2 states-Sumer and Akkad-during the 2nd half of the third millennium B.C. The southern part of this region was the settlement area of Sumer, while the northern part was that of the Akkadian Kingdoms. Both Sumerians and Akkadians were collectively referred to as Babylonians (that is, the land of Babylon) [13]. Geographically, Babylon represented the southern half of Mesopotamia, while the northern half of Mesopotamia was represented by the land of Assyria [11].

Following the appearance of the Sumerians in Southern Mesopotamia, the local and foreign elements blended in all aspects of life, and the local culture was formed from a common blend of Sumerian, Ubaid (or Proto-Frat), and others [14]. At the beginning of the historical period, the Sumerians were dominant in the southernmost region, roughly from Nippur to the Gulf, whereas in Central Mesopotamia the region was dominated by the Akkadians after 2400 BCE; the 2 ethnic groups lived in close contact in the region alongside the small, scattered minority of uncertain origin (the Proto-Fratians or the Ubeid people). The dividing line between the 3 components constitutes the earliest historical people of Mesopotamia, as related to the language [15]. The two main languages identifiable in Mesopotamia have been Sumerian, spoken in the South; the earliest people attested in written records are the Sumerians [16].

Biodiversity characteristics of Mesopotamia

The Marshes here, particularly in southern Iraq, are a globally significant biodiversity area and an ecosystem that has persisted since the Sumerian civilization. Looking at the flora and fauna; region is home to many bird, fish, and aquatic species, as well as endemic plants. The agro-genetic diversity in this region, including Anatolia, is the birthplace of agriculture and plant domestication due to its fertile soils. The area abounds in critical ecosystems. In northern Mesopotamia, the riverbeds and surrounding areas of the Tigris and Euphrates rivers offer rich ecological niches; however, there are several threats, as natural habitats are under significant threat due to climate change and human interventions (drainage projects, dams). The "Mesopotamia" encompassing Türkiye's Southeastern Anatolia region maintains its status as one of the most important ecological corridors of the Middle East [17].

The swamps: the equation of the contrast between water and land

This swampy environment in southern Iraq, covering an area of 35-40 km, extends beyond Lebanon and is teeming with water birds as well as fish species, thus forming an equation of the infinite contrast between water and land. The swamp environment stands out for its environmental and biological diversity, as confirmed by ecologists. There are 371 species in 3 main swamps (the Huweiza, al-Hammar, and Anwar al-Furat swamps, with a 4,000-year history). The region, between water and desert, witnessed the emergence of great civilizations in an extraordinary diversity. This harmony between water and soil reveals its effects on the life, richness, and diversity of animals, and the abundance of animal and plant resources, as reflected in Iraqi proverbs such as "No one dies of hunger in Iraq." The people of the region filled their food baskets with fish hidden in the swamps, and used the reeds growing in the water to protect their homes from the summer heat and winter cold [18].

Houses on land and water

Scattered along the roads in the lands outside the marshes were reed houses. For centuries, the late Sumerians lived near sources of oil, tar, and gas around three marshes filled with papyrus and reeds. Their boats were coated in tar so they wouldn't take on water in the marshes. These were small boats carrying one or two people, traversing the marshes between interconnected reed farms in an environment that Orientalists called "Venice." The marshes brought together 4 components: humans, fish, papyrus, and birds. The marsh birds embarked on an endless journey from cold regions to marshes in winter, traveling thousands of Km to reach warmer areas to lay their eggs. However, in the 1980s, a decision was made to drain the marshes as a result of the war. This led to the death of birds that

reached the lukewarm waters, forcing them to leave their nests or shelters [19].

The story of draining the swamps and destroying their surroundings is not just a tragedy for animals; the draining of swamps is a broader tragedy. The swamp was one of the largest natural reserves. The food sources of those who had lived there for centuries were also destroyed. The regime made the decision to drain the swamps to stop Iranian infiltration. The Huweiza swamps, in particular, witnessed significant losses due to infiltrations from swamp ports on the front lines, where the Iraqi army and security forces suffered heavy casualties. The decision to drain the swamp and turn it into scorched earth resulted in the removal of wetlands in the region. The inhabitants were relocated to adjacent areas with different environmental characteristics. Iraqis in the south of the country recalled the revolutions that took place in the swamps, much like the Abbasid era, when those rebelling against the state took refuge in the swamps, after which the area was ordered to be evacuated and drained. However, the swamp was completely drained in the late 1980s. According to the experts the population has decreased from 60,000 to 6,000 [19].

The challenges of reviving the swamps

Reviving the swamps has proved almost impossible. The environmental groups in Iraq and around the world have attempted for the restoration of the swamps as a global and humanitarian duty. The relevant ministry announced that it had launched a program to remove the pollution that prevented water from reaching the swamp. Experts and local people made intensive efforts to revive these areas. They also called for action to overcome the challenges of refilling the swamp with water and protecting the settlements in the region. UNESCO's decision to add four marshes to the World Heritage List was positively received by environmentalists working

internationally. The cities of Ur, Eridu, and Urku, surrounding the marshes of the 3 cities, were also included in the World Heritage List [19].

UNESCO National Culture Coordinator stated that the goal of including any area in the World Heritage List broadens the task of protecting it. Therefore, as an international organization, we have to reorganize the region, protect it from war, and facilitate access for tourists to the marsh areas. The conditions accompanying the process of adding these to the list were quite serious. We know that if there is no water, there will be no wetlands. One of the most significant challenges facing the marsh environment is Iran's control of the region where the Qarun River, the main source of the marshes on the shores of the marshes in Iraq and Iran, flows into. Today, life is being re-established in the marshes. However, it is surrounded by dams built on the Euphrates. Mesopotamia, thanks to the Tigris and Euphrates rivers, as it has a rich biodiversity consisting of wetlands, reedbeds, and fertile plains. The Mesopotamian Marshes, in particular, harbor a critical ecosystem for migratory birds and endemic species. The region is also quite important in terms of genetic diversity as it is where agriculture began [17].

Mesopotamia emerges as a region that served as a distinct culinary center where settled life and agricultural practices were first established. Also known as the "Fertile Crescent," this region was frequently visited by travellers, who brought back new items from the places they visited. Furthermore, the influence of various cultures-including the Assyrians, Persians, Greeks, Romans, Byzantines, Umayyads, Abbasids, Arabs, Seljuks, and Ottoman civilizations- led to a diverse culinary culture emerging in Mesopotamia [20]. Today, in many neighboring regions, namely Mesopotamia and Anatolia, the traditional uses of plants, as well as their

uses in culinary culture, continue to this day [17, 21 - 56].

Plant resources in ancient Mesopotamia as natural and cultural heritage

The natural resources in Mesopotamia have significantly influenced ways of life and the development of civilization in the region [20]. The backbone of their economy has been agriculture, fertile soil, and abundant water resources. Consequently, soil cultivation and the maintenance of irrigation canals have played an active role in the flourishing of civilizations [8, 20]. The first crops cultivated in the region were: wheat, barley, vetch, flax, hemp, lentils, and peas [20]. Natural plant products such as sesame and dates also generated significant economic income [20, 57]. Gobekli-tepe, located within this region in the State of Urfa, dates back 12,000 years, with its world's oldest temple, and is recognized as the birthplace of both wheat and lentil [58].

The people in Mesopotamia easily exported large quantities of grain, vegetables, dates, reeds, and plant-based fiber products, thus flourishing in economic sectors such as agriculture, date cultivation, and reed production; all these were easily exported. While wheat, apple, and stone fruit cultivation were prominent among the Assyrians, the Sumerian economy also relied on date cultivation. Among the Babylonians, while temples held an important position in the economy, the trade sector-particularly an economy based on agricultural products-was also strong. In this region, the cultivation of rice, corn, dates, and vegetables had also gained significance. Other plant resources like pomegranates, figs, and dates were effectively used in winemaking. It is also known that fruits like; peaches, apricots, cherries, and plums also originated from here and were cultivated in Mesopotamia part (present-day Iraq) [3, 20]. The historical sources mention that Sumerians

typically cultivated vegetables such as lentils, peas, beans, cucumbers, leeks, lettuce, onions, beets, and garlic; fruits such as grapes, apples, melons, figs, pears, and pomegranates; as well as various wild herbs and nuts in the gardens shaded by tall date palm trees [20].

Mesopotamia is recorded among the key regions where agriculture originated. The development of agricultural tools and the domestication of animals to assist humans made life much easier here. Along with the cultivation of land and the beginning of the consumption of animal meat as food, the discovery of flavorful spice plants-particularly those with high aromatic potential-paved the way for the emergence of culinary culture. All through the history, various cultures-heirs to the Fertile Crescent-have shaped today's culinary culture by following the footsteps of the past [20]. The millennia-old civilizations situated along major trade routes in Mesopotamia have helped sustain their natural cultural heritage, leading to the emergence of rich culinary traditions in this region. From the past to the present, ingredients such as wheat, barley, bulgur, rice, dates, sesame, saffron, cinnamon, sumac, garlic, cumin, and various spices, along with cooking methods and preservation techniques, have not only formed today's dishes but have also added character and richness to cuisines [59].

The culinary culture emerging from Mesopotamia is placed among the world's oldest food and beverage production centres. The agricultural products and production techniques were developed, following 2 branches that led to the formation of Anatolian cuisine, as geographically very close to it. Their history progressed following travels from other cultures, paving the way for the emergence of Chinese and Japanese cuisines. While Anatolian cuisine helped shape Egyptian cuisine, it in turn influenced ancient Greek cuisine, thereby leading to

the development of other European cuisines [20, 59 - 60].

The medicinal and aromatic plants (MAPS)

The early information on MAPS available to modern scientists comes from cuneiform tablets dating back to ancient Mesopotamia [61]. Most of the tablets describe medical practices which have survived from 20,000 BCE to the present day, originating from the library of Ashurbanipal, the last great king of Assyria [61]. The clay tablets reveal that people obtained grain from barley and wheat; spices were used not only to flavor meals but also as fragrances and medicines; and syrups made from fruits, dates, and honey served as the primary sweeteners [62-64]. Most comprehensive medical studies from Ancient Mesopotamia to the present day have been undertaken by researchers from different countries, and they have examined a large number of different clay tablets and contributed to the discovery of medical texts, the vast majority of which are prescriptions [61]. The information contained constitutes a synthesis of several centuries of Mesopotamian medical knowledge and is organized from head to toe into separate subsections covering diagnostic examination, convulsive disorders, gynecology, and pediatrics [61].

The information on the traditional medicinal uses of certain plants reveals that these were widely used in Ancient Mesopotamia. Onions have been widely used here, not only to add flavor to meals but also to cure illnesses; also known to be beneficial for the eyes and to warm the body, thus preferred by physicians. The leeks are another popular vegetable holding an important place in the culinary culture of this area. Physicians highly recommended leeks for their medicinal applications, as they helped balance body temperature, clear the throat, and improve the clarity of voice. The apples were widely used for

stomach ailments as early as 3000 B.C. In addition to these the syrups were among the medicines used for various illnesses [20, 65]. Plants like hemp, poppy, henbane, and mandrake have also been widely used in Mesopotamian botany for both medical and mystical rituals, generally serving as pain relievers as well as hallucinogens and hypnotics [66 - 68].

An assessment of current plant diversity in upper Mesopotamia

Diyarbakır (Chayonu) and Şanlıurfa (Göbeklitepe) are among the earliest settlements in Southeastern Anatolia (Türkiye), and these have been prominent cultural centers in Mesopotamia. There are 10 provinces in Anatolia where civilizations converged: Gaziantep, Diyarbakır, Kahramanmaraş, Kilis, Batman, Adıyaman, Mardin, Siirt, Şanlıurfa, and Şırnak; all located in the Upper Mesopotamia [17, 20]. The latest floristic studies reveal that nearly 4000 plant taxa are distributed in this region, out of these 450 are endemics. The vegetation of the region is ecologically classified as steppe, halophytic, forest, ruderal, dry stream, meadow and wet-marshes. Our evaluation here mainly covers 3 subheadings: sacred, fragrant and poisonous plants. The well-known sacred plants are: olive, fig, pomegranate, carob and nigella; fragrant plants include aromatic plants, and data on some important popular poisonous plants have also been pooled [17].

Although Upper Mesopotamia is arid due to low precipitation, the soil has a very high lime content. It is generally dominated by steppe plants, typical of arid environments. In the grassland formation, Poaceae and Fabaceae families exhibit a rich diversity. Plants such as wheat, lentils, vetch, peas, and alfalfa are also commonly found [17]. The forests can be observed starting at elevations of 700-850 m; in some areas of this region, which are affected by land

degradation, certain oak shrubs such as *Quercus infectoria*, *Q. brantica*, and *Q. libani* are dominant. Along the riverbanks, tree species such as *Salix triandra* and *Populus euphratica* are frequently encountered. Among trees of high economic importance, *Olea europaea* and *Pistacia vera* stand out in this region. Particularly west of the Euphrates, limestone plateaus at an elevation of approximately 500–600 m are covered with *Olea europaea* and *Pistacia vera* trees [17].

In all, 367 plant taxa are used medicinally by the local inhabitants in this area. These are believed to have healing effects against ailments by the local population. The reports indicate that 108 plant taxa are used for urinary system disorders, 101 for stomach ailments, and 84 for respiratory system disorders. A total of 225 plant taxa are consumed as food in addition to other traditional uses, and 19 taxa are used in herbal beverages, 19 in spices, and 25 in cheese making [17].

Ozturk et al. [17] have reported that the taxa such as *Allium scorodoprasum*, *Anethum graveolens*, *Capparis spinosa* var. *spinosa*, *Crataegus monogyna* ssp. *monogyna*, *Geranium tuberosum*, *Glycyrrhiza glabra*, *Gundelia tournefortii* var. *armata*, *Lepidium sativum* ssp. *sativum*, *Malva sylvestris*, *M. neglecta*, *Mentha pulegium*, *Morus nigra*, *Nasturtium officinale*, *Nigella sativa*, *Olea europaea*, *Orchis coriophora*, *Ornithogalum narbonense*, *Rheum ribes*, *Rhus coriaria*, *Pistacia khinjuk*, *P. vera*, *Portulaca oleracea*, *Rubus sanctus*, *Rumex acetosella*, *R. pulcher*, *Thymbra spicata* var. *spicata*, *Thymus* sp., *Trigonella foenum-graecum*, *Urtica dioica* and *U. urens* are used by the locals as food, in salad and spices, and also consumed as tea. The taxa like *Capparis ovata*, *C. spinosa*, *Cerasus mahaleb*, *Glycyrrhiza glabra*, *Pistacia khinjuk*, *P. terebinthus*, *Rhus coriaria* and *Thymbra spicata* are collected from the wild and sold all over the country, and a part is exported to other countries in the world

[17].

Among these plants, the following spice plants have high aromatic potential and are valued for their potential fragrances: *Allium ampeloprasum*, *Allium longicuspis*, *Filipendula ulmaria*, *Foeniculum vulgare*, *Mentha aquatica*, *Mentha longifolia* ssp. *longifolia*, *Mentha longifolia* ssp. *typhoides* var. *calliantha*, *Mentha pulegium*, *Mentha spicata* ssp. *spicata*, *Ocimum basilicum*, *Origanum vulgare* ssp. *gracile*, *Primula auriculata*, *Ranunculus kotschyi*, *Rhus coriaria*, *Salvia syriaca*, *Scilla persica*, *Thymbra sintenisii* ssp. *sintenisii*, *Thymbra spicata* var. *spicata*, and *Thymus kotschyanus* var. *kotschyanus*.

The plants listed below are added to cheese making due to their aromatic effect and pleasant scent: *Allium giganteum*, *Allium kharputense*, *Allium scorodoprasum* ssp. *rotundum*, *Allium trachycoleum*, *Allium vinele*, *Chaerophyllum macrospermum*, *Diplotaenia cachrydifolia*, *Eremurus spectabilis*, *Euphorbia cheiradenia*, *Ferula haussknechtii*, *Ferula orientalis*, *Ferulago angulata* ssp. *angulata*, *Ferulago angulata* ssp. *carduchorum*, *Ferulago stellata*, *Gundelia tournefortii* var. *tournefortii*, *Heracleum persicum*, *Medicago sativa* ssp. *sativa*, *Pimpinella kotschyana*, *Prangos pabularia*, *Primula auriculata*, *Prunella vulgaris*, *Ranunculus fenzlii*, *Sium sisarum* var. *lancifolium*, *Thymus kotschyanus* var. *kotschyanus*, and *Trigonella foenum-graecum*.

Altay et al. [69] have identified a total of 275 toxic plant taxa belonging to 58 families and 166 genera in Upper Mesopotamia. The families with the highest number of toxic plant taxa are Ranunculaceae (31 taxa), Asteraceae (25 taxa), and Liliaceae (22 taxa). The genera with the highest number of toxic plant taxa are *Euphorbia* (14 taxa), *Ranunculus* (13 taxa), *Papaver* (8 taxa), and *Ornithogalum* (8 taxa).

Potential climate change impacts on plants

Mesopotamia is a vast foothill region surrounded by semi-arid plateaus where dry farming is possible [5, 70]. The dominant vegetation in this region is generally steppe, and precipitation increases as one approaches the surrounding mountains. Consequently, Upper Mesopotamian region receiving approximately 200 mm of annual precipitation, is suitable for dry farming. It allows for a single wheat harvest per year without irrigation. This region is also rich in pastures, suitable for livestock farming [5 - 6].

In any given habitat, certain key ecological factors-such as temperature, humidity, drought, and soil salinity-may become even more significant in the context of climate change [71 - 77]. This is because climate-change-driven warming increases evaporation, reducing soil moisture and increasing drought [74 - 75, 78]. As temperatures rise, these lead to ecological mismatches in the timing of biotic interactions among plants, pollinators, and herbivores [79]. Drought from high temperatures increases evaporation in the soil-plant continuum, gradually reducing water availability, inhibiting root development, and impairing seed germination [74 - 75, 78].

Other significant potential effects of climate change include hydrological changes and abnormal alterations in soil structure [73 - 75, 80]. Depending on soil structure, processes such as erosion and leaching can lead to sudden variability in the nutrient cycle [80 - 81]. Along with climate change, factors such as human interventions and overgrazing can significantly alter species diversity [82]. Many of these species, particularly endemic and rare ones, are extremely sensitive to warming and drought [73 - 75, 80, 83].

Considering the region's floristic and

vegetational structure, while some woody species can withstand drought and high temperatures to a certain extent, climate change-characterized by a significant decrease in precipitation and a significant increase in temperature-will pose a serious threat to their survival [84 - 85]. There is widespread consensus that severe effects of global warming will affect vast areas with arid and semi-arid characteristics [74, 75, 86 - 87]. These areas are expected to experience significant increases in soil salinity, along with freshwater scarcity [77, 86 - 87]. Halophyte-dominated habitats may be affected by climate change through hydrological factors, including changes in flood regimes, groundwater levels, temperature increases, and shifting precipitation patterns [87].

Significant potential impacts of climate change in meadow and wetland habitats include changes in water regimes and water levels, which are of primary concern. This is due to variability in precipitation patterns and decreased precipitation amounts, which lead to lower water levels [80 - 81, 88]. Additionally, irreversible changes in riverbeds and shifts that lead to rivers drying up can occur [81, 88]. In these areas, plant growth may be affected by changes in precipitation patterns in high marsh and reed bed habitats, sudden changes in groundwater levels, temperature increases, and resulting drought, which can alter soil structure and nutrient cycling [80 - 81]. Steppe areas encompass the distribution ranges of herbaceous plant species in arid grasslands; therefore, climate change will cause hydrological changes and abnormal alterations in soil structure in these habitats [74 - 75, 85, 89]. Additionally, because of anthropogenic impacts such as habitat destruction and agricultural expansions, the ruderal plants may develop in these areas over time [90 - 95]. Heat islands in ecologically degraded habitats exhibit higher air and surface temperatures than natural areas [91, 94, 96]. As such, these habitats tend to become warmer and drier

over time [74 - 75, 94, 97]. Primarily due to climate change, the establishment of ruderal plant species in these degraded areas will affect the geographical distributions and climatic niche boundaries of certain plant species in the natural flora [74 - 75, 97].

Conclusions

The present-day Mesopotamian plant cover is sensitive to climate change pressures. However, it depends on their sensitivity levels. This is particularly true for plants growing in the forests, meadows, and on wet marsh habitats. Any increase in human activities will significantly result in a decline in present-day plant diversity and gradual degradation of habitat quality over time [74 - 75]. Climate change may exert significant ecological pressures, particularly on endemics and rare and threatened plant taxa [83, 98]. Therefore, all potential impacts need to be incorporated into short-, medium-, and long-term biodiversity conservation plans at the local and regional level [99 - 105]. The data obtained need to be evaluated in detail to update regional sustainable development action plans, thus contributing significantly to the development of effective conservation plans.

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