

Article

Negative Effects of Forest Extractivism on the Water Crisis in Rural Mapuche Territories: Mapuche Knowledge and Sociocultural Activities to Preserve Water

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Abstract

The forestry extractivist model has systematically transgressed and violated Mapuche territories, thereby generating tensions, crises, and socioenvironmental injustices. The following objectives were proposed: (a) Unveil the implications of forestry extractivism on bodies of water in rural Mapuche territories. (b) Investigate Mapuche knowledge, socio-cultural activities, and their relationship with preservation and sustainability of water in Mapuche and non-Mapuche territories. A qualitative methodology was employed, framed within constructivist grounded theory. To collect the information, in-depth interviews and participant observation were used. The study subjects corresponded to 51 kimeltuchefes (People with knowledge, experience and ancestral wisdom). Regarding objective (a), the findings reveal that pine and eucalyptus forestry extractivism has considerably deteriorated natural (sacred) spaces and the soil. Along with this, it has caused water scarcity, which in turn has reduced medicinal plant and food production and, in general, has deteriorated the ixofil mogen (a concept similar to biodiversity). It was concluded that the forestry extractivist model threatens the existence of all forms of life that cohabit in nature (material and immaterial); it deteriorates Mapuche culture; likewise, it poses a considerable risk to the health and survival of the Mapuche population. Regarding objective (b), the findings reveal that the knowledge of az mapu, ngülam, pepilkantün, rakizuam, llellipun and kümelkawün, and the sociocultural activities, trawün and kelluwün, constitute essential contributions for the preservation and sustainability of water. These forms of knowledge and activities are founded on ethical and moral principles that underlie the normative, legal, social, and educational frameworks of the Mapuche people. It was concluded that sociocultural knowledge and activities are essential for conserving and ensuring water in a sustainable, equitable, and efficient manner for both the Mapuche and non-Mapuche populations and for all life; likewise, they safeguard and promote Mapuche culture. Indeed, these forms of knowledge and sociocultural activities must be incorporated into environmental public policies.



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1. Introduction

The world's population is experiencing unprecedented water scarcity [1–3]. World-wide, an estimated two to three billion people suffer from water scarcity. This shortage will become more acute in the coming years and decades [2]. In the Chilean context, it is no exception [4,5]: 53% of the country's communes have been declared in a state of water drought, and most of these communes are under water rationing [6]. This situation is explained by the convergence of the following factors: (i) effects caused by climate change; (ii) gap in water resources management; (iii) precarious infrastructure to face water scarcity; (iv) pressures from the productive and extractive industry; (v) poor management and coordination by institutions in decision-making; (vi) the legal framework has limitations related to water issues; among these and one of the most important is the lack of recognition of the human right to water; (vii) the availability and use of data for decision-making are limited [4].

The above has also affected Mapuche territory. The Mapuche are an Indigenous people who have inhabited the southern cone of the Americas for thousands of years. Mapuche means “people of the land” in Mapuzugun [7]. In Chile, they inhabit from the Aconcagua Valley in the north to the Reloncaví Sound and, farther south, to Chiloé Island, dividing into different groups depending on the area of Wallmapu (ancestral territory of the Mapuche people) [8]. These groups are located in the following territories: (i) Pewenche (people of the pewen: araucaria); (ii) Wentche (people of the valleys and the banks of the Cautín River); (iii) Lafkenche (people of the sea) [9]; (iv) Huilliche (people of the south); and (v) Pikunche (people of the north) [10]. The Mapuche population in Chile, according to the 2024 census, is 1,623,073 [11].

In this scenario of structural water vulnerability, extractive forestry activities, particularly pine and eucalyptus plantations, have significantly affected water bodies in rural Mapuche territories [4,12–15]. In response, the Mapuche communities are supplied with water by cistern trucks, which are managed and operated by the municipalities [16–19].

In this context, it should be noted that the forestry sector is among the largest in the country [20,21]. This is because Chile's economic model is heavily based on forest extractivism [22–24]. Extractive forestry activity has been developed for decades, with financial support from the Chilean State for private forestry companies, through Decree Law 701 [25]. In this context, it should be noted that forest plantations cover an area of 3,121,969 hectares. The largest proportion corresponds to radiata pine plantations, and second place goes to eucalyptus plantations [21]. Studies show that most of these plantations are located in Mapuche territories as monocultures [24,26] and are intended for sustained exploitation and commercialisation [14,27–29]. In addition, it is important to point out that forestry activities are covered by the “water code”, due to the gaps and weaknesses in the regulation of the “water code”, since these are defined and marketable by private organisations [30,31]. In this sense, a restricted role is envisioned for the State in regulating water [31]. At the same time, there is ambiguity and weak monitoring and control of the waters by the General Directorate of Water [32], particularly in areas covered by extensive pine and eucalyptus plantations.

The extractivist and mercantile economic model has generated negative effects on Mapuche rural territories [13,14,33,34], since pine and eucalyptus plantations absorb large amounts of water and require large areas of land [13,26,35–37] for cultivation. This type of

affectation generates concern, since for the Mapuche, nature is considered mother and sister, with which they maintain a close spiritual and material bond [38,39]. In this regard, water is considered the centre of the material and spiritual existence of the Mapuche people [16,40]. In this regard, Mapuche, nature, and water form a relational, harmonious, and indissoluble whole [41]. In this way, water is considered a valuable source of knowledge for the Mapuche. This way of relating to water positions the Mapuche as a respectful person and caretaker of nature [42].

Despite the existence of research related to forestry extractivism and its connection to the water crisis in southern Chile, these studies do not address the problem of the water crisis in relation to Mapuche sociocultural knowledge and activities and forestry extractivism [13,24,26,34,36,40]; nor do they highlight or propose Mapuche knowledge and sociocultural activities aimed at the preservation and sustainability of water in Mapuche and non-Mapuche territory. Indeed, these ancestral forms of knowledge and activities are deeply connected to the land and water [38,43] and, at the same time, rooted in the Mapuche worldview. The land and the Mapuche are inseparable and, at the same time, maintain interdependent relationships. In this regard, Hurberlt et al. [43] state that the ancestral cultural practices of Indigenous peoples are fundamental knowledge and ways of life for the self-determination and governance of water. Respect for this knowledge and for sustainable and harmonious coexistence with nature enables improved care and, therefore, water governance [44–46].

Based on the background and problem exposed, this study sought to (a) unveil the implications of forestry extractivism on bodies of water in rural Mapuche territories; (b) investigate Mapuche knowledge, sociocultural activities, and their relationship with the preservation and sustainability of water in Mapuche and non-Mapuche territories.

2. Theoretical Framework

Forest Extractivist Economic Model: Implications in Mapuche Territories

The extractivist model refers to the indiscriminate extraction, exploitation, and massive accumulation of natural resources, with minimal processing. These resources are exported to international markets in large volumes [22,23,47]. Extractivist activity is closely linked to the neoliberal economic model [48,49], since it is based on the accumulation of resources, based on the depredation of natural resources on a permanent basis [50] until they are exhausted. In this sense, the extractivist forestry model promotes the exploitation of resources in large quantities and the systematic commercialisation of nature, while at the same time energising and propelling the neoliberal economic model in Chile [28,48,51,52].

In accordance with the above, the extractivist forest economic model is based on neoliberalism, which promotes the intensive, indiscriminate, and large-scale exploitation of natural resources [14,22,26,47]. In this sense, this model has been widely linked to the deepening of the environmental crisis, due to the systematic overexploitation of ecosystems and the weakening of environmental regulation mechanisms. In this context, the extractivist forest economic model has commodified nature [50,52] and treated it as a utilitarian resource [28,48,53], since it treats nature and water as tradable commodities and aggregates. In this sense, forestry companies promote processes and mechanisms to appropriate common natural resources through violence, manipulation, persuasion, and seduction [52,54,55] to obtain substantial financial benefits and, in turn, increase consumption [28,56,57].

This type of extractive practice and activity leads to the violent devastation of natural resources and the loss of ways of life [58], generating soil erosion, water scarcity [13,14,59], and, therefore, environmental degradation. Consequently, it generates the breakdown and significant loss of biodiversity [35,55,60] and depletion of natural resources, which leads to a lack of water security [55]. This also considerably affects the ways of life and subsistence of

the Mapuche people, which are based on spiritual, medicinal, sociocultural, economic, and political activities strongly rooted in their worldview. In short, the extractivist economic model has generated vulnerability, hunger, poverty, misery, and death over decades [61,62] and dispossession [63] in Mapuche territories.

3. Materials and Methods

3.1. Methodological Approach

This study is framed within a qualitative methodology, since it allows the study of things, activities, and situations in natural contexts, based on the interpretation of meanings, to understand a phenomenon [64]. In this research, this methodological approach was used to interpret and describe the practices and the everyday knowledge of the participants (Kimeltuchefes) in a situated context. For this purpose, open and flexible methods and techniques were used. In this context, constructionist grounded theory [65] was used to study the meanings that arise from experiences, from the perspective of the subjects (kimeltuchefes) who live them [66]. This implies that the categories and subcategories created were derived from these stories. In this sense, the findings derived from them (categories and subcategories) were validated by the kimeltuchefes with the help of the intercultural facilitator.

3.2. Participants

The selection of participants was intentional; that is, subjects with knowledge about the object or phenomenon under study were selected [67]. In this sense, the participants in this study were selected by 51 kimeltuchefes, distributed across 67 Mapuche communities. The kimeltuchefes are Mapuche people dedicated to teaching and educating the people of their communities, as they carry ancestral knowledge, experience, and wisdom [14,68], and they are located in rural Mapuche territories.

The kimeltuchefes, in turn, are categorised according to their role or functions: (i) Kimche: person who has social and cultural knowledge of Mapuche society; (ii) Logko: leader who directs the decisions of the community to which they belongs; (iii) Machi: a person who has the ability to come into contact with the world of the gods, and at the same time, wields the power of healing and fights evil through herbs; (iv) Lawentuchefe: a person who practices healing methods, which he applies to people, through the use of medicinal plants; (v) Norche: a person who is founded on the wisdom of things and acts correctly; (vi) Azelechefe: a person who represents the community at school; their function is to guide, train, and monitor the process of inclusion of Mapuche culture in the school educational context [9,68]; (vii) Ngenpin: an authority who directs the nguillatün and considers himself the owner of the word [69]. Table 1 presents the inclusion criteria.

Table 1. Inclusion criteria for participants.

Criteria	Description
Indigenous People	Mapuche
Key Participants	Kimeltuchefes: Kimche, Logko, Norche, Machi, Lawentuchefe, Ngenpin, Azelchefe
Language	Mapuzugun
Gender	Female and Male
Age	People over 60 years old
Ability	Have the Mapuche kimün

Note: Original work.

The inclusion criterion for people over 60 years of age is justified, as in the case of the Mapuche culture, the holders of the knowledge are the grandparents [70]. In this sense, the grandparents who acquire the category of kimeltuchefes are the most appropriate people

to educate the new generations, since they have acquired during their lives, experience and wisdom, and therefore, the capacity and methodology to teach and transmit Mapuche kimün (Mapuche knowledge and wisdom) orally [71].

3.3. Study Area

The study was carried out in 67 Mapuche communities located in rural areas: (i) Pewenche: Pewen (araucaria) people; (ii) Wentche: people from the valleys and banks of the Cautín River; (iii) Lafkenche: people of the sea [9]. In this context, customs, sociocultural practices, activities associated with spiritual beliefs, agriculture, economics, medicine and politics develop. The Mapuche person is also trained from the Mapuche kimün. This formation is transmitted within the family by the parents and especially the grandparents, in any space and at any time. On the other hand, in the territories of the Mapuche communities, there are schools to train Mapuche and non-Mapuche children; however, the training is largely framed within a Eurocentric Western rationality.

3.4. The Instruments of Information Collection

To collect the information, in-depth interviews and participant observation were applied. The in-depth interview was used, since it followed a flexible question scheme. It was oriented toward investigating the experiences and facts related to the object of study and the ways in which the kimeltuchefes have related to the object of study. This type of interview allowed the kimeltuchefes to express themselves broadly and in depth, in order to grasp rich and deep meanings [72]. Along with this, participant observation was used, where the researchers remained in the Mapuche communities to observe and record facts, activities, situations or practices (in detail) related to the object of study. This observation ranged from actively intervening to just observing [73,74].

3.5. Procedure and Ethical Aspects

This research considered the ethical criteria set out in the Singapore Declaration [75] and the Helsinki Declaration [76]. The first contact was made with the logkos of the communities; they were given a formal letter requesting authorisation from their community to conduct the study and requesting access to information from participants. Once the letter of authorisation was signed, the kimeltuchefes were invited, through an informed consent protocol, to participate in an in-depth interview and participant observation on a voluntary basis. It should be noted that the informed consent was previously approved by the Scientific Ethics Committee of the Universidad de La Frontera. In this consent, the objectives, method and ethical aspects of the research are described. Along with this, it is indicated that the identity of the participants and the information obtained in the research are protected through confidentiality and anonymity. In addition, it was established that they could decline to be interviewed or observed when required. Finally, the informed consent indicates that, once the research is completed, the participants (kimeltuchefes) will have access to the final results of the research (it should be noted that, once the research was concluded, the results and conclusions were sent to each kimeltuchefe in a synthesised document). Once informed consent was signed by the kimeltuchefes, the information collection instruments were used.

The collection of information through in-depth interviews was conducted in the homes of the kimeltuchefes, with support from an intercultural facilitator who speaks Mapuche (Mapuzugun) to translate the stories and guide the interview process. This allowed them to build trust and, in turn, to express themselves in a broad and deep way. The interview lasted approximately 40 to 60 min. A tape recorder was used to obtain a clear precise record of the interviews, and notes were taken in a notebook. On the other hand, during participant observation, the researchers remained in the Mapuche communities for extended periods

to obtain in-depth detailed information on the phenomenon under study. To develop observations, a field notebook was used to record events.

The researchers retired from fieldwork once the data were saturated [77]. This was achieved when credibility was established: this implies that the study's findings were recognised as real or true by the kimeltuchefes who participated in the study and by the people and researchers who were in contact with the phenomenon investigated.

3.6. Data Analysis

The information obtained through fieldwork using in-depth interviews and participant observation was transcribed in Word format and analysed using ATLAS.ti 8.0 software. This allowed large volumes of textual data to be analysed and stored [78]. To do this, the interviews and observations transcribed in this software were first uploaded, specifically to the hermeneutic unit. To carry out this analysis, constructionist grounded theory [65] was used to develop theoretical categories and subcategories based on the data and to analyse the relevant relationships between them [79]. This process was carried out in two phases. In the first phase, "open coding" was used, in which the thoughts, ideas, and meanings in the text were disaggregated and examined in detail and compared to identify similarities and differences [80]. Categories and subcategories were immediately created [65]. In a second phase, "axial coding" was carried out to relate the categories to their respective subcategories.

To avoid bias and deviation, during the two analysis processes (open and axial coding), the criteria of confirmability and credibility were used. To carry out "confirmability", the data or information were analysed and interpreted in a neutral manner [67]. To do this, an expert researcher in Mapuche and intercultural education was required, as well as support from another expert researcher on issues related to forest extractivism and the collaboration of the intercultural facilitator from the Mapuche culture.

Throughout the process of open and axial coding, the Constant Comparative Method (CCM) was used, which allowed triangulation of the interpretations of the narratives in the interviews and the ethnographic records of observations [81]. In this sense, the CCM helped researchers compare the codes (categories and subcategories) on an ongoing basis with those already obtained [82].

In addition, during this analysis, the researchers repeatedly visited the kimeltuchefes to clarify and deepen the information. Finally, it is important to note that, in order to achieve the "credibility of the study", the participants (kimeltuchefes) were visited again, who recognised the findings as true. This entire process of returning to the subject (return to the field of research) was carried out through conversation, interpretation, and reflection between researchers and kimeltuchefes, with the help of the intercultural facilitator. All this allowed us to enrich and validate the findings. Similarly, these findings were recognised as true by the researchers and participants in the study [67].

Based on the two phases (open and axial coding) and considering the first objective of this study, "unveil the implications of forestry extractivism on bodies of water in rural Mapuche territories", the category "forest extractivism" was created, which was related to the following subcategories: (a) forest extractivism and the water crisis; (b) sociocultural activities and cultural loss; (c) food scarcity; and (d) decrease in lawen (See Figure 1). From the second objective, "to investigate Mapuche knowledge, sociocultural activities, and their relationship with the preservation and sustainability of water in Mapuche and non-Mapuche territories, the category "Mapuche knowledge, sociocultural activities, and their relationship with water" was created, which is linked to the subcategories (a) az mapu; (b) ngülam; (c) pepilkantün; (d) rakizuam; (e) llellipun and kümelkawün; (f) trawün; (g) kelluwün (See Figure 5). The subcategories of both categories presented a high level of saturation and frequency.

According to Glaser and Strauss [77], theoretical saturation is achieved when the data begin to repeat, and no new findings emerge. In this sense, the analysis of the information did not provide new concepts, ideas, or new knowledge for the categories of analysis. Likewise, it should be noted that the concepts or meanings that enriched the categories and subcategories (of this study) were repeated consistently. This is because these concepts and meanings, which contributed to the construction of the categories and subcategories, are highly relevant to the kimeltuchefes.

4. Results and Discussion

Figure 1 shows the results (through the process of interpretation) of the category “forest extractivism” and the respective subcategories. It should be noted that these subcategories presented higher theoretical saturation and significance. Along with this, these results are discussed (in the light of the theory) by subcategories. On the other hand, it should be mentioned that, in Figure 1, “forest extractivism” has a direct negative impact on the subcategories (this is coherent with the direction of the arrows): “water scarcity”; “sociocultural activities and cultural loss”; “scarcity food”; “decrease in lawen”. Water scarcity, in turn, also has a negative impact on these last three subcategories: “sociocultural activities and cultural loss”; “scarcity food”; “decrease in lawen”. This is coherent with the direction of the arrows.

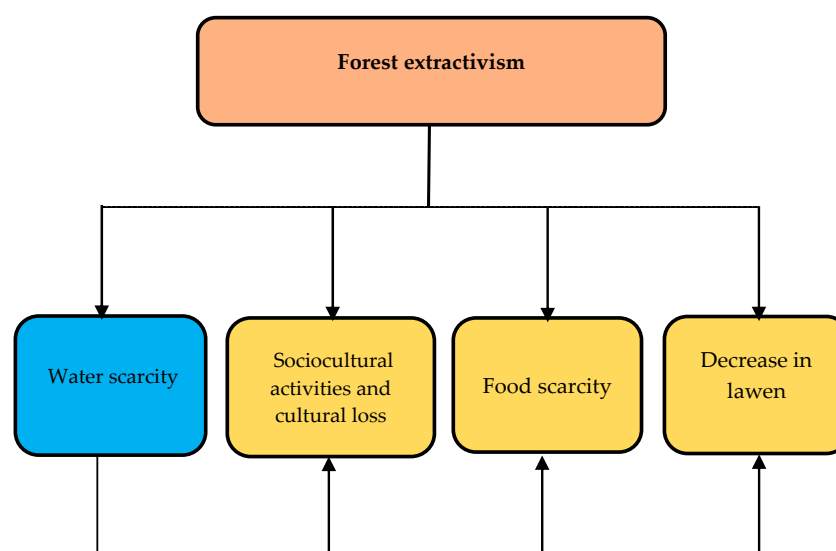


Figure 1. Implications of forest extractivism on water bodies.

Category 1. Forest extractivism.

This category shows the negative effects of “forest extractivism” on Mapuche natural and sacred spaces, thus reducing the levels of water bodies. This, in turn, results in effects on the biodiversity and ways of life of the Mapuche people.

In Table 2, the number of citations per subcategory is presented. These subcategories are related to the category: “forest extractivism”.

Table 2. Number of citations by subcategory.

Subcategory	Number of Citations
Forest extractivism and the water crisis	47
Sociocultural activities and cultural loss	41
Food scarcity	44
Decrease in lawen	45

Note: Original work.

Subcategory a. Forest extractivism and the water crisis.

This subcategory shows the systematic exploitation of eucalyptus plantations and their close relationship with water scarcity. This is reflected in the following accounts: “Today it is complicated because the family has grown and we have little space to go in search of water, because the forestry companies have eucalyptus plantations everywhere and they have reduced the water in the wells” (Logko).

The eucalyptus forestry plantations that surround our communities damage our spaces. The river brings little water, and the wells no longer have water. Here, water is brought in tanker trucks. And. . . the other thing is that the forestry companies are only interested in making money from the exploitation of eucalyptus plantations, and they are not interested in the lives of other people and animals (Norche).

The large expanses of eucalyptus forestry plantations negatively affect Mapuche communities, and river and well water levels have decreased [14,35,36]. In this regard, a study conducted by [83] shows that eucalyptus plantations retain less water in the soil (24% less water) than native forests. This is because eucalyptus plantations consume significantly more water than native forests. Consistently, a study conducted by Riechert et al. [37] indicates that dense eucalyptus plantations absorb an excess of water.

Eucalyptus forestry plantations and the extraction of this species affect the development of the Mapuches’ daily life and, at the same time, endanger their existence and that of other living beings. In addition, eucalyptus wood is processed, commercialised, exported, and converted into capital, generating substantial profits [28,48]. This is concerning, given that such extractive activity puts biodiversity and the well-being of all life in nature at risk.

Subcategory b. Sociocultural activities and cultural loss.

Transgression of sacred spaces is appreciated through pine and eucalyptus plantations, affecting the development of sociocultural activities. This is visualised in the following stories and in Figures 2 and 3.



Figure 2. Pine monocultures in Mapuche territories (September 2019) [84].



Figure 3. Pine and eucalyptus monocultures in Mapuche territories (September 2019) [84].

Most children and Mapuche and non-Mapuche people are unaware of sacred spaces, for example, the menoko (wetland) the trayenko (waterfall), the wingkul(hill), because Westerners passed the backhoe and destroyed these sacred spaces, cut down our native forests to plant eucalyptus and pines. With these plantations, we have lost many sacred spaces, and with this, too, our sociocultural activities, our spirituality, and above all, our identity have been lost (Azelcheffe).

In the previous narration and in the images, it can be seen that pine and eucalyptus forest plantations have ruptured Mapuche sacred spaces, such as the menoko (wetland, where medicinal plants are found, which has high biodiversity), the trayenko (waterfall), and the wingkul (hills). Along with this, one can see the loss of native forests. This has left children and young people, as well as Mapuche and non-Mapuche people, generally unaware of these sacred spaces. In turn, it has led to the disappearance of sociocultural activities. This is worrying, since these activities aim to strengthen the spiritual dimension between Mapuche and nature, as well as the sociocultural and socioenvironmental dimensions, and to foster collaboration among members of a Mapuche community or between people from different Mapuche communities [85,86]. This is also visualised in the following narration: “Because of the forest plantations, there are very few sacred spaces left to carry out the nguillatün (religious ceremony)... to celebrate the We Txipantu (Mapuche New Year). It’s very painful... everything that’s going on, because it affects our spirituality and our ways of relating to nature” (Ngenpin). As a result, forest plantations have considerably affected the relationship between the Mapuche and nature [14,87]; along with this, spirituality has been weakened, and the identity and culture of the Mapuche people have been lost. In short, the küme mogen (good living: philosophy of harmonious life, which maintains the Mapuche with everything that exists in nature and in the cosmos) of the Mapuche population has deteriorated considerably.

Subcategory c. Food scarcity.

In this subcategory, water scarcity affects food scarcity. This is evidenced in the following narrative and observation:

They taught me to respect and care for water and everything in nature, because we eat from Mother Earth every day. Here, my daughters and my son work the land... I am a bit old (...), they sow, plant, then they see their fruits, but lately very little is cultivated, because water is scarce. Forestry companies are mainly responsible for the drought of wells, and that rivers carry little water (Kimche).

Water levels in the lewfü (river) and springs have decreased due to pine plantations, mostly eucalyptus forests. This affects wheat and vegetable crops. These crops have experienced reduced growth, and many are dehydrated [Observation, 2].

In the first narration (in the first two lines), the Mapuche show respect and care for nature, since it provides food. Subsequently, both the first and second reports indicate the water scarcity due to forest plantations, as reflected in the considerable decrease in water levels [13,33] of the Lewfü (rivers), Kowe (water well), and Wefko (springs). Regarding this, a study by Riechert et al. [37] indicates that eucalyptus plantations with high population density use excessive water. This is corroborated by another study conducted by [88] and by a study by Huber et al. [36] in Chile's Biobío region, which showed that soils planted with pine and eucalyptus exhibited a severe reduction in water availability.

This affects agricultural and livestock activities: “Every day that passes, the Lewfü . . . , wefko, wells, are drying up more. That is complicated for our planting, too, for my cows and my lambs. In general, these plantations affect all of our communities” (Logko). It is observed that water scarcity has decreased the production of food, including wheat, vegetables and meat, deteriorating the economy in the Mapuche communities [26,61], which, in turn, generates social inequalities and poverty [61] and, therefore, puts the food and subsistence of the Mapuche population at risk. To address the above, it is necessary to monitor and efficiently manage the use of water [89] by the institutions in charge of the environment, with the purpose of contributing to economic growth, maintaining the health of ecosystems, and restoring areas deteriorated [90] by extractivism.

Subcategory d. Decrease in lawen.

An absence of ancestral medicinal herbs (lawen) is observed, due to eucalyptus plantations, which require large areas of land and volumes of water [13,35]; likewise, the extraction of this type of plantation is visualised. This has led to water scarcity and drought [14,17], which is reflected in the following narrative “. . . the ancestral Mapuche medicine (Lawen) is no longer found, because the Menokos (wetland) are dry, due to the noxious plantations (eucalyptus) that are near the community” (Lawentuchefe). Along the same lines, it is observed: “walking through the Mapuche communities, large extensions of land planted with eucalyptus (. . .) medicinal herbs are not appreciated, because the wetlands have dried up” [Observation, 8]. The above is also manifested in the following narration and in Figure 4.



Figure 4. Eucalyptus extraction in Mapuche territories (May 2022) [90].

The Wigkas have destroyed the sacred places, which are very important for our spirituality and health, such as the Trayenko (waterfall), Lemu (forest), the Menokos (wetland), etc., and replace them with noxious plantations. . . of pine and eucalyptus and then cut them. I cry because they destroy those sacred spaces, they destroy all the life that was there. . . the medicinal herbs, that's why I have to go out to other distant places to look for medicine, and. . . sometimes they are not found (Machi).

The destruction of sacred spaces such as trayenko (waterfall), lemu (forests), and menokos (wetland), among others, through pine and eucalyptus forest plantations, and the systematic extraction of these, have caused the loss of ancestral medicinal herbs and all kinds of life that inhabit them. This is worrisome, since they disrupt the interdependent relationships of the forms of life that coexist in nature, including the relations between the Mapuche and nature [26,91]. In effect, forest plantations, in the form of monoculture and constant exploitation, generate imbalances in the health of the Mapuche across the psychological, spiritual, material, and social dimensions [14,92]. This has negative effects on the health of Mapuche community members [29] and leads to the loss of ancestral medicinal knowledge and practices.

Figure 2 shows the results (through the process of interpretation) of the category “Mapuche knowledge, sociocultural activities, and their relationship with water” and its respective subcategories. It should be noted that these presented higher theoretical saturation and significance. Along with this, these results are discussed (in the light of the theory) by subcategories. Furthermore, it should be mentioned that in Figure 2, the direction of the arrows coming from the category “Mapuche knowledge, sociocultural activities, and their relationship with water” are linked to Mapuche knowledge and sociocultural activities: (a) az mapu; (b) ngülam; (c) pepilkantün; (d) rakizuam; (e) llellipun and kümelkawün; (f) trawün; (g) kelluwün. In turn, these knowledge and sociocultural activities (subcategories) have a direct positive impact on water preservation. The double-direction arrows are associated with knowledge and sociocultural activities and represent a continuous interdependence.

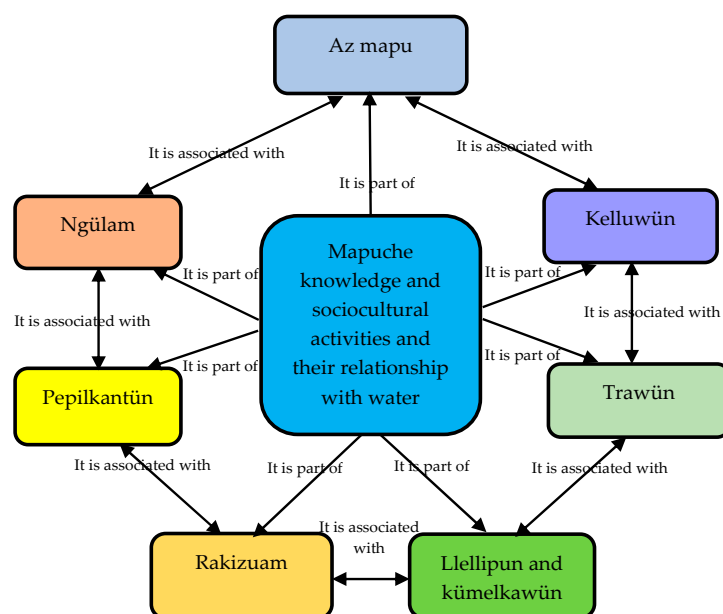


Figure 5. Mapuche knowledge, sociocultural activities, and their relationship with water preservation.

Category 2: Mapuche knowledge, sociocultural activities, and their relationship with water.

In this category, Mapuche knowledge and sociocultural activities are presented as essential contributions to the preservation and sustainability of water in Mapuche rural territories. This knowledge and these activities are grounded in ethical and moral principles that reflect a deep respect for nature. Likewise, the different forms of knowledge and sociocultural practices represented in this figure revolve in a circular interdependent way around the care and preservation of water, forming a dynamic system in which each form of knowledge nourishes and is nourished by the others. This means that these forms of knowledge and sociocultural activities do not operate in isolation but are continuously intertwined, generating a circular movement of knowledge, action, and meaning that sustains a respectful and balanced relationship with water as a source of life.

In Table 3, the number of citations per subcategory is presented. These subcategories are related to the category: “Mapuche knowledge, sociocultural activities, and their relationship with water”.

Table 3. Number of citations by subcategory.

Subcategory	Number of Citations
Az mapu	42
Ngülam	49
Pepilkantün	46
Rakizuam	42
Llëllipun y kümelkawün	43
Trawün	41
Kelluwün	40

Note: Own elaboration.

Subcategory a. Az mapu.

The Mapuche relate to nature through the ethical and normative code “az mapu”. This is visualised in the following narration:

In our Mapuche culture, I was always taught to respect nature. A person cannot say that he is superior to nature, that is impossible, because nature at any moment appears. . ., there can be a flood, there can be a storm, tornadoes as they call it now. We are part of nature, and we are mostly part of water, so we must respect and protect it. We have a code called az mapu that guides our behaviour regarding everything that exists in nature (Logko).

Mapuche people relate to nature through respect and reciprocity [41], given that nature from the Mapuche worldview is not just another addition but is considered a sister and, at the same time, a mother for the Mapuche [38]. In this sense, the Mapuche people maintain relations of protection and reciprocity with everything that exists in nature and water. In this context, the az mapu plays a relevant role, as it regulates the Mapuches’ behaviour towards nature and all people, from both individual and collective perspectives, based on ethical and moral norms and procedures [39,93]. The above is also manifested in the following narration:

The Mapuche maintain contact with nature day by day, from the moment they get up until they go to bed. The Mapuche are governed by the az mapu, which regulates our behaviour to establish relationships of respect and reciprocity with the water, with the ngenh and beings that inhabit those waters and with all nature (Ngenpin).

In this series of relationships that the Mapuche maintain with nature, the interaction between the Mapuche and the Ngenh, who inhabits the waters, is evident. The ngenh is a spiritual divinity and protector of spaces, in this case of water, with which the Mapuche

establish connections, through prayers that guide their actions [16,87]. These interactions are based on respect, reciprocity and spirituality, in order to maintain balanced and harmonious relationships. From this premise, water and the other spaces that are part of nature are constituted as “sacred spaces” [40], and consequently, they cannot be transgressed or dominated.

From the perspective of water governance, the *az mapu* at the institutional level operates as a traditional and inherent system of law, whose norms and procedures are oriented toward (i) influencing the development of environmental public policies, (ii) resolving water-related conflicts through dialogue and mediation, (iii) sanctioning those who transgress the norms, (iv) managing and ensuring the efficient and equitable use of water, (v) preserving and securing water for current and future generations through sustainable mechanisms and strategies, (vi) guaranteeing the health and well-being of people and other forms of life that exist in nature, (vii) valuing and safeguarding Mapuche culture and identity, ways of life, and traditions linked to the preservation and sustainability of water, and (viii) ensuring the care of the Mapuche territory and bodies of water through norms and protocols.

Subcategory b. Ngülam.

The teaching around the preservation of water focuses on value and ethical formation, through the use of “*ngülam*”:

One always advises that whatever knowledge one teaches is present in the *ngülam*. Everything is related, because if I talk about nature, in this case about trees, animals and water. First of all, we must have respect, empathy... and responsibility towards nature, not to spoil animals, not to spoil plants, not to transgress water, because it is very important for the life of our mother nature. That is related to all Mapuche cultural knowledge; I teach all of that (*Azelchefe*).

The training process through the *ngülam* takes place from an articulating and comprehensive perspective on knowledge, considering respect, reciprocity, empathy, and responsibility, among other values, that the Mapuche must maintain toward nature. *Ngülam* is a method that involves advice; it is used to teach values and attitudes and knowledge related to nature, taking into account the social, cultural, and spiritual dimensions [94]. This type of advice is mainly transmitted by grandparents and parents through oral communication during childhood and adolescence [95]. In this sense, another narration can be appreciated:

Sacred spaces must be taught, such as the *menoko* (wetland), the *trayenko* (waterfall), *haaa*... and the *Lewfü* (river). One advises one’s children to take care of the waters of these spaces, because they are very important for medicine, spirituality, and the beings who live there... As we say, you have to take care of the *Ixofil Mogen* (*Lawentuchefe*).

The teaching of respect for sacred spaces (*menoko*, *trayenko*, and *lewfü*) acquires special relevance, since water is the essential element for the life of the *ixofil mogen*, which refers to all types of life (material and spiritual), without exclusion, which interact interdependently [91]. Likewise, the *ixofil mogen* is vital for the maintenance of spiritual relations of the Mapuche with all forms of life existing in nature and in the cosmos; consequently, it allows the Mapuche to maintain good health and achieve a good life (*küme mogen*). The *küme mogen* is a way of life grounded in horizontal, harmonious relationships among human beings, nature, and spiritual beings, based on reciprocity, mutual respect, equity, protection, and the pursuit of what is just [92,96,97].

Subcategory c. Pepilkantün.

The “*pepilkantün*” is presented as a method for learning from practice in real contexts by applying theory or knowledge. This is visualised in the following narration: “Teaching

from practice is something fundamental, so that children... not only do they know the theory, but they also integrate the Mapuche kimün into practice, they learn in an experiential way issues related to the protection of water" (Kimche). In this sense, Carihuentro [98] indicates that pepilkantün facilitates the consolidation of learning through practice-based educational experiences grounded in real activities and contexts. Along the same lines, the following can be seen:

Our grandparents taught us that when a tree was cut down, a prayer was said and another tree was planted so that the tree would not run out. The leaves that fell from the trees, my father told us, served as fertiliser. We learned that here in the community, with our families, we planted native trees and medicinal plants for our healing, to recover the land and maintain water, because in the surroundings of our communities, there are eucalyptus plantations, and these plants consume a lot of water. So it is very important to be in contact with nature, and because that way you learn better (Azelchefe).

In the previous narration, it is observed that knowledge about protecting nature is passed down through oral tradition from generation to generation. Likewise, to reverse the negative effects derived from eucalyptus plantations, the development of activities in real contexts, through plantations of native trees and medicinal herbs, aims to recover and preserve soil and water and, at the same time, improve the health of the Mapuche population. In addition, this type of activity, developed using the pepilkantün method, enables significant [99] and deep learning [100].

Subcategory d. Rakizuam.

The "rakizuam" is a process of fundamental reflection on the relationships of ethical and moral behaviour, which the Mapuche must maintain with nature: This is visualised in the following narratives:

They instilled in me the importance of connecting with and respecting nature, taking care of water because it sustains life, and recognising that Mother Earth is very wise and generous. So, one has to think before acting, so as not to transgress the spaces that are sacred to us. I ask my students questions, such as: How can I protect nature? How can I take care of the water? How to make good use of water, so that they reflect (Azelchefe).

The person should have a space to do rakizuam, where questions are asked, such as: Why is it important to protect sacred spaces? Why is it important to take care of native forests? How important is the water of the lewfü (river), trayenkos (waterfall), menokos (wetland), wingkul (hill)? Etc. This is so that the child or young person learns to be a norche (correct person) in the future, and to be a person of good thoughts, to respect others, and to protect nature (Norche).

In the two narratives, it is observed that it is essential to generate spaces to develop rakizuam in people through questions, aimed at the protection and conservation of nature, which contains sacred spaces such as lewfü (river), trayenko (waterfall), menoko (Wetland where medicinal plants are found and which has great biodiversity), and wingkul (hill), among others that contain water. In this sense, Durán and Qatriquir [101] point out that rakizuam is a process of reflection that guides the Mapuche in their learning, from individual and social perspectives, and in relation to nature. Likewise, gñezuamün is closely related, which, through permanent introspection, allows us to become aware of its actions [97] and, therefore, to generate awareness. This reflective process also impels one to become a Che (person), guided by ethical and moral values [102], through constant construction, to maintain correct behaviour toward society [103] and nature.

Subcategory e. Llellipun and kümelkawün.

The “llepupun and kümelkawün” are a fundamental practice in the relationship of the Mapuche with nature, since to obtain water from a sacred space, permission must be requested through a rogation (llepupun) addressed to the ngenh (spirit that inhabits and protects a space) that dwells in a given space: “When we drew water from a well or the river, my grandmother told me before drawing water, the first thing to do is to pray, is to ask and thank the nengh of that space for the water” (Ngepin). The llepupun is a ceremony materialised in a prayer, in which nature is asked for forgiveness for the offences made; at the same time, the ngenh (of a certain space) is asked for the protection and maintenance of life in harmony with nature [39]. In addition, this ceremony (llepupun) allows the Mapuche to request the ngenh for a resource(s) and, at the same time, to thank them for the resource(s) provided [62,98]. This ceremony operates on the principle of kümelkawün (reciprocity) between the Mapuche and nature. This principle is grounded in mutual aid and responsibility, which, in turn, leads to mutual good [104,105] in receiving, giving, and sharing [71]. This is observed in the following narration: “We care for and thank nature. . . to the water. We leave as an offering in these spaces, the seeds that we harvest (. . .), these are scattered in the earth or in the water, so that one can have food back” (Kimche). The protection and mutual help that occurs between the Mapuche and nature allows the Mapuche to maintain harmonious relationships with nature and, therefore, a full life.

Subcategory f. Trawün.

The “trawün” is a practice related to encounters or meetings, where debates and dialogue are held to make decisions. In this regard, Rain-Rain et al. [106] maintain that the trawün are expanded meetings to address issues affecting the Lof (Mapuche families) or the Mapuche population in general. In this case, the preservation of water is addressed in the trawün:

In our communities, we do trawünes, such as carrying out activities on the theme of water protection. During the trawün, a conversation takes place, the most important opinions are sought, and activities are planned to make good use of the water (Logko).

To organise the activities of the community, we do a trawün, where cultural things are discussed. It is also done to program, organise, and carry out an activity, for example: the nguillatün (religious ceremony), to ask for water (Kimche).

In the previous narratives, it is visualised that, during the development of the trawün, dialogue is held to seek ideas, relevant opinions, and consensus on the preservation of water. In this sense, the activities that must be developed in practice are planned, such as the efficient use of water and the nguillatün to request water from the divinities. In this regard, Catrileo [107] points out that the nguillatün consists of a prayer that is made to the gods of the Wenu Mapu (land above: spiritual world of good), to maintain or restore the well-being and balance of the inhabitants of the Mapu (land) [107].

From the perspective of water governance, the function of the trawün at the institutional level contributes to and enables the following: (i) expressing ideas and debating issues or problems related to the environment that affect the communities, while also generating solution proposals; (ii) evaluating and planning actions or initiatives for water conservation and management; (iii) collaboratively building community projects and programs related to water management and conservation; (iv) making decisions to develop activities related to the efficient and equitable use of water; (v) resolving water-related conflicts through dialogue; (vi) constantly monitoring strategies and actions linked to the proper and sustainable use of water; (vii) influencing the development of environmental public policies aimed at protecting nature and water.

Subcategory g. Kelluwün.

The “kelluwün” is a collective community practice practised in Mapuche communities and characterised by strong solidarity. This can be seen in the following narratives:

In our communities, we help each other, do things together, and, as a family, recently helped another family plant native trees to conserve water and sustain life. We help each other maintain our sacred spaces because the water has been lost. Rivers bring less and less water, due to eucalyptus plantations. In these activities, solidarity is being established; there is a lot of help among communities and families (Kimche).

In the communities, there is a lot of water scarcity. . . the menokos (wetland) and the slopes are drying up due to large-scale forest plantations. We, as Mapuche, help each other; we have the responsibility to help nature, we have to take care of water, because without water, there is no life. So we make kelluwün to take care of the water through plantations of medicinal herbs and native trees: cinnamon, boldo, mañio, coihue, etc. We also collaborate with communities to reuse water (Logko).

In the two previous narratives, mutual and solidarity help between families is observed, to avoid the scarcity of water caused by eucalyptus and pine forest plantations through the development of activities such as planting native trees (cinnamon, boldo, mañio, coihue, among others), planting of medicinal herbs, maintenance and protection of sacred spaces, and reuse of water. Kelluwün is an ancestral sociocultural practice based on mutual aid, manifested in the activities carried out in Mapuche communities. This sociocultural practice involves the active, collective, and supportive work of all participating families [108] to protect bodies of water. In turn, the kelluwün is essential for conserving sacred spaces, all existing forms of life, sociocultural activities, and ancestral ways of life in Mapuche communities.

Finally, Mapuche sociocultural knowledge and activities are centred on the deep respect that the Mapuche maintain for all forms of life (material and immaterial) that coexist in nature [14,109], through spiritual and reciprocal relationships that allow the harmony of the Mapuche to be maintained, from the spiritual, material, psychological and social aspects [14,92,110]. In this sense, such knowledge and sociocultural activities are fundamental to promote and protect bodies of water; likewise, to protect and revitalise the language, culture, and ways of life; and at the same time, to promote and ensure the territorial rights [43,55,111] of the Mapuche people on their ancestral lands and bodies of water.

From the perspective of water governance, the function of the kelluwün at the institutional level is oriented toward the following: (i) designing programs that involve working collectively in the development of different activities linked to water governance, from a sustainable model; (ii) carrying out activities that involve collaborative work around the maintenance and protection of rivers, canals, waterfalls, wells, and wetlands, among others; (iii) developing and carrying out collective actions and activities aimed at significantly reducing forestry extractivism, among other threats; (iv) managing the use of water efficiently and equitably from a collaborative approach; (v) promoting and strengthening the development of environmental public policies aimed at safeguarding water and, therefore, benefiting collective well-being; (vi) agreeing on consensual decisions aimed at valuing the identity, traditions, and ways of life of the Mapuche people, related to the protection and sustainability of water.

5. Conclusions

Based on the first objective proposed in this work, “unveil the implications of forestry extractivism on bodies of water in rural Mapuche territories”, it is concluded that the extractivism of pine and eucalyptus plantations has violated and transgressed the natural

and sacred spaces (Menoko: wetland, Trayenko: waterfall, Wingkul: hill, Lewfü: river, Kowe: water well, Wefko: spring, and Lemu: forest, among others) that make up the Mapuche territory. This has had evident negative effects, including the disappearance of sociocultural knowledge and practices, soil deterioration, and water scarcity, which have led to a considerable loss of *ixofil mogen*. This is reflected in the decline in medicinal plants and food and, in general, in the deterioration of various forms of life, both material and immaterial (*ngenh*). It is also found that extractive forestry activities break the interdependent relationships between these ways of life. In this regard, the spiritual and harmonious relations that the Mapuche maintain with all forms of life that inhabit nature and water are also broken. These relationships are deeply related to the preservation of water.

In short, forestry extractive activities significantly reduce water levels, seriously affecting the survival of all forms of life that coexist in nature. At the same time, they undermine the culture, health, and economy of the Mapuche people and therefore endanger the subsistence of the Mapuche population living in rural territories, where this type of activity is carried out.

From the second objective proposed, “to investigate Mapuche knowledge, sociocultural activities, and their relationship with the preservation and sustainability of water in Mapuche and non-Mapuche territories”, it is found that Mapuche knowledge, including *az mapu*, *ngülam*, *pepilkantün*, *rakizuam*, *llellipun* and *kümelkawün*, and the Mapuche sociocultural activities, *trawün* and *kelluwün*, are rooted in the Mapuche worldview and have a strong ethical and moral component. This knowledge and these sociocultural activities are integrated into “laws, norms, ethical and sacred protocols” [39]. In this sense, such ancestral knowledge and sociocultural activities are fundamental to the conservation and guarantee of the sustainable and equitable use of water for the Mapuche and non-Mapuche populations and, in general, for all forms of life. In addition, they safeguard and strengthen Mapuche identity and culture, including medicinal, socioenvironmental, economic, and spiritual practices, among others. Consequently, the knowledge and sociocultural activities generate and guarantee substantial improvements in the well-being of the Mapuche and, at the same time, allow the Mapuche population to achieve a harmonious and full life. Finally, it is verified that this knowledge and these activities will contribute to building bonds of trust and common life projects between the Chilean State and the Mapuche people.

In view of the conclusions, there is a need for workspaces among the Chilean State, the Mapuche, and non-Mapuche people, focused on collaboration, dialogue, horizontality, and active participation, to generate sustainable and regenerative environmental policies. In this regard, culturally situated environmental education policies must also be designed and framed in a critical intercultural approach to deconstruct and transform the structures that sustain the extractive forest economic model and, in this way, move towards a sustainable and comprehensive economic model. This implies considering the knowledge and ways of relating that the Mapuche people maintain with nature.

In this regard, knowledge and sociocultural activities must be incorporated into water governance, considering the following recommendations: (i) regulation of land use; (ii) regulation of water use; (iii) replacing areas planted with pine and eucalyptus with native vegetation; (iv) restricting pine and eucalyptus plantations near rivers, wetlands, lakes, wells, waterfalls, and streams, among others; (v) maintenance and restoration of aquifers [112]; (vi) rainwater harvesting [113]; (vii) institutions must manage and coordinate the use of water efficiently and equitably; (viii) developing strategies and activities to reduce, reuse, and recycle water [55] in areas affected by forestry extractivism; (ix) citizen participation [55] from all of Chilean society in water management; (x) creating community programs for the protection and efficient use of water.

From the perspective of water governance, particularly in the field of environmental educational policy, the following is recommended: (i) design environmental education

programs with an intercultural approach; (ii) connect students with their territory through the development of situated environmental activities; (iii) coordinate the participation of the school with Mapuche communities to generate educational projects aimed at preserving nature and water; (iv) create spaces for dialogue between kimeltuchefes, teachers, and students to promote an exchange of knowledge around water protection; (v) develop educational activities to reduce, reuse, and recycle water in both Mapuche and non-Mapuche communities [55]. All this aims to restore and protect natural ecosystems and, consequently, to recognise water as a natural human right and, therefore, a greater good. Likewise, ensuring water security is necessary, including sufficient, permanent, clean, and potable water [55]. In this way, the human right to water can be managed and guaranteed for Mapuche and non-Mapuche people, as well as for all biodiversity. This, in turn, will make it possible to move toward water security. Finally, the above implies rethinking water governance and consequently moving towards an approach of collective rights, ecological balance, social and territorial justice.

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