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The use of firewood in a Mapuche community in a semi-arid region of Patagonia, Argentina

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ARTICLE INFO

Article history:
Received 5 January 2011
Received in revised form
1 September 2012
Accepted 4 September 2012
Available online 26 September 2012

Keywords:
Arid environment
Fuelwood
Indigenous people
Plant use
Traditional knowledge

ABSTRACT

This ethnobotanical study was conducted to identify which wild plants were used for fuel by a rural population of the Patagonian steppe. We studied the species used, gathering patterns, socio-economic factors, preference criteria, and alternative fuel sources. Semi-structured and open interviews were conducted with one member of each family unit. It was found that firewood is a vital resource, since it is the main fuel used for heating. The gathering of firewood is performed mainly on foot and is gender-independent. The inhabitants reported a decrease in the availability of firewood because each year they have to travel greater distances to find dead wood and preferred species. This study recorded 27 species used for fuel, of which 22 were wild native bushes and 5 were exotic trees planted by inhabitants. The four preferred species for firewood were: *Schinus jhonstonii*, *Schinus marchandii* (Anacardiaceae), *Prosopis denudans* (Fabaceae) and *Monttea aphylla* (Scrophulariaceae). Resources used as alternative energy were: *Liquefied Petroleum Gas* (LPG), cow dung, and to a lesser degree, horse dung. The findings indicated that 64% of inhabitants depended solely on the gathering of firewood, 32% on gathering and purchasing, and 4% on purchasing alone. Purchased firewood consisted of local bush species from the neighboring Patagonian region, and also species from the northern and central areas of the country. The inhabitants' capacity to adapt to this harsh environment seems to be based on their intensive use of local flora, which is at the same time controlled by their protectionist worldview and care of the plants and environment.

1. Introduction

The world's diversity of woody species is suffering serious depletion. Conservation and research into their exploitation by human populations which depend on them is therefore of special interest. Since ancient times, humans have used energy derived from wood as their main source of fuel. This has been mentioned in descriptions of various archeological studies [1–3]. Nowadays, plants represent almost 90% of the worldwide consumption of fuel used for cooking and heating in developing countries [4]. The FAO reported a global decrease in the consumption of firewood per capita due to higher incomes, urbanization, less availability of wood and easier access to alternative sources [4]. However, high consumption of firewood in countries with high population densities and rural settlements still exists [5–10].

In South America, fuel plants continue to be an essential part of subsistence economies, and as previously mentioned, this is especially true in rural populations [4,7,11–14]. In arid or semi-arid environments, firewood generally consists of

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0961-9534/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biombioe.2012.09.008

low-shrub plants since arboreal species are less abundant [13,15–17], whereas in forest areas hardwood trees are preferred [10,18–21]. In certain insular territories, however, many softwood species of lesser quality are also used as fuel [22]. Thus, selection processes and the use of fuel respond to various factors such as the availability of the local resource [23], quality and accessibility of wood [7,10,20], the use of alternative fuel resources [24–26] and the socio-cultural aspects inherent in each community [5].

Numerous works have described the negative effects of overexploitation of woody resources and how this leads to a serious decrease in the diversity of native species in various regions [14,21,27–30], and also to accelerated processes of erosion [15,31]. As in other countries, firewood is the main fuel used in rural areas of Argentina, where native forests have undergone serious retrocession due to non-sustainable government policies and other socio-economic reasons [32,33]. For example, from the end of the 19th century to the mid 20th century, wood from native forests was freely available and therefore exploited by European and National companies which used it for their own purposes. At that time, wood was used for railroads, the tanning industry, posts, fences and vineyards; all associated with the roaring boom of agriculture, which became a model for the dominant economic development [32,34].

In rural cultures, the gathering of wild fuel plants is part of the traditional ecological knowledge of accumulated learning, practices, and beliefs developed through cultural transference and adaptive processes and passed down through generations [35]. This cultural transference is a complex cognitive process in which practices, attitudes, and values learned are closely related to ecological and socio-cultural contexts. Therefore, variables such as age, gender, education, and degree of acculturation are all relevant in the intra-population variation [36]. As perception and action are closely linked to the cognitive process [37], perception and cultural interpretation of the environment lead to direct action on plants and surroundings [37,38], which generates patterns of interaction between humans and their environment.

Research studies conducted in Mapuche communities of Northwestern Patagonia show that the knowledge and gathering patterns used for wild plants are related to searching distances [39], resource availability [40], and the gatherer's socio-cultural characteristics, e.g. gender [41–43]. In addition, it was found that certain useful resources were preferred due to their cultural and symbolic values, thus becoming irreplaceable elements [44,45]. These findings demonstrate the strong interrelation between resource, environment, and culture. Furthermore, this relationship varies within the different categories of plant use with regard to how they are perceived, culturally valued, and the peculiarities of their gathering [46].

In addition, it was found that gathering practices (in the case of edible and medicinal plant use) maintain flexible characteristics, and in most cases represent a resilient strategy when facing situations of change and/or scarcity [44,47]. The inclusion of exotic plant use is an example of how inhabitants have learned to take advantage of new resources and use them in their daily lives [48,49]. However, little is known about the flexibility acquired in a population as regards firewood resources.

In the Patagonian region, few studies have been carried out on the use of woody resources as fuel [47,50] in spite of its importance to past and present rural communities. The lack of firewood in rural steppe areas is one of the most important regional issues, according to local dwellers and technicians who work in extension programs [51]. However, there are no studies up to this time which assess use patterns, gathering strategies, and forestation. Populations living in these harsh environments develop diverse strategies, such as the purchasing of firewood [52], the use of alternative energy [53], and the gathering of non-vegetal supplies [25,26]. In addition, forestation is an acquired practice also carried out to overcome the firewood shortage [15,51].

In arid and semi-arid regions, human populations are subject to environmental limitations which bring about adjustments and restrictions in daily life and also possible structural changes in the plant communities near their settlements [22,51]. Driven to a situation of high-environmental vulnerability [42,53], current populations inhabiting the arid steppe depend substantially on woody species for fuel, while at the same time adding new learning to their traditional knowledge. Rural communities of "Mapuche" origin ("Mapuche" means people who belong to the earth) of northern Patagonia base their economy on livestock, complementing and varying it with home horticulture [38,42,52]. This is the case of the Mapuche community of "Pilquiniyeu del Limay" ("Squirrel Canyon" in Mapuzungun language), the focus of this research. The community consists of two types of settlements, one rural and the other a village, which face different socio-environmental challenges. Given the changes that these populations are currently suffering in relation to the acquisition of fuels due to firewood scarcity, we will explore how dwellers manage to survive in these hostile conditions.

We will identify characteristics of their traditional ecological knowledge related to the use and preference of fuel resources, and ask the following general questions: How do fuel consumption patterns vary within the population and what alternative fuel sources are utilized? How do gender, perception, and the preference criteria used to select woody species influence gathering strategies? We hypothesize that according to their traditional ecological knowledge they would prefer native plants as firewood. Given the scarcity of local flora due to the constant use of native species and the severe environmental conditions in the region, we also hypothesize that dwellers will travel long distances to search for these woody plants, and that they will complement the use of firewood with alternative fuel resources and the purchase of firewood.

2. Methodology

2.1. *Study area*

Pilquiniyeu of Limay is a Mapuche community located in northwestern Patagonia, Rio Negro province, Argentina. In total there are 55 families distributed throughout an area of 55,000 ha on an indigenous reservation [54]. Nine families are established in the town, where the school is located (40° 31′ 16″ S; 70° 02′ 36″ W) and the remaining families are distributed