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**Women and Woods: The Provisioning of Forest Ecosystem Services
to Support Livelihood of Local Communities in Mountainous Area of
Hyrcanian Region**

**Frauen und Wälder: Bereitstellung von Walddienstleistungen zur
Unterstützung des Lebensunterhalts lokaler Gemeinschaften in
Berggebieten in Hyrcanien**

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Abstract

Forest ecosystem services are necessary for rural communities' livelihood and well-being. Forests provide various raw materials such as timber, fuelwood, and fodder and a significant share thereof is often handled by women. However, these issues have been barely addressed in the scientific literature in Iran. The objectives of this paper are to illustrate the significance of raw material sourced from forests and the role of women in maintaining and improving rural households' livelihoods in mountainous villages of the Hyrcanian forests. A qualitative case study was conducted using interviews, focus group discussions, and field observations. Our results indi-

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cate that households use forest raw materials for building construction, improving agricultural production, for generating energy, and as livestock fodder. Forest thus has critical contributions to local livelihoods. These forest products are consumed in households and not traded with external partners. Families substitute forest raw materials partially with new products for increased multiple use and convenience. The widespread use of wood, the deficit in infrastructure networks, the remoteness of villages, and the poor financial situation of local households, led to forests being the major source of raw materials. As forest products extraction and consumption are mainly feminine tasks in our study region, it will be essential for policymakers to consider the gender aspects of forest policies.

Zusammenfassung

Walddienstleistungen sind für den Lebensunterhalt und das Wohlbefinden ländlicher Gemeinden wichtig. Wälder liefern eine Vielzahl Rohstoffe wie Bauholz, Brennholz und Futter, wobei oft ein erheblicher Teil davon durch Frauen verwendet wird. Diese Themen wurden jedoch in der wissenschaftlichen Literatur im Iran bisher kaum behandelt. Ziel dieser Studie ist es, die Bedeutung von Walddienstleistungen und die Rolle von Frauen bei der Erhaltung und Verbesserung der Lebensgrundlage ländlicher Haushalte in den Bergdörfern der hyrkanischen Wälder zu untersuchen. Wir haben eine qualitative Fallstudie mittels Interviews, Fokusgruppendifkussionen und Beobachtungen durchgeführt. Unsere Ergebnisse zeigen, dass Haushalte Waldrohstoffe für den Hochbau, für die Verbesserung der landwirtschaftlichen Produktion, als Energiequelle und als Viehfutter verwenden. Waldrohstoffe sind somit eine wichtige Lebensgrundlage für die lokale Bevölkerung. Diese Waldprodukte werden in der Regel in den Haushalten verwendet und nicht gehandelt. Familien ersetzen Waldrohstoffe teilweise durch neue Produkte für besseren Mehrfachnutzen und Komfort. Die weit verbreitete Verwendung von Holz, die schlecht entwickelte Infrastruktur, die Abgelegenheit des Dorfes und die schlechte finanzielle Situation der Haushalte haben dazu geführt, dass Wälder nach wie vor die Hauptquelle für Rohstoffe sind. Da Transport und Verbrauch von Waldprodukten hauptsächlich weibliche Aufgaben in unserer Untersuchungsregion sind, ist es wichtig für politische Entscheidungsträger, geschlechtsspezifische Aspekte in der Waldpolitik zu berücksichtigen.

1. Introduction

Forests deliver multiple economic, social, and environmental services for forest-dependent communities around the globe, sustain local livelihoods, and provide opportunities to increase their welfare (Kumar, 2012; Marongiu *et al.*, 2017; Newton *et al.*, 2016). Globally, about 1.6 billion people depend on forest resources for their livelihood, of which 350 million people live inside or adjacent to forests and depend on forests for their subsistence and income (Chao, 2012). In the same regions, gender dimensions of forest ecosystem services have not been adequately addressed (Fortnam *et al.*, 2019). The gender roles bring women in direct contact with renewable natural

resources in rural and remote areas. Women in forest-dependent communities have significant roles and knowledge in finding, collecting, and using forest products and restoring and conserving forest resources which are pivotal for generating family livelihood and environmental maintenance. Women are the main gatherers of forest fruits and fuelwood in communities of developing countries (Fortnam *et al.*, 2019). They are familiar with the local natural environment and its changes; e.g., which tree species provides better fuel wood, which plants have medicinal properties, when and where can one find them, and how can one find water or wild fruits.

Following The millennium ecosystem framework in 2005, the globally accepted classification for forest ecosystem goods and services, The Economics of Ecosystems and Biodiversity (TEEB) framework was introduced in 2008. TEEB evaluates the economic significance of ecosystem services, assesses the contribution of ecosystem services to human well-being, enhances the conservation and sustainability of those systems, and predicts the consequences of ecosystem changes on social-ecological systems (Kumar, 2012). Based on the TEEB framework ecosystem services can be understood as the direct and indirect contributions of ecosystems to human well-being. TEEB proposes 22 types of ecosystem services which have been divided into four main categories: provisioning, regulating, habitat, and cultural and amenity services. Raw materials such as timber, fuelwood, fodder, fertilizer, fiber, etc. are a subset of provisioning services (see the main literature in Kumar, 2012). Natural forest ecosystems provide a great diversity of raw materials for construction and fuel and more than half of all global forests have been designated for such production (FAO, 2020).

Building material, fuelwood, wood for agricultural production, and fodder are among the main raw materials provided by forest ecosystems and are widely used in rural areas. Building poles and timber have been extracted for rural house construction for many centuries. Log houses are constructed by family members and neighbors' help in rural areas (Klein and Grabner, 2015). Fuelwood is one of the main solid fuels that rural households have access to and depend on for cooking, house heating, and crop processing. Fuelwood has a significant role in the welfare of rural households in developing countries. This is particularly critical in mountainous areas, where the temperature is low, winter is long, and limited access to other energy sources leads to high pressure on forests (Moayeri *et al.*, 2013; Nurzad *et al.*, 2014; Sunderland *et al.*, 2014). It is reported that about 2.7 billion people in the world use wood to fulfill their energy needs (Song *et al.*, 2018). In many rural areas in developing countries, women and girls have the main responsibility for gathering the household's fuelwood and have to walk for several hours for this purpose. Rural poor all around the world have no alternative to fuelwood either because of the lack of physical access or the inability to pay the price for alternative fuels.

Pollarding tree branches and using the limbs and twigs of trees to feed animals are common feeding systems in areas where subsistence herding is practiced. Harvesting leaf fodder is a wide-range system with two important roles in rural areas of

developing countries: First, in times of extreme climate conditions such as droughts, rural people use leaf fodder to meet production shortage in pastures. Second, compared to crop fodder, the leaves of most trees have higher nitrogen content, which is used to increase the low nutritional value of natural pastures and crop residues (Cuni-Sanchez *et al.*, 2018).

Recent studies showed that in Hezarjarib district, northern Iran, the most important uses of rural communities from the forest resources were building materials, wood for field fencing, fuelwood for cooking, heating, washing, and bathing, wild edible fruits, and medicinal plants. Medicinal and edible uses had less priority (Moayeri *et al.*, 2013). In the mountainous villages of Kheyroud forest in Nowshahr County, Northern Iran, each household used 1.9 to 2.2 m³ of fuelwood monthly. The time spent to collect, transport, and prepare fuelwood varied from 1.5 to 3 hours daily and 9 percent of the rural households had earned income from the sale of fuelwood (Nurzad *et al.*, 2014). In the few studies that investigated forest wood extraction by local households in Iran, the use of forest wood, in particular, fuelwood was not considered as a gendered-specific activity. Ignoring the role of women in issues related to wood harvesting has caused an underestimation of women's contribution to family livelihood promotion and has led to failure in the implementation of inter-fuel substitution policies which is critical to facilitate sustainable development.

The process by which households begin substituting some or all traditional fuelwoods with higher-value modern fuels is explained by inter-fuel substitution theories (Masera and Navia, 1997). There are two competing theories in the literature about the choice of fuels used by rural households in developing countries: "energy ladder theory" and "fuel stacking theory". A complete transition from traditional to more advanced fuels has been explained by the "energy ladder" driven by increasing household income. Modern fuels are more energy-efficient and cleaner, but also more expensive than primitive fuels. A competing theory, "the fuel stacking theory", states that rural households adopt new fuels as income rises, but even the most traditional systems are rarely abandoned. In other words, many rural households switch only partially to modern fuels to capture the benefits of different types of fuels. Contrary to expectations of the energy ladder concept, the stacking theory assumes that while income is one of the most important factors in determining rural household fuel choice, fuel transition is a complex process that economic aspects are interlinked with social and cultural issues. There is growing evidence to show that the use of traditional biomass fuels (fuel wood and charcoal) remains quite common in many rapidly developing countries in Asia which is more consonant with the fuel stacking theory. As women hold liable in wood harvesting and food cooking, their role in the choice of fuel is undeniable (Masera and Navia, 1997; Masera *et al.*, 2000; Gupta and Köhlin, 2006; Nansaior *et al.*, 2011; Song *et al.*, 2018).

It is noteworthy that conducting social queries focussing on females' practices in traditional communities needs female researchers, who can communicate with rural

females. Due to local values and norms, communication with females is not possible for males. Cultural and mindset considerations cause the females not to participate in research meetings held by men, as women prefer to not express themselves in the presence of men. In this context, male and female researchers have access to different information, as they have different access to people, settings, and situations (Kawulich, 2005; Njenga and Mendum, 2018). Avatefi Hemmat (2006) thus suggested to conduct studies led by female field researchers to understand the gender aspects of traditional forest resources management in the Caspian Hyrcanian forests of Iran. The first author of this paper is a female, who conducted the field research and the fourth co-author is a woman with a professional background in anthropology, who guided the field researchers to communicate appropriately with local women and girls.

The objectives of this paper are to illustrate the significance of forests in providing raw materials for rural communities and the women's role in maintaining the livelihoods of rural households by describing gender aspects of practices in the mountainous villages of Iran in the Caspian forests. In future sections of the article, we describe the study area and research methods, overview the rural community livelihood briefly, focus on the raw materials that have been provided by the forest. Then we elaborate the wood extraction from the forest for various purposes and report the amount of them. We discuss the gender arrangements associated with raw materials extracting from the forest ecosystems and their contributions to households' livelihood. The closing section will deal with research implications for policymaking.

2. Material and methods

2.1 Study Area

This study was conducted in Chetan Village, which is located in Kojur district, Nowshahr County, Mazandaran province, North of Iran. Chetan is a mountainous village about 20 km west of Kojur district administration center surrounded by the mountains of northern Alborz at an altitude of 1650 meters above sea level. The rural customary area of the village is 3431 ha, which consists of 2237 ha temperate deciduous forest, 906 ha upland pasture, 279 ha farm and grassland, and 9.5 ha residential area. Most forests are coppiced for supplying timber, fuelwood, and charcoal (Shamekhi and Avatefi Hemmat, 2010). The average annual temperature in the region is 12.8 °C with an average temperature of January is 1.5 °C (Dejban *et al.*, 2019) and the annual precipitation is about 600 mm (Avatefi Hemmat, 2006).

According to the national population and household census data of 2016, there were 166 families and 511 people living in Chetan (SCI, 2018a). While 96 families were living permanently in the village, other 70 rural families were residing temporarily in the warm season. The temporary households were spending the cold seasons in cities on the Caspian plains. Chetan had facilities including a primary school, middle school, mosque, public transport, plumbing water, and electrical power. Although featuring

a sizeable forest with 2237 ha, the area did not have forest management plans and rural people met their primary needs from the forest with few official restrictions.

2.2 Research method

The present paper was a part of a qualitative case study that assessed rural women's activities about the nearby forest resources. A case study is defined as "*a type of design in qualitative research that may be an object of study, as well as a product of inquiry*" (Creswell, 2012). A case study inquiry focuses on contemporary phenomena in the context of cases' real-life. The case study examines a few cases in-depth and explains their situation in multi-dimensions to provide a deep understanding of their behaviors (Azkia & Darban-e Astaneh, 2014; Yin, 2014). In other words, purposefully selecting participants or sites is the key idea behind qualitative research that helps researchers to study issues from participants' views. Four different aspects about participants and sites including the setting, the actors, the events, and the process examined in the case study (Creswell, 2014). The cases in a case study research could be individual, a small group, a community, an institution, an activity, an event, a decision process, and so on (Creswell, 2012; Yin, 2014).

Data collection in the case study is extensive and relies on multiple sources of information such as unstructured, semi-structured, and structured interviews, participant and direct observations, as well as documents, audio, and visual materials. The results of a case study inquiry could be a description of the cases, themes, or issues uncovered in a study. Although the context of each case is different from one to the other, however, the researcher would select representative cases to generalize a concept or theme (Creswell, 2012; Yin, 2014).

Between October 2016 and November 2017, the first author stayed for 34 days in Chetan village. During field visits, she lived with the family consisting of two women and a schoolboy. Each round of stay in the village lasted from 2 days to a week. Multiple techniques of structured and semi-structured interviews, as well as direct and participant observations, were used to collect data in the field. Note-taking, audio and videotaping, and photography were used for data recording.

2.2.1 Interviews

The structure of the interviews, the nature of the research, and the goals of the study underpin the flow of the interview schedule or guide (Ryan *et al.*, 2009). Initial semi-structured interviews were conducted individually and in groups to attain two important objectives. First, interviews are an 'icebreaker' activity that warmed up the conversation among participants, which is important for researcher and participants interacting comfortably with each other. Second, interviews can help establish trust between researcher and participants. The interviews obtained preliminary information about the research objectives, which was necessary for determining the questions of

structured interviews. The researcher guided the directions of these conversations toward the women's daily activities, their role in generating households' livelihoods, and their relations with forest resources by asking open-ended questions. The notes of these interviews were organized and some themes were obtained for structured interviews. Through these interviews, the names of people with different socio-economic status who could have provided more information were identified and listed. The interviews were guided individually or the researcher engaged in focus group discussions. By combining participant observation, interviewing and group interaction, the focus group investigates people's thoughts concerning a specific topic (Plummer, 2017). The questions of focus group interviews were developed in topics that covered different uses of forest wood, the style of wood cutting and carrying, the role of women and men in these practices, and the amount of wood consumption. The researcher asked the question, guided the discussion, and asked more questions to clarify the details of the phenomena on necessary occasions.

The keywords and important parts of interviews were transcribed during the procedure and were completed after finishing the interviews. Also, some interviews were recorded electronically and transcribed during free times.

2.2.2 Field observations

Qualitative observations are those where the researcher takes field notes on the behavior of individuals at the research site utilizing certain prior queries (Creswell, 2014). The focus here was to understand the participants' daily and seasonal practices, in particular, the details of women's activities in collecting, carrying, and using wood in farms and forests as well as at home. The researcher was involved in some daily practices of the women's normal course of life, experienced their daily life and simultaneously observed their activities and learned about them by doing. The notes of observations were recorded.

Data on the amount of consumed wood, such as middle diameters and length of wood pieces were measured by tape meter, or loads weighted by portable hand scale and recorded as well.

2.3 Sampling strategy

In qualitative research studies, there are several non-probabilistic sampling strategies that researchers can select among them. Creswell (2012) used the term "purposeful sampling" as an umbrella term to call them in general because the inquirer needs to select individuals who can provide good information on the research objectives purposefully. In this context, the objectives of the study determine the selection of target group informants in focus group discussions (Plummer, 2017).

In our study, the first participants were selected by convenience, which were from

women easy to reach, i.e., those who were relatives or neighbors of the researcher host. At the beginning of each meeting the objectives of the research and interview were introduced briefly and at the end of the interview, asked the informant to introduce other women from various socioeconomic statuses who could help in elaborating research objectives. The participants with different socioeconomic status including herders, farmers, NTFPs collectors, and neither owned farm nor owned livestock were interviewed and accompanied during forest related activities.

This procedure of purposeful sampling helped to identify cases of interest from interviewees, who had much knowledge and knew other potential people to introduce to the researcher. Thus, the sample group grew like a rolling snowball and this type of purposeful sampling is known as "snowball sampling" or "chain sampling" (Creswell, 2012).

The other consideration of qualitative research is the size of the sample. The general guideline about the size of the sample is selecting a few samples, however collecting extensive details related to research objectives about each studied sample (Creswell, 2012). In this research, each informant was a case and multiple cases were surveyed and the procedures for each case were repeated. New cases were added until saturation of information was reached. Saturation indicates the point when little or no new information is arising by adding more cases (Creswell, 2012; Plummer, 2017). Table 1 shows the details of the steps taken to collect data. Totally 20 individual interviews were conducted as well as 11 focus group discussions with the size of 2.7 participants (Min=2, max =5), and 20 cases were observed directly or participatory.

Table 1: Details of the data collection procedure. Each interview was conducted with one participant. It shows the number of various types of interviews or observations (cases) conducted and the number of participants, who were interviewed or observed during the fieldwork.

Tabelle 1: Details zu den Erhebungen. Jedes Interview wurde mit einem/einer Teilnehmer/in geführt. Es zeigt hier die Anzahl der Interviews oder Beobachtungen (cases) und die Anzahl der Teilnehmer, die interviewt oder beobachtet wurden.

Data collection techniques	Number of cases	Number of participants	
		Women	Men
Individual semi-structured interview	7	7	0
Individual structured interview	13	10	3
Focus group discussion	11	26	4
Direct observation	13	10	5
Participant observation	7	17	4

2.4 Data analysis

Analyzing the data of qualitative research is a repetitive process that starts from the early stages of qualitative data collection (Creswell, 2012). In this research, the transcripts of interviews and field notes were organized, read, and re-read several times during the progress of fieldwork, according to the objectives of the research. By reading the transcript, assigning code to each section of it, and grouping the codes, the main themes of the research were identified in an iterative process. In the final step, the results were organized around key themes and the pattern of women's interactions with forest resources emerged. Moreover, the research findings were discussed with the research team to get feedback and suggestions during the research period.

The volume of each piece of wood was calculated by multiplying the cross-section by its height. The number of households that use each type of wood was asked from the informants and an estimation of the amount of each type of wood used by households during the year was obtained.

To evaluate the validity of the data, the results of each stage were shared with local informants to confirm, correct, or reject them. Moreover, the results of this study were compared with those of other similar studies and, in particular, the research team considered Avatefi Hemmat (2006) as reference.

3. Results

3.1 Livelihood status

The main job of men was pastoralism and livestock keeping around Chetan or in adjacent villages or cities. Some men were working in orchards in remote areas to pick fruits such as cherry, apple, and citrus. In consequence, women became the chief director of the families. The main activities of women were keeping household livestock, doing small-scale farm works, and extracting forest products for family subsistence. Only two women occupied social service jobs, one was a healthcare provider and the other was the teacher of the village.

Keeping cattle was often the responsibility of women, while sheep were often kept in flocks outside of the village by men. Most rural households had cattle that were going to the forest and pasture for grazing during the day and were returning to the house at dusk. Women cleaned the stable, fed and cared for calves, pregnant, and injured animals during the day, milked the cattle and fed them in the stables or around rural houses at night.

Farm productions were limited and crops such as potatoes, beans, beet, and vegetables were usually planted and used in the families. Moreover, one of the most common jobs of rural people for children, young people, the elderly, and especially wo-

men was collecting forest products for use in the household or sale.

Women produced dairy products from the livestock's milk that they had kept. they produced different types of crops by farm activities and harvested fuelwood, tree fodder, fruits, and vegetables by working in the forest. Each of these activities was primarily performed to meet the household needs and the rest (except fodder and fuelwood) was sold to local merchants or in the nearby cities to gain money for the household.

The money that had been earned from women's activities was often used in the family. Depending on the economic needs of the household, some women were spending their money on buying food or clothes for themselves or their children. However, if families had a girl who was about her marriage ceremony, they paid it to prepare a dowry for her. This was one of the important traditions of the region.

Working in the forest, especially gathering fuelwood, was one of the main tasks of women; this was evident in the conversation with the rural women. One of the middle age women pointed out that:

"We helped our parents from the age of nine. We had to plow the ground and reap the harvest. We were 13 years old when we went to the forest to gather fuelwood" (interview, 19 November 2016).

One of the elderly women in describing the difficulty of pregnancy said:

"We were working during pregnancy like before. We had to harvest fodder and gather fuelwood. In the past, some pregnant women went to the forest to work but suddenly felt pain and gave birth there" (interview, 17 December 2016).

Since forest wood has been widely used as raw materials by forest dwellers in Iran, the national government has adopted an inter-fuel substitution policy to reduce the consumption of fuelwood over years. The government has expected that rural families substituted forest wood as a source of energy with fossil fuel, especially kerosene and liquefied petroleum gas (LPG). Kerosene was mainly used to heat the house. Every rural family had a 1000 liters Kerosene quota annually at the subsidized price of 1500 Iranian Rials (IRR; the average exchange rate was 1 USD = 33,000 IRR in the study year) per liter. The location of the distribution of kerosene was within 25 km of the village and the villagers had to pay the freight. Usually, kerosene tankers installed on the pickup truck delivered the fuel to the villagers' houses and received 500 IRR per liter as transportation costs from the rural household. Therefore, each liter of kerosene cost 2,000 IRR for the villagers. LPG was used in the kitchen for cooking daily food and boiling water to make tea. Each 11-kg LPG cylinder, which cost about 80,000 IRR, supported a family for a month on average. Gas cylinders were recharged in the surrounding cities and were carried to the village by a public minibus.

3.2 Local community usages of raw materials provided by the forest

The rural households extracted building timber, fuelwood, wood for use in farms, and tree leaf fodder from the forest. These products are explained in the coming sub-sections and figure 1a-d illustrates them.

3.2.1 Building materials

Rural people used forest wood as a building material. The old houses had been built completely from wood and mud. However, in recent years, the walls of new houses were made of stone, brick, and cement. The use of wood was common in building the gable roof structural framework of houses, stables for livestock, barns, baking places, and repairing the old constructions. Trees such as oak (*Quercus macranthera*), beech (*Fagus orientalis*), hornbeam (*Carpinus betulus*), and wild pear (*Pyrus sp.*) were used in rural buildings. The diameter of trees used in buildings was between 10 and 30 cm typically. The poles felled with an ax or chainsaw and it was a task of men but sometimes women also participated in this activity. According to the experience of local people, if the trees have been cut down in the late summer to the middle winter, they would be long-lasting but if they have been cut in the late winter to the spring, they would be prone to wood-boring insects and less durable. To build a timber roof truss of an 80 m² building, which was common in the village, almost 5 m³ of wood was needed on average. Almost 6 houses were built or repaired in the village every year that they needed timber.

3.2.2 Fuelwood

The rural households used wood-fired stoves for heating their rooms during cold seasons. Other uses of fuelwood were to make fires in the ground tandoor for baking bread, to process of dairy products, and some non-timber forest products such as Solomon's seal (*Polygonatum orientale*), to heat the stable during the winter, to warm water for washing clothes and cooking.

Fuelwood was gathered from various species such as oriental hornbeam (*Carpinus orientalis*), field maple (*Acer campestre*), honeysuckles (*Lonicera sp.*), ash (*Fraxinus excelsior*), oriental beech (*Fagus orientalis*), and oak (*Quercus sp.*). Among the woody species, oriental hornbeam was the best choice for fuelwood as it burns for a long time. Gathering fuelwood was a female-dominated activity, where some women were collecting alone and some in groups. Even when rural people went to the forest for fun and do not have much to carry, they would gather fuelwood and bring it home. Owing to the high altitude of the area, the cold seasons were long-lasting, and using wood-burning stoves continued from October to April.

The families usually prepared their food and tea with gas stoves. However, when they needed to cook a large amount of food, they used fuelwood; e.g., when it was wed-

ding ceremony time. The extracted pieces of fuelwood were in various diameters up to 40 cm and length up to 6 meters, however, most pieces were in 10-15 cm diameter and 1-1.5 meters length. The amount of wood used as fuel was varying from 2 to 28 m³ per family annually depending on the using fossil fuel and the period of staying in the village. On average each household used 14.4 m³ of wood per year.

3.2.3 Wood for agricultural use

Different types of forest wood were utilized for improving crop productivity and protecting orchards, farms, and grasslands from physical damages such as animal attacks. Beans were one of the crops of Chetan that were planted in the second month of spring. When the seedling first emerged, it might seem small and delicate. However, over time, the vines were wrapping around a thick mass of leaves and pods. Thus, providing crop stakes for these plants was essential. The villagers pruned tree branches to make crop stakes for beans. The wood supports, which were derived from different species such as beech, oak, hornbeam, and Cappadocian maple (*Acer cappadocicum*), had a length of up to 1.5 m and 1-3 cm in diameter. When the rural people harvested beans, they mostly kept the supports for the next year. On average, each square meter of the field under bean cultivation needs 6 pieces of wood support.

Rural people were enclosing the farms and grasslands against livestock (cow, sheep, goat, and dog) damages and wild animal (wild boar and bear) attacks by tree trunks or wooden posts and branches. They were using thorny tree branches like hawthorn (*Crataegus* sp.) and medlar (*Mespilus germanica*) to build the fence. Each household's farm needed 0.8 m³ of forest wood annually on average and 111 households had farms in Chetan.

3.2.4 Tree leaf fodder

The tree leaf was a source of livestock food and pollarding forest trees for fodder was common practice in the area. The tree hay fodder was produced from branches and twigs of the deciduous trees. The use of tree leaves started in late March with the opening of buds and new leaves of trees and ended with the fall of leaves at the end of September.



Figure 1: Four types of forest wood usages in Chetan. a: part of roof structure of a house under construction. b: stored fuelwood for winter uses in a rural house. c: the bean farm with woody supports and fences around. d: bundled tree branches for fodder (photographs by Mohammad Avatefi Hemmat).

Abbildung 1: Vier Arten von Holznutzung in Chetan. a: Teil einer Dachstuhlkonstruktion. b: gelagertes Brennholz für die Verwendung im Winter. c: Bohnenfeld mit Ästen als Stütze und Schutz. d: gebündelte Äste als Viehfutter (Aufnahmen durch Mohammad Avatefi Hemmat).

Pollarding trees and providing tree hay fodder were generally done by children and women from specific species at certain times. They pollard hornbeam trees in the early spring, continue with beech, ash, field maple, Caucasian elm (*Zelkova carpinifolia*), lime (*Tilia begonifolia*), and ended in late summer with oak foliage. Tree leaf fodder was often used to feed lambs and calves. The cut branches had 2 cm diameter and 50-150 cm length on average and were packed in small bundles of 30-50 stems, and then the whole bunch was clamped with a young and long branch. Each bundle provided fodder for 3-4 calves a day. In the village 102 households kept livestock and each household harvested 3.5 m³ of tree branches and twigs annually to feed calves, lambs, or goat kids. Women used the residual of the bundles for lighting the ground tandoor for baking. Table 2 summarizes the amount of forest wood consumed in the various subset of raw materials provided by the forest to rural families.

Table 2: The annual volume of forest wood consumption in Chetan village.

Tabelle 2: Holzverbrauch im Dorf Chetan.

Type of raw material	Properties	Number of households	Household usage (m ³ /year per household)	Total usage (m ³ /year)
Construction wood	Mainly thick pole with 10-30 cm and 4-6 meters length	6	5.07	30.42
Fuelwood	Varying in diameter (2-40 cm) and length (up to 6 meters)	166	14.36	2383.76
Agriculture wood	crop stakes (1-3 cm diameter) and wooden posts (5-20 cm diameter) and almost 1.5 meters in length	111	0.77	85.47
Tree leaf fodder	Tree branches with 2 cm diameter and 1.5 meters length in average	102	3.5	357

3.3 Carrying forest wood

There were three mechanisms for transporting harvested wood in the village including carrying on back, beast of burden, and pulling wood through skid trails that explain below.

3.3.1 Carrying on back

Tree leaf fodder, wood for agricultural use, and fuelwood were often stacked and carried on the back. In this mechanism, the extracted wood often consisted of tree branches and wooden posts bunched with a piece of rope or tree branches. In this way, rural people were choosing the nearest surrounding forest areas (an approximate distance of 1 km), which were often high slope paths. The weight of fuelwood that an elderly woman picked up in one turn was 26.3 kg. The fuelwood that rural women carried on the back is often used to lighten the tandoor fire.

3.3.2 *Beast of burden*

Transporting wood with the beast of burden (horses or mules) was similar to carrying on the back. In both ways, the main tool for cutting branches was billhook and there was no priority in selecting tree species; however, easier transportation allowed rural people to gather more wood. In this way, the diameter of the harvested wood varied from 2 to 20 cm. The wood carried with a beast of burden was usually used for construction purposes and wood-burning stoves. If the path was long and steep, the weight of a load was about 70 kg. Besides, in paths that were short and flat, the beast carried on twice much weight.

3.3.3 *Pulling wood through skid trails*

In Chetan, there were 18 traditional skid trails. The rural people pulled the tree logs in these paths and called them '*Keshen*' which, means paths for pulling wood in their local language. Among the 18 skid trails, the names of 16 paths have been derived from the names of the areas where these roads were located and the names of two skid trails '*Shirin Keshen*' and '*Mahnesa Keshen*' have been known as the name of two women in the village. According to the interviews with rural people, '*Shirin*' and '*Mahnesa*' had been two sisters that the ends of two adjacent skid trails adjoined to their grasslands. So, they always traveled on these paths and their names have remained on these skid trails. The logs had a length of 2-6 m and an average diameter of 20 cm. In contrast to the two previous approaches in which the harvested wood was often the branch of trees, in this mechanism, the tree trunks have been cut down, the branches were delimbed, and the logs were pulled on the path. For this purpose, a hole was created on the thicker side of the log then a rope was passed through the hole. By pulling the rope, the thicker side of the timber was raised from the ground and so glided on the paths. Because of the steep slope of the paths, pulling the poles did not require much force but it was more important to control and guided the moving wood along the skid trails. The average weight of each pole was about 70 kg. Women usually fasten two poles to the rope but men fasten up to four poles. At the end of the paths, the poles were carried to the house by using a pickup truck or beasts. This stage required men to be present because women did not drive in this region. Figure 2a-c shows the different methods of transporting wood in the region.



Figure 2: Wood transportation methods in Chetan. a: an old lady with a load of fuelwood on her back. b: steep slope and skid trail (Keshen) near the endpoint in the south area of the village. c: transport of construction poles by the mule. These timber poles were pulled in the skid trail shown in b by human force (photographs by Mohammad Avatefi Hemmat).

Abbildung 2: Methoden des Holztransports in Chetan. a: eine alte Frau mit einer Ladung Brennholz am Rücken. b: eine Rückegasse an einem steilen Hang (Keshen) südlich der Ortschaft. c: Transport von Holzstämmen durch Maultier. Diese Stämme wurden vorher in der Rückegasse (siehe b) durch menschliche Arbeitskraft gezogen. (Aufnahmen von Mohammad Avatefi Hemmat).

4. Discussion

The first objective of this paper was to illustrate the significance of raw materials providing by forest ecosystems for the forest depending communities. Based on TEEB typology (Kumar, 2012) the results showed four types of raw materials subset of the provisioning services category, directly and indirectly, contributed to the villagers' well-being. They included: the building materials used for constructing rural houses, livestock shelters, and barns; the fuelwood used for providing thermal energy, baking, heating water, processing non-timber forest products, and dairy products; the agricultural wood used for improving food crop productivity and protecting them against damages; and the tree leaf fodder used to feed the immature livestock or adult livestock during the forage shortage time.

Public availability of fossil fuels such as oil and gas in Iran should not marginalize the importance of forest wood as an essential ecosystem service for forest-dependent communities' livelihood. The studied community depended extensively on forest raw materials. In the Chetan customary forest area, 2857 m³ of forest wood was extracted by the forest dwellers annually that 1%, 83%, 3%, and 13% were used as building timber, fuelwood, farm wood, and fodder respectively. None of these forest products

were traded but used in rural households. They did not produce income for the household directly but were necessary for and supported families' livelihood. Providing these materials or substitute goods from the market and its transportation to the village required significant costs that most households could not afford. Therefore, the supply of raw materials from the forest indirectly reduced household costs.

Forest raw materials had various usages. Although villagers had other choices for each usage, they preferred the forest; for example, while they had choices such as iron, blocks, and cement for building construction, they used forest wood for constructing roof framework. While they used fossil fuels for heating and cooking, also they used wood for heating, baking, and processing. They used various fodder such as agricultural residues, forage obtained from household grasslands, and tree leaf fodder. These strategies diversified their choices and helped them in times of shortage such as money shortage, winter road closure, or income decline. In other words, keeping traditional systems of raw materials provided by forest secured them against supply failure or decreased their vulnerabilities in times of price fluctuation (Kumar, 2012). These findings can also be justified by the fuel stacking theory, elaborated and examined by (Masera and Navia, 1997; Masera *et al.*, 2000; Nansaior *et al.*, 2011) which states rural families adopt new fuels as income rises, however, they do not abandon the traditional systems. In other words, many rural households only partially switch to new materials to capture the benefits of different types of them. Therefore, the scope of fuel stacking theory can be extended to other raw materials provided by forest ecosystems used by forest dwellers.

This paper utilized qualitative research to provide a deep understanding of forest wood extracting in the mountainous region of the Caspian forests and its gender implications. Moayeri *et al.* (2013) reported various uses for forest wood including the construction of a house, stables, fencing of fields, and fuelwood for cooking, home heating, washing, and bathing purposes in the Hezarjarib region of Caspian Forests. In Chetan village, fuelwood was not used for bathing. One major explanation for this difference was the presence of a public bath in the village which was worked by mazut. In another study, Bazgir *et al.* (2015) reported the use of fuelwood for baking, home heating, and making charcoal in the Zagros Forest of Iran. Charcoal making has not been practiced in the area for many years. Our observation showed a considerable amount of fuelwood was used to heat livestock stable in Chetan, probably due to the cold and toughness of the winter which was not mentioned in the other publications. On the other hand, (Bazgir *et al.*, 2015; Moayeri *et al.*, 2013; Nurzad *et al.*, 2014), had no explicit reference to the gender aspects of forest product collection and utilization. It seemed researchers implicitly stated that extracting and using forest wood is masculine. While in contrast, our results showed it is feminine.

The second objective of the paper was to examine the gender aspect of forest services' extraction in traditional forest-dependent communities. Table 3 shows the contribution of rural women in various activities related to wood extracting from the

forest. As the table illustrates, 4 tasks of using the fuelwood, cutting tree branches for fodder and carrying it, and feeding the livestock were done by women, while 1 duty of using wood for rural houses constructing was done by men. Also, women had more contribution in collecting and carrying fuelwood and agriculture wood as well as applying wood in farms to improve crop production. While men had more contributions in cutting down and transporting the construction timbers. It seemed the rural men did professional work such as gable roof building and cutting down thick trees by ax or chainsaw. However, the women did several simple and general tasks such as using fuelwood for cooking and heating; cutting, carrying and feeding with tree fodder. Besides, rural men and women cut down and carried the construction timber cooperatively but, in most cases, extracting other types of wood was women's duty.

Table 3: The contributions of women and men to various practices of forest wood extracting. In cells with both genders, the first gender contributes more.

Tabelle 3: Der Beitrag von Frauen und Männer bei den Arbeitsschritten in der Holznutzung. In Zellen mit beiden Geschlechtern, das erst genannte Geschlecht trägt mehr bei.

Practices	Cut/collect	Carry	Use
Type of raw material			
Construction wood	Men/women	Men/women	Men
Fuelwood	Women/men	Women/men	Women
Agricultural wood	Women/men	Women/men	Women/men
Tree leaf fodder	Women	Women	Women

The findings of Fortnam *et al.* (2019) in Kenya and Mozambique showed there were high differences between male and female notions and practices about ecosystem services. Men and women often benefited from different ecosystem services and each gender has different traditional ecological knowledge. The authors added prescribed gender roles embedded in culture, traditions, and institutions as well as the market arrangements and labor relations. A global comparative study (Sunderland *et al.*, 2014) found significant gender differentiation in forest product collection globally, which supported the gendered nature of forest product collection. However, they found men played a much more important role than had been reported already. Although they reported great differences among regions of Asia, Africa, and Latin America and various forest products.

Most forests are often located within rural and remote areas which have not been developed in terms of infrastructure, services, markets, and jobs. Therefore, communities living adjacent or in the forests are characterized by high levels of poverty and limited livelihood opportunities (Shackleton *et al.*, 2007). In this context, forests provide materials for rural families and maintaining their livelihood (Kumar, 2012; Marongiu *et al.*, 2017) and women reduced household costs with wood harvesting, thus have a positive impact on household livelihood. If women do not harvest wood, households are forced to buy it from the market to meet their needs while many rural households can't pay for this. Overall, rural women are engaged in activities that do not make income straightly; rather they invest their time in reproductive and non-market activities that contribute to securing family life (Johnson *et al.*, 2016). That is, in traditional communities such as Chetan, family livelihood stood on both men's and women's shoulders and women tried as hard as men to sustain the families' subsistence.

Keshens were introduced in this research as a kind of traditional permanent skid trail for wood transportation and we noted that there was no mentioning of *Keshen* in the literature prior to this study. Wood transportation in these traditional trails has been common in the mountainous villages of the Hyrcanian forests already. Transporting wood in a high steep forest area was not an easy job, but the rural communities did it using natural facilities. In this regard, further researches are suggested.

Although forest material extraction had a positive impact on rural households' subsistence, however, overexploitation has degraded forest and stands quality. In Chetan at least 2857 m³ of forest wood was extracted by the forest dwellers annually. The forest area in the village customary land was 2237 ha (Shamekhi and Avatefi Hemmat, 2010), and assuming an even distribution of wood extraction, 1.28 m³/ha were removed annually. However, the harvesting was greater in forests near to the village, which led to local degradation in that area. Unsustainable use of forests is not only a threat to the environment but also to rural households.

5. Conclusion

Considering that conservation of renewable natural resources is one of the most important principles of the national development plans and the solid fuel transition to fossil fuel has been on the agenda since 1992. Iran is rich in hydrocarbon resources and the country has 9.3% of the world's proved reserves of oil, and 17.2% of global natural gas (BP, 2018). Nevertheless, the country is poor in forest cover. Almost 7.8% of the total land is covered with forests, which is 0.18 ha per capita (FAO, 2020; SCI, 2018b). Therefore, most forest areas are designated to provide other ecosystem services besides wood. The government expects that rural families substitute forest wood as a source of energy with fossil fuel, especially kerosene and LPG. Nowadays, after three decades of providing facilities to reduce fuelwood consumption, forest wood is still harvesting. Because the diverse use of raw materials extracted from the

forest is not limited to energy sources. It was shown in this study that in addition to fuelwood, three other types of raw materials were harvested from the forests. On the other side, the deficit of distribution networks, the remoteness of villages, the poor financial situation of households, and the inability to buy fossil fuels leads to forests remains the major source of materials within forest areas while wood extracting and consumption are mainly feminine role. therefore, policymakers need to pay attention to the gender aspects of forest policies.

Possibly, plantation programs to plant high-growth trees (like some varieties of the poplars or alders) on the margins of agricultural land and abandoned rural areas, as well as the crops that do not require the support for their growth, can reduce wood harvesting in the medium term. Furthermore, given that women harvest a significant amount of forest wood to meet household needs, it is necessary to pay more attention to the women's situation and their needs in programs related to the forest. Hence, the extension programs to promote forest conservation need to focus on females who interacted with the forest ecosystems.

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