

Knowing our Lands and Resources

Indigenous and Local Knowledge and Practices
related to Biodiversity and Ecosystem Services in Asia



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► Edited by:

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INTRODUCTION

The Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) includes the following commitment as one of its operating principles:

Recognize and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems.

UNEP/IPBES.MI/2/9, Appendix 1, para. 2 (d)

To spearhead its work on this challenging objective, the IPBES Plenary created a task force on indigenous and local knowledge systems (ILK) at its Second Meeting.

The present document is a contribution towards the IPBES regional assessment for Asia and the Pacific. Its aim is two-fold:

- ▶ To assist the co-chairs, co-ordinating lead authors, and lead authors of the regional assessment by facilitating their access to indigenous and local knowledge relevant to the assessment theme.
- ▶ To pilot the initial approaches and procedures for building ILK into IPBES assessments that are under development by the ILK task force in order to test their efficacy and improve the final ILK approaches and procedures.

To meet these two objectives in the framework of the regional assessment for Asia and the Pacific, the task force on ILK implemented a step-wise process including:

- ▶ A global call for submissions on ILK related to biodiversity and ecosystem services in Asia and the Pacific;
- ▶ Selection of the most relevant submissions from ILK holders and ILK experts, taking into account geographical representation, representation of diverse knowledge systems and gender balance.
- ▶ Organization of the Asia-Pacific Dialogue Workshop (Chiang Mai, Thailand, 26–28 June 2016) to bring together the selected ILK holders, ILK experts and experts on ILK with the co-chairs and several authors of the IPBES assessment report;
- ▶ Development of proceedings from the Asia-Pacific Dialogue workshop; and
- ▶ Organization of local follow-up work sessions by the selected ILK holders, ILK experts and experts on ILK in order to work with their communities to address additional questions and gaps identified by authors at the Chiang Mai workshop.

In addition, the Institute for Global Environmental Strategies (IGES), with support from the Japan Biodiversity Fund, organized sub-regional dialogue workshops for South and West Asia, South-east and North-east Asia and for the Pacific. Participants at the sub-regional workshop for South and West Asia (29 November - 2 December 2016, Dhulikhel (Kathmandu), Nepal) have also contributed papers to this volume.

These contributions from the Asia-Pacific Dialogue Workshop and its various follow-up meetings, including the sub-regional workshop organized by IPBES, provide a compendium of ILK about biodiversity and ecosystem services in Asia and the Pacific that might not otherwise be available to the authors of the assessment. It complements the existing body of ILK on biodiversity in Asia and the Pacific that the authors are able to access from scientific and grey literature.

1. Threats and Challenges to Ensuring the Requirement of Biodiversity and Ecosystem Services for the Indigenous Begnas Ritual System of Sagada, Northern Philippines

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1.1. Introduction

1.1.1. The Environment and Culture Nexus

Environmental conditions result from complex interactions between human populations and their immediate physical landscape (Tengberg et al. 2012). Nature is always part of culture, and analysing ecological issues should not only account for ecosystem structures but also for the cultures of people residing within, and interacting with, the ecosystem (Wilson 1992). Through a holistic and systemic lens of viewing the environment with its human inhabitants, one can observe and recognise culture-environment dynamics that arise from human interactions with ecosystem structures; relationships between ecosystem functions and social structures; and energy flows between and among humans and other organisms (Rambo 1983). People are inextricably bound to nature, and the ecological quality of the environment and the quality of human life are largely one and the same through time and space (Linehan & Gross 1998).

Indigenous peoples are critical in considering environmental conditions since they have synthesised knowledge systems through many years of coexistence with nature. As a result, indigenous communities appear to have distinct environmental and cultural characteristics associated with high levels of environmental and cultural sustainability (Takeuchi 2010). At the core of sustaining indigenous resources are culture-bound systems which regulate the provision of necessary and essential ecosystem goods and services (Satoyama Initiative 2010). For example, traditional and established upland agro-ecosystems have high degrees of sustainability due to the use of indigenous techniques that maintain soil fertility and reduce crop pests and diseases. Furthermore, traditional land tenure and social practices ensure that productivity is equitably distributed among community members. In general, the sustainability, productivity, resilience and stability of socio-ecological ecosystems usually found in indigenous and rural communities are dependent on the cultural values exhibited by its indigenous peoples (Conway 1986).

In the Philippines, the Cordillera Administrative Region (CAR), an area with a number of indigenous groups, warrants research for a greater understanding of the complex cultural

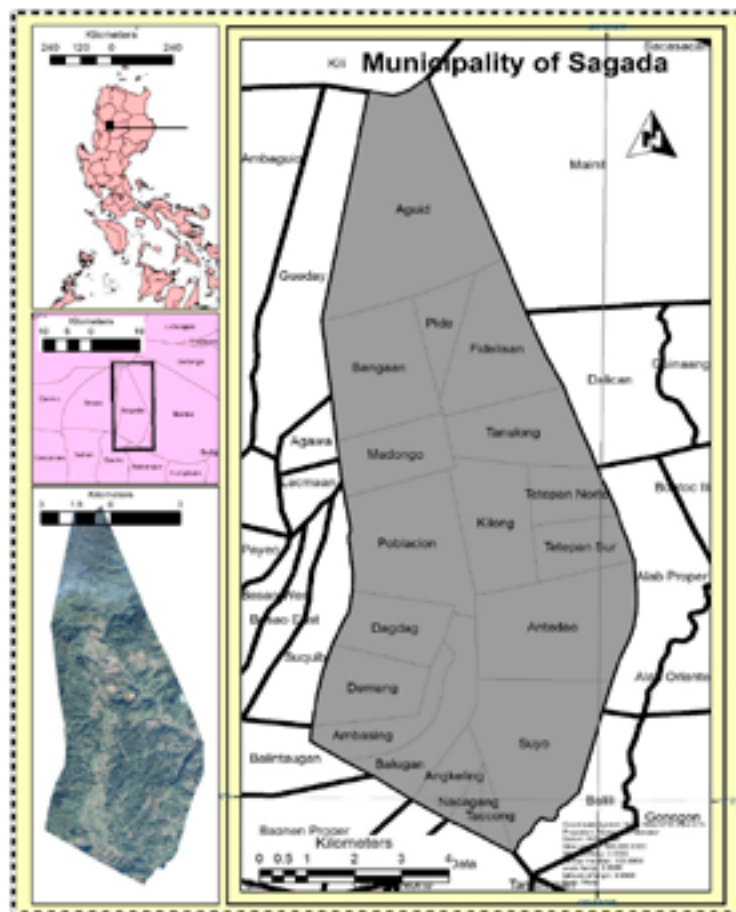


Figure 1.1 Map of Sagada showing geographic location in the Philippines, current land cover, and administrative boundaries relative to adjacent territories. (Projection: WGS84, UTM Zone 51N. Source: PhilGIS.org. Created by DBAnacio, 2014)

and environmental interactions. Modernisation and globalisation have inevitably introduced changes to the traditional practices of highland indigenous peoples and an analysis of their repercussions is useful for understanding current and future trajectories. Buguias municipality in Benguet province, CAR, for example, presents a “stratified, demographically dynamic community with a highly entrepreneurial ethos, engaging in chemical-intensive commercial production, in typhoon-prone tropical upland with a deeply weathered bedrock mantle”, just one aspect of the many culture-environment issues in the region (Lewis 1992, p.247). In the municipality of Banaue, Ifugao, CAR, notable impacts on the socio-ecological system are occurring: disasters enhanced by nature, such as typhoons, landslides, and earthquakes; integration into the market economy and increasing trade; uncoordinated development of tourism (e.g. conversion of rice terraces for hotel or restaurant construction); and the intentional or unintended introduction of invasive alien species (Martin, Grütz and Holzhauser 1998; Castonguay et al. 2016). In general, as indigenous peoples in the Cordillera weave traditional and modern cultures and technologies to adapt and capitalise on current developments, some unfavourable outcomes have been inevitable.

1.1.2. Sagada, Northern Philippines and the Begnas Ritual System

One of the municipalities of CAR is Sagada (Figure 1.1), Mt. Province, which is inhabited by the northern Kankana-ey, an indigenous ethno-linguistic¹ group which also occupies a great portion of Mt. Province. It has a total land area of 9,969 hectares, of which around 99.3% is classified by

¹ Ethno-linguistic group is used in this paper to define a particular ethnic group and their common language. There are numerous ethno-linguistic groups in the Philippines, a majority of which are indigenous peoples.

national law as forest and public land, with an elevation range of 1,313 to 2,318 metres above sea level (masl). Sagada is situated in a Type 12 climatic zone, having two pronounced seasons: dry season from November to April and the wet season from May to October.

Sagada's rich tradition, culture and social arrangements have allowed harmonious interactions with the landscapes, including various uses of inherent ecosystem services provided by the mountainous terrain and pine (*Pinus kesiya Royle ex Gordon*) dominated forests. Here the begnas (b gnas) ritual system is analysed to deepen appreciation for the role of the natural environment in the lives of the Sagada people. The begnas synchronises planting and harvesting activities through a system of rituals that require the participation and co-operation of community members. Invocations in the various rituals seek blessings from indigenous deities, mainly Kabunian, and the spirits of ancestors. Specifically, this paper aims to: (a) document the indigenous begnas ritual in the context of biodiversity and ecosystem services, and (b) describe threats and challenges for ensuring the practice of the ritual system amidst Sagada's developing landscape.

1.2. Methodology

1.2.1. Data Sources

Key informants have been pooled from elderly men and women, farmers, municipal officials, hotel and restaurant owners, and the people of Sagada in general (including the author), who were knowledgeable in and familiar with various indigenous rituals and related practices. Individuals who work with issues and concerns regarding Sagada culture-environment nexus, specifically factors which may affect the practice of begnas, were also consulted.

1.2.2. Field Methods

Participatory observation, key informant interviews, focus groups, meetings, and a reflexive involvement with daily events, gossip, meetings, and other day-to-day activities in Sagada were used. Note-taking and synthesis of interesting events were recorded in a journal, aided by audio and video recordings, as well as still photographs. Data gathering has been conducted since October 2015 until October 2016.



Credit

Photo 1.1 Participants of the Begnas Meeting-Workshop conducted on October 8-9, 2016. Location: Patay, Sagada.

- 2 There are four climate types in the country as identified by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). Type 1: Two pronounced seasons: dry from November to April and wet during the rest of the year. Type 2: No dry season with a pronounced rainfall from November to January. Type 3: Seasons are not very pronounced, relatively dry from November to April, and wet during the rest of the year. Type 4: Rainfall is more or less evenly distributed throughout the year.

1.2.3. Data Validation

Being a native of the municipality, Mr. Anacio is knowledgeable of the language, local customs and traditions, geography, and other necessary conditions and circumstances that would otherwise encumber data analysis, validation and interpretation. Additionally, triangulation through the comparison of personally written notes, secondary sources, key informant resources and primary observation has been applied to gathered data.

Data were validated together with key informants in order to clarify and rectify gaps and misinterpretations. On 8 and 9 October 2016, a meeting and workshop on the begnas ritual system was conducted at the Sagada Municipal Hall Library and Multi-purpose Hall. A total of 40 participants from Sagada knowledgeable in indigenous rituals and graduate students of environmental science from the University of the Philippines Los Baños attended the validation activity.

1.3. Results and Discussion

1.3.1. Cultural and Environmental Elements Required for a Begnas

In its broadest sense, the begnas is seen as a resource-associated system used for mobilising communal effort to achieve a particular purpose. This view is further supported by informants who always state the recurring theme of the begnas as a ritual that espouses unity and co-operation. This is achieved by invoking good values to be bestowed upon the community, as well as the actual need for participants to be unified and co-operative during the event. Specifically, begnas is performed to fulfil three general purposes: (1) for marking agricultural activities, (2) as a means of thanksgiving for particular events (other than agricultural activities), and (3) as a means for cleansing misfortunes within the community.

The elements comprising the begnas can be simply categorised as 'culture' and 'environment' elements. This categorisation is not meant to oversimplify the begnas, but is utilised as a technique for easier understanding of an otherwise complex ritual. Cultural elements refer to tangible and intangible constructs indigenous to Sagada, while environmental elements pertain to natural resources which have not been modified or processed by people.

A begnas requires an active and collective participation of the whole community. At the same time, it requires the integrity of the landscape in order to support the cultivation of crops and the manifestation of various omens and to provide resources needed to conduct the ritual. This synergy of culture bearers, who view their natural environment as an important stage for conducting important rituals, as well as a foundation of resources needed for the ritual itself, ensures the significance and performance of the begnas through time and changing spatial conditions.

The mamegnas (performers of the begnas) signal the start of the planting season through a begnas, and by seeking supernatural blessings for the abundance and fertility of planted crops. During harvest season, the begnas become a means for thanksgiving for a recent harvest in order for it to last a longer time and not be easily exhausted or depleted (*masika/ensika*). The celebration of the begnas thus marks important events related with community welfare, most especially for ensuring food supplies and community survival.

By inculcating the value of co-operation through the begnas, village unity is reinforced. Since the begnas also constitute a communal consumption of food and drink, it is an important social technology for strengthening social transactions, making alliances and ensuring community integrity (see also Dietler & Hayden 2001). This allows the lightening of heavy manual labour required during harvesting, house building, crop planting, etc., by synchronising such activities within and among the whole community. To complement the ritual system, rest days during

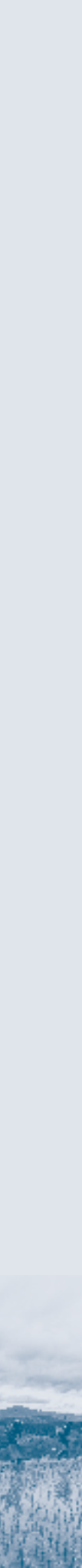




Photo 1.2 Villages celebrating a begnas. Women bring food stuffs for men who have just arrived from an omen-seeking trip. Dagdag, Sagada. November 2, 2013.

the begnas are strictly observed, and when field activities resume, the traditional practice of reciprocal labour (ub-obbo) is important. Additionally, practicing the ub-obbo depends on social capital, which is incidentally strengthened by the begnas.

1.3.2. Biodiversity Requirements of the Begnas Ritual System

Through combining indigenous and scholarly perspectives regarding biodiversity, a number of biodiversity requirements are identified as crucial for the continued practice of the begnas ritual system. First is the variety of ecosystems used during the begnas. Throughout the phases of the begnas, various landscapes are required. In the initial phase, sacred sites are visited for observing various omens. These include certain grasslands, paddy fields and nearby environs, hills and mountain sides, and almost all the mountain peaks. These are considered sacred landscapes and during the begnas, access to these sites should be secured, and any human intrusions or man-made disturbances should be avoided. In some villages practising begnas, river ecosystems and mountain edges or cliffs are required to wash away bad omens, or allow the cleansing of one self after the performance of a particular begnas-associated ritual.

Second is the diversity of species required for the begnas. During the initial phase, various birds, reptiles, rodents, fowls and other fauna in general, are carefully noted and observed. Decisions are made by elders and knowledge holders about the local term for these species, as well as the variety of behaviours exhibited by these species as to which indicates a good or bad begnas. In the final phase of some begnas celebrations, various crabs, eels, and fish are collected in water bodies for communal feasts and ceremonial purposes.

Finally on a genetic level, the various traditional rice varieties in Sagada serve as the main rationale for the begnas. Rice agriculture forms the basis of the begnas, as annual begnas celebrations revolve around pre-post planting and pre-post harvesting of rice. In Sagada, varieties of rice (*Oryza sativa* subsp. *japonica* or subsp. *tropical japonica*) have been planted probably as early as the 17th century.³

³ William Henry Scott's (1974) interpretations of Spanish records mention the existence of Sagada villages during the 17th century.



Photo 1.3 Men from barangay Pidlisan going back to the village after an omen seeking trip. Location: Pide and Aguid, Sagada. December 1, 2015.

Biodiversity also plays an indirect role in the celebration of the begnas. Dried vegetation and fallen/cut tree branches serve as fuel for cooking ritual food. During the initial phase, poles of *Phragmites vulgaris* (Lam.) Crép. are used for impaling and roasting etag (tag) or salted pork meat. Parts or the entirety of musical instruments, ceremonial shields, spears and other tools used during certain begnas celebrations are made of *Pinus kesiya* Royle ex Gordon wood, as well as the wood of other trees naturally growing in Sagada. Ritual containers and baskets are made from the stems or fibre of native plants. In general, various plants are needed as base materials for different implements required for a begnas celebration



Photo 1.4 The papatayan, a sacred site used during begnas celebrations in the central barangays (villages) of Sagada. Note the vicinity of housing infrastructure in the background. Location: Dagdag, Sagada. June 6, 2016.

1.3.3. Threats to Biodiversity Requirements of the Begnas

Ongoing population growth and development in various barangays as a result of tourism and economic growth in Sagada have direct and indirect impacts on the practice of the begnas. With growing population trends (0.43 annual growth rate as of 2010), various sacred landscapes are facing threats from housing and other related infrastructure, as well as increased human activities. Infrastructure is being built near sacred landscapes, locally termed as babawiyaw/kakayewan, totolingan, wawalitan, and papakde-an/papadkelan depending on the terminologies of each village practising begnas. A number of dap-ay, which refers to the men's common house with a stone paving and shed, central to various cultural rituals and social arrangements and located within villages, are increasingly becoming disregarded or underutilised.

Mt. Kiltapan, for example, is being capitalised upon by Sagada residents to establish their business infrastructure due to scenic views and its popularity among tourists who watched a popular Philippine movie 'That Thing Called Tadhana'. However, a particular area in Kiltapan is required as the wawalitan (sacred site for omen observation) of Tetep-an Sur and Norte begnas performers. The pathway to and peak of the mountain are currently blocked and occupied by human activities and infrastructure development in the area, and begnas performers are facing inconveniences during omen-seeking trips. As a result, the sacredness of natural-settings required for begnas rituals is deteriorating due to the presence of nearby houses and other infrastructure, which in turn decreases the meaning, authenticity, and quality of the begnas. The preservation of these landscapes for begnas is thus critical to sustain the meaning of ritual, as well as for maintaining a sense of community and interconnectivity with the land.

The relevance and importance of various landscapes for the continuity of the begnas is manifested in various ways. One is the manifestation of omens, such as particular bird songs and behaviour, which, when heard or seen, signal a good or bad begnas. It is generally understood that undisturbed



Photo 1.5 Men from barangay Pidlisan going back to the village after an omen-seeking trip. Pide and Aguid, Sagada. December 1, 2015.

natural landscapes and human-inhabited areas have diverse impacts on the presence, behaviour, and interactions of different flora and fauna. Sound ecosystems are very much needed for the conversion of natural capital to other resources required for a begnas. The dono, for example, is seen as the most economically taxing phase of the begnas since it requires the most number of sacrificial animals. As a traditional means of offsetting such costs, the saguday (communal wood lots maintained by a particular dap-ay, or clan) allow the harvesting of timber to enable the purchase of, or barter for, a pig and chickens (Batang-ay 2015). With increasing demand for timber as a construction material, the saguday is also facing threats from overcutting, thus minimising its ability and role in supporting begnas celebrations.

Concluding statements

The begnas is an agricultural and communal ritual system requiring cultural and natural resource elements. As revealed in this paper, changes in the form and function of landscapes have subsequent implications on the begnas. In the manifestation of omens, for example, the presence of bird songs and particular faunal behaviours is critical. These biodiversity components occur in sound ecological conditions, and human-disturbed sites may eventually lose the manifestation of omens, both good and bad. Without the presence of environment-embedded omens, the meaning and complexity of the begnas is greatly reduced. Good omens are preferred, on the one hand, while bad omens require the knowledge of identifying consequences and necessary rituals. In the case of a bad omen, relatively natural and sound landscapes are required for performing equalising rituals, or omen-seeking trips are performed in forests and grasslands to observe a good omen that would neutralise or circumnavigate the ill impacts of an unfavourable omen. Thus, the preservation and conservation of these related landscapes is important. When the required landscapes for celebrating a begnas are lost, appreciation and need for the begnas are lost as well. Additionally, various sacred sites, which are scattered and located all over Sagada's landscapes, are needed for the performance of various begnas rituals. The diversity and integrity of landscapes is essential for the continued celebration of the begnas in Sagada.



Photo 1.6 Traditional spears, with rice paddy fields, housing areas, and pine forests in the background. Spears are held upright while men wait for bird songs that indicate a good omen for a begnas. Location: Pide and Aguid, Sagada. December 1, 2015.

The presence of cropping systems, mainly rice, is required to guide the schedules of the begnas throughout the year. Thus, the diversity and continued cropping of traditional rice varieties enhances the relevance and meaning of the begnas. Additionally, ecosystem services, mainly water cycling systems, soil-cycling systems, and cultural services to support and sustain rice agriculture, are all linked with the begnas ritual system.

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2. Forests, Communities and Ecosystems: A case study of the Huay Hin Lad Nai community, Thailand

Gam Angkang Shimray and Kittisak Rattanakrajangsri (IPF) & Chaiprasert Phoka, Nevet Siri, Pichet Sinhearndoi, Suthiphon Phaiwangul, Wallapha Chapoh, Chalearmphon Wetchakit and Precha Siri (community members)

Background and Acknowledgements

This case study is the result of participatory research conducted by the Indigenous Peoples' Foundation for Education and Environment (IPF) and members of Huay Hin Lad Nai community between August and October 2016. The case study was conducted to contribute to the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) Sub-regional workshop on Indigenous and Local Knowledge (ILK) for South-East and North-East Asia sub-region which was held from 14-17 October 2016.

The research team would like to express its gratitude to the community members for willingly co-operating with the team. The knowledge of the community was extremely enlightening and their hospitality was warm and comfortable.

The research team, community members and IPF also express their deep appreciation to UNESCO for their goodwill and for financing the project.

2.1. Introduction

2.1.1. The community and its history

The Northern region of Thailand is the area with the highest concentration of indigenous peoples' population. The Karen, with a population of approximately 400,000 people (Delang 2003), is the largest indigenous group in Thailand and comprises at least 20 sub-groups (Institute of Medicine 2006). The community in Huay Hin Lad Nai too belong to the Pgakenyaw tribe of the Karen group.

2.2. Research Methodology

The research methodology and process adopted was guided by the objective of involving the community members as contributors and as co-authors (to the extent possible) in order to encourage in-depth reflection within the community and to promote ownership of the results of the study.



Photo 2.1 A view of Huay Hin Lad Nai village

The process adopted was as follows:

- ▶ Sharing the purpose and scope of the research followed by obtaining free, prior and informed consent (FPIC) from the community leaders and elders.
- ▶ Nomination and formation of the research team from IPF and the community.
- ▶ Agreement on the framework and research methodology.
- ▶ Validation of the research findings with the community as well as FPIC for sharing it in the IPBES regional assessment process.
- ▶ The research methods used were as follows:
 - ▶ Survey questionnaires
 - ▶ Semi-structured interviews
 - ▶ Focussed group discussions
 - ▶ Participatory community workshops
 - ▶ Field observations
 - ▶ Literature survey

2.3. Huay Hin Lad Nai community

The Huay Hin Lad Nai village is in Moo 7,⁴ under Wieng Pa Pao district in Chiang Rai Province. Moo 7 is located between the National Forest Reservation area and Khun Chae National Park.

⁴ 'Moo' is an administrative unit in Thailand usually comprising a cluster of villages (hamlets). In the case of Moo 7, there are three hamlets i.e. Hin Lad Nai, Pha Yuang, and Hin Lad Nok.



Photo 2.2 Huay Hin Lad Nai community

The community's village territory measures 10,279.75 rai (16.45 km²) consisting mostly of mountainous lands. The neighbouring villages of Huay Hin Lad Nai, Pha Yuang and Hin Lad Nok and Huay Sai Khao together form the Moo 7 administrative unit.

Huay Hin Lad Nai consists of 20 households with 35 families. The total population of the community is 107 people with 5 clans. While 11 households consist of one family each, there is more than one family living together in the other nine households. (Table 2.1)

Table 2.1 Number of households and population

Population of Huay Hin Lad Nai			
Households	Male	Female	Total population
20	57	49	107
	53.5%	46.5%	100%

Source: Survey data

34 persons (19 male; 15 female) are above the age of 42 years. The number of youth—all unmarried adult population (from the onset of puberty)—in the community is 30 in total. Out of this, 11 of the youth are studying outside the village but they continue to maintain close contact with their fellow villagers. Till date, there is not a single case of any family which has migrated to a town or city.

Out of the 11 students studying outside the village, 2 (1 male; 1 female) are studying bachelor's degree, 6 (2 male; 4 female) are in high school, and 3 (1 male; 2 female) are in secondary school. The young children of the village are studying in the government's primary school and the rest

of the youth are studying in the non-formal education system in the village which they think is culturally more appropriate for them.

2.3.1. Village governance

The village Headman and the Assistant Headman are appointed by the Government. In addition, the community is also required to form a Village Committee of 15 members, as per government law, which includes both women (2) and youth (6) representatives.

The traditional leader is referred to as Zee Khou, who is the spiritual leader as well as the founder of the village. The Karen is a matrilineal society but this position is only held by a male member of the community and the position and title are inherited. Therefore, the eldest son of the Zee Khou does not marry outside the village for the continuity of their traditional leadership role. At present Mr. Nu Papa, as the direct blood line of the founder of the village, is the Zee Khou of the village.



Gan Angkong Shimay

Photo 2.3 Zee Khou, the spiritual leader

The Village Headman, Assistant Headman and the Village Committee are democratically chosen/elected as per the requirement of the government. The villagers follow the government rules as a formality. Within their village, they follow their customs and customary law. The village follows consensus-based decision making and agrees on its leadership through discussion rather than formal election.

Generally, the villagers work together on everything and understanding among them is achieved through informal interactions. Specific issues and concerns regarding women and youth are handled by these groups themselves so they have their own respective committees.

The Headman is mainly responsible for social and political affairs of the community and for most of the representation to the outside world. The Zee Khou is responsible for all spiritual matters such as ceremonies and divining and seeking blessings from the spirits; he is considered the protector of the community.

2.3.2. History of Huay Hin Lad Nai

According to the oral history of Huay Hin Lad Nai, their migration to the present settlement area starts with riding an elephant during the first half of the 1900s led by Mr. Suka. They migrated from Mae Chang Kao watershed which is located in the Doi Inthanon area. They had to change their settlement site nine times for various reasons until they permanently settled down in the present site of Huay Hin Lad Nai in 1966.



Photo 2.4 This house was rebuilt on the original settlement site of the village founder, Mr. Suka (three families are living together in the house now).

The government granted concessions to the Chiang Rai Tha Mai logging company in 1986 in the Khun Chae area covering about 80,000 rai (12,800 ha) of forests. The concession area also included the village territory of Huay Hin Lad Nai. As recounted by the villagers, only about 10% of the big trees were left in their village forests. Sacred forests such as De Paw and the burial site were also destroyed in a very short span of time.

Destruction of the forests also caused dryness in the forests and wild fire every summer. The villagers recount that they had to stay on guard all night and it took four years to bring the wild fire under control by making fire-break lines. Unfortunately, the government blamed the villagers for the loss of forests and shifting cultivation was banned. This caused great hardship in terms of food security for the villagers. They resorted to other forms of cultivation but also secretly continued to practice shifting cultivation at a minimal level in order to survive.

The communities were deeply hurt that they were branded as ‘destroyers of the forests’ and as ‘illegal occupants’ by the government. It was in this context that the Huay Hin Lad Nai community resolved to continue to stay and prove to the government and the world that humans and nature can co-exist based on their worldview.



Gan Angkang Shimray

Photo 2.5 One of the few big trees left after the logging in 1986

In 1992, the Khun Chae National Park was established and many communities were under the threat of being evicted. Some of the communities responded by forming the Northern Farmers' Network (NFN) in order to stand up for their rights. They also joined the 'Assembly of the Poor' (national level) in 1997 and carried out several protest actions. As a result, in 2003, the village was officially registered as Huay Hin Lad Nai under Wieng Pa Pao town of Chiang Rai province.

Huay Hin Lad Nai has won several awards since 1992 for environmental restoration and is also recognised as a model 'sustainable village' by the government of Thailand. However, they continue to struggle for their communal land rights.

2.4. Beliefs and worldview of the community

2.4.1. Cultural revival and worldview

The community's resolve to prove that human beings and nature can co-exist is also part of their resolve to revive their culture and re-strengthen themselves. Revitalising their culture and worldview was the most important means available to them to renew their symbiotic relationship with the forests.

The reason for choosing cultural revival as the means for renewal and sustainability of their community's life is an obvious one. In the worldview of the community, everything starts from the forest and ends with the forests. In the words of the community, they say, "No forest, No life". By this, the community is referring to dependence of life on different kinds of ecosystem functions and services of the forests i.e. in terms of products from the forests, water sources for drinking and irrigation for farming. For example, the community says, "we seek permission from the forest for using the water from the stream or river and we thank the forest for the same" and "we take care of whatever we eat or use". The community also refers to the forest as a habitat for flora and fauna, as a means for soil conservation, and as the source of healthy air and weather in the area. Most importantly, the forest is the dwelling place for different types of spirits, including their own spirits and those of their ancestors.

Therefore, if all the forest is destroyed, not only will the resources disappear, but all the spirits will also be gone; and this will mark the end of all life. The community clearly sees the broader scheme of the function of forests and ecosystems which is not the same as ecosystem services. For the

community, ecosystem functions—including the function of the spirits—are the preconditions for ecosystem services.

The above belief and worldview of the community associated with the forest is clearly demonstrated by their ceremony called Ta lue kaw (offering to the Guardian Spirit). The ceremony is performed by the Zee Khou by offering chicken contributed by all households to pay respects to the spirit for protection as well as to symbolically give back something for what they have been receiving from the forests. A portion of the chicken is offered to the forest spirit, another portion is eaten in the forest, and the rest of the meat is brought home to share with members of the household. Therefore, the renewal of their symbiotic relationship is achieved through this ceremony.

Further, the forest as the dwelling place of their spirits and of their ancestors also speaks of their reverence and connection with the forests. This belief is demonstrated by putting the umbilical cord of a new born in a bamboo container and tying it to a tree. This is to symbolically express that the spirit of the new born lives in that tree and that she/he will rest in peace in the forest when she/he grows old and dies.

Their belief and worldview is associated with the forests, as described above, and determines the moral grounding of their social institutions and customary practices. The core values and principles that guide their customary rules and practices, land use, and resource management are grounded in this belief and worldview.

It is because of this that the community does not encourage outsiders taking citizenship in their village. The community explains that it is not easy for an outsider to learn and understand their belief and worldview, and that this can affect the integrity and sustainability of the community.

2.5. Holistic land use and livelihood system of the community

Guided by their beliefs and worldview, the land use and livelihood system of the Huay Hin Lad Nai community is holistic and sustainable. Their land use practices and livelihood system strongly support one another and are, therefore, interlinked and inseparable. The relationship between their holistic land use and sustainable livelihood system is best understood by the effective management of their agriculture, forests, natural resources and income generation activities, including other land use practices. Their holistic approach that nurtures a sustainable lifestyle in the community is described below.

2.5.1. Livelihood

The main source of subsistence and cash income of Huay Hin Lad Nai community is through both self-sufficient and commercial farming. Several of their members are also engaged in gathering forest products, making handicrafts and utensils from bamboo, furniture making, blacksmithing, natural dyeing and weaving, etc. The villagers also rear domestic animals such as chicken, pigs, cattle, buffalo, dogs and cats for their daily food and other purposes. However, most of these are mainly for local consumption.

In the village, labour exchange is commonly practised but during the harvest season, some of the community members are paid for working in the fields of others. This is because exchange of labour during this season is not enough to make up for the shortage of labour. However, none of the villagers are engaged in wage labour outside the village. Rather, during the main harvesting period for tea, the villagers engage paid labourers from other villages because there is a short window of time (one month) to complete this work.

There is no shortage of farming land and all families in the village are engaged in farming. Food and income security in the village are strongly based on a diversified production system and local livelihood. According to the community, the village is able to have an annual surplus of income over expenditure; and their consumption patterns also show that more than 92% of the food comes from household production and natural resources. This claim is substantiated by a study conducted in 2008 (Huay Hin Lad Nai, NDF, AIPP and IWGIA (ed.), 2010) which shows that annual savings per head in the community amount to THB 1,986; and only 8% of the food comes from markets outside the community.

All their livelihood and production activities are governed by customary rules and ceremonies. The Zee Khou and members of the village firmly assert that as long as they know how to perform their ceremonies, the community will flourish. Otherwise, the community will perish because their system will stop working without their ceremonies. This assertion from the community shows that they consider spiritual consciousness as the highest form of awareness and nothing works without it.



Village archive

Photo 2.6 Performing the Jue M-nga Kaw ritual in the shifting cultivation field

The table (Table 2.2) below provides a brief description of their important ceremonies relating to livelihood and production activities. These ceremonies apply to both wet-paddy farming and shifting or upland cultivation.

Table 2.2 Description of the important ceremonies

Ceremony	Description	Participants/performers
Ta lue kaw	The ceremony is performed by the Zee Khou. Chickens contributed by every household are offered to pay respects to the guardian spirit as well as to symbolically give back something for what they have been receiving from the forests.	Men are allowed to observe the ceremony while women, as owners of the house, wait at home to share the remaining chicken meat (offered to the guardian spirit) that will be brought home.

Jue M-nga Kaw	A virgin male digs a hole in the ground with a hoe and a virgin female puts rice into the hole. After this, the handle of the hoe is tied to a bamboo pole pointing towards the Dao Thai (local term for the Great Bear constellation) while the other end of the hoe with the blade is placed in a bamboo container filled with water and the remaining rice. The water in the container symbolises sufficient water in the soil for good crops. The hoe is kept pointed towards the Dao Thai so that all the spirits in the forests send up their spirits to the Dao Thai. And the Dao Thai sends down their blessings through the spirits of the spirits for good rain and harvest.	The ceremony is first performed in the farm of Zee Khou (followed by others) by a virgin male and female because virginity symbolises purity in the community. Purity is needed for the sanctification ceremony in order to receive blessings from the spirits.
Ta Ter Moh	A hen is killed and boiled. A small piece of meat from every part of the chicken is taken out, including the feather, and is placed in the middle of the field on the 'chicken offering stand' for the spirits so that the grains grow well. A hen is used for this ceremony because female represents productivity and multiplication.	The ceremony is first performed in the farm of Zee Khou followed by others. The community also explains that this is a metaphor to prevent the use of artificial fertilisers.
Ta ka Keh	Bamboo poles and shrubs are used to block the entrance of the field. Items like lead, bullets and eggs, including any items that can destroy the crops such as caterpillars and insects, are also placed at the entrance. This ceremony is performed to prevent destruction of crops by pests and other animals, including intrusion by human beings.	The ceremony is first performed in the farm of Zee Khou followed by others. The community also explains that this is a metaphor to prevent the use of pesticides.

► Rice cultivation

The cultivation of rice is the most important part of the Huay Hin Lad Nai community's livelihood and it determines the life and work of the people throughout the year. The community in general decides on how much each household and each family should farm so that they have enough rice to eat throughout the year.



Photo 2.7 Chicken offering stand in the middle of the paddy field

Rice is grown in both shifting or upland cultivation and wet-paddy fields. There is still enough land for expansion of both the types of farming which they have reserved for the future. The community practises both types of farming as part of their food security and sustainability strategy.

Shifting cultivation is more reliable under unpredictable climatic conditions and is valued more highly by the community because it is a greater source of food variety and quantity. However, the yield in the wet-paddy field is higher so it is a major contributor to food security and control of expansion of agricultural land. Therefore, they feel that it is crucial to maintain both the systems of farming for sustainability.

Furthermore, production in these two types of farming is strictly for local consumption only except for some surplus items that are sold to outsiders.

► Other crops and sources of income

Apart from rice, the people in Huay Hin Lad Nai depend on a range of crops grown or edibles collected from shifting cultivation, mix farm and the forests. The types of crops grown or edibles collected from the different types of farms and forests are shown in Fig.15.

Even though no scientific survey was conducted, the community is of the opinion that household expenses mostly pertain to:

- ▷ Education
- ▷ Hospital or medical expenses
- ▷ Transportation
- ▷ Clothes
- ▷ Food from outside the community
- ▷ Toiletries and detergents

Of this, they ranked education as the highest in terms of expenditure. At the community level, a lot of their income is also spent on controlling forest fires and managing fire-break lines.

Cash crops are the most important source of cash income for the community but farming at the individual level is not encouraged. Therefore, commercial farming is a communal activity in Huay Hin Lad Nai and they call it mix farming. The table below shows the major sources of cash income (Table 2.3).

Table 2.3 Main sources of cash income in 2015

Product	Annual income in THB	Annual income in USD
Wild tea	414,000.00	11828.60
Seasoned food, herbs and macadamia	56,000.00	1600.00
Honey and mushroom	246,000.00	7028.60
Bamboo shoot	350,000.00	10,000.00
Honey soap	Not available	Not available
Bamboo worm	Not available	Not available
TOTAL	1,066,000.00	30,457.14

Source: survey data

One of the important sources of income is from the sale of bamboo worms but no data was available for the year 2015. The community has also introduced soap making from honey in 2016 and it is beginning to generate good income. However, no data was available because it was introduced recently.

At the household and family level, they also get some income from domestication of animals, weaving clothes and baskets, furniture making, handicrafts, etc.

Up to a maximum of 20% of the income from selling products from the mix farm goes towards the funds set up by the community. There are three types of funds in the village:

- ▷ Women's fund
- ▷ Youth fund
- ▷ Village fund

A percentage of the sale proceedings by women or youth goes to the women and youth funds respectively while that by men goes to the village revolving fund. Normally, everyone has access to any of the funds, especially the village fund as per one's requirements. Records and accounts for the revolving fund are not maintained; they are managed on the basis of trust among members of the community.

Records and accounts for the women and youth funds are maintained and used for specific programmes such as educational and cultural activities and youth exchange programmes, etc.

2.5.2. Land types and their uses

Huay Hin Lad Nai community has a complex system of land use. Each type of land is used in different ways and is a source of different types of food and other important resources. The way they use resources reflects their intricate knowledge of the different ecosystems within the village territory. And the way they manage their land and avoid land pressure and degradation demonstrates their holistic approach to land use practices. The table below (Table 2.4) shows the main types of land distinguished by the Huay Hin Lad Nai.



Photo 2.8 The village Headman with the village revolving fund box

Table 2.4 Main types of land distinguished by the people of Huay Hin Lad Nai are:

Sl.	Land use type	Total area	Percentage
1.	Settlement area	14.08 rai (5.57 acre)	00.14%
2.	Burial area	04.97 rai (1.97 acre)	00.05%
3.	Wet-paddy field area	49.98 rai (19.77 acre)	00.49%
4.	Shifting cultivation area	786.77 rai (311.06 acre)	7.65%
5.	Mix farm area	788.58 rai (311.78 acre)	7.67%
6.	Community forest	8,635.75 rai (3414.31 acre)	84.00%
TOTAL		10,280.13 rai (4064.46 acre)	100%

► Village settlement area

The total settlement area of Huay Hin Lad Nai is 14.08 rai (5.57 acres) and includes housing area, a Buddhist monastery, a school, a meeting hall and kitchen gardens.

Most households in the village have small kitchen gardens where vegetables are planted, as well as herbs and medicinal plants.

► Burial area

The pasakho (local term for burial area), which is the natural burial site of the community, is also a conservation area. Burial takes place under a tree because the shade of the tree is cool and pleasant; so it is a peaceful place to rest. Therefore, the burial sites in the community are also a tree preservation area. The community identifies 250 types of trees in the burial area.

► Wet-paddy field

All households and families in the community own chi (local term for wet-paddy fields) and it depends both upon rain and irrigation. The total area of the paddy fields owned by the villagers is 49.98 rai (19.77 acre). The size of the paddy fields owned by each family is more or less equal because it was distributed in proportion to the size of the family. The community has maintained this balance successfully over many years.

As rice is the main food for Huay Hin Lad Nai families, specific ceremonies are performed and taboos are observed before preparing the land for the cultivation of rice. The Zee Khou is responsible for identifying a suitable area for cultivation and permission is sought from the spirits. Making offerings to the river/streams and water source is an important part of the ceremony.

After successful completion of the ceremonies, small irrigation canals are dug to bring water to the fields. Once the fields have been soaked, the soil is prepared. Rice seedlings are grown elsewhere and then planted in the paddy fields during the rainy season when they are ready. Rice takes up to six months to grow and it is harvested between November and December.

2.5.3. Shifting cultivation

The Karen's form of shifting cultivation is called rai mun wian ('rotating upland fields'). The main form of agriculture in Huay Hin Lad Nai is shifting cultivation and the total land size for this type of farming is 786.77 rai (311.06 acre). Out of this, the total area under actual cultivation in a year ranges between 80–100 rai (12.7–15.9 acres). Shifting cultivation cycle aids the regeneration of fauna and flora, harbours hundreds of insects that include pollinators, and consequently promotes biodiversity, conserving both animals and plants.

The community pointed out that selecting the area for shifting cultivation is very important. The first rule is that the higher slopes of the mountains are meant strictly for conservation and are not used for cultivation. This is because nutrients in the soil on the higher slopes of the mountains

are not as good as in the lower slopes. Therefore, forest rejuvenation will be much slower if cleared for cultivation. The second rule they follow is not to use the slopes near the river/stream, even though the soil in these areas remain moist and fertile, because these areas are prone to erosion.

The area the community chooses for such cultivation is between these two areas. In these areas, nutrients in the soil are very rich and trees grow well. Therefore, the forest can rejuvenate very fast after it has



Village archive

Photo 2.9 Fallow forest in the village

been cut down, burnt and cultivated for a year. The villagers explain, “We cut the trees to prepare the land but not their roots. In seven years, the trees will be restored. We also do not cut trees along the streams/ rivers and water sources”.

Before undertaking any activity, the Zee Khou seeks permission from the spirits to access the area until the right place is identified for farming. Once the place is identified, firebreaks are made around the farming area. After the land has been burned, the community erects ritual poles or sticks as a declaration to the spirits that the area now belongs to them for cultivation.

Shifting cultivation is a cultural and physical integration of the community, forest and agriculture. During the process of planting and harvesting, women and men play complementary roles. For instance, men dig the holes in the soil and women put the seeds in them. Shifting cultivation is clearly an integral part of the community’s traditions and beliefs that strengthens collaboration and unity among its members. The community often re-echoes, “Lowlanders usually don’t understand our systems in which people and nature bond together.”

2.5.4. Mix farm land

The concept of what the community calls ‘ta su chi chu’ in their local language is translated as ‘mix farm’ in English. Mix farm is an interesting innovation. Mix farming is actually similar to the concept of natural farming where farming mimics nature. The total area of mix farm land in the village is 788.58 rai (311.78 acre).

Mix farming helps them address three crucial issues and concerns:

- ▶ Enable farming without clearing up new forest areas to have enough cash income to take care of their basic needs e.g. education, healthcare, etc.
- ▶ Resolve the dilemma of controlling the clearing of new forest areas for commercial farming as well as the problem of shortage of labour in the village
- ▶ Enhance resilience, livelihood diversification and food security of the community

Village archive



Photo 2.10 Women collecting tea leaves

In the mix farm, each villager is responsible for certain tasks and they work together in small groups. These groups share produce and products with the community; and surplus is sold to nearby villages, visitors and other buyers in the market. The major products in the farm are discussed below.

Wild tea is the main product commercialised by the community and is produced without any chemicals. There are three main seasons for harvesting tea leaves but the community can also harvest them throughout the year. The young tea leaves are priced at THB 100 per kg (approximately US\$ 3.00) and the old leaves at THB 15 per kg (less than US\$ 1.00). In a year, the community sells about 30,000 kg (or more) of tea and is now collaborating with a Japanese university to improve the quality of tea. The community also uses tea as a herbal remedy to reduce cholesterol and prevent diabetes and cancer.

Beekeeping was introduced in 2011 with nine bee hives. However, they failed in the initial stage because birds ate them and the weather was also not favourable that year. Chairasert Phoka, the Village Headman, went back to the village where he learned the art of beekeeping a few times. In 2012, six bee hives were installed again and this time they succeeded.

They have three species of bees (called ke nae, kwea doh and kwea poh in Karen language) in the village which are native to the surrounding forests. The regeneration of the forest helped the bees return to the village forest. The number of bee hives has increased to about 200 (as of 2016). The best honey is available from March to May and the sales have picked up very well since 2014. Their special honey comes from kwea poh (channarong in Thai) bee, which is harvested only once a year and is sold at a very high price.

Village archive



Photo 2.11 Honeycomb

As a byproduct of honey, the village has also introduced soap making from honey in 2016. It has started with good sales and appears to be a promising source of income for the community.

Bamboo shoots from bamboo groves in the mix farm area are another source of good income as well as an important part of local diet. Thirty one years ago, two bamboo species were introduced

from a nearby forest outside their village. As of 2016, there are several bamboo clumps in the mix farm area with seven bamboo varieties. There are about 2000 bamboo clumps in the entire village territory.

Their traditional agroforestry farming has not destroyed the ecological balance. Even in the case of bamboo harvesting, they observe the life cycle of native bamboos in order to use them sustainably. The community gathers only the first two pairs of bamboo shoots exposed over the soil from each bamboo clump in July and August. They keep the last pair of bamboo shoots, which will bear in September, for reproduction in the next season. Further, to ensure long-term usage of bamboo worm, which is one of their favorite foods, the community cuts only specific bamboos that have worms inside. They also have protected areas for conserving bamboo worms.



Photo 2.12 Mix farm showing wild tea, bee hive and bamboo clump

The community is able to sell more than 50,000 kg of bamboo shoots per year. The most favoured bamboo shoot variety for consumption is called phaisang (Thai term) and that for sale is the hoc (Thai term) variety. Bamboo leaves and poles are also used for making mats, handicrafts and other small articles for household use.

2.5.5. Community forest land

The community forest land constitutes 84% of the village territory with a total land area of 8,635.75 rai (3414.31 acre). However, this does not include the mix farm land, burial area and the fallow forest areas. Therefore, even if we exclude the fallow forest areas, the total forest cover in the village is 91.70% (9426.92 rai=3727.11 acres).

The community forest land is the main regulator of ecosystem functions and services on which their agricultural system, water resources and overall environmental health depend. It is also a source of a number of natural medicines and herbs, numerous edibles and food items, housing materials and firewood, etc.

The table below (Table 2.5) shows the depth of knowledge of their forest areas and ecosystems as well as the importance of forests to the community.

Table 2.5 Land use types and major resources found

Sl.	Land type	Major functions	Major resources found
1.	Community (conservation) forest	<p>Main regulator of ecosystem functions and services</p> <p>Habitat for flora and fauna</p> <p>Water and soil conservation</p> <p>Source of livelihoods, medicinal plants, energy (firewood) and water</p> <p>Grazing area</p> <p>Learning area, etc.</p>	<p>Wild animal: 100 species (including 20 protected large animal species)</p> <p>Rat and mice: 20 species</p> <p>Bird: 20 – 25 species (approx.)</p> <p>Tree*: 250 species (including about 150 protected species)</p> <p>Bamboo: 10 types</p> <p>Edible fruit tree: 20 species</p> <p>Vegetable: 50 species</p> <p>Edible herb (e.g. vegetables): 30 varieties</p> <p>Perennial edible plant: 200 types</p> <p>Perennial herbal plant: 50 types</p> <p>TOTAL = 750+</p>
2.	Mix farmland forest	<p>Farm for income generation and livelihood</p> <p>Umbilical cord trees (conservation of protected sacred trees)</p> <p>Habitat and breeding area for wild animals</p> <p>No hunt zone</p> <p>Seasonal harbouring of insects, including pollinators</p> <p>Grazing area</p> <p>Source of energy (fire wood), construction material, medicines and drinking water</p>	<p>Wild animal: 100 species (including 20 protected large animal species)</p> <p>Bird: 30 species</p> <p>Bee: 3 species</p> <p>Tree: 250 types (including about 150 protected species)</p> <p>Bamboo: 5 types</p> <p>Wild tea: 1 species</p> <p>Edible fruit tree: 20 types</p> <p>Vegetable: 50 types</p> <p>Herb: 100 species (approximately)</p> <p>Pollinator: varies from season to season and data is not available</p> <p>Stream: 6</p> <p>TOTAL = 559</p>
3.	Burial area	<p>Burial site</p> <p>Conservation of trees</p> <p>Breeding area for wild animals</p> <p>Ritual site</p>	<p>Tree: 250 species</p> <p>TOTAL = 250</p>
4.	Bamboo grooves	<p>Source of income and food</p> <p>Source of materials for handicrafts, housing materials, materials for farming tools and implements and household articles, etc.</p> <p>Major source of organic fertiliser for shifting cultivation</p> <p>Main material for rituals</p> <p>Close association with the daily and spiritual life of the community</p>	<p>Bamboos clumps: 2000</p> <p>Bamboo: 10 species</p> <p>Bamboo worm: 1 type</p> <p>TOTAL = 11</p>

Sl.	Land type	Major functions	Major resources found
5.	Streams	Source of drinking water and irrigation Habitat for aquatic animals and plants Source of food	Stream: 9 major streams (Hin Lad Nai, Keu Baw Eh, Kli Pu Klo, Cher Su Klo, Cher Paw Klo, Kaw Ko Klo, Haw Phi Klo, Chaw Naw Kwi Klo and Baw-a So Klo) Turtle: 3 species Fish: 6 species Crab: 1 species Frog: 7 species Edible aquatic insect: 4 species Vegetable: 3 types TOTAL = 24
6.	Kitchen garden and surroundings	Source of herbs Source of vegetables and spices	Herb: 10 species Vegetables and spices: 20 types TOTAL = 30
7.	Wet paddy fields	Source of staple diet (rice) and other food Breeding area for some bird species	Rice: 2 Fish: 5 species Vegetable: 10 types Edible snail: 2 species Crab: 2 species Bird nest: 5 types TOTAL = 26
7.1.	Rotational farming (Current cycle)	Main source of staple diet (rice) Main source of vegetables Propagation of plant species and seed preservation Source of food for domestic animals such as pigs, cows, buffalos and chicken, etc. Ritual site	Rice: 5 varieties Vegetable: 20+ types Chilli: 3 varieties Taro: 3 varieties Yam: 7 varieties Cucumber: 5 varieties Sesame: 4 varieties Lemon grass: 1 type Turmeric: 1 type Galangal: 1 type Pumpkin: 2 varieties Green shallot: 3 varieties Corn: 4 varieties Beans: 4 varieties Bamboo: 4 species Eggplant: 5 varieties Millet: 4 varieties Rat and mice: 20 species Total = 99

Sl.	Land type	Major functions	Major resources found				
7.2.	Rotational farming (fallow land year 1)	Source of food for humans and domestic animals Source of energy (fuel wood) Source of herbs Harbours pollinating insects	Chilli: 2 varieties Eggplant: 5 varieties Lemon grass: 1 variety Bamboo: 4 species Tree sprout: 300 (approx.) species Wild animal: 17 species Birds: 20 species Rat and mice: 20 species Insect: 200 species Herbal plant: 50 species Rattan: 3 species Total: 602				
7.3.	Rotational farming (fallow land year 2 to 10)	Source of food for humans and domestic and wild animals, including for large animals from year 3 onwards Source of material for weaving, fuel woods, house construction materials Breeding area for small wild animals, including jungle fowl Harbours pollinator insects Source of medicinal plants for healing and curing several types of diseases and wounds	Resource	Year 2	Year 3	Year 4	Year 5 - 10
			Tree**	300	280-290	260-270	250
			Bamboo	7	7	7	7
			Herbal plant	70	70	60	50
			Rattan	3	3	3	3
			Kaw (local name) tree	1	1	1	1
			Wild animal	30	50	50	70
			Bird	24	24	24	30
			Rat and mice	20	20	20	20
			Insect	200	150-190	120-150	100+
			Fruit tree			10	10
			Mushrooms	5	5	2-3	2-3
			Chilli	2			
			Eggplant	2			
			TOTAL	664	610+	557+	543+

Source: Survey data

*The number of tree species found in the village is shown as 250 in all the land use types (except for the early fallow period of shifting cultivation) because the village keeps a count of only the major tree species which are found all over.

**The number of tree species reduces as the fallow forest grows older.

In the community, forestlands are distinguished into many types of forests and zones: community forest, mix farmland forest, fallow forests, burial area, haw phi thu (guardian spirit forest), de paw (umbilical cord tree forest), watershed forest and no hunting zone.

The de paw or umbilical cord forest is a sacred forest and it also plays a very important role in the conservation of different tree species. This is because, as a practice, the community ties the umbilical cord to different tree species. So the number of umbilical cords tied helps them keep a count of the number of tree species available in the umbilical cord forest. Even after people have died, their trees are still preserved because it is believed that their spirit continues to live there.

The watershed forest is also sacred to the Karens. The area is protected by the community so that there is no disturbance to the area. They build firebreak lines around the watershed areas during summer. Sometimes they also plant banana trees to maintain the water resources.

2.6. Resource management rules and strategy

Most management rules and regulations are not written down but embedded in the customs and practices of the community. Those that are written down are mostly the important 'dos and don'ts' for both outsiders and community members, including rights of the community on land inheritance, transfer and amendment of rules and regulations. Some of the important resource management rules and strategies are briefly discussed below.

The community maintains a 'no hunting zone' of approximately one kilometre radius just outside of the settlement area. The villagers explain that this zone has been declared immediately beside the settlement area because it is easier to monitor the enforcement of rules. And at the same time, it is easier to keep a count of wildlife in the area.

Hunting is allowed outside this zone but selling of wild meat is strictly prohibited. Further, use of nets or glue for catching birds is also prohibited, including electric shocks or fish poisoning in the streams/rivers.

Outsiders are prohibited from taking any forest resources or exploiting them. There are also strict rules for outsiders in terms of taking citizenship in the village but marriage is not restricted.

While proper enforcement of rules and regulations is crucial to the management of their forest, one of the most important measures they take is implementing the firebreak line system. The community spends a lot of resources and effort in making firebreak lines and staying vigilant during the summer.

The community makes two main firebreak lines, one at the boundary of the village and the second at the inner circle of the village forest forming the second layer of protection. In addition to this, for all shifting cultivation plots, they make firebreak lines to prevent fire outbreak from inside. Furthermore, the community makes another important firebreak line for all watershed forests. The watershed areas are considered important and ecologically sensitive. Therefore, firebreak line system is one of the main methods used by the community to protect the forest in Huay Hin Lad Nai.



Photo 2.13 Umbilical cord tree



Photo 2.14 Villagers making the main firebreak line

2.7. Revitalisation of indigenous knowledge

Cultural revival, revitalisation of indigenous knowledge and restoration of forests go hand in hand in the Huay Hin Lad Nai community. This is because rituals and ceremonies define their cultural life and it is considered, metaphorically, as the fence (protection from harm) of the community. Further, they are the means for renewing respect and reciprocity with the forest, which is the source of life and knowledge. It is for this reason that the community believes that they will flourish as long as they know how to perform their ceremonies.

Therefore, knowledge of ceremonies is most important and comes first in the community. The different types of important knowledge the community identifies are as follows:

- ▶ Rituals and ceremonies for different occasions
- ▶ Healing: casting spells and application of herbal medicines for different kinds of illness or injuries
- ▶ Agriculture: wet paddy and shifting cultivation
- ▶ Irrigation for cultivation
- ▶ Mix farming/natural farming for income generation such as bamboo shoots and worms, wild tea harvesting and processing, honey harvesting and honey soap making, food processing, etc.
- ▶ Sustainable harvesting of forest products such as food and medicinal plants
- ▶ Weather reading and prediction: mostly through insects and plants
- ▶ Musical instruments
- ▶ Blacksmithing
- ▶ Weaving
- ▶ Natural dying

- ▶ Handicrafts
- ▶ Carpentry
- ▶ Traditional architecture
- ▶ Rearing animals

Some of the important knowledge of the community is discussed briefly below.

2.7.1. Weather forecasting and signs for agriculture

For agricultural purposes, they rely heavily on their weather reading and forecasting knowledge. For farming, one of the insects they follow is the cricket. When the community hears the cricket sing during the plantation season, it means that it will rain soon. So women in the village start to prepare seeds for sowing.

However, when the cicada sings “eelia, eelia”, they change their plan because it is either a bad sign or means that it is not the right time to sow the seeds. If they ignore the sign, it is believed that for each seed you sow you will get only one grain of paddy. So the community either switches to planting peanuts or performs rituals to overcome the bad sign.

According to the community, the cicada can tell many more things. They believe that if you hear them sing from behind, it means that you will have to work very hard but if you hear it from the front, the harvest will be very good. However, it does not matter if you hear them sing after the paddy has grown.

The table below highlights some of their knowledge on weather forecasting (Table 2.6) which the community considers to be reasonably accurate.

Table 2.6 Weather forecasting knowledge

Plan/tree/insect	Sign	Meaning
Te Er Nah (a type of local fig tree)	Tree bears lots of fruits	Abundance of rain in the year
	Fruiting is only from base of the tree to the middle	Very little rain in the year
	Fruiting from base of the tree to the top	Rain will be spread out throughout the year
	Big and heavy bunches of fruiting in between the base and top of the tree	Sporadic heavy rain in between (throughout the year)
Bee	Bee hive is moved to lower branches	Strong wind or storm is predicted within the year
	Bees flying low	Strong wind or storm is expected shortly
Cicada	Singing “eelia, eelia” before sun rise	Strong wind is expected shortly

Conclusion

The story of Huay Hin Lad Nai is an inspiring case of environmental restoration through cultural revival that encompasses their beliefs and worldview and revitalisation of indigenous knowledge. It is important to recognise where the strength of the community comes from. Their beliefs and worldview support living in respect and reciprocity with the forest. And they have developed a way of life and a knowledge system that is intimately guided by the objective of maintaining ecological balance and moderation in the community.

Their worldview and ecological awareness informs them of their land-use practices allowing them to effectively utilise the different land-use types. These different land-use types support one another and help to maintain ecological balance and sustainability in the community. The following examples of their land-use practices speak of their sound ecological knowledge:

- ▶ Conservation forests (areas of higher altitudes and watershed areas) as the main regulator of ecosystem functions and services
- ▶ Shifting cultivation (areas where trees take strong root and regeneration of forest is fast) for food security and nutritional needs
- ▶ Wet paddy field in the small valley areas (areas where irrigation is easy with minimum risk of soil erosion) which is the bulk contributor to rice production
- ▶ Mix farming (natural farming) for income generation and livelihood security without causing ecological pressure

Their holistic approach to land use is part of their strategy for sustainable livelihood and for maintaining sufficient land reserves for the future. It is also a strategy to prevent ecological pressure and land degradation and to propagate ecosystem functions and services.

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3. Sustainable resource use and forest conservation by the Kaani indigenous community of Kanyakumari forests in the Western Ghats, India

3.1. Status of Indian Forests

India is one of the world's 12 mega-biodiversity centres and has two of the 18 biodiversity hotspots, namely the Eastern Himalayas and the Western Ghats. India is perhaps one of the few countries whose Constitution enshrines the concept of environmental protection and specifies this as the bounden duty of the State as well as of all the citizens. A number of legal and policy initiatives have been taken to protect and conserve forests and wildlife, along with its biodiversity. India has also led the world in participatory approaches to forest management through the Joint Forest Management initiative.

Humanity faces exceptional challenges of eroding natural resources and declining ecosystem services due to a multitude of threats caused by unprecedented growth, development and consumerism. Coupled with hunting, the loss of habitat to make way for human land use, particularly for agriculture, urban development and energy production, continue to be major threats. Humans have left ecological footprints such as grazing, encroachment on forest lands, forest fires etc. In the wider landscape, conflicts between development and biodiversity arise. In order to conserve forests, Conservation Reserves have been created and Community Reserves and Management Advisory Committees have been established.

3.1.1. Indian Forest Acts

A number of legal and policy initiatives have been taken to protect and conserve forests and wildlife. These include the forest policies of 1884, 1952 and 1988, which may be due for another revision to keep pace with the changing scenario. The Indian Board for Wildlife was formed in 1952 to provide advice in the field of wildlife conservation. The Indian Forest Act of 1927 (now under revision and redrafting), the Wildlife (Protection) Act of 1972, the Forest (Conservation) Act of 1980 and the Environment (Protection) Act of 1986 are important Central legislations.

3.1.2. Ecological footprints in forests

The ecological footprint of humans in forests is increasing as it includes the biologically productive area or bio-capacity needed for crops, grazing land, built-up area, fishing grounds, roads, residential buildings, dams, eco-tourism and its related activities and allied non-forest activities.

► Grazing

Due to a very high cattle population (450 million), there is a severe shortage of fodder. Cattle are generally allowed to graze openly in forest areas. Even though grazing is prohibited in Protected Areas, 67% of National Parks and 83% of wildlife sanctuaries have reported incidences of grazing. Heavy grazing in forest areas damages trees, destroys herbs, compacts soil, prevents regeneration and introduces diseases among wild animals.

► Encroachments on forest lands

Reliable data on encroachments of forest lands are not available. The Forest Survey of India estimated in 1987 that over 700,000 hectares of forest lands have been encroached. By now, it has increased considerably. Most of the forest area under encroachments is being used for agricultural purposes, construction of resorts and recreational areas. At several places, it has been observed that some encroachments began as a sort of shifting cultivation and then turned to settlement and permanent cultivation. This act has a very devastating effect on forests which get fragmented and mutilated. In the southern state of Tamil Nadu, many educational institutions and organizations in Coimbatore district have encroached upon forest lands and blocked elephant corridors exacerbating human - animal conflict, resulting in the death of many elephants.

► Forest fires

Fires are a major cause of destruction of forest areas. It is estimated that most forests suffer burns annually. Most of the fires in the forests of India are surface or ground fires. Crown fires seldom occur and are more commonly reported from coniferous forests in the Himalayas. Sometimes, ground fires are also reported from forests at high altitudes. Nearly 98% of fires in the country are caused by people. Forests are set on fire by shifting cultivators, to induce fresh shoots of grass for cattle and to collect NWFPs (Non-Wood Forest Products). These fires often go out of control and cause massive damage to forest resources.

3.1.3. Biodiversity and conflict

In the wider landscape, conflicts between development and biodiversity arise as a consequence of the over-exploitation of natural resources, bringing about a direct loss of wildlife species and habitats. Equally problematic to biodiversity is the intensification of production systems. In replacing mixed production with monocultures, diverse low input cropping systems are replaced by genetically uniform production systems. Equally damaging to biodiversity are the intensive control measures taken by the modern farming system through the use of hormones against weeds, pests and vermin. Many of these species have useful functions in the ecosystem.

► Resource use conflicts:

Growing tensions are evident in many areas in forest fringes among proponents of alternative forms of land use. Disputes typically arise where natural resources are exploited for commercial gain and where biodiversity is perceived to be harmful to the production process. In India, there are growing incidences of conflict between people and elephants, tigers, leopards, sloth bear etc. The causes of the increasing conflict are instructive as with minor modification they can be applied to many other species. Firstly, the intensification of agriculture and its expansion into areas of land formerly bordering forests have greatly increased the zone of contact between people and wildlife populations. Secondly, the demands on resources of the management authorities in many places have increased, but budgets and staff numbers have declined. Thirdly, the specific reasons why elephants raid crops have not been fully explored, nor have cost effective and non-lethal methods of deterring this behaviour been adequately developed.

3.1.4. Forests of Kanyakumari

Forests are the lifeline, heritage, assets and natural resources of the nation, on which all forms of life depend and thrive. The forests in Kanyakumari district are verdant and virgin and said to be 75 million years old. Of the total district area of 1,67,130 hectares, forests occupy an area of 50,486 hectares which is about 30.2% of the total geographic area of the district, which is second to Nilgiris district with 59% and Dharmapuri district with 38% in the state of Tamil Nadu. Kanyakumari wildlife sanctuary Kanyakumari wildlife sanctuary with adjacent areas of Kalakkad Mundanthurai tiger reserve and Neyyar wildlife sanctuary of Kerala state constitute the southern-most tip of Western Ghats, a biological hot spot and a UNESCO Heritage Centre. The natural vegetation of this region represents biomes ranging from southern thorn, dry deciduous, moist deciduous and semi-evergreen forests to evergreen hill sholas with grassy plains. The tract is exceedingly rich in wildlife and harbours a variety of animals. The avifauna, reptilian and amphibian fauna of this region are also rich and diverse.

In recognition of the tremendous biological potential, Kanyakumari forest division was declared as Kanyakumari wildlife sanctuary in 2002 vide G.O.Ms.No.152 dated 16.07.2002 with an extent of 45,777.57 hectares. Later, in 2007, Kaani tribal settlements, approach road to settlements and area leased out to the Government-owned Arasu Rubber Corporation were excluded from the sanctuary vide G.O. (Ms) No.128 (E&F) dated 20.11.2007 and an area of 40,239.55 hectares was declared as the Kanyakumari wildlife sanctuary.

► Ecological significance

The ecological significance of the Kanyakumari wildlife sanctuary is of paramount importance. The forests serve as a catchment area for 10 reservoirs namely Pechiparai, Perunchani, Chithar-I, Chithar-II, Upper Kodayar, Lower Kodayar, Kuthiyar, Chinna Kuthiyar, Poigai and Mambalatharu. These reservoirs irrigate an area of about 50,000 hectares and feed about 2,500 ponds and more than 500 km. length of channels. The wellbeing of these water systems is closely related to the prosperity of the farmers of the district as the economy of the district depends on agriculture. Hundreds of hill streams collect the rainwater from precipitation in the reserve forest. These streams drain into Kodayar, Paraliyar, Pazhayar and Valliyar.

► Floral significance

The vegetation and flora of Kanyakumari sanctuary are exceptional because of an extraordinary variety of species found within a small area. Kanyakumari wildlife sanctuary is floristically one of the richest areas in India harbouring not less than 3,500 species of flowering plants. The IUCN has identified 11 plant species as critically endangered, 12 species as endangered and 21 species as vulnerable. This indicates the fragile nature of the ecosystem and the unique floral diversity of the forest.

► Geomorphological significance

Kanyakumari forests, though small in area, have as many as 14 forest types according to the Champion and Seth (1968) classification (Table 3.1):

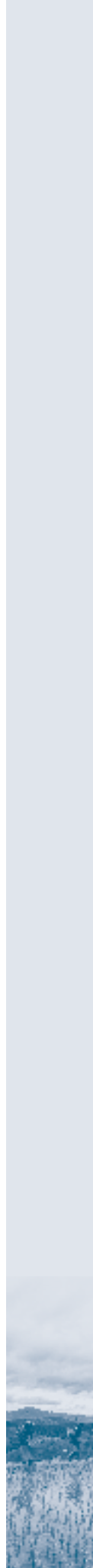


Table 3.1 Types of forests in India

No.	Type of forests	Species
1 1A/C3	Southern hill-top tropical evergreen forests	Calophyllum elatum, Cullenia excelsa, Hydnocarpus species
2 1A/C4	West coast tropical evergreen forests	Calophyllum elatum, Cullenia excelsa, Hydnocarpus species
3 2A/C2	West coast semi evergreen forest	Hopea parviflora, Mesua ferrea, Kingiodendron pinnatum
4 3B/C1 (b)	Moist teak forest	Tectona grandis, Pterocarpus marsupium
5 3B/C1(e)	Slightly moist teak forests	Pterocarpus marsupium, Emblica officinalis, Carreya arborea
6 3B/C2	Southern moist mixed deciduous forests	Terminilia paniculata Albizzia odoratissima Dillenia pentagyna
7 5A/C1 (b)	Dry teak forests	Tectona grandis, Pterocarpus marsupium
8 5A/C3	Southern dry mixed deciduous forests	Anogeissous latifolia, Pterocarpus marsupium, Wrightia tinctoria
9 5/DS2	Dry savannah forests	Mostly grasses like lemon grass
10 6A/C2	Carnatic umbrella thorn forests	Acacia Planifrons, Zizyphus xylopyrus, Cimmiphora caudate
11 6A/C1	Southern thorn forests	Zizyphus xylopyrus, Albizzia amara
12 6A/DS1	Southern thorn scrub	Zizyphus xylopyrus, Albizzia amara
13 8A/C1	Southern sub-tropical hill forests	Zyzygium arnottianum, Vitex wightiana, Actinodaphne hookeri
14 8A/E1	Ochlandra reed brakes	Ochlandra travancorica, Ochlandra brandisii, Ohlandra rheedii

3.2. The Kaani community

The Kaani hill tribe inhabits the forests of Kanyakumari district in 48 settlements in the Western Ghats at the Southern tip of India. The habitat of the tribal people is scattered inside the forest. Traditionally, the Kaani is a semi-nomadic hill tribe which practised shifting cultivation and depended upon the forest for subsistence. They had a high degree of interaction with the forest, ecology and its beings. They are an ethnic group with their own unique social institutions and organizations with self-rule, who prioritised harmonious relationships with their ecology through cultural and religious observations and beliefs.

In earlier days, they lived in treetop houses and caves. Now they live in small huts, built with bamboo and wild grass. The walls are made of flattened bamboo and floors with mud. There are no separate rooms in the huts. The hut has a single room, which is called 'padi', 'kanikkudi' or 'kanipatti'. The hut is devoid of kitchen, windows, ventilation or toilet. The floor is made of mud and smeared with cow dung.



Photo 3.1 A Kaani couple in their hut

3.2.1. Living in consonance with nature

The first thing one notices about the Kaani indigenous people is how they use the natural resources in forests with minimum disturbance. They are nature worshippers and revere the forest and its animate and inanimate inhabitants. They secure their food, fodder, medicines, tools and all other requirements for their sustenance from the forests.

Due to their close relationship with the forests, the Kaani tribe possesses inherent knowledge about animals. The Western Ghats is one of the major habitats of the Asian elephant and the forests in Kanyakumari are considered an elephant corridor. Due to the illegal demand for ivory, elephants often become the victims of poachers. The Indian government is initiating efforts to save the elephants. The Kaani tribal people have an inherent intuition to track elephants. Due to this, the Tamil Nadu Forest Department engages the Kaani tribe in tracking elephants, monitoring their habitat and breeding patterns and vigilantly watching their movements.

3.2.2. Food Culture of the Kaani

The Kaani people get their food by harvesting or collecting forest produce and sharing the food among the community. They collect fruits like jackfruit, mango, edible green leaves, mushrooms, tubers and honey. They cultivate coconut, areca nut, banana, pineapple, vegetables and tubers. Tapioca is their staple food but now they find it impossible to grow it as the tapioca crops are raided by wild animals. Deforestation has resulted in less forest space to be shared between the tribal people and animals.

They depend heavily on the monsoon rains for agriculture and do not have any other type of irrigation for crops. If rains fail, they are forced to refrain from agricultural operations.



Photo 3.2 Red banana cultivated for consumption

The land is fertile, and the people do not use any artificial fertiliser. They do not adopt any pest control. Because their gardens are of a manageable size, large scale attacks by pests – the kind that threaten conventional farms covering vast acres of land – are rare. For common types of garden pests, they use local traditional folk remedies with organic herbal derivatives to keep them out.

3.2.3. Political structure

Earlier the traditional social structure of the Kaani community was that of a highly co-ordinated unit under the control of a tribal chieftain, called the Mootukaani. Traditionally, the Mootukaani combined the roles of the law maker, protector and dispenser of justice, physician, and priest.

A triumvirate, having a headman named Mootukaani, a secretary called Vizhi-kaani and a physician named Pilathi, governed the tribal community administration. The triumvirate administers the community in decision making, judgement, punishment, celebrations, rituals, facing the challenges of natural disasters and attacks by wild animals and maintaining the integrity and cohesion of the community. They solve their own problems, issues and disputes. They do not allow outsiders to interfere in their problem solving nor do they seek their aid. Major decisions are made at the community level.

However in due course of time, the traditional system of governance in the Kaani community has been gradually eroded to a large extent and the role of the tribal chief is only a token one. Their day-to-day activities and system of governance today are linked to that of non-tribal people who live in and around the forest fringes. This system of governance, referred to as the Panchayat Raj system, is based on the principle of devolution of administrative powers to the local village level, dependent on democratic principles and has been institutionalised under the Constitution of India.

The tribe adopts an egalitarian value system. No one claims a superior status, nor does the community allot a superior position to any one based on social, economic, cultural or educational criteria.

The Kaani people are not swept away by the mainstream culture of modernisation and sophistication as the tribal settlements are far away from the din and bustle of city life. Access to a majority of the tribal settlements is not easy, as they are not connected by motorable roads. Many settlements are located beyond dams so that one has to undertake risky travels in water by crossing the dam, followed by steep uphill treks in forest trails. The huts are not established in clusters, but each one is apart from the other.

3.2.4. Material culture of the tribe

The Kaani tribe is a vast repository of one of the rich cultural heritages of India. Their material culture reveals their deep-rooted perceptions of their culture with a distinct identity of the community. They maintain a traditional culture communicated from their ancestors and keep the traditions of their lineage alive. They have learnt the traditional folk technologies and share their treasure of traditional wisdom through cultural transmission processes.



Photo 3.3 A typical hut of the tribe

Folklore studies of material culture typically address how objects are designed, made, and used, and what they mean on various levels to those who make and use them. Folklorists are also interested in the objects themselves, and in such matters as their shapes and dimensions, the materials from which they are made, their decorative elements, and the variations among different makers and groups, as well as variations over time and place. In general, folklore studies of material culture have favoured handmade objects and craftsmanship itself has been a special focus.

3.2.5. Animistic worship

The existence of the nature, man and spirit continuum is reflected in the life of the Kaani tribe. The living consciousness of spirits in nature allows them to have a different perspective from those of other communities. They believe in the invisible spirit or supernatural powers and refer

to the spirits as deities and have names for them. Animals, ponds, trees, rivers, stones, cliffs or mountains are abodes of spirits. The tribe lives constantly under the watchful eyes of spirits. The veneration of ancestors finds a very vital place in the tribal religious belief with strong faith in malevolent and benevolent spirits. They plant a tree at the grave of the dead and maintain sacred groves in the forests and firmly believe that any one damaging a tree in the grove will be doomed forever. They perform rituals led by the priest-magician of their clan to avoid animal attacks, perform rituals to safeguard themselves from animals and to ward off ailments and diseases.

For fertility, they symbolically display cycus leaves (*Cycus circinalis*), ulathi inflorescence (*Caryotaurens*), areca-nut bunches, bunches of bananas and tender coconuts.

They strictly believe in the ethics of conservation and are against destruction, disruption and devastation. They maintain certain taboos, for example, the belief that consuming cow's milk would incur the wrath of God as the cow is revered as a sacred animal.

Some specific plants that are considered sacred are grown by the Kaani tribal people in the vicinity of their houses and temples, for example, *Ficus bengalensis*, *Ficus religiosa*, *Mangifera indica* and a host of others.

Rituals have a major role in environmental ethics among the Kaani tribe. They maintain religious or ritual representation of resource management. Before cutting a tree, they perform a pooja, led by the clan's priest-magician Pilathi to the spirits with the belief that they are killing a tree with a life and the spirit residing in the tree should not avenge itself. While constructing a hut with forest wood, they perform another ritual led by the Pilathi so that the spirit allows the inmates of the hut to live in peace and harmony.



Photo 3.4 The priest- physician Pilathi performing a ritual with his assistant

3.2.6. Ethical consumption

Religion has a strong role in restraining consumption patterns of the Kaani tribal people such as abstinence from consuming cow's milk. The cow is regarded as a sacred animal in India and extracting its milk as food is a great sin against God. They ask a pertinent question: Is it fair on the part of humans to consume God's milk? They do not consume beef as they believe that eating God's meat is an equally great sin against God. They are not in the habit of domesticating cows. They are meat eaters, but not beef eaters. Most of the Kaani tribal people abstain from consuming wild pork, as wild boar is not a clean animal as it forages in dirt and in muddy areas.

Indigenous traditions closely tied to their bioregions for food, and material resources for clothing, shelter and cultural activities, tend to have their environmental ethics embedded in their views. Ritual calendars are derived from the cycles of nature, such as the appearance of the sun or the moon or the seasonal return of specific animals and plants. Indigenous communities have a very light environmental footprint compared with industrial societies. The Kaani people tenaciously cling to environmental ethics and ecological prudence amidst the current environmental stress to save the rich environmental heritage and biodiversity of the forests.



Photo 3.5 Kaani girls collect wild cashew fruit

3.2.7. Linguistic diversity

Any peoples' language is influenced by the peoples' physical environment. Conservation biology needs to be paralleled with conservation linguistics. The Kaani community has a dialect called Malam-pasha (language of the mountain people) or Kaani-pasha (language of the Kaani people). Many of the names of places bear references to biodiversity, such as Keeri-Paarai (Mountain of Mongoose), Pura-villai (Garden of Dove) and the proverbs also bear relevance to biodiversity, for example, pannipola urangatha ("do not sleep like a boar"), nina-puli-pidichin-athu ("behave properly, or the tiger will attack you").

3.2.8. Material culture

The objects and technologies required to make the materials of human requirements formed linkages between life and the surrounding environment. The mastery of primitive skills comprises two factors – the method and the technique. The method is in the mind and the technique is in the hands. Method is the logical manner or set of systematic and orderly processes, using a preconceived notion.

It is based upon the obvious premise that the existence of a man-made object is concrete evidence of the presence of a human mind operating at the time of fabrication. The common assumption underlying material culture research is that objects made or modified by humans, consciously or unconsciously, directly or indirectly, reflect the belief patterns of individuals who made, commissioned, or used them, and by extension, the belief patterns of the larger society of which they are a part. The Kaani tribal people live in accordance with the rhythm of nature and secure everything from the forests for their livelihood and material needs. The materials go down deep into their inner recesses leading to a strong communion with nature and a sensed knowledge of their ancestors. The culture is passed on from ancestors to posterity through practical exercises and the present generation acts as culture-bearers.

They use a collected assortment of traditions and technologies with tools. They have created tools and innovations, an inevitable human need for their survival. The material culture refers to the totality of physical objects made by a people for the satisfaction of their needs; especially those articles requisite for the sustenance and perpetuation of life.

A host of such materials are used to drive away wild animals that raid and destroy their agricultural crops. The tools reveal the relationship of the tribal community with the range of environments they face and experience.

The population pressure of man inside the forests by way of rubber plantation workers with their residential quarters, roads and other infrastructure facilities for residential areas, vehicles for transportation of man and materials, hydroelectric power stations, a host of private plantations, research plantations, and unplanned eco-tourism heavily contribute to habitat disturbance of wild animals in the Kanyakumari forests. The human population on the forest fringes also exerts severe stress on forests and they rely on forest resources as they secure most of their needs from forests.



Photo 3.6 A Kaani tribal person using a bamboo canoe for transport

3.2.9. Ecological imbalance and animal conflict

Owing to ecological imbalance, there is imbalance in predator-prey ratio in the wild and population of some specific species of predators such as tiger, panther, hyena, Indian wild dog, small fox, wolf, snakes has drastically dwindled while the population of some prey species has exploded such as wild boar, bonnet macaque, sambar, langur, porcupine and hare. The population explosion of the latter has resulted in severe destruction and wreaked havoc upon agricultural crops.

The current pace of forest land conversion for non-forest activities and monoculture plantations of rubber in Kanyakumari forests deprives wild animals of wild fruits, tubers, wild jack fruit, wild mango, nuts, greens, Naval (*Syzygium cumini*) and Aiyini (*Artocarpus hirsutus*) in the wild. A high degree of habitat disturbance is experienced by the wild animals such that they are forcibly pushed out from their own native habitats in the wild to agricultural areas for foraging and to satiate their food and water requirements.

The prevailing drought conditions, drying of water resources in the interior forests, truant monsoons, the impact of global warming coupled with climate change severely aggravate the human versus animal conflict.

► Tools to combat wild animals

The Kaani indigenous community has traditionally developed many tools to combat wild animals that raid their agricultural crops. Some of the tools to chase out wild animals are listed here.



Photo 3.7 A tribal person with Adi-udukku

Kudukkai: This is a piece of bamboo about three feet long with a reaper measuring one foot attached at the middle, tied to a string. When the tool is in operation, the attached wooden piece strikes the central bamboo making a noise that scares the animals and causing them to leave the agricultural fields.



Photo 3.7 A tribal person with a Kudukkai

Kal-Vil (Stone Bow): This consists of a bow with two strings and in between the strings at the middle, they are united. In the strings, for a length of about two inches, there is a rectangular space covered with woven thread, where a stone can be attached. Instead of an arrow, a round stone is used. This bow is used to chase away monkeys and squirrels that destroy crops during the day.



Photo 3.8 Kal-Vil (Stone Bow)

Nanthini: This is a bamboo tool that serves to eliminate animals from agricultural areas, by making noise during the day and at night. It is made of bamboo measuring three feet, where part of the top portion is cut off. Down below, a small area is left and below that an area of one inch is cut off and removed. When the user strikes the top portion with two sticks each measuring one foot, it makes a noise that scares the animals.

Participating in the discussion workshop and exposure program on 'ILK and Sustainable Forest Conservation' by the Kaani indigenous people of Kanyakumari Forests, R. Madhavan Kaani, 78, a senior clan leader of Padu-paarai tribal settlement, said that owing to ecological imbalance, the population of specific species like monkey, wild boar, porcupine and sambar have increased, and these animals destroy all the agricultural crops throughout the year without any check.



Photo 3.9 A tribal person with Nanthini

C. Appu Kaani, 66, another senior leader of Cherukadathu-kaani settlement, said that the dwindling population of the predator species such as tiger, leopard, hyena, and wild dogs and the local extinction of fox and wolf have negatively impacted forest ecology causing an increase of prey population and called for the proper conservation of these predator species.

P. Sahadevan Kaani, 52, of Chacka-parai settlement detailed some of the traditional knowledge to drive out animals from agricultural fields. He highlighted that the menace and destruction of the various wild animals caused them to refrain from agricultural practices in some of the areas in the forest and depend on the government supply of rationed rice for their livelihood. If the present situation prevails, he feared that the future of agriculture in the community might be questionable.

S. Kumar Kaani, 48, of Vellambi settlement, said that the wild boar is a great threat to the Kaani people in their farming, that wild boars dig the wet soil and eat away the earthworms. Earthworm is a friend of the farmers and if the earthworm is destroyed, it will result in reduction of the soil wealth and have a detrimental effect on composting of dead vegetative matter.

Mundathi Kaani, 89, of Vellambi settlement, a senior woman advisor of the clan, said that drought, water scarcity, failure and truancy of monsoons as well as forest destruction forced the wild animals to seek food and water in tribal residential areas and destroy the crops. The restrictions of the Forest Department in using forest resources add to the existing woes in their life.

The indigenous people revealed the following ILK aspects in the Dialogue sessions.

► Chasing Elephants:

The Kanyakumari forests have about 72 elephants in seven or eight matriarchal groups. Over the past five years, five people have been killed by elephants and about 20 were injured.

The Kaani people use stone bow, fire and beating of drums using old tins to make noise to chase the elephants away from their area.

► Sloth Bear:

Sloth bears, which live in higher elevations, are nocturnal animals that eat their favourite delicacy, jack fruit, and invade the jack trees during the jack fruit season from April to June.

They also eat domestic honeybee nests and the bees. Therefore, the tribal people, who domesticate honeybees, have to keep them at lower elevations and the people residing in higher elevations are not able to culture honeybees. The population of sloth bears is more than 500.

► Wild Boar:

Wild Boar is a perennial threat to the agriculture of the indigenous people and to their residential areas. The population of predators such as tiger, leopard, hyena as well as snakes such as cobra, king cobra and vipers has drastically dwindled, and consequently the population of wild boar has proliferated. Wild boars number more than 30,000. Making noise by sitting on top of rocks using metal tins and packs of trained country dogs to chase the wild boars are the ILK concepts of deterring agricultural raids by this species.

► Monkey:

Monkeys are a severe destructive threat to the indigenous forest dwellers. They destroy all agricultural crops and invade the huts to take away anything and everything. They make terrestrial and aerial attacks on crops, fruits and all harvests. Their population has registered very high numbers due to ecological imbalance of predator versus prey ratio. As the population of predators such as tiger, leopard, hyena, fox, wolf, cobra, king cobra has decreased, the prey population has drastically proliferated with a population of more than 30,000.

Using a stone bow, the tribesmen drive out the monkeys. They make a noise using the noise producing tools described above to chase them out from the fields.

They also use dried fish and banana in an earthen pot. The monkey takes the banana along with the dried fish, smells the fish and discards it. It rubs its palm to remove the remnants of the dried fish and tries to get rid of the obnoxious smell by rubbing its palm on a hard, rough, uneven surface such as a tree bark or a rock that causes injury to the palms. Since it experiences physical injury in the palm, the whole group of monkeys will avoid revisiting the area in future.

Alternately, the top of a tender coconut is sliced open leaving a small hole and it is kept in a place that the monkeys frequent in the agricultural fields. The monkey puts its paw into the coconut to extract the kernel. It may not be successful in the initial attempt and struggles to pull its paw out, thus getting scared and trapping its paw in the coconut. After some struggle, it pulls its paw out and avoids the area for fear of risking an injury to the paw again.

Packs of trained country dogs are also used to chase away the monkeys.

► Sambar and Barking Deer:

Sambar and Barking Deer invade the agricultural fields at night and destroy the crops. The population of the sambar is about 4,000 and that of barking deer is about 3,000.

To chase these timid animals, a noise is made.

Fencing made of thin bamboo and discarded twigs also prevents entry into the agricultural farms.

Packs of country dogs are used to chase them.

► Tree Top Huts:

Bamboo Huts are constructed on huge treetops to avoid the threat of and conflict with wild animals, especially during the nights. There is every possibility of the wild animals entering into their small, unsafe, unlocked huts and attacking them. Residing in treetops is a safe way to avoid confrontation with wild animals at nights. Presently, the tree top hut culture is vanishing.

► One-leg bamboo ladder:

The Kaani people live in tree top huts to avoid conflict with wild animals. A one-leg bamboo ladder with side branches of about one foot is used to reach the tree hut. After reaching the hut, the ladder is taken up the tree. When the occupants of the hut want to climb down, they use it. When any person climbs on a two-legged ladder, there is every possibility of a sloth bear or a leopard following the person by climbing on the ladder. However, the one-leg ladder is not viable for the animals to climb as it has only one bamboo.

► Use of Maadam:

‘Maadam’ is a word in Tamil language, meaning a small, low roofed hut. This is made of bamboo and forest wood with roofing made of forest grass and it is usually open on all the four sides.



Photo 3.10 A maadam

Usually, it is constructed on higher ground to monitor the movement of animals. In a majority of cases, it is constructed near a rock, so that if any wild animal chases people, they can climb the rock to avoid the attack. People stay in the maadam at night to monitor the movements of wild animals with the objective of driving out animals that raid their crops.

3.3. Impacts of ILK on sustainable conservation

The Kaani people help the Forest Department when elephants, sloth bear or any other animals enter the residential villages or forest periphery by chasing the animals using ILK tools. Forest laws are very strict and implemented with a good spirit that supports conservation and the Kaani community sincerely obeys the forest laws and co-operates in conservation activities.

The indigenous people are animists and do not harm the animals. By adopting ILK, crop raiding animals are not harmed and thus the Kaani people help in forest conservation.

The Kaani people serve as informers for the Forest Department. Entry into forests for non-tribal people is strictly banned and any illegal intruder is penalised; this helps to reduce human footprint in the forests, which helps in conservation. The tribal people alert the Department if any one intrudes into the forest for hunting or poaching or to plunder forest resources.

3.4. Negative Drivers

- ▶ 1. As entry into forests is restricted, indigenous people are not able to collect minor forest produce.
- ▶ 2. The traditional way of fishing is banned and they are unable to fish in dams and are thus deprived of their traditional fish food. Dams are leased to private people for fishing. 3. As using forest resources is prohibited, they have to buy all materials required for housing and other activities, often travelling to towns far away, incurring costs of materials and transportation which impacts their poor economy.
- ▶ 4. The destruction and devastation of crops by animals deprives the indigenous people of their livelihood and of their basic sustenance that ultimately results to starvation and penury.
- ▶ 5. Global warming and climate change have a severe impact on agriculture through failure and trunacy of monsoons, water scarcity, drought conditions and by the constant crop raids by wild animals.

3.5. Suggestions:

- ▶ 1. The Kaani indigenous people can be encouraged to grow alternative crops that are not invaded by animals.
- ▶ 2. Alternative job opportunities can be created with self-employment schemes.
- ▶ 3. Eco-tourism can be promoted: for example, boating, trekking and supply of indigenous traditional, organic food to eco-tourists in dams with the permission of the Forest Department.
- ▶ 4. Agriculture can be promoted by having proper fencing for protection from wild animals.

- ▶ 5. The Kaani tribal people can be made partakers in conservation along with the Forest Department and NGOs.
- ▶ 6. Apiary and banana plantations with adequate protective measures can be promoted for their livelihood and to raise their economy.
- ▶ 7. Herbal gardens with nurseries that accommodate plants that are not raided by animals can be promoted as a commercial venture to boost their economy.

The Kaani tribe is inevitably facing gradual transition in all aspects of life. The forces of globalisation, free trade and the present communication revolution are making indelible impacts on their lives. The impact is felt more severely on the younger generation who are not interested in their culture. Acculturation and cross-culturalisation occur now. Consequently, erosion and dilution of traditional ethics and values espoused by their ancestors is observed, and this is why documentation of the culture of the Kaani community is vital. It is suggested that their pristine culture be documented to record a rich repository of cultural heritage of an indigenous community in India.

3.6. Documentation of indigenous knowledge and benefit sharing mechanism

The Kaani indigenous community is aware of the anti-fatigue properties of the Arogyapacha plant, *Trichopus zeylanicus* ssp. *Travancoricus*, which they eat during long treks in the hills. The tribal physicians have knowledge of ethno-botany and they pass it on to the next generation through oral transmission.

In 1987, a team of botanists came across this herb, when they went for a field survey in the forest in the Western Ghats, when members of the Kaani tribal community accompanied them. The team observed that the men ate some fruits that kept them energetic and agile; the team members were later offered these fruits during arduous trekking and upon eating them, they experienced renewed energy and strength. The team asked them about the source of the fruits, and after much persuasion and assurances that the information would not be misused, the Kaani people finally showed them the fruits.

Later, Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) produced a scientifically verified and standardised herbal formulation for its reproduction by crushing the plant's leaves and combining it with three other plants. JNTBGRI named this formulation "Jeevani," which means "giver of life." The product is available in the form of granules and is mixed with hot water or milk.

With an interest in helping the Kaani people through a benefit sharing agreement, Dr. Pushpangadan wanted to secure financial gains for the Kaani people. The committee chose a pharmaceutical company based in Coimbatore, India, to be the primary manufacturer, and in 1995, they signed a seven-year licensing agreement with JNTBGRI.

Recognising the rights of traditional knowledge holders can make a significant impact on economic and social development. Intellectual Property (IP) protection is one of the most important tools through which this recognition can come. Even before the patent applications based on Arogyapacha were granted, they yielded strong financial gains, half of which was shared with the Kaani people. As this case reveals, the effective use of IP with benefit sharing agreements can help to foster development for traditional knowledge holders and their communities.

3.7. Conclusion

Documentation of ILK will help the Kaani community get recognition in society. Strengthening of the traditional institutions is highly necessary as presently they are being swept away by the concepts of globalisation and communication revolution. Capacity building is vital as the Kaani indigenous community is far away from the mainstream society owing to the distance, hilly terrain and dense forests, specific culture, ban of entry into the forests for the common man, low level of literacy, severe poverty, low status of economy and language barrier.

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4. Case Study: Mukkuva Community in South India: socio-religious history and biocultural diversity

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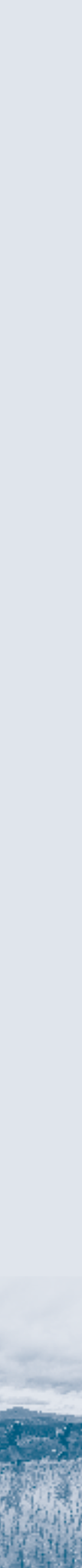
Last but not least, we express our sincere gratitude to the members of the Coastal Students Cultural Forum (CSCF) whose volunteer contributions were helpful in organizing events with Chelaalikkootam (fishermen elder and expert groups) especially, Mr. Jaison John, Mr. Kumar Karumkulam, Mr. Vipindas Thottathil, Ms. Greeshma, Ms. Reshma, Ms. Soumya and others.

Executive Summary

- ▶ In this report, we only consider the most important and relevant information, especially with regard to biodiversity and ecosystem services, although we have collected a large volume of data from the two local follow-up meetings, focussed group discussions and key informant interviews.
- ▶ The socio-cultural traditions and livelihood of Mukkuvar are deeply connected to marine ecosystems like estuaries, coast lines and the open ocean. In order to understand the history

of the Mukkuva community, awareness of marine ecosystem services is essential. There is an inseparable relationship between the sea and the Mukkuva community. The ocean and the marine environment have become an integral part of the history and evolution of the community.

- ▶ The language of the Mukkuvar has evolved through their interconnection with the sea and the marine environment. Their language contains many aspects of the marine environment and marine ecosystems. Acquiring this language is beneficial in order to understand the ecology of coastal areas. Protection of marine biodiversity also influences the protection of local and indigenous languages and vice versa.
- ▶ Livelihood practices demonstrate the unique features of seabed ecosystems and marine biodiversity in the study area. The features include large platform reefs, rocky reefs and multitudes of marine organisms including vast varieties of fish species. This has encouraged the seasonal migration of traditional fisher folks from one place to another, revealing their nomadic characteristics.
- ▶ Imported technologies such as bottom trawling and modern development trends like adakkam kolli vala (one net for all with a large vessel) diminish their traditional knowledge and sustainable living practices. This encourages overfishing and over exploitation of fish stocks and destroys marine ecosystems in the deep sea. However, the Mukkuva community in Trivandrum has resisted and boycotted bottom trawling since its introduction in the 1960s. The community does not own any bottom trawlers and discourages community members from using the ring seine and purse seine as they are destructive methods of fishing.
- ▶ The indigenous technologies developed by fishermen promote the sustainable use of marine resources and protect and promote marine biodiversity through their environment-friendly fishing techniques and through the building of artificial reefs to compensate for the destruction of natural reefs by fishing techniques such as bottom trawling.
- ▶ The study reveals that they have a deep and clear knowledge and understanding of three essential elements: the ocean, the sky and the seabed ecosystems. This triangular and integrated knowledge of the ocean, astronomy and the seabed ecosystems are essential for sustainable fishing.
- ▶ According to the fishermen, some fishes have already disappeared, many fish species are threatened with extinction, and the numbers of other fishes have been reduced over the years. There are also examples of the arrival of new fish species, invasion of exotic species and the reappearance of some others that were thought to be extinct in their territorial waters. Apart from the depletion of fish stock, the numbers of phytoplankton in the ocean have been reduced; their appearance has been delayed. Irregularity is a key feature. This information is invaluable in documenting climate change impacts.
- ▶ As a result of these changes, they are not able to catch fishes with their traditional fishing equipment and small boats and they are forced to travel to distant places, which is too risky, more expensive and far too inefficient.
- ▶ Due to the human interventions from 'others' and coastal urbanisation by successive Governments made without the fishermen's consent and consultation, the coastal villages experience sea erosion and sea accretion. All these affect their socio-economic conditions.
- ▶ There are issues around Mukkuva community's religious, caste and socio-cultural identity. Influences of colonisation and the Catholic Church are visible at almost all levels of their socio-cultural and religious settings.
- ▶ One of the key limitations of the case study is that the participation of women was limited therefore their contributions are insufficient. Very few experiences of women's livelihood have been collected and collated for this report.



4.1. Background

This report is a case study about the Mukkuva Community from the south-western state of Kerala in South India. It contains the outcomes of two follow-up local meetings that were conducted in Thiruvananthapuram (also called Trivandrum), Kerala, from August-September 2016, in which traditional fishermen (Chelaalikkootam, literally fishermen elder groups or indigenous marine experts) and academics from the coastal fishing communities in Trivandrum and Kanyakumari (a district in the neighbouring state of Tamil Nadu) participated. The local meetings are a response to the UNESCO-IPBES regional workshop held in Chiang Mai, Thailand in June 2016. The discussions were focussed upon the local and indigenous knowledge (ILK) of fishermen with regard to marine biodiversity, the sea and the coastal environment together with their socio-religious history, and cultural and linguistic diversity of the Mukkuva and other related communities.



Figure 4.1 Map showing Trivandrum and Kanyakumari districts of South India

Mukkuva is a traditional fishing community, officially termed Latin Catholic Mukkuva or more recently Latin Catholic, which is a contentious issue. They are mainly located on the south-western coast of India. They constitute 42% of Kerala's traditional marine fisher folk with a population of about 200,000, spread around 30 fishing villages in the capital district of Trivandrum. Kanyakumari, the district bordering the states of Tamil Nadu and Kerala, has 40 fishing villages belonging to Mukkuvar. Until the enactment of India's States Reorganisation Act, 1956 along linguistic lines, both districts were part of the princely state of Travancore. However, the Mukkuva community in both districts of neighbouring states still continue their association with common historical, religious, linguistic and cultural orientations. Most of these villages are densely populated, and have large settlements made up of a series of clusters. They are among the most disadvantaged, disaffected and economically 'backward' communities in the states of Kerala and Tamil Nadu, whose source of living largely depends upon marine fishing and related industries. A unique feature of the Mukkuva community is that their spoken language is different

from the official languages of both Kerala and Tamil Nadu. They speak a mixture of both the regional languages, Malayalam and Tamil respectively. Another key aspect is that the fishing practices of these fishermen are different from those in other neighbouring districts, and are characterised mainly by hook and line fishing that is based in seabed reef-based ecosystems.

4.2. Methods

For data collection purposes of this case study, two main meetings were conducted in Trivandrum, Kerala, South India:

- ▶ with ILK experts and practitioners in the capital city on 24th August 2016 and
- ▶ with the local community representatives from various fishing villages in a local context on 11th September.

The meetings were followed by a focus group discussion on 7th October in which 15 people participated and six key informant interviews were held during the course of the month. Socio-religious history of the community was the main theme of the focus group. All the participants are from the Mukkuva community. Key informants with 30-70 years of fishing experience were recommended by other community members and were intentionally selected. The interviews were conducted individually according to the preferred time and place of the participants. All information was video recorded and relevant notes were taken into account. Ethical procedures were followed. Relevant acknowledgements have been made and confidentiality and security of data has been ensured.

4.2.1. Data Analysis

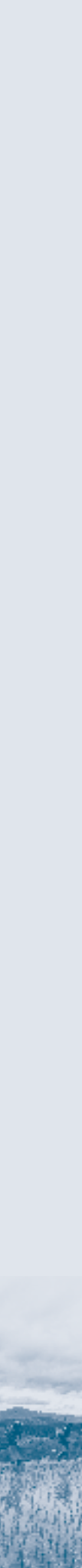
The data were collated and coded according to the thematic framework that was initially developed for the purpose. As the database was huge and larger than expected, this report contains only the most important and relevant information on livelihood practices, socio-religious history, language and ecological knowledge of Mukkuva community in South India.

4.3. The Mukkuva community and ILK

4.3.1. Socio-religious History

The earliest record of information from ILK experts suggests that all the South Indian inhabitants were grouped into five geographical landscapes; one of them is seashore or neithal where the people's main occupation was fishing, export business and related activities. The word Mukkuva is considered to have originated from mukku which means tip or corner in both Tamil and Malayalam languages. The people who live in the corner or the tip were known as Mukkuvar; they were concentrated in a particular and more isolated locality. Some coastal historians attribute their origin with reference to Araya-Dravida Civilisation.

The focus group data show that the origin and history of the Mukkuva community is related to ocean ecology and marine environment. There is a strong and deep interconnection between the Mukkuvars' settlement in the coastal areas and their marine environment and seabed ecosystems. Representation from the village for the study suggests that the origin and formation of each village is related to this interconnection with the sea and its bountiful resources. According to their marine expeditions, the discovery of new ecosystems for fishing purposes or seasonal



changes, they expanded their settlements and started to build temporary houses near the coast. They considered the sea and open beaches as their common livelihood areas, so they did not own them privately; as they commonly believe that the ocean would be there always as would they. The participants view this as one of the many reasons for their varied and different culture and economic practices such as poor saving and extravagance which has now become a huge problem for their survival. At the same time, people living in estuaries, promontories and cliffs have a different culture and history. All these suggest that ecological understanding is necessary when documenting human history.

Though there were a small group of native coastal communities in these villages, a higher number of the present dwellers have commonly originated from Kanyakumari district of the present Tamil Nadu state. This emphasises the fact that both Trivandrum and Kanyakumari coastal districts have a common origin and ancestors in line with the specific features of the near-in shore and deep sea marine ecosystems in these two districts. Better understanding of this may lead to ecological perspectives of human history - how people and nature are connected. Such a discussion was one of the highlights of the focussed group discussion. However, the shoreline changes caused by both natural and largely coastal constructions negatively influence the socio-economic conditions of the people here. Some villages lost their beautiful and long beaches.

A vast majority of Mukkuva community members in the study mainly practise Christianity, predominantly Roman Catholic traditions, regionally termed as the Latin Catholic rite. A mass religious conversion movement initiated by the Portuguese Christian missionaries during 1600s under the leadership of St. Francis Xavier is particularly significant in their religious practices. Most of the Mukkuva villages have some stories associated with the arrival of St. Francis and his religious mission. Since then, they became part of an organized Catholic religion. Even after India's Independence up until 1955, a larger part of the Mukkuva community was controlled by the Portuguese Padroado system, according to the focus group participants. The system did not promote local and indigenous priests and the first local priest was selected from the richest family in one of the coastal villages. Most of the educational and health institutions were established only after the ordination of the local priests. There is a presence of sub-caste identity within the community which is directly linked with the history of their religious conversion. For example, some villages were known as sub-stations to the main village which was already a Christian village; there were limited inter-marriages between these different groups though these aspects are changing these days. There are also stories associated with signs of Christianity well before the arrival of European missionaries.

However, it does not mean that they have completely stopped their indigenous and traditional religious practices. They still believe in black magic, supernatural and inanimate beings, spirits and other extra-terrestrial forces. They worship natural forces and legends; Kadalamma or the Mother Sea/Ocean is worshipped and her blessings are sought for safety in the sea and abundance in fishing-related occupations. Even some Christian practices indicate their religious history and tradition. They believe in multiple deities expressed in the form of worshipping and celebrating saints and have preferences for believing particular deities while not excluding or disbelieving others and the love of a personal god or representational god is evident through their practice of pathukaval (village patron saint or sub patron saint) system. They have faith in the possibility of liberation and release (moksha). In their songs and mantras (manthrams), there are some references to Hindu gods, namely, Shiva and others. Lighting a lamp during religious and wedding ceremonies, offering flowers before the images of deities (or Catholic saints), shaving a boy's head to gain the favour of St. Antony of Padua (anthonyarpiritham), pilgrimage to Velankanni (a town with a church holding an idol of Mother Mary) some days after the wedding or expectation of pregnancy, and the rituals associated with cremation of an adult and hosting a feast after cremation are some examples of their Indian ethnic religious traditions.

Currently, the Mukkuva community is controlled and led by the Catholic (Latin) clergy; they represent most of the socio-political and economic forums relating to community affairs

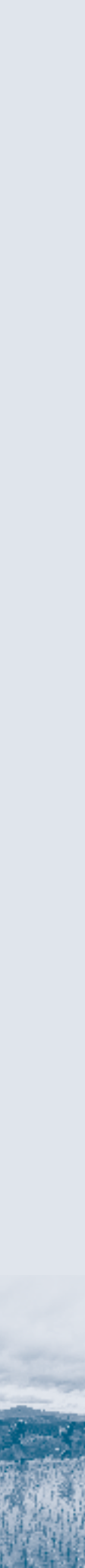
and their support and interests and in some cases their approval is sought after even by the Government and other organizations. Though modern education and English language are promoted by the Catholic Church in the community, some others highlighted the evidence that there were deliberate efforts to discourage education in the coastal communities during the period of Portuguese control. The local village parish priest is the main leader or ex-officio who looks after not only the religious aspects but also the socio-economic concerns of the community including the management of educational institutions. Most of their village festivals are strongly influenced by the religious activities. Belief in many facets of Virgin Mary is a noteworthy feature. Propagation of religion is very high and participation in religious activities is mandatory, so they have become more of a religious community.

However, some community members are sceptical about the concentration of power in the hands of the Catholic clergy and the religious identity in the place of community identity which is closely connected to their ancestral roots. They cited that the Church establishments have not made any efforts to preserve and promote the coastal language and culture; instead they try to demolish them and portray fishermen and their families as 'subaltern and uncivilised people' because of their indigenous characteristics. In many cases, the local church forcefully levies a tax on the fishermen's revenue which is usually 5%. The right to collect tax or the Kuthaka as it is locally known, is auctioned and usually goes to someone wealthy and hands the money over to the local church. (In the past, under the Portuguese Padroado system, another type of tax system, shraapeeli kuthaka, was practised. Shark fins were given to the church hierarchies, and the collection was sent to European administrations; there were stringent punishments if this tax system was not adhered to.) This amount is usually spent on the activities of the local church and construction of buildings that mainly promote religious practices. Although, with strong opposition and resistance, some villages were able to stop such systems since the 1980s, some of the community leaders still fight against this "cruel imposition" or "colonial practice" followed in some villages.

4.3.2. Livelihood Practices and language

Livelihood practices of the Mukkuva community under the case study suggest that they use both net fishing, and hook and line fishing. Hook and line fishing requires a higher level of knowledge, skill and understanding. Their fishing practices show a deeper understanding of seabed morphology, seasonal variations, climatic conditions, astronomical objects and marine biodiversity of fish species. This is particularly the case when they are engaged in many forms of hook and line fishing through locating seabed ecosystems, assessing the underwater conditions and deploying an appropriate method of catching. As their knowledge, skills and understanding of seabed ecosystems improve, a good number of fishermen travel to distant places and innovate in their fishing practices according to their expeditions, at the same time leaving others to continue to engage in their fishing activities in near-inshore areas. This reveals their nomadic characteristics and migratory history. This also suggests that as a community, they both protect traditional fishing and encourage innovations. The hook and line fishing is concentrated on rocky reefs and platform reefs revealing the fact that Trivandrum and Kanyakumari coasts are blessed with these particular ecosystems.

One of the main indigenous technologies of the fishermen is the kanicham or kaniyam. It can be considered as the equivalent of the modern world GPS system and for this, fishermen use a triangular self-calculated method that they assess simultaneously using the reef-based ecosystems (or seabed morphology), pole star (which is known as kaniyavelli, meaning the star for Kanicham) at night or raakanicham which is the term for identifiable objects on land such as hills, mountains, tall buildings or towers during the day. This shows their integrated knowledge of three important natural elements: the ocean, land and the sky. They also build artificial reefs using materials that are naturally available to them, but not using plastic-based or metal-based



materials since they have identified that ocean bed reef ecosystems were destroyed by the use of destructive fishing techniques by 'others'.

4.3.3. Evolution of fishing techniques and fishing equipment

Several types of fishing craft and gear are employed: Catamaram which is made of four wooden twigs tied together with coir ropes used both for sailing and rowing purposes, vallam which is a small boat or plank canoe which is made by seaming together several planks of jungle jack with coir ropes. Vallams are of three types: kettuvallam which is made of large logs of softwood; ottathadi vallam, literally, single wood boat; and plywood or fibreglass boats that were introduced by a Belgian missionary. Outboard engines were introduced in the early 1980s. They also use a variety of nets for surface level fishing according to the size and characteristics of particular fishes - for example, for anchovies they use anchovy net, for sardines, they use sardine net, for bigger fishes, they use different nets. For bottom fishing, they mainly use different varieties of hook and line fishing techniques and long line technique that uses main line with baited hooks attached at intervals by means of branch lines called snoods. This line is made of cotton yarn. The skin and cell saps of local trees are used ensuring appropriate level of temper for the lining. This process is called uthiyiduka in the local language. Tamarind seeds are used to make the sails stronger for sailing purposes. These fishing techniques catch more adult fishes than juvenile ones, protect seabed ecosystems and encourage sustainability. The following changes have occurred in their methods of fishing since the 1960s: nylon fishing nets were introduced in the place of cotton fishing nets, choondakkayar (traditional line) has been replaced by kankoose (troll - the main line), natural bait has been replaced with artificial bait, and sails made of cotton or corduroy 'odupa', have become plastic-based. The process of making the traditional odupa is as follows: first, the korathuni (corduroy) is shaped in a triangular form, then it is dyed with shell bean of tamarind seed and then the sail odupa is ready for use. The fishermen believed that it was not ethically right or that it amounted to cruelty toward the fishes to catch them without offering prey or to cheat them with artificial bait. They also have a history of resisting destructive techniques such as bottom trawling and ring seines.

They acknowledge that there is strong evidence of the depletion of fish species; a number of varieties of fish species has already disappeared, some of them are in the process of extinction, for example parava – trevally (*Lactarius lactarius*) fish. Some fishes are new arrivals in their territorial waters, such as karikkadi, a type of prawn (*Paraphalaenopsis stylifera*), and some others that fishermen used to catch at a depth of 20 metres are now available at about 200 metre depth, for example valaa – ribbon fish (*Trichiurus lepturus*), as seen in Photo 4.1. At the same time, some fish species that were thought to be extinct have reappeared recently. The occasional arrival of plankton has been reduced and delayed: while they used to arrive in the middle of July, in 2016 it was at the end of September. According to the fishermen and community elders, some of these changes have been mainly caused by some imported technologies such as bottom trawlers using Norwegian technology since the 1960s that has destroyed the marine ecosystems as well as licences to foreign ships since 1990s to use the marine resources in the Indian Ocean



Photo 4.1 Types of fishes: left to right parava, karikkadi and valaa

which encouraged over-fishing. Due to these changes, some fishermen have started to use bigger boats, bigger nets and engines with higher horse power to increase their fish catch. They are forced to travel greater distances to search for fish concentrations. These influences are evident in numerous technologies in traditional occupations, in the architectural designs and the nuances of language and the food habits.

4.3.4. Traditional knowledge systems

The Mukkuva community's language has the potential of revealing rich marine, coastal, ecological and biodiversity data. A vast array of words is used to describe waves (kadal), wind (kaththu), ocean currents (valivu), astronomical objects (velli or meen), seabed ecosystems (paaru), directions (for example, mela-north, keela-south) and other ocean-related knowledge.

The waves have many shapes and forms as described by fishermen. They are classified according to their source indicating various definite directions such as melaakkadal (the breaking of waves from north to south), keelaakkadal (the breaking of waves from south to north), nerukadal (the breaking of waves from straight ahead, just opposite to the shore) (Photo 4.2). Usually, waves touch the shore with a 10 second gap, which is known as ottamedu (single wave). Occasionally, two waves come together at a time, which is known as irattamedu or iranamedu (double waves) especially during the rough season (Photo 4.3). During melaakkadal, there is a phenomenon called kadalvaayneettam meaning there is more space between wave breaking and the shore. The fishermen say that these phenomena are commonly caused by winds or wind movements. Sometimes, waves are also caused by the gravitational pull of the moon and the sun; high tides and low tides are called ettam and irakkam respectively. The monsoon waves are rough and can be extremely dangerous. Their terms describe the constant restless motion of sea water. This knowledge is very important to assess the threats and risks for fishing and ocean voyages.



Photo 4.2 (left to right) melaakkadal, keelaakkadal and nerukadal

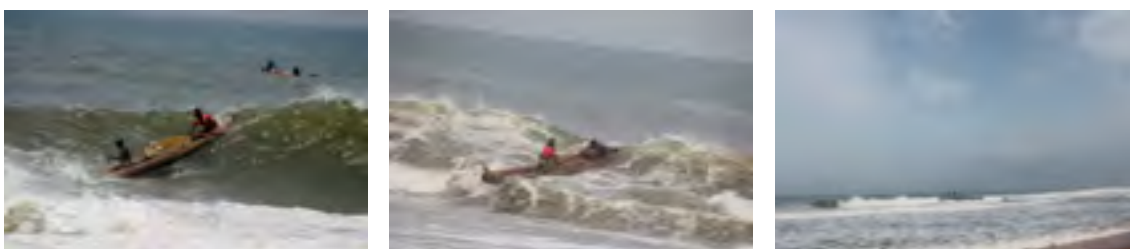


Photo 4.3 (left to right) ottamedu, irattamedu or kadalvaayneettam

The fishermen categorise major winds or wind systems into 8 wind directions: This version of knowledge can vary with different locations. This is according to the ILK of fishermen in Trivandrum.

- ▶ a) koda or karakaatu (towards the ocean/easterly wind or wind that comes from the east),
- ▶ b) kondal or kadalkattu (towards the coast/shore or western wind or wind that comes from the west)
- ▶ c) kachaankaatu (towards south, from the north)

- ▶ d) vadakaatu, (towards north, from the south),
- ▶ e) kachaankoda (towards south-west, from north-east),
- ▶ f) kachaankondal (towards south-east, from north-west)
- ▶ g) vadakoda (towards north-west, from south-east) and
- ▶ h) vadakondal (towards north-east, from south-west).

This is represented in Figure 4.2: Wind Systems. Note that West is indicated at the top instead of the mainstream notation with North at the top of the figure. This is because the sea in this region is to the west of the land, so the fishermen use this to orient themselves. Thus West becomes the 'main' direction and the others are in relation to the West.

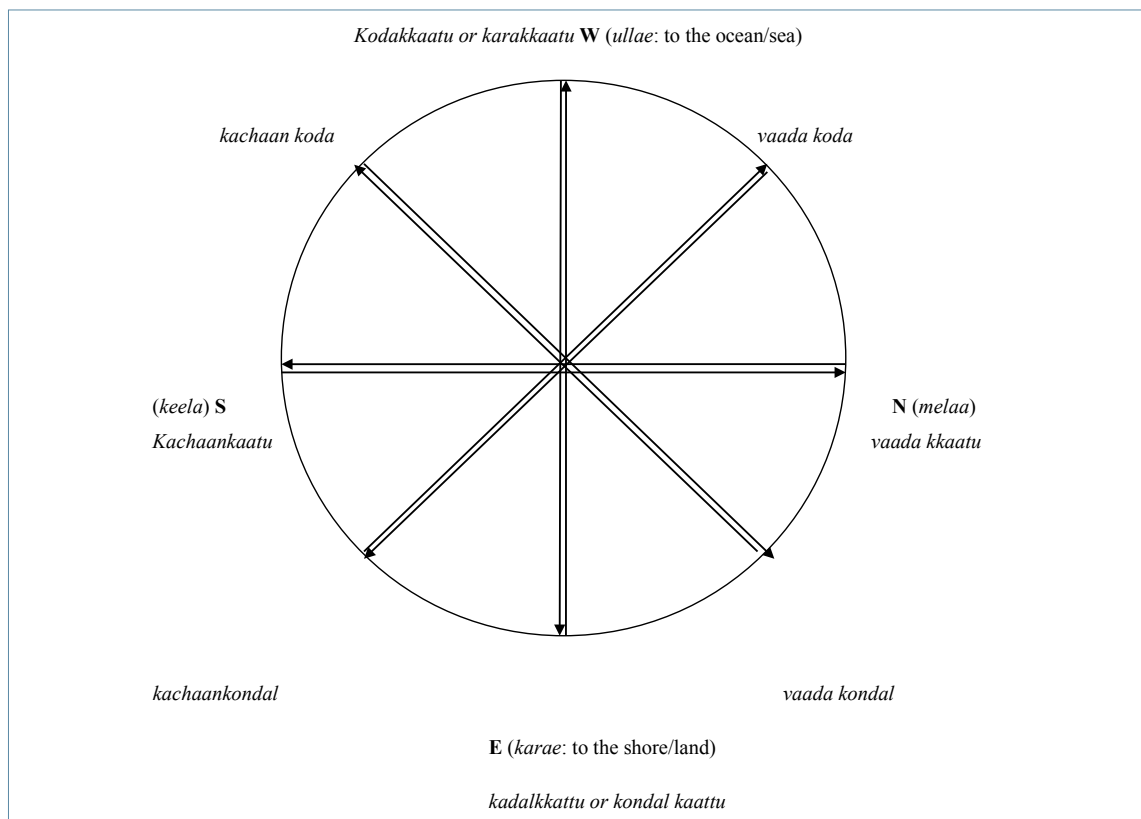


Figure 4.2 Wind systems according to the indigenous fishermen.

The ocean currents (valivu) move mainly in eight different directions:

- ▶ a) unnakke (towards the ocean)
- ▶ b) karayittu (towards the coast/shore/land)
- ▶ c) melaattu or vaadanivaadu (westward/eastwards from south towards north)
- ▶ d) keelaattu or cholaneevaadu, (eastward/northwards from north towards south)
- ▶ e) mela unnakki or vadanivaadu unnekki (from south-east to north-west; towards the ocean)
- ▶ f) melakarayittu or vaadanivaadu karayittu (from south-west to north-east; towards the coast)
- ▶ g) keelaa unnekki or cholanivaadu unnekki (from north-east to south-west; towards the ocean) and
- ▶ h) keelaakarayittu or cholanivaadukarayittu (from north-west to south-east; towards the coast).

Figure 4.3 is a representation of the ocean currents according to indigenous fishermen. Note that West is again at the top of the figure unlike the mainstream notation which has North at the top.

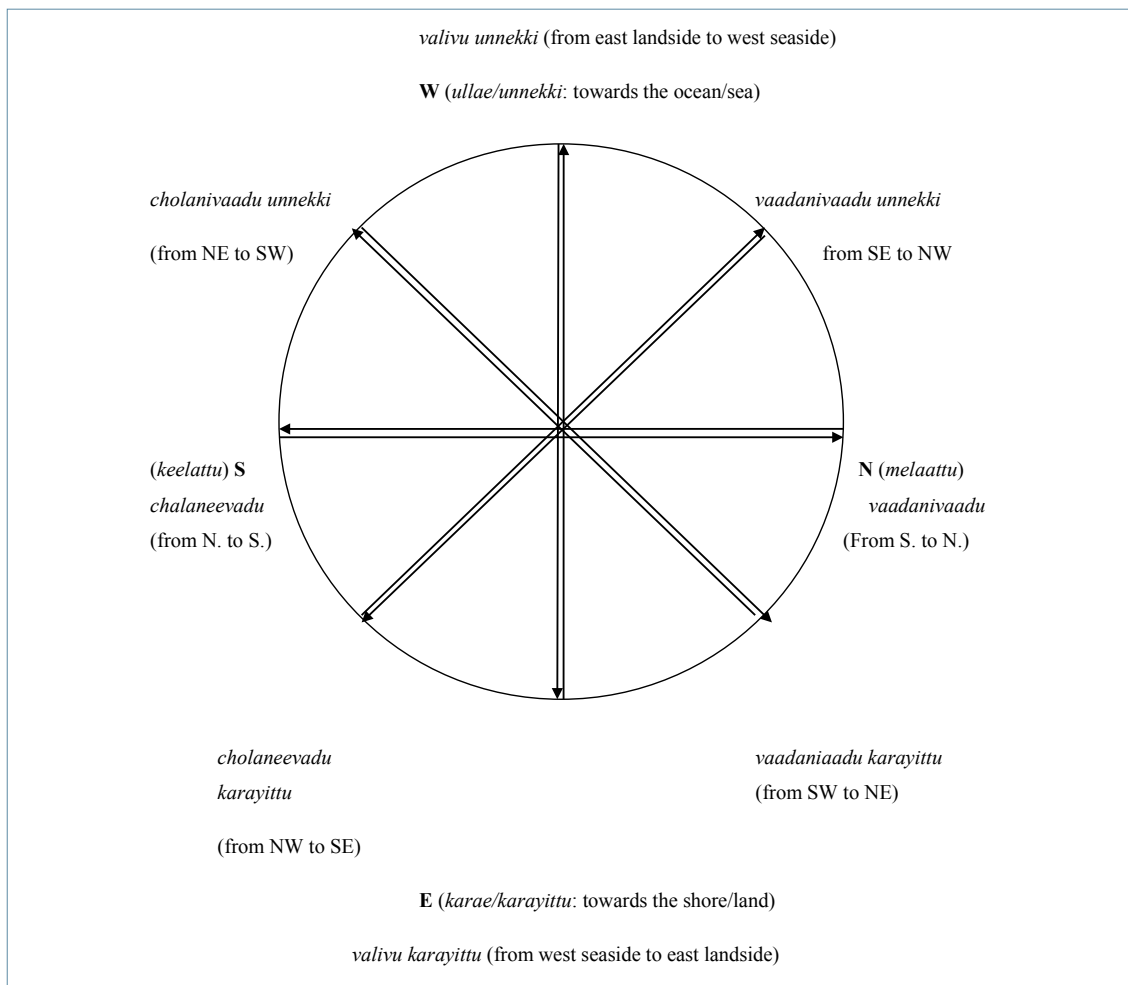


Figure 4.3 Ocean Currents according to the indigenous fishermen

Ocean currents are also keevalivu (deep water currents) and mevalivu (surface currents). Keevalivu and mevalivu can go in different directions and some times in the same directions. If the valivu or water movements are in two different directions, they are known as valivu ivalivappettu. According to the fishermen, wind systems are one of the primary forces that make the water move or cause the motion of the ocean.

Strong currents, when flow of ocean water is stronger than usual, are called uratha valivu. A current which is called upperukkam vachu, flowing from the east to west, is very dangerous for kattamarams that ready for landing on the shore.

Some ocean currents are seasonal: during south-west monsoon (June-July-August or Aani-aadi-aavani: the Tamil Months), south-west monsoon winds move from the west to east (cholanivaadu). During this time, the sea and the coastal environment are comparatively cooler than during other months. This season is known as kuluthi, when the submarine water is the coolest. As a result, deep sea fishes are forced to move to the ocean surface and/or they try to look for warmer weather conditions closer to near-inshore. This phenomenon enables the fishermen to catch more fishes than during other months. The upwelling process is much more visible during these days and that leads to the arrival of karaneeru or planktons. Due to the large presence of planktons, they are able to catch more fishes during this season. Monsoon season is particularly featured with kachaankondal (wind movements from north-west to south-west) and

cholanivaadu (ocean currents move eastwards). However, these are changing since last few years, for example, according to fishermen, the karaneeru which was usually visible in the middle of July, arrived at the end of September in 2016.

Aggregation of plankton is called kadalkkarakal and they are of two types: poonkara and karaneeru. Karaneeru appears in the middle of July and that gives the sign when demersal fishes come up to the ocean surface and deep sea fishes come closer to the shore. The fishermen say that there are changes in the ocean water and ocean temperature and it becomes colder than usual, there is upwelling in the higher stages and other similar factors. During the monsoon season, there is more fresh water joining the sea from estuaries and lagoons with the possibility of higher nutrients. This joins the natural currents in the seabed (near inshore seabed), this process is called upwelling. Usually during this process, more sunlight is discharged and more plankton is produced. When there is presence of more plankton, naturally they attract fishes. This enables the fishermen to catch more fishes. This is the most important and productive season for the fishermen. This understanding enables them to predict the type and volume of fish species and they are able to catch more fishes than usual. January - March is the poonkara season which is marked by the presence of surface water fishes such as tuna, sardine and other similar types. Kavaru (phytoplankton) is another type of plankton that would affect the fish catch: they shine at night in the sea water.

Traditionally, these fishermen's annual season commences with south-west monsoon or Aani-Aadi though the first month of Tamil calendar is chithirai (corresponding to mid April-mid May) and Malayalam calendar is Chingam (August-September). This could be also termed as their season of harvest considering large appearance of planktons/phytoplanktons in the sea and they are able to catch more fishes, but with rough seasonal changes due to impact of heavy rain and strong wind during the monsoon season.

4.3.5. Stars and astronomical knowledge

Aaraameen or Pleiades helps the fishermen to locate the landmark that guides them to find their way back to the coast, malameen or malayaameen or Spica is a star that appears in the sky at around 11 p.m. and 3 a.m. and helps them to identify a particular ecosystem with multitudes of chemeen fishes. Mulakkaameen (muzhakkol) or the Orion belt is a group of 3 stars which rise on 10th Chithira, the first month of the Tamil calendar. This signifies a rough sea and strong wind, and is likely to be very dangerous with risky weather conditions for fishing. They are therefore naturally discouraged from fishing at this time. The sun and the moon influence the ocean weather conditions. During the full moon, the fish catch is comparatively less when the fishermen usually take a break. According to them, this astronomical knowledge is very essential for their livelihood and for helping them to navigate, understand the behaviour of the sea and fish according to weather conditions and reach their original destination and point of departure.

Conclusion

Apart from what has been mentioned earlier, the data suggest that the fishermen also have some other different seasons with reference to the availability of fish production such as keelaameenu (when fishes come from south-west), melaameenu (when fishes come from north-west), thelivunaalu (when water is clear and very few types of plankton are found) and others. People with tremendous knowledge about the seabed ecosystem, winds, seasons, currents, physiological factors, astronomy, behaviour of the fishes and the sea and other such aspects are known as chelaali. The fish catch and income from fishing depend upon the presence of chelaali in each fish expedition or boat.

In short, there is a feeling among the community that efforts should be made to bring back the lost glory of the community including community cohesion and unity and therefore more such discussions and dialogues should be held. Most of the areas that have been identified under the study would benefit from further research. The study encouraged participants to work collaboratively to document and disseminate the unique origins as well as the varied and different cultural and occupational practices of the Mukkuva community. On such efforts, one issue identified was that there is a high brain drain from the community. This means that some people who are able to make contributions are motivated to leave the community as they are not happy with their indigenous identity. One of the key limitations of the study is that contributions from the fisher women were not collected. This is another area for future studies.

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5. Traditional knowledge-based conservation and utilisation of bioresources by war Khasi tribe of Meghalaya, India

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Abstract

The survival of mankind depends upon the availability of bioresources and their judicious utilisation. Indigenous peoples across the world have evolved their customary policies, principles and practices on conservation and utilisation of bioresources based on experiential learning, and the associated knowledge was passed on from generation to generation mostly through word of mouth. Northeast India is home to more than 200 tribes who are almost fully dependent on bioresources for their livelihoods. A number of these tribes hold a vast body of knowledge related to the management of bioresources. This paper documents the practices followed by War Khasi tribe of south Meghalaya, India, for conservation and utilisation of bioresources. People belonging to this tribe nurture bioresources in the vicinity of their habitations, near water sources, on the steep slopes and other ecologically sensitive lands. The maintenance of sacred groves, village restricted forests, village supply forests and clan forests in almost every village is an example of forest management which is need-based and qualifies all scrutiny of modern scientific forest management. Traditional fishing, bird harvesting, water conservation and health care practices also seem to be based on sound ecological principles. However, rapid population increase and expanding demand of cash income have put tremendous pressure on bioresources and, based on the results, it can be said that conservation of bioresources in future may not be possible unless appropriate governmental policies are framed for this purpose, based on indigenous and local knowledge.

5.1. Introduction

Bioresources include all products and services emanating from the natural environment that satisfy the needs and wants of humans. The survival of mankind depends upon the availability of bioresources and their proper management. Overexploitation of bioresources by growing population has given rise to many environmental problems that humanity is facing today. Destruction of vegetation has resulted in land degradation, denudation, soil erosion, landslides, floods, drought and distorted ecosystem processes. Traditional resource management systems are considered unbiased and often ensure equitable sharing of benefits from forests and other natural resources (Nongbri 2003; Fitzpatrick 2005; Hunnam et al. 1996). India is bestowed with rich reserves of bioresources and forests are among them. For generations, these forests have been

managed by the indigenous and local communities to enhance productivity and maintain their integrity. The practice of setting aside areas for the conservation of bioresources can be seen in several examples of sacred groves, royal hunting forests and sacred gardens (Gadgil et al. 1993). These practices involve a variety of restraints on harvesting in term of quantity, locality, season and age, gender and social class (Gadgil et al. 1992). Norms are set up for the use of these resources by community institutions. These institutions regulate the use and preservation of bioresources like forests through decentralised community control systems (Krishnan 2000). In all, prudent use of the resource was practised which served as a common good for the communities who in turn shared common interest and understanding towards the sustainable use of the resource. The practice of management of forests by indigenous people in the state of Meghalaya has been recently documented by Overlack et al (2015) and Tiwari et al (2013).



Photo 5.1 A bird's eye view of forest gardens of War area of Meghalaya

In the hill region of north-east India, large tracts of lands remained under the control of local communities. Several communities continued to manage their forests through community institutions (Poffenberger 2007). Like many indigenous communities, the War tribe of south Meghalaya has a long tradition of natural resources conservation based on customs and religious beliefs which have been passed on from one generation to the other. These communities set aside patches of village forests for religious purposes under the traditional land tenure system (Gurdon 1975). Traditionally, such forests are called Law Kyntang and Law Lyngdoh. Ethnic groups across the globe possess tremendous amounts of traditional knowledge (TK), most of which are poorly documented and hence are largely unknown. Meghalaya, situated in the northeastern region of India, is a treasure house of TK on various disciplines including flora and fauna. Traditional knowledge has been reported on healthcare, fisheries, forest management, pest management, etc. (Tynsong and Tiwari 2008). Such knowledge still remains largely unreported especially from the northeastern region of India. Recording such knowledge is crucial before it gets lost forever in the rapid drive of modernisation and globalisation. The role of TK in meeting the larger goals of biodiversity conservation and understanding the impacts of climate change at small scales is gaining importance in current mainstream conservation paradigms. Overexploitation, in

conjunction with intense habitat transformation, represents one of the main worldwide threats to biodiversity. In the tropics, this problem acquires greater significance due to overlapping of high biodiversity with high human population and the greater dependence of humans on bioresources for subsistence and profiteering. Hence the threat is not only to biodiversity but also to the large number of people who depend on bioresources for their survival and subsistence (Tynsong et al. 2009). The present research was undertaken to document and discuss the traditional knowledge associated with conservation and utilisation of bioresources by the War community of south Meghalaya.

5.2. Study Area

The study was conducted in south Meghalaya, India, locally known as the War area. The area is located between 25°6'25"-25°18'29" N latitude and 91°57'38"-92°1'26" E longitudes (Figure 5.1). The surveyed villages included: Lyting Lyngdoh, Mawkria, Mawlat, Mawpran, Mawshun, Mawriang, Myllat, Nohron, Nolikata, Nongkhlieng, Nongkwai, Nongsder, Pongtung, Pynursla, Ranikor, Siatbakon, Umkrem, Wahumrem, Wahlakhiat and Wahlyngdoh. Cherrapunjee-Mawsynram plateau, one of the wettest places on earth, is located in this region. The altitude of the study area varies from 10 m to 1200 m asl. The mean annual maximum and minimum temperature is 23°C and 13°C respectively. The mean annual rainfall is 11,565 mm. The slope of the area is predominantly towards the south and the angle of the slope varies between 100 - 400. The area has a large number of rivers and rivulets, which drain into the plains of Bangladesh. At times, narrow and deep river valleys separate one hill range from the other. The population density is sparse. Horticulture, forestry and fisheries are the principal occupations of the people. Agriculture is limited to some small valleys where mainly tuber crops are grown. Arecanut, orange, betel leaf, jack fruit, bay leaf, honey and broom grass are the important produce of the region. The area is inhabited by War Khasi people, a tribal community with a long tradition of forest conservation. People gather a variety of edibles from the water bodies found inside and near the forests, such as fish, frogs, crustaceans, molluscs, bush meat, tubers, wild fruits, medicinal plants and wild vegetables. The staple diet of the local inhabitants is rice, fish and meat. People collect, process and market a large variety of non-timber forest products (NTFPs) and medicinal and aromatic plants (MAPs) such as *Cinnamomum tamala*, *Piper peepuloides*, *Phrynium capitatum*, bamboo, honey, mushrooms, nuts, tubers, edible worms, insects and leafy vegetables from the forests (Tiwari 2000). Farmers of south Meghalaya have developed a system in which arecanut groves are deliberately and intensively grown while maintaining most biodiversity elements of the natural forests (Tiwari 2005).

The natural vegetation of south Meghalaya ranges from tropical evergreen to sub-tropical evergreen forests (Balakrishnan 1981-1983). The plant species in the forests are distributed in distinct vegetation layers. The important evergreen trees found in south Meghalaya include: *Cinnamomum tamala*, *Daphniphyllum himalayense*, *Myrica esculenta*, *Sarcosperma griffithii*, and *Syzygium tetragonum*. The deciduous elements include: *Betula alnoides*, *Cedrela toona*, *Engelhartia spicata* and *Ficus roxburghii*. The shrub layer is thick and is predominantly composed of *Ardisia griffithii*, *Boehmeria malabarica*, *Goniothalamus sesquipidalis*, *Mahonia pycnophylla* and *Wallichia densiflora*. The ground vegetation (herb) is dominated by *Borreria pilosa*, *Commelina benghalensis*, *Impatiens* spp., *Ophiorrhiza hispida*, *Sonerila khasiana* and a large number of ferns. There are a good number of lianas and other climbers seen twining on the trees. The tree trunk and branches are covered with large number of mosses, epiphytic ferns and a variety of orchids. The invasive weedy species like *Artemisia* spp., *Eupatorium* spp. and *Mikania micrantha* are also present in good numbers.

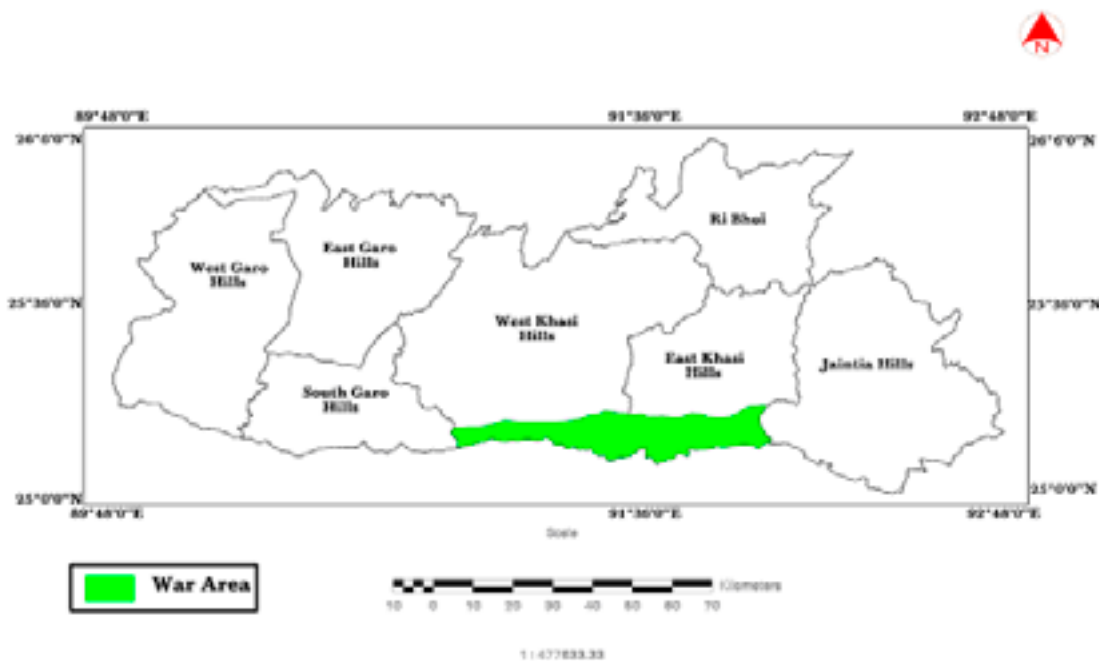


Figure 5.1 Indian state of Meghalaya showing location of the study area

5.3. Methodology

Data on management practices, institutional arrangements and typology of traditionally managed forests were collected from government records and through interviews with officials engaged in management of forests in the state forest departments, autonomous district councils and the heads of traditional institutions. Various participatory research tools such as group discussions, semi-structured interviews, key informant surveys and on-site observations were used to acquire insight into various traditional practices followed by the community. Visiting bird hunting, fishing and irrigation sites etc. allowed us to observe directly the construction of structures and procedures followed in these traditional practices. During the interviews, the hunters answered questions about each of the bird species they hunted, their hunting techniques and the reason for hunting the bird species etc. Prior informed consent was obtained from all interviewees. Plant species were identified with the help of the texts of Flora of Jowai (Balakrishnan 1981-1983), Forest Flora of Meghalaya (Haridasan & Rao 1985-1987) and Flora of Assam (Kanjilal et al. 1934-1940). The birds were identified by local people in their local languages and then we verified their zoological names by consulting with the preserved bird specimen available in the Zoological Survey of India, Shillong. The fishes were also identified with the help of Zoological Survey of India, Shillong.

5.4. Results

5.4.1. Forest Management Practices

Seven different types of community forests were recorded from south Meghalaya managed by the War community. Some of the community-managed forests found in the study area are briefly described in Table 5.1. The typologies of these forests are described subsequently.

► i. Law Raid (Group of village forests)

These forests are jointly owned by a group of contiguous villages. The area under this type of forest is generally large and stretches from one village to the other. This type of forest is managed by a Raid council which comprises the Head of the group of villages (Sordar), and the headmen of all the villages within the territory (Raid). No village can claim ownership over this type of forest. Although located in a particular village, all people within the Raid can access, collect and use the resources from these forests with prior permission from the Sordar if they are not protected or sacred forests. Such forests mainly benefit the poor people who do not own any forest land. The forest land belonging to the Raid can be allocated to families for shifting cultivation and other livelihood related activities in case the village council is not in a position to do so. Any village or its residents can approach the Raid for land and forest resources and, if available, the needy are provided resources by the Raid to enable them to meet their livelihood needs. For example: Law Raid Mawja (Table 5.1).

► ii. Law Shnong (Village forest)

These forests belong to and are the common property of a particular village, are mostly found within the village boundary, and are usually set aside to meet bona fide day to day needs of the villagers. They are under the control and management of the village council (Village Durbar). Villagers can collect both timber and Non-Timber Forest Products (NTFPs) from these forests. In most villages, land under village forest is allotted for construction of houses for landless and poor people of the village. Collection of timber and fuelwood is restricted to personal use only and not for commercial purposes, whereas NTFPs such as mushrooms, wild vegetables and fruits can be collected for sale in local markets. Some villages have more than one village forest. In such cases, the village council has the responsibility of ensuring the sustainability of these forests. Towards this end, a certain period is fixed (typically 5-10 years) during which a forest area remains open for extraction of forest products, particularly collection of fuelwood. At the end of this period, extraction from this forest patch is prohibited to enable its regeneration while another forest patch is opened for extraction. In this way, the regeneration of the forest is ensured and the resource is conserved without affecting the availability of the forest produce for the people. In several villages, this common property resource is under stress as fuelwood demand is in excess of forest regeneration and therefore the village forests are degrading at a rapid rate. For example: Law Shnong, Mawshun (Table 5.1).

► iii. Law Adong (Village/Raid restricted forest)

Law Adong is either under the control of a particular village or under the control of a Raid (group of villages). This category of forests is similar to village forest in terms of its overall management. The only difference is in the degree of protection. These forests are given a higher degree of protection, and access to forest resources is restricted. They are reserved particularly for the poorer families in the village and for some occasional needs by the village as a whole. Extraction of

timber and fuelwood is usually restricted from this type of forest, but there are no restrictions on the collection of NTFPs such as mushrooms, edible fruits and vegetables, which can be extracted without affecting the health of the forest. Extraction of timber from such forests is allowed only when acute needs arise, such as for construction of houses for the poor and needy, for making coffins in the case of a villager's death, for construction of community structures (a hall or school, for example) or in the case of natural calamities. The decision to allow extraction of timber from such forests is made by the village council. Mature trees are usually harvested for timber using selective felling methods. In certain cases, it was noted that mature trees were extracted for raising funds for a village or in other cases the revenues generated from the proceeds were shared equally among the villagers. In all such cases, the integrity of the forest was maintained and under no circumstances was the forest converted to other land uses. Examples of village restricted forest: Law Adong Siatbakon, Law Adong Pongtung, Law Adong Wahphadar, Law Adong Pynter etc. and Raid restricted forest: Law Adong Wahtyrjut Raid Nongkhlieng and Raid Shabong Law Adong (Table 5.1).



Photo 5.2 A view of Raid Shabong Law Adong community forest, Pynursla

► iv. Law Kur (Clan forest)

This type of forest belongs to either one particular clan or more than one clan located within the village boundary. Some clans may own forests which are located outside their village. All members of the clan are entitled to get a share of the benefits which are derived from the use of these forests. The management of clan forests is the responsibility of the whole clan, and no individual can sell land which belongs to the clan. Decisions regarding these forests rest with the clan council, which is usually led by the eldest uncle from the maternal side of the clan. Access to the forest and collection of forest products is permitted only for the households belonging to the particular clan. In some villages, collection of dead branches for fuelwood, dry leaves, and manure, are allowed for other villagers but only for their personal use. Most of the clan forests are well protected and are rarely converted to other land use as it is thought to be their ancestral property which is to be preserved for future generations. Examples of clan forest owned by one clan: Khlaw Khongmawloh Nongmadan Mawpran and clan forest owned by more than one clan: Ri Sawkur Nonglyngdiang Mawpran (Table 5.1).

Table 5.1 Community forests and their management type found in the study area

Name of forests	Size	Management type	Dominant species	Products extracted	Remarks/history
Kharai Law Lyngdoh Nongkhlieng (Sacred forest)	1.5 km ²	Raidship	Ficus spp., Toona spp., Lithocarpus elegans, Artocarpus heterophyllus, Sarcosperma griffithii and Bischofia javanica.	No extractions are allowed.	Village elders shared that about 20 years ago, rituals used to be performed by the Lyngdoh (priest), who stayed inside the forest and never cut even his hair. During that time, nothing was allowed to be collected from the forest; the forest was looked after by the Khongtyngkut clan but now the forest is under the Raid Nongkhlieng. During that time people believed that if someone destroyed or collected anything from the forest, fire would burn his/her house.
Law Lyngdoh Mawshun (Sacred forest)	1km ²	Clanship	Bambusa spp., Quercus spp., Schima wallichii, Castanopsis hystrix, Oroxylum indicum and Sarcosperma griffithii.	No extractions are allowed.	Originally, this forest was owned by the 5 clans (Khongdkhar, Rynjah, Khongbuh, Massar and Nongsteng). But as the village grew, the forest fell under the control of the 10 clans. To perform the rituals, these clans empowered either Khongdkhar or Rynjah clan. Which clan actually performed rituals was decided by performing rituals. The whole village had to contribute money towards the expenditure incurred during the rituals, and even the Raid Mawshun also contributed to the purpose. If someone destroyed or collected anything from the forest, fire would burn his/her house.
Law Lyngdoh Lyting Lyngdoh (Sacred forest)	1km ²	Raidship	Quercus spp., Schima wallichii, Castanopsis hystrix, Machilus khasyana, Bridelia retusa and Calicarpa arborea.	No extractions are allowed.	This forest is situated near the market way (Lynti iew). During performance of rituals, even entering the forest was not allowed. Now the forest is under the control of Raid Lyting and performance of rituals has stopped.
Law Kyntang Mawkliaw (Sacred forest)	2km ²	Village Durbar	Castanopsis spp., Quercus spp., Schima wallichii, Calicarpa arborea, Sarcosperma griffithii and Glochidion thomsoni	No extractions are allowed.	This forest is under the control of Mawkliaw village durbar (council).

Name of forests	Size	Management type	Dominant species	Products extracted	Remarks/history
Law Shnong Mawshun (Village forest)	2.5km ²	Village Durbar	Bambusa sp., Quercus sp., Schima wallichii, Castanopsis hystrix, Oroxylum indicum and Sarcosperma griffithii	Firewood, Bamboos, Medicinal plants	This forest is protected with the main aim of serving the day to day biomass needs of the people in the village.
Law adong Pynter (Protected forest)	3km ²	Village Durbar	Schima wallichii, Quercus spp., Callicarpa arborea, Bischofia javanica, Sarcosperma griffithii and Glochidion thomsonii	No extractions are allowed.	This forest belongs to Pynter village. On special permission from the headmen of the village, people can collect anything from the forest, especially if there is a fire outbreak in the village or other natural calamities.
Law adong Pongtung (Protected forest)	1km ²	Village Durbar	Castanopsis spp., Schima wallichii, Actinodaphne abovate, Quercus dealbata, Quercus dilatata and Syzygium tetragonum	Firewood, Broom, Medicinal plants.	On special permission from the headmen of the village, people can collect anything from the forest, especially if there is a fire outbreak or other natural calamities in the village.
Law adong Wahtyrjut Raid Nongkhleng (Protected forest)	2.5km ²	Raidship	Castanopsis spp., Myrica esculenta, Schima wallichii, Quercus dealbata, Quercus dilatata and Syzygium tetragonum.	Medicinal plants, Fruits, Firewood	This forest is under the control of the Raid Nongkhleng, a local traditional institution having jurisdiction over a group of villages.
Law adong Wahumrem (Protected forest)	500m ²	Raidship	Castanopsis spp., Quercus spp., Actinodaphne abovate, Sarcosperma griffithii and Glochidion thomsonii.	Medicinal plants, Fruits, Firewood	This forest was under the control of the Raid Nongkhleng, but it was looked after by Wahumrem Village Durbar.

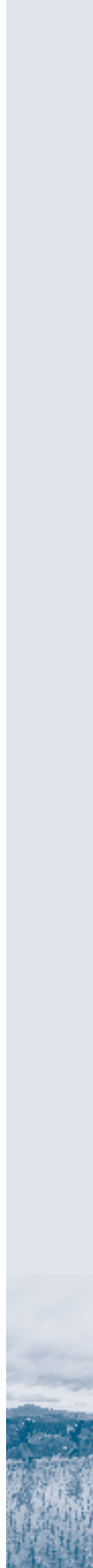
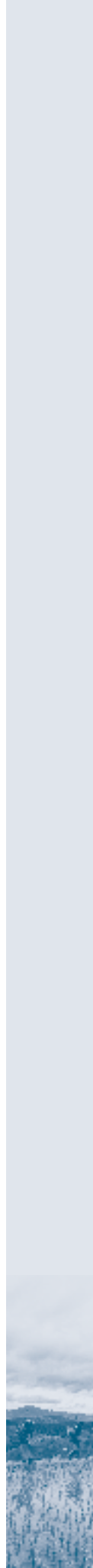


Table 5.1 Community forests and their management type found in the study area

Name of forests	Size	Management type	Dominant species	Products extracted	Remarks/history
Raid Shabong Law adong (Protected forest)	7km ²	Raidship	Sezygium spp., Castanopsis spp., Quercus spp., Myrica esculenta, Schima wallichii and Glochidion thomsoni.	Medicinal Plant, Mushrooms, Fruits, Nuts.	This forest is looked after by the Wahpathew-Urksew village durbar, while the rituals and sacrifices are performed by the Raid Shabong.
Law adong Siatbakon (Protected forest)	9km ²	Village Durbar	Castanopsis spp., Schima wallichii, Actinodaphne abovate, Quercus dealbata, Quercus dilatata and Syzygium tetragonum	Medicinal Plants, poles, firewood, fruits, nuts	This forest was previously known as Phiang U Diah, but now is known as the Law adong Siatbakon. The rituals and sacrifices are performed by the Raid Shabong.
Lawadong Wahphadar (Protected forest)	500m ²	Village Durbar	Sezygium spp., Castanopsis spp., Quercus spp., Myrica esculenta, Schima wallichii and Glochidion thomsoni.	Medicinal Plants, poles, firewood, fruits, nuts	This forest is looked after by the Umkor Village Council.
Ri Tynsong (Private forest)	10km ²	Family	Ficus spp., Toona spp., Lithocarpus elegans, Artocarpus heterophyllus, Sarcosperma griffithii and Bischofia javanica.	Poles, Medicinal plants, Brooms	This forest belongs to one family of Tynsong's clan.
Law Raid Mawja (Group of village forest)	4km ²	Raidship	Sezygium spp., Castanopsis spp., Quercus spp., Myrica esculenta, Schima wallichii and Glochidion thomsoni.	Firewood, fruits, medicinal plants	Any extraction made from this forest needs prior permission from the Sordar of Raid Mawja.

Name of forests	Size	Management type	Dominant species	Products extracted	Remarks/history
Ri Sawkur Nonglyngdiang Mawpran (Clan forest)	6km ²	Clanship	Castanopsis spp., Schima wallichii, Ostodes paniculata, Quercus spp. and Myrica esculenta.	Firewood, fruits, medicinal plants	This forest is jointly owned by the 4 clans viz., Khongmawloh Diengdoh, Khongmawloh Syntiew, Khongmawloh Khongiar and Khongmawloh Khongthngan
Khlaw Khongmawloh Nongmadan Mawpran (Clan forest)	2km ²	Clanship	Castanopsis spp., Schima wallichii, Actinodaphne abovate, Quercus dealbata, Quercus dilatata and Syzygium tetragonum	Firewood, Medicinal plants, Wild fruit	This forest is jointly owned by all families belonging to Khongmawloh clan.
Sohlong Arecanut agroforest (Forest garden)	2-4km ²	Family	Areca catechu, Cinnamomum tamala, Piper peepulooides, Artocarpus heterophyllus, Quercus dilatata and Syzygium tetragonum	Cinnamomum tamala, Piper peepulooides, fuelwood, Phrynium leaf	People manage it mainly for arecanut, but also for many NTFPs and wild native plants.



► v. Law Ri-Kynti (Private forests)

Generally small in size, these types of forests are owned by individuals and are scattered within the village boundary. Most of the forests in Meghalaya belong to this category. They are managed and used according to the requirement and wishes of the owner. These forests are mostly maintained for productive purposes and are often subjected to over-exploitation. Poorly stocked private forests are often converted to other land uses (for example, for agriculture or charcoal burning activities) by the owners. In south Meghalaya, most private forests have been converted into agroforests (forest gardens or home gardens). While collection of forest products by people other than owners' family members is strictly prohibited, in some cases it was noted that the owners allowed fellow villagers to extract dead and fallen wood and NTFPs for their personal use. For example: Ri Tynsong (Table 5.1).

► vi. Law Lyngdoh or Law Kyntang (Sacred Forests)

These forests may belong to Villages, Clans or Raid and are set aside for religious purposes. They are managed by the Lyngdoh (religious head) or persons to whom the religious ceremonies for the particular locality or villages are entrusted in accordance with customary practices. No timber or NTFPs are removed for any purposes except for those connected with religious functions or ceremonies recognised and sanctioned by the Lyngdoh. Sacred forests are mostly natural forest, and are well preserved, often in their pristine state, and are very rich in biodiversity. In the past, almost every village in the Khasi Hills had a sacred forest (Gurdon 1975). Examples: Village sacred forest: Law Kyntang Mawkliaw, Clan sacred forest: Law Lyngdoh Mawshun and Raid sacred forest: Kharai Law Lyngdoh Nongkhlieng and Law Lyngdoh Lyting Lyngdoh (Table 5.1).

► vii. Forest Gardens

Tribal people living in southern Meghalaya, where the climate and topography is not conducive to agriculture due to extreme rainfall (>6000 mm) and steep slopes (20-40°), have developed a unique production system called forest gardens in which economically useful trees are managed within natural forests. These complex agroforests provide a high level of productive benefits and the biodiversity values are similar to those in Village Restricted Forests or Sacred Forests of the area. The forest gardens are sources of cash income as they include economically important plants such as bayleaf (*Cinnamomum tamala*), pepper (*Piper peepuloides*), and packing leaf (*Phrynium capitatum*) for which a ready market exists (Tynsong and Tiwari 2010). The maintenance of these complex agroforests in an otherwise fragile environment (very high rainfall and steep slopes) is an example of perpetuation and utilisation of forest-related indigenous and local knowledge for enhancing livelihoods. Example: Sohlong Arecanut agroforest (Table 5.1).

5.4.2. Traditional Health Care System

The tradition of health care based on folk medicines is widespread and popular in south Meghalaya. The War communities are very knowledgeable about wild medicinal plants and depend on herbal products for the treatment of most of their common ailments and diseases. Medicinal plants mostly collected from the community forests are the most vital resource for the traditional health care systems. A total number of 85 medicinal plants were recorded from south Meghalaya (Tynsong et al. 2006). Almost every village has one or more such herbal practitioners. As many as 70 per cent of medicinal plants used in the traditional health care systems in the state come from natural forest (village restricted forests and village forests), 10 per cent from forest gardens and 20 per cent from home gardens. Folk knowledge related to medicine and health care exists in almost all the rural communities of the state and also supports the livelihood of many people. A majority of the people of the state including housewives, elders, midwives, herbal

healers and bone setters use some form of folk medicine. The use of such knowledge and herbal ingredients in the treatment of common ailments, and in some cases, even major diseases or chronic ailments, cuts across social and economic strata (Tiwari et al. 2004).

5.4.3. Betel Leaf Cultivation

The tribal people of south Meghalaya grow betel leaf on slopes inside forests or under the shade of trees. The growers prune the tree canopy at the right time, making openings for light. In some places, the growers make bamboo channels for irrigation of the betel vines planted at the base of the trees – this is known as bamboo drip irrigation. The betel leaf growers observe strict hygiene of self, the implements and tools used for tendering of the plant and harvesting of leaves. Thus, they prevent infection and maintain the plantation disease-free without using any pesticide. Within a few years, the trees sprout and develop a thick canopy and provide support and desired shade to the betel vine. These plantations provide most forest ecosystem goods and services while also providing economic returns to the planters. The cultivation of betel leaves inside forests without clear felling is probably the most sustainable agroforestry practice evolved by the indigenous people in the fragile slopes of southern Meghalaya that receives very high rainfall (Tynsong 2009).

5.4.4. Bamboo drip irrigation

In south Meghalaya, because of the sloping terrain of the area, irrigation is the main problem faced by the farmers. People have devised an ingenious system of tapping of water resources by using bamboo pipes to irrigate their plantations. Bamboo pipes are used to divert perennial springs on the hilltops to the lower reaches with the aid of gravity. Depending upon the size of bamboo (*Bambusa vulgaris*), about 18-20 litres of water entering the bamboo pipe system per minute is transported over a distance of several kilometres. This water has to be judiciously used by dividing it into 20-30 drops per minute at the site of the plant. Bamboos of smaller diameter (*Bambusa tulda*) are used for the diversion and distribution of water from the main channel to the specific plant. This traditional irrigation system is used mainly by farmers involved in cultivation of betel leaf (*Piper betle*), arecanut (*Areca catechu*) and orange (*Citrus reticulata*) in War area of Meghalaya.

5.4.5. Community forests as source of water

Springs and streams are the principal source of water in south Meghalaya. Villagers pay ample regard to these water sources. They use this water for drinking and make efforts to keep the sources clean and unpolluted. They have their own traditional system for the management of drinking water. They do not permit their cattle at the places from which they collect drinking water and do not allow anyone to throw garbage in its source/current to avoid pollution and infection. In villages where government supplies of water are inadequate or absent, water from these community forests plays an important role in their daily requirements. Ponds and wells are constructed at most water sources, and in some villages a signboard is put up bearing cautionary notes on how to use the water judiciously. A number of water pipes which draw water to the people's houses in most of these forests can be easily seen. Some community forests act as a source of government water supply. For example, from Ri Sawkur Nonglyngdiang Mawpran (Clan forest) two government water pipes draw water which is supplied to two villages viz., Nongmadan Mawpran and Nonglyngdiang Mawpran and from Law Adong Siatbakon (community protected forest) at Siatbakon, there is one government water pipe supplying water to nearby habitations. A few community forests supplying water to nearby villages are listed in Table 5.2.

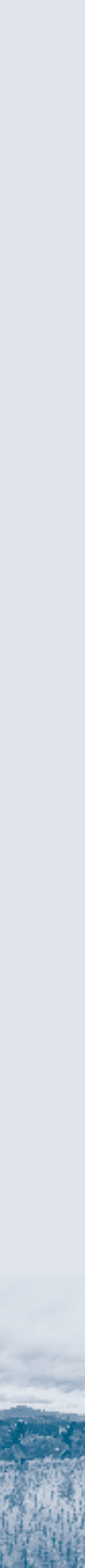




Photo 5.3 Law adong Siatbakon, community forest is a source of water for village Saitbakon

Table 5.2 Community forests and number of water sources

	Water source (No.)		Water pipe (No.)		Village benefitted
	Spring	Stream	Individual households	Govt. water supply	
Law Lyngdoh Mawshun	3	-	4	-	Mawshun
Law Kyntang Mawkliaw	2	2	4	-	Mawkliaw
Law adong Pynter	1	-	6	-	Pynter
Law adong Pongtung	1	-	2	-	Pongtung
Raid Shabong Law adong Pynursla	3	-	15	-	Urksew, Wahpathaw
Law adong Siatbakon	3	2	14	1	Siatbakon
Lawadong Wahphadar	1			-	Umkor
Ri Sawkur Nonglyngdiang Mawpran	4	-	10	2	Nongmadan Mawpran and Nonglyngdiang Mawpran
Khlaw Khongmawloh Nongmadan Mawpran	10	-	12	-	Nongsder, Pynter and Nongmadan Mawpran
Khlaw Khongmawloh Nongmadan Mawpran	10	-	12	-	Nongsder, Pynter and Nongmadan Mawpran
Sohlong Arecanut agroforest	1	-	5	-	Sohlong and Mawriang

5.4.6. Fish Resources

War Khasi community of south Meghalaya possesses a wealth of knowledge related to ethnofishery techniques. The community has evolved a number of techniques for harvesting fishes. These techniques are specialised according to the structure and size of the stream, the season, and species of fish intended to be harvested. The fishermen have evolved several specialised & innovative hunting techniques for fishes. Principal among them are fishes locally known as: Riam kria, Riam khohka, Buh kroh, Riam kyllong, Ring khashiar, Buh ruh, Krang Wah and Bia dohpieh. Thirteen edible animals collected from forest streams and rivers are listed in Table 5.3.

The people living in the study area have thorough knowledge of the habits, habitat, reproductive behaviour, food preferences and life cycle of the fishes found in the region. The communities also have a very good understanding of the plants that can be used as sedatives or as baits for catching the fishes. During recent years, the local people have taken several decisions pertaining to management and conservation of stream fishes. These include a ban on chemicals and explosives for catching the fish in the streams. The village durbars (congregation of all adults of the village) do not allow fishing in bigger rivers during the breeding seasons of the fishes. Fishing is done on a small scale mostly for self consumption to maintain the stock and prevent over harvesting. The decisions of village councils are respected by every member of the community. Thus, the fishes are considered as a community resource on which every member of the community has equal right but no one has ownership. The community control over the resource has helped in perpetuation and conservation of the river fishes of War Khasi region of Meghalaya.

Table 5.3 Fishes and other edible animals collected from forest streams and rivers of south Meghalaya

Scientific name	English name	Local name	Season/ month of collection	River
<i>Neolissocheilus hexagonolepis</i> (McClelland)	Katli	Kha-saw	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Neolissocheilus</i> sp.	Not available	Kha shi-iar	Dec-January	Umsong and Umsi
Unidentified	Not available	Kha shbiar	Whole year	Umsong, and Umsi
<i>Anguilla bengalensis bengalensis</i> (Gray)	Indian longfin eel	Kha bsein	Whole year	Umsong, and Umsi
<i>Cyprinus carpio</i> (Linnaeus)	Common carp	Kha bten	May-August	Umsong and Umsi
<i>Garra lamta</i> (Hamilton-Buchanan)	Lamta Garra	Dohkew	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Garra lissorhynchus</i> (McClelland)	Khasi Garra	Doh sher	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Lepidocephalus caudofurcatus</i> (Tilak & Husain)	Tilak loach	Syngkai	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Channa orientalis</i> (Bloch & Schneider)	Asiatic snakehead	Doh thli	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
Unidentified	Not available	Kha shyrmrit	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Pseudecheneis sulcatus</i> (McClelland)	Sulcatus catfish	Briang	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Crangon crangon</i> (Linnaeus)	Brown Shrimp	Shymbrong	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Uca</i> sp.	Crab	Ka tham	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat

5.4.7. Bird Resources

In south Meghalaya, the art and science of bird hunting has evolved with the local communities and is being passed on from generation to generation. The War Khasi community possesses a wealth of knowledge related to bird hunting. There have been few studies conducted in Meghalaya regarding wild fauna resource population, especially on birds: their extraction rate, season of availability and social demand. In an effort to understand the importance of birds as a wild resource of rural tribal people of Meghalaya, we documented the local hunting techniques, season of availability of birds, tools used in hunting and purpose of hunting. It was found that bird hunting in the forests has been practised since time immemorial and represents not just a form of resource extraction but also a traditional form of wildlife management. Thirty species of birds were found to be most hunted and were used by the local communities for various purposes such as food, pets, recreation, sports and cash income (Table 5.4).

The hunters have evolved several specialised and innovative hunting techniques for birds. Principal among them are birds locally known as Suh Sim, Suh Sim Um, Suh Lynglit, Riam Shynroh and Riam Dkhoh. Suh Sim and Suh Sim Um were found to be the most commonly hunted and yielded maximum birds. Hunting could have negative impacts on the bird population and might prove unsustainable as many bird species were hunted during the breeding season. It was found that the choice of hunting technique depended mainly on the habits and habitat of the bird species. The local people are of the opinion that disturbed areas and secondary forests harbour fewer species of birds than primary forests in the same locations which corroborate recent ecological studies elsewhere (Alves et al., 2009). In our opinion, it is this congruence between TK and conventional scientific studies that can form the basis of a constructive goal-based dialogue among scientists, conservationists and indigenous people. Although hunting might be detrimental to the wild animal populations, it is important to note the hunter's perspective on the problem too. The hunters' 'guild' felt that jhum cultivation, commercial logging and conversion of natural forests into agroforests have led to the depletion of their 'niche'. Such information would be useful to grapple with the issues of setting sustainable limits on use of wild bird resources in this region.

Table 5.4 Bird species, common name, local name and uses of birds by War Khasi community, Meghalaya

Bird species	English name	Local name	Purpose of hunting
<i>Alcippe vinipectus</i> (Hodgson)	White-Browed Fulvetta	Ruria	Food
<i>Alophoixus</i> sp.	-	Sim Ad	Food
<i>Aprosmictus erythropterus</i> (Gmelin)	Red-Winged Parrot	Khlung	Food, pet, sale
<i>Arachnothera longirostra</i> (Latham)	Little Spiderhunter	Jiriak Padung	Food
<i>Arachnothera magna</i> (Hodgson)	Streaked Spiderhunter	Jiriak Padung	Food
<i>Athene noctua</i> (Scopoli)	Little Owl	Dkhoh Rit	Food , Pet
<i>Blythipicus pyrrhotis</i> (Hodgson)	Bay Woodpecker	Kumpiat	Food
<i>Cettia flavivivacea</i> (Blyth)	Aberrant Bush-Warbler	Sim Um	Food
<i>Chalcophaps</i> sp.	-	Lyngtliew	Food
<i>Chloropsis cochinchinensis</i> (Gmelin)	Blue-Winged Leafbird	Sim Jalaeit	Food, pet
<i>Chloropsis hardwickii</i> (Jardine& Selby)	Long-Tailed Minivet	Jala Eit	Food, pet
<i>Dicrurus leucophaeus</i> (Vieillot)	Ashy Drongo	Shyrwat	Food
<i>Dicrurus</i> sp.	Racket-Tailed Drongo	Risei	Food
<i>Lonchura punctulata</i> (Linnaeus)	Scaly-Breasted Munia	Pdit	Food, pet
<i>Macropygia</i> sp.	-	Shiir	Food
<i>Megalaima asiatica</i> (Latham)	Blue-Throated Barbet	Pohrong	Food
<i>Megalaima virens</i> (Boddaert)	Great Barbet	Jyllup	Food
<i>Niltava sundara</i> (Hodgson)	Rufous-Bellied Niltava	Thabalong	Food
<i>Otus sunia</i> (Hodgson)	Oriental Scops-Owl	Dkhoh Heh	Food

Bird species	English name	Local name	Purpose of hunting
Pericrocotus ethologus (Bangs & Phillips)	Long-Tailed Minivet	Jaraitsiaw Stem	Food
Pericrocotus sp.	-	Jaraitsiaw Saw	Food
Picus canus (Gmelin)	Grey-Faced Woodpecker	Kynjar	Food
Psarisomus dalhousiae (Jameson)	Long-Tailed Broadbill	Lakadia	Food
Psittacula columboides (Vigors)	Malabar Parakeet	Kyrkhiah	Food, pet
Psittacula himalayana (Lesson)	Slaty-Headed Parakeet	Shynrang	Food, Pet, sale
Pycnonotus leucotis (Gould)	White-Eared Bulbul	Pait Puraw	Food
Pycnonotus melanicterus (Gmelin)	Black-Crested Bulbul	Sim Klong	Food
Seicercus sp.	-	Sim Rit	Food
Treron apicauda (Blyth)	Pin-Tailed Green Pigeon	Kuwo	Food
Unidentified1	-	Sim Kdait	Food
Unidentified2	-	Sim long	Food
Unidentified3	-	Phreit	Pet

5.5. Discussion and Conclusion

Traditional forest management contributes to livelihood, water availability, biodiversity conservation, food security and health care of the people. The system is built upon active participation of the people, and equity and social justice are the key ingredients of management.

The management system needs little external input, is flexible and evolves with time for which an in-built mechanism in the form of traditional institutions is in place. Forest management is based on traditional ecological knowledge and is characterised by features such as assurance of the availability of resources to herbalists and the fulfilment of spiritual, social and ecological needs without neglecting its ability to generate cash income for the needy. It is believed that the forefathers of these communities designated these forests keeping equity concerns in mind especially to safeguard the interests of the poor and the landless. It is hoped that with improvement of income and livelihood, the values of ecosystem services will get preponderance over forest products, and then the traditional knowledge-based bioresource management systems will gain additional strength.

This most fascinating tribal community, which has lived in this region for thousands of years, has built a precious knowledge-base about the use and traditional system of conservation of bioresources of this region. The community has thorough knowledge of the habit, habitat, reproductive behaviour, food preferences and life cycle of the animal species found in the region. The findings of this study throw light on the wealth of TK of War Khasi people in hunting bird species, it also gives an insight that such knowledge of other ethnic groups of the region should be recognised and documented as a priority. The TK of all ethnic communities may serve as valuable data for developing conservation strategies because their livelihoods bring them in close link with the environment. Most hunters feel that non-sustainable activities such as slash and burn agriculture and conversion of natural forests into agroforests and cash crop cultivation result in loss of habitat for many wild species as well as in loss of fruit trees which is the principal cause of loss of avian diversity.

While people in most parts of India as well as the world have already forgotten the use of wild plants for edible and medicinal purposes, it is still well preserved and practised by tribal communities. The conservation and sustainable use of biological diversity is of critical importance in meeting food, fodder, fibre, health, water and other needs of a growing population, for which purpose, access to and sharing of both genetic resources and technologies are essential. Research and documentation of traditional knowledge of tribal people related to conservation

and the sustainable use of biological diversity is needed for the benefit of present and future generations. Involving all stakeholders in a participatory mode including tribal people, ecologists and government officers, for the conservation and utilisation of bioresource wealth of this area is the need of hour. Awareness creation among people, school children, students and teachers in colleges and universities is very important to conserve the biodiversity wealth. More such studies involving different ethnic groups are required in order to document the traditional, indigenous and local knowledge of the people. This knowledge has immense potential for formulating strategies for conservation of biodiversity.

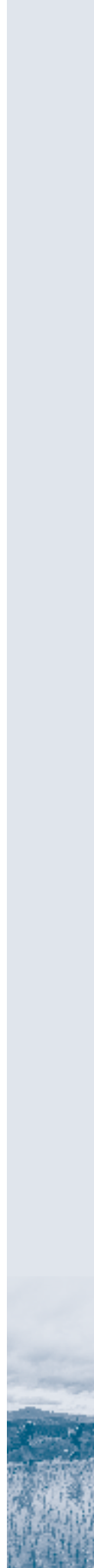
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M. Dkhar and H. Tynsong are the knowledge holders belonging to Khasi tribe and are residents of the area of study. A number of other knowledge holders were interviewed for clarification and for collection of village specific information. Authors thank all of them for their help in documentation of the traditional knowledge of War Khasi tribe of Meghalaya. Authors are also thankful to the Head, Department of Environmental Studies, North-Eastern Hill University, Shillong for providing facilities for this research.

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6. Indigenous system of pastureland management: A case of Limi in the Kailash sacred landscape, Nepal

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Abstract

Indigenous systems of the management of natural resources are deeply embedded in cultural values espoused by local communities both as groups and as individuals. Under this project, we explored the role of customary arrangements and the enabling factors that allow the informal local and community-based institutions to effectively manage pastureland in Humla District, a part of the Kailash Sacred Landscape Conservation and Development Initiative (KSLCDI) in Nepal where the grasslands are important livelihood resources. This study focusses on how the locally designed institutional arrangements have managed the pastureland in Limi valley of Humla district. The study revealed that the community governance institutions are long enduring, have evolved through generations and are embedded in the social hierarchy. These community institutions have effectively managed the pastureland by aiming to ensure the sustainability of the resource base while enhancing equitable resource use.

Key words: Kailash Sacred Landscape; Humla; Pasturelands; traditional resource governance

6.1. Introduction

The Kailash Sacred Landscape Conservation and Development Initiative (KSLCDI) is a transboundary collaborative programme among China, India, and Nepal that has evolved through a participatory, iterative process among various local and national research and development institutions within these countries (Zomer and Oli 2011). The project has been initiated in Nepal as a collaborative project of the Ministry of Forests and Soil Conservation (MoFSC), Government of Nepal; International Centre for Integrated Mountain Development (ICIMOD); and Research Centre for Integrated Mountain Development (ReCAST), Tribhuvan University, Nepal with financial support from the Department for International Development (DFID), United Kingdom and German Corporation for International Co-operation (GIZ). The programme aims to achieve long-term conservation of ecosystems, habitats, and biodiversity while encouraging sustainable development, enhancing the resilience of communities in the landscape and safeguarding the cultural linkages between local populations at a transboundary scale.

The Kailash Sacred Landscape (KSL) in Nepal comprises four districts Baitadi, Bajhang, Darchula, and Humla, located in the far and mid-western regions of the country (Figure 6.1). High

biogeographic, climatic, geological, and altitudinal variations as well as topographic complexity contribute to the high biodiversity of the landscape over a relatively small area. The landscape thus forms a complex mosaic of ecosystems unique to the mountain system (CDB-TU 2010).

Generally, pasturelands dominate the land use type in the higher elevation of the landscape and animal husbandry plays an important role in the household economy. In the past, overall socio-ecological systems and several sub-systems in the region were largely shaped by the barter economy practised in the region (Adhikari 2008). Large quantities of salt from Tibet used to be exchanged with grains from the region, the southern part of Nepal, and the Indian plains (Haimendorf 1988). The salt-grain trade linked the communities at different elevations and united them in the larger economic system. As the trading system survived with the maintenance of large flocks of sheep and goats and herds of yak to haul the loads of grain and salt, the economic system was well-linked with the management of pastureland and forest areas. People used to rear large flocks of sheep and goats and herds of yak and exploited pastureland and grazing areas at different elevations. As this economic system continued, intricately planned systems of managing pasturelands in higher reaches and rules for accessing forest areas for caravans of animals in lower elevations were developed.

Traditionally, herders from Yari and Limi village development committees (VDC) would take their animals to pasture lands, now in the Tibetan Autonomous Region (TAR) of China, during the winter season, as the pastures there are better and wind blows the snow away. However, with the new political arrangements between the two countries, such a practice of cross-border winter grazing has ceased. This has had a severe impact and the number of animals herders can keep has greatly reduced. The political boundaries do not match the ecological and traditional livelihood boundaries of the region.

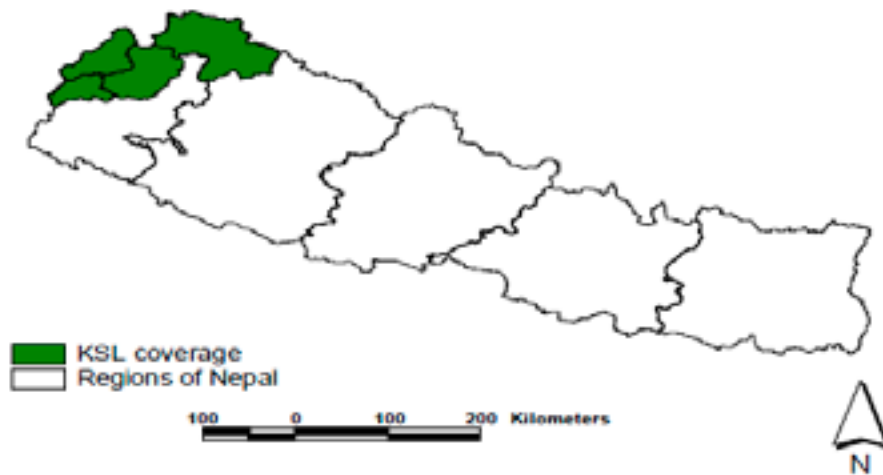


Figure 6.1 Kailash Sacred Landscape in Nepal

People have managed pasturelands over generations through community institutions which are rooted in social systems. Over the years, the dynamics of interaction and the interface between the components of socio-ecological systems have changed owing to various internal and external pressures. This study attempted to explore the role of community-based institutions in the management of pastureland in Limi valley of Humla, one of the districts of the landscape.

6.2. General features

The Limi Village Development Committee (VDC) in Humla district is the northern-most VDC in Nepal and has three main settlements namely Halji, Tila, and Zhang. Halji, with four wards, is the largest settlement located between two other settlements. Tila has two wards and Zhang has three. People here subscribe to the Dhikung Kagyu sect of Tibetan Buddhism and follow polyandry system of marriage.

However, over the years, the polyandrous system of marriage is yielding ground to the monogamous system of marriage. Crop production and animal husbandry aided by seasonal employment in Taklakot (Tibet) are the main livelihood strategies adopted by the people in the region. Farming is mainly of subsistence type and crops can only be grown in one season. Animal husbandry is an important integral component of the farming system. The priority animals are dairy cattle, sheep, horses and yak. Raising livestock is an integral part of the household economy of all inhabitants of the district. In lower Humla, cattle and buffaloes are reared in limited numbers. As one moves to higher elevations, dzo, Jhuma, cross-breeds of yak and local cattle become common. The herding of yak involves seasonal moves to high pastures.

Local people have developed an elaborate system of breeding of local breed of cattle, called Lulu, and yaks. Many Lama communities keep a few Kirkoo bulls (Lulu) to cross with Tsauris (Yak cows). Jhuma, the female offspring, is prized for its higher milk yield. Similarly, Djos, the male offspring is highly prized as a pack animal. Offspring of Jhuma and Lulu bulls are called Tolba (male) and Tolbini (female) and are of relatively little value (CDB-TU 2010).

6.3. Results and Discussion

6.3.1. Institutional arrangement

► Social hierarchy system

The community system is very closely weaved with cultural practices. Hierarchy in the society and the selection of authorities for the management of the community system are closely linked with the property inheritance system associated with the polyandry system of marriage (Lavine 1988). People here follow impartible primogeniture system of property inheritance, where the eldest son inherits the property and the property is not normally divided among the brothers. In case a family does not have a son, the uxori-local son-in-law inherits the property. The eldest son of the family who inherits the property becomes a Dhongba. If younger brothers do not share the same wife and separate, they get a smaller proportion of the property and become Dhongjung. The unmarried sisters who separate from their brothers become Bhomdang.

Bhomdang get an even smaller proportion of property than Dhongjung. Dhongba refers to both individuals and the estate. The number of Dhongba in a village always remains the same; however, the number of Dhongjung and Bhomdang may increase or decrease. A Dhongjung can never become a Dhongba, however, a son borne to a Bhomdang can become a Dhongjung. The number of three different types of households in three villages is shown in Table 6.1.

Table 6.1 Compositions of households in Limi VDC, Humla, Nepal

Name of settlement	Dhongba	Dhongjung	Bhomdang	Total
Halji	29	31	20	80
Tila	13	11	15	39
Zhang	15	33	14	62

In the ladder of social hierarchy, Dhongba are at the top followed by Dhongjung and Bhomdang. This hierarchical order is also manifested in the property ownership, with Dhongba owning more properties followed by Dhongjung and Bhomdang. Being a Dhongba also requires taking on more responsibilities, especially in religious matters. They are obliged to contribute more towards religious rituals and ceremonies. For example, if a Dhongba family has two sons, one has to join the monastery and become a monk, but in the case of Dhongjung, such a requirement is imposed only if the family has three sons.

► Selection of authorities

Since there have not been any elections of local VDC bodies for over a decade, people elect the VDC chairperson and ward chairpersons locally following a system called Hipsing, wherein lotteries are drawn in the name of each individual household (Dhongba and Dhongjung only) for a period of five years. In the case of Tila village, which has two wards, one chairman is elected from among Dhongba and the other from among Dhongjung households. However, in the other two settlements, they are selected from either Dhongba or Dhongjung households. In earlier times, only the Dhongba households were eligible to hold the posts of chairman, but the societies have become more egalitarian over the years and no such discrimination is made today. The system of Hipsing, a mystic equity arrangement, ensures that all the potential households have equal opportunities. It is adopted in other activities as well like deciding turns on drawing water, selection of pasturelands etc. Selection of authorities, even when the official elections in the country were held, followed more along the social arrangements than along the political party lines as commonly practised in other parts of the country. The position of the village chief is held exclusively by a male, and other positions are also generally held by men, clearly manifesting gender discrimination.

In addition to the VDC chairman and ward chairpersons, there are two more types of officials called Loiba and Lora, which are rotated annually within a settlement. Loiba are responsible for monitoring forest areas and, in some cases, pastureland, and Lora are responsible for ensuring that animals do not stray into the fields. Each village has two Lora and only the Dhongba households are eligible to become a Lora. If animals are found straying into the fields, the owner has to pay a fine consisting of both grains (about 4 kg. of naked barley) and Rs. 50. The cash component of the fine goes towards the community fund and the grain is kept by the respective Lora. The number of Loiba who look after the forest ranges from four to six, representing both Dhongba and Dhongjung households. The social organization that has evolved in alpine environments coordinates socio-political systems, high altitude agro-pastoral activities, and indigenous resource governance systems (Rhoades and Thompson 1975).

Religious institutions have played an important role in the management and conservation of resources. In many northern societies of Humla district, religious institutions like monasteries, monks, and shamans play a key role in the way resources are extracted and managed (Photo 6.1). In fact, even today, they play a major role in dispute settlement, maintenance of the social order and conservation of resources. The conservation ethos promoted by religious leaders like abbots of monasteries has been found to be very effective in reducing hunting activities. The religious institutions are key units in addressing the symbolic aspects of resource management like appeasing various deities of water, rain, good harvest, forest; officiating ceremonies of agricultural activities; and transferring the knowledge and tradition of resource management.



Photo 6.1 Monasteries play an important role in resource governance

6.3.2. Resource governance

The village authorities set the rules for access to the forest, agricultural operation, and pastureland management. They decide certain dates when dried firewood can be collected from the village forest. Loiba check each load of firewood collected just before people enter the village and if anyone is found picking fresh twigs, he/she is fined up to Rs. 5,000. People take oaths before religious idols that they will not collect any fresh twigs or fell any trees. Such oaths are respected by every individual. People are strictly prohibited from hunting animals. If anyone is found using a gun, he/she is fined Rs. 50,000. The community decides the calendar of operation of agricultural practices like the date of sowing seeds (usually allowing two days), weeding the crops, cutting grasses from the field, irrigation and harvest. All people strictly adhere to such decisions.

Although generally each settlement has its own forest, they hold pastureland in commons among the settlements. If important decisions are to be made among the villagers - for example, deciding the turn/rotation of pasture land - ward chairpersons meet at a supposedly neutral ground located at Sunkhani.

Moving animals to the high pasture is co-ordinated among the three villages. They resort to Hipsing (lottery system) to ensure equity among the resource users.

6.3.3. Pastureland management

People here practice transhumance, moving their herds to pastures of different elevations called Soika, Yarka, Tonka, and Ghunka based on the seasons (Photo 6.2). They follow a seasonal calendar in grazing their animals. All the animals are taken to the high pasture called Soika in the summer after planting of crops.



Photo 6.2 Transhumance is a major livelihood strategy in Limi, Humla

Generally, pack animals dzo and horses are not taken to the higher pasturelands and are grazed near the villages. However, sometimes they are also taken to the higher pasturelands and are brought back to the villages from the high pastures if there is a need to carry loads. The pastures for rainy season called Yarka are higher. Usually, around August, with the onset of Tonka, pastoralists start bringing their animals down to lower elevation pastures. The Tonka pastures are the same as Soika pasture (Photo 6.3). Around the end of the Tonka season, crops are also harvested and animals are brought back close to the village when the Ghunka or winter season begins. These rotational grazing systems are closely monitored and regulated by the community.

If any individual is found grazing animals in Ghunka pasture in other seasons, he/she is severely punished.

Even within a particular seasonal pasture, the community makes decisions on where to take animals so that pasturelands are maintained. For example, people take their animals to Ning Khola, Talung, Artang in Soika; to Shakya Khola, Gyau Khola in Yarka; Talung, Ning in Tonka, and in the villages, Rak, and Ning Khola in Ghunka season (CDB-TU 2010).

Not all the households go with their animals to the higher pasture. People with only a few animals request their neighbours or relatives to look after their animals as well. In such cases, those absentee owners provide food and other required materials to the herders. In the case of collective herding of milking animals, ghee (butter) and dried cheese (chhurpee) are divided among the animal owners in proportion to number of milking animals or the amount of milk produced by the animals.



Photo 6.3 A Soika pastureland in Limi valley, Humla District, Nepal

6.4. Conclusions

The institutional arrangements for governing community systems and resources have evolved over the years becoming more egalitarian and allowing people belonging to even lower rungs of the hierarchy system to represent themselves in resource governance.

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7. The challenges faced by Bakhtiari nomads in local management of pastures in the Tangsayad – Sabzkouh Biosphere reserves, Iran

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Abstract

Humans, now, in the future and for the rest of their lives, need the Earth's natural resources, particularly pastures, as they are the most vital platform for environmental sustainable development and ecological phenomena and the main source of traditional animal husbandry and livestock feeding systems.

Today, several research results are revealing the importance of local knowledge of exploiters such as nomads, who are the main beneficiaries of these pastures, in reviving these areas.

This study aimed to identify challenges facing the traditional system of pasture management by nomads, the policies of the current government and pasture management with existing methods in order to provide recommendations and solutions to combine indigenous and formal knowledge in line with sustainable management of pastures. For this purpose, the Bakhtiari nomads, settled in all areas of Tangsayad – Sabzkouh biosphere reserves in different seasons, have been considered as the population of study.

Bibliographical and field research was carried out. The research was conducted using a combination of qualitative and quantitative data collection techniques (group discussions, focussed groups, semi-structured interviews and structured interviews via a questionnaire). Geographic area of research is the Tangsayad – Sabzkouh biosphere reserve in the provinces of Chaharmahal and Bakhtiari.

Overall, results show that some government policies such as settlement of nomads, issuing rules without prior research in pasture ownership, unsustainable rural development, lack of interest of younger nomadic generations in accepting traditional systems of pasture management and outdated laws are the main challenges ahead of traditional pasture management systems by nomads.

In order to solve the problems in pasture management, it is important to consider favourability of indigenous and formal knowledge on the grounds of improved livelihood of nomad and rural communities, preserving and revitalising indigenous knowledge, reviewing and revocation of conflicting and contradictory laws, laws of land ownership, completion of the audit and issuing of updated documents, freehold pastures and natural resources laws, producing educational content

in the field of indigenous knowledge and enabling the new generation to become familiar with benefits of this knowledge.

7.1. Introduction

7.1.1. Background

Indigenous knowledge is increasingly important to identify sustainable methods of intervention with respect to environmental protection with economic development of local communities (Chandrasekhar et al 2006). Neglect of local knowledge and values of pasture utilisers is considered as a waste of resources, thus it would be appropriate that the researchers associate with different people and development goals in their approach and seek to recognise and integrate indigenous knowledge revision with other knowledge in this area (Niamir 2006; Kilongozi 2005; Osunade 1994; Melvyn et al. 1989; Chandrasekhar et al. 2006).

Iranian nomadic society has certain social systems which, in terms of type or nature and systems of economic, political, cultural or social stratification mentioned in the typology, are not applicable and we can separate its ideal type from other social systems as tribal system. Iranian tribal system prevailing in nomadic society today has lost its development power due to increasing ecological, demographic, technological, economic, social, political and cultural bottlenecks and limitations (Chalabi and Abdollahi 2002).

Iranian nomadic society has a long history and culture. Iran as a developing country has groups of the population in the Zagros forests who live as nomads. Despite the many poor people in rural and tribal communities, they continue to be the holders of natural resources and play an important and crucial role in the stability of ecosystem of Zagros (Adeli et al. 2005) and from the distant past were considered the country's largest livestock producers.



Photo 7.1 Bakhtiari nomads

Natural and climatic factors of Tangsayad - Sabzkouh in heart of Zagros have created specific conditions of biodiversity from the south-west to north-west of Iran. Zagros forest ecosystem has served as winter and summer ecosystems for nomadic herders, which is one of the largest Bakhtiari tribes. Bakhtiari tribes herd in summer and winter rangelands at suitable times.

7.1.2. Migration management in Bakhtiari tribe

The migration of nomads has had a fundamental role in grazing management on summer and winter grasslands and the feed in the pastures continued to be maintained at a high level as long as nomadic livestock was removed during summer or winter when these grasslands could have a break. Even with the possibility of farmers violating and entering into pastures, the nomads would protect their pasture by assigning guards.

The route and duration of migration tribes in any home on the migration route was devised intelligently so that they first entered the summer pasture when the plants were fully mature. If the readiness of the pasture was not confirmed by investigators of the tribe, the tribe delayed its arrival to the summer pasture by renting excess rural pastures or wheat fields in the countryside.

Migration management in the Bakhtiari tribe is one of the management masterpieces of the tribe's organizational structure and is run by sheik and a hierarchical system. Durability of the tribe and pasture management had a high level of discipline such that no unit could continue to move arbitrarily and reach the summer or winter rangelands sooner than the others. Traditional management practices based on the sheik and respect for elders ensured that pastures were allowed to grow and after enough growth was achieved, migration command was issued for the next year. Today, it is understandable that after the dissolution of the traditional administrative system and tribal hierarchy and non-replacement of new functional entity, great and irreparable damage has befallen the pastures (Amir Ahmadian 2004).

Over the year, Bakhtiari tribes migrate twice: they are called 'spring migration' and 'autumn migration'. Spring migration is from winter rangelands "qishlaq" to summer rangelands "yaylak" and autumn migration is from summer rangelands to winter rangeland grounds. The duration of migration of nomadic tribes is different. Migration routes fluctuate from one day to one month and up to 45 days in depending upon the near and distant winter and summer places. In Bakhtiari, migration is mostly "vertical migration". This means that movement is from the plains to the highlands in summer rangelands and movement from elevated regions to the plains in winter rangelands. This kind of migration is the most common form. Sometimes in between nomadic families, migration around the villages is "horizontal migration" and it is conducted over a short period of time (Amir Ahmadian 2004).

Autumn migration usually begins in early October or late September. The date of migration depends on two factors: weather conditions and vegetation. If the forage in rangelands is naturally finished sooner, or due to drought, the summer pastures are poor, migration starts early. Also in the summer when the air gets cold early, nomadic families are forced to migrate. Spring migration as well as migration in autumn depends on natural or social factors. Sometimes, due to lack of agreement with the villagers, surrounding tribes, and conflict over pasture and grazing rights and other issues, migration occurs sooner (Amir Ahmadian 2004).

When the nomads are in the summer or winter rangelands, they do short and limited migrations between winter and summer rangelands for access to forage for livestock which is called "movement". These movements are mostly for pasture rather than for using water resources due to lack of water. During migration in early summer, when mountains still have snow and the earth is wet, and pasture plants have not yet flowered, pasture livestock are not allowed to enter the pasture. When livestock enters pastures where plants have not yet flowered and are wet, they just trample them and eat them and the reproductive power of the plant and the earth is reduced, leading to destruction of the pasture (Amir Ahmadian 2004).

Unfortunately, after the collapse of the tribe, and the destruction of its traditional and control system and framework, none of the other tribes follow the law because there are no ranks and government. To reach the summer grazing fields early, they migrate prematurely and to obtain earlier and therefore lower costs and higher profits, they overtake each other and here begins the degradation of pastures. This leads to the disaster of the floods, now due to downhill slopes and degradation of steep mountain pastures, damaging villages and cities (Amir Ahmadian 2004).

7.1.3. Indigenous pasture management of Bakhtiari nomads

Bakhtiari nomadic tribes as well as other nomads in Iran, have had native solutions for grazing and pasture management which helped the conservation and sustainable use of pastures in their possession during migration. In the following, we refer to pasture and grazing indigenous management strategies of Iranian nomadic tribes.

Grazing and pasture indigenous management strategies include: seed planting, intermittent grazing, herd diversity, segmentation, pastures, adjusting the number of livestock (Amiri Ardakani and Emadi 2003); use of supplementary feed (Shah-Hosseini 2001; Amiri Ardakani and Emadi 2003), evaluation of the pasture and migration (Safinezhad 1996; Amiri Ardakani and Emadi 2003), guarding and protection (Farhadi 1998; Amiri Ardakani and Emadi 2003; Shah Hosseini 2001), private property and the right to graze, estimation of the pasture condition, the separation of livestock and herd (Shah-Hosseini 2001; Amiri Ardakani and Emadi 2003).

Popzan and Afsharzade's study (2010) on indigenous pasture management mechanisms show that in indigenous pasture management of Kalhor tribe, nomads have divided pastures based on grazing system (open and close grazing), the deployment season (spring, fall and winter feeding), and kind of pasture (intact and eaten pastures). Previously untouched pastures are called 'intact pastures' locally called ana khoard. On the other hand untouched pastures after grazing are called 'eaten pastures' locally called khoarda. 'Millennium' meadows are able to feed 1000 livestock, 'half millennium' pastures can feed 500 livestock and the quartiles are capable of feeding 250 livestock.

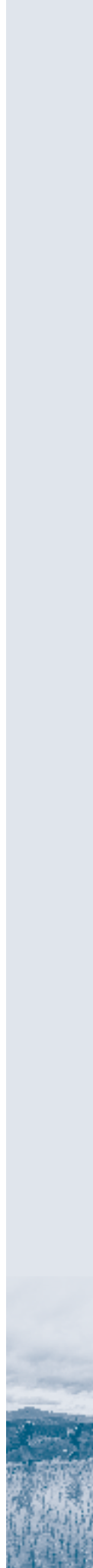
The slope of the ground between south and north pastures and pastures between the southern and northern are referred to as navro.

Popzan and Afsharzade (2010) also consider that indigenous pasture management mechanism includes migration, assessment of pasture, pasture segmentation, rotation, delayed grazing, pasture leasing and protection; and livestock management includes herd diversity, separating livestock, livestock moderation and the use of manual feeding.

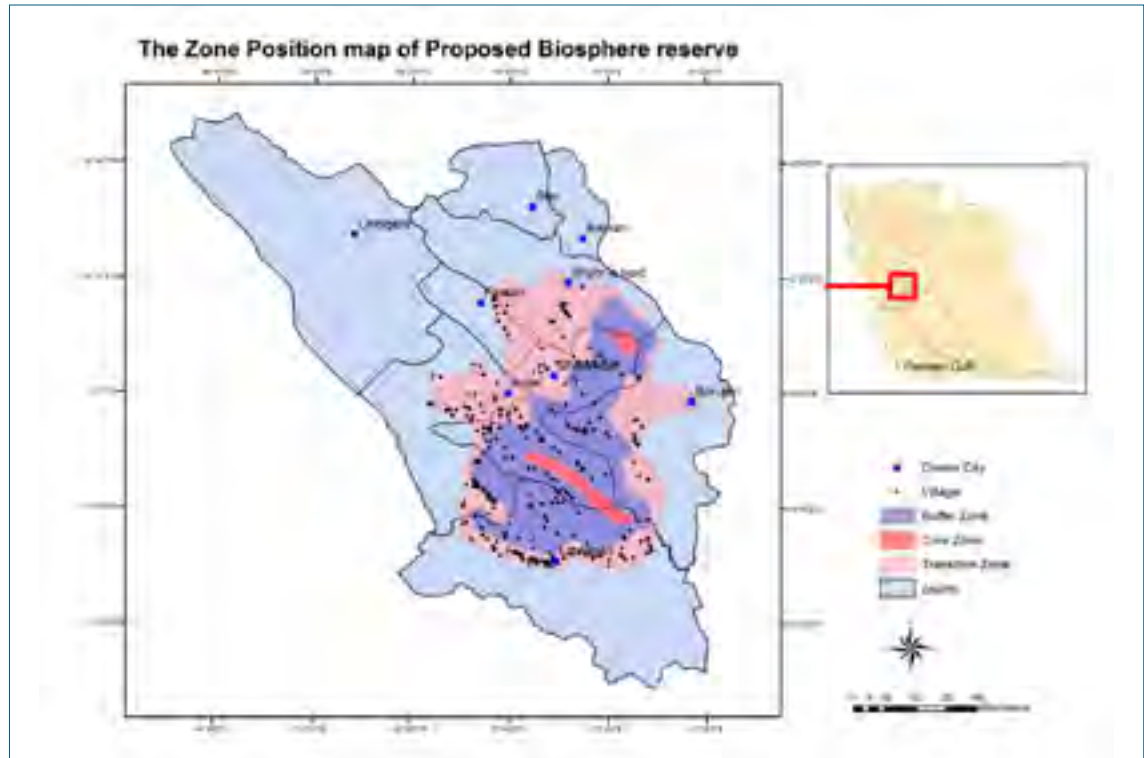
Nomadic pasture management system has faced challenges during its long history due to imposed policies at economic, social and political levels of nomadic society. Investigating factors effective in creation of such challenges against this traditional system and analysing solutions and strategies can lead to sustainable management of pastures in pasture exploitation system.

7.2. Methodology

This article relies on other research achievements with regard to the Bakhtiari nomads of Tangsayad - Sabzkouh Biosphere and seeks to deal with the question of the extent and direction of unsustainable rural development. Settlement of nomads and policies imposed by the government and its laws have changed the traditional system of pasture and grazing management of nomads. With an area of 532 thousand hectares, Tangsayad - Sabzkouh biosphere reserve covers more than a third of Chaharmahal and Bakhtiari and its major mountain pastures are in the range of Bakhtiari nomads summer pasture areas. More than 20 families from different Haft Lang Bakhtiari



tribes were considered as the sample. In order to get further information, Bakhtiari tribal elders referred by the Chaharmahal and Bakhtiari nomad administration, and some informants who were introduced by the department were also interviewed. The elites were mostly from Babadi and Durak Bab tribes.



Management planning of Tangsayad-Sabzkouh Biosphere reserve, Behzad Behzad, CO, 2015

Figure 7.1 The zone position map of Tangsayad-Sabzkouh Biosphere reserve

To conduct this study about the life and pastures of tribes, more than 10 facilitators who were veterinary doctoral students were present in the area and at the end of each day, they analysed discussions and observations and devised the next day's plan. Furthermore, 5 focussed groups consisting of 9 members were formed and group discussion was conducted and data analysed using content analysis method. In addition, for higher confidence level, more than 50 people were sampled randomly and data was collected through questionnaires and interviews. Regarding the role of nomads' settlement in traditional grassland exploitation system, Zia Tavana and Tavakoli (2007) research results are used.

7.3. Results

7.3.1. The role of government policy in the settlement of nomads and rural unsustainable development, and challenges in indigenous pasture management of nomads

Zia Tavana and Tavakoli's (2007) research findings in Chelgerd and Bazoft region of Chaharmahal and Bakhtiari province in terms of nomads' settlement policies suggest that in the current situation, due to insufficient loans granted by the agricultural bank, the tribes inevitably have had to sell all or part of their animals. Reduction of livestock numbers may be useful in reduction of pasture damage but we must observe to what extent qualitative indicators such as method of

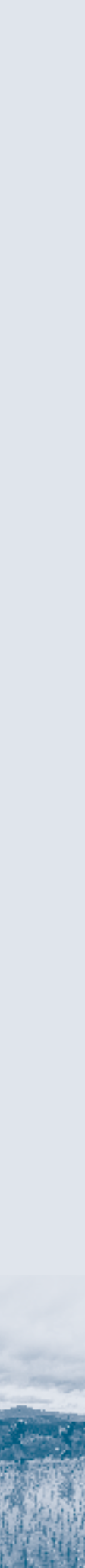
exploitation and factors such as early pasture intensification, prolonged stay of livestock in the pasture and loss of livestock mobility in the settlement process have changed. The authors also mention that not only has the settlement led to early entrance of livestock into pastures from settled families but by increasing the competition on this ground, it has also led to hurry in migration to exploitation of summer pastures, thus leading to early grazing. The important point is that in local interviews conducted with nomadic tribes in the biosphere reserve, the nomads noted their disputes with the tribes settled in the ranges. 67% of respondents stated that settled households use pastures before the start of the exploitation season, and when the other families of the tribes of nomads arrive, the pasture is already grazed and due to this early grazing, nomads face problems in feeding their livestock. Migrating nomads believe that settled nomads do not accept past indigenous systems to use pastures and due to the fact that they don't migrate any more, they have replaced lack of winter pastures by overuse of summer pastures so they don't have any commitment to past normative systems.

The authors also observe that when nomads settled, the livestock stay longer in the pastures and the effect of early grazing and increased time spent by livestock in pastures together with spatial limitation resulting from settlement and decreased radius of daily graze, caused increased damage to pastures.

Interview results with migrating nomads show that after decades of nomads' settlement policies having economic, social and cultural consequences for nomads, the government and settled nomads are interested in settlement because they can use pastures and benefit from health and accommodation facilities. This helps them to overcome the dangers of migration and the deterioration of Bakhtiari traditional management structure and lack of commitment to normative management systems of pasture and grazing and also conflicts with rural people but unfortunately so far the package of state support in this regard has not been able to help improve the quality of life of nomads. Results from interviews and facilitating reports show that more than 60 percent of the nomadic tribes that participated in the study population call for settlement with more government support packages and improvement of their livelihoods. On the other hand, some migrating nomads are against this program in its current form. They cite inadequate infrastructure services, livestock losses during housing, lack of skills in other fields of work and therefore lack of income as causes of lack of housing interest. However, statistics show that demand for housing is high among Bakhtiari tribes and this demand and results of research on nomads' settlement show that if the government fails to act on improving and diversifying nomads' livelihood and fails to turn strategic plans about pasture shared management and livelihood improvement into operative plans, Iran will face unsustainable tribal and rural settlements, and, further the destruction of pastures and natural resources.

7.3.2. Rules of natural resources and the challenges ahead in indigenous management of pastures by nomads

Results of the studies show that until 1961, exploitation of pastures was mostly in nomadic system and rural communities in nomad territories had no right on grasslands outside the country's limit. At that time among rural communities, rearing sheep was not very common and this means the exploitation of pastures was limited to communities of nomadic tribes (Bazhyan 2007). After nationalisation of pastures, the ownership of nomads was eliminated and nothing replaced it - that is one of the reasons of pasture deterioration. Nationalising forests and grasslands and land reforms led to land acquisition in tribal communities. Since agriculture was excluded from the coverage of rangeland thus changing pastures into dry lands, it led to land destruction (Papeli Yazdi 1994). Kyanvand (1990) also observes that joint ownership of nomads on the grasslands of 1962 disappeared as a result of direct government intervention: As a result, the nomadic pastures were occupied by villagers, grassland was converted to croplands and orchards and scope of nomads became very limited. The nationalisation of local rangeland reduced management and sustainable exploitation of the indigenous pastures by tribes. Iranian organisation of nomadic



affairs (2005) said that the main conflict between nomads and the government is normative system of nomads with nationalisation of forests and pastures and that nomads feel that the government doesn't care about them.

Nationalisation of forests and lands was in line with reforms of the past king of Iran that was conducted without sufficient information and planning so it left the ownership and management of forests and pastures at the hands of the government. Unfortunately, prolonged struggles between the tribes and the government during the decades of 1930 and 40 provided grounds for rejection of tribal society and the declared nationalisation of pastures in 1962 was the government's last resort stripping the country's political and economic independence of tribes living in their territory (Amir Ahmadian 2004). Unfortunately, sustainability of the nomadic system vanished in the process of modernisation and renewal that was not too deliberate and government intervention at the foundations of ecological and socio-economic relations with rural communities and urban nomads. For example, during the land reform and then with the exception of mechanized land, in many areas, pastures went under the plow and became dry farms (Bakhshande Nosrat 2001; Mousavi Nejad 2001). Outdated rules were also one of the challenges that existed in pasture management and unfortunately the law has many shortcomings and is weak for today's conditions. The last comprehensive law approved for forests and pastures of the country was passed in 1967 and it has been 49 years since.

Beside studies conducted by other researchers, findings of discussions and interviews with migrating nomads in biosphere reserves show that many normative systems of their pastures are assigned for rural and farming development by governmental organizations. And rural people also do farming on their normative systems with the permission of the government. 75% of migrating nomads want the government to stop intervention in pastures.

However, in recent years the government tried to stop the procedure by conducting projects in relation to shared pasture management, pasture insurance and protection.

7.3.3. The reluctance of young nomads to practice indigenous pasture management

Due to the development of technology and communication as well as severe economic challenges in tribes, younger generation tribals do not adhere much to traditional administrative and management systems. Results of interviews and facilitating with nomads show that more than 70% of Bakhtiari young nomads want to sell their livestock and live in cities. Unfortunately, lack of support for nomads and violation of their rights in management has led to increased poverty among them, thus youth are reluctant to commit to management and administrative systems of the tribes but they are trying to provide a rural or urban life. Results of the study show that more than half of the youths are not informed about traditional systems in pasture and grazing management and don't believe in them. Young people of Bakhtiari nomads did not know the importance of indigenous knowledge and traditional practices in the exploitation of pastures and they are also not motivated to use them.

Thus, the educational system must take into account the important need to produce educational content to introduce indigenous knowledge to children and adolescents, especially in tribal areas. Content production in indigenous knowledge can be conducted in line with formal and informal education to allow the young generation to become familiar with traditional skills and systems.

Conclusion

Results of the present study and other research show that the current procedure and challenges ahead of traditional nomadic exploitation system can be damaging for pastures and forests. Therefore, it is necessary to intervene to restore indigenous grasslands management. Shah Vali and Bazhyan (2001) proposed the following for the restoration of indigenous grassland management:

- ▶ The revival of local structures of pasture management such as setting the desired operating range, solutions to territorial and ethnic disputes, organized migration, protection of pastures and the appointment of responsible leaders.
- ▶ Revival of traditional social institutions of pasture management; these institutions are divided into two official institutions – tribal councils and value institutions – which are essential for the revival of local management.
- ▶ Revival of traditional communication such as social customs matters, dispute resolution, selection of council members, handling of administrative affairs, pasture utilisation and division of inheritance between heirs.
- ▶ The revival of local management requirements is concerned at the same time with exploitation and protection, as well as revenue for nomads.
- ▶ The contradiction between local management of pastures by nomads with applicable laws and regulations and endowments is due to the nature of laws or is related to the implementation of the above mentioned regulations.

In general, in order to revive indigenous pasture management and grazing of nomads, strategies and plans of the government should have a comprehensive insight on past systems of pasture and grazing management based on management and administrative structure of the tribe to fill in the gaps in management systems. As Bazhyan (2007) observes in his article, the realisation of optimal management of livestock depends on how communities determine ways of life of nomadic migration, settlement, semi-nomadic systems, sheep handling and so on. In this case, the objectives of the development plan of nomads can be achieved. Due to the fact that shared strategy of development is based on local conditions, appropriate management strategy for the development of livestock in tribal communities and new methods must be used specific to social and cultural conditions of tribes. Modelling and simulating of pasture management based on livelihood desired by nomads will create situations that can be achieved with the presence of indigenous structures and social institutions.

According to the material, following suggestions are offered to overcome the challenges:

- ▶ Improving the livelihood of nomads helps to prevent further destruction of pastures by settled nomads.
- ▶ Eradication of poverty of semi-nomadic tribes in winter rangelands, especially by encouraging projects such as grazing, development of technical and vocational schools, creation of plans including strategies that can be done to improve the livelihood of nomads.
- ▶ Ownership problems of grasslands by giving pastures to tribes on condition of exploitation in accordance with the principles of land use
- ▶ Review of national law and regulations of forest and pasture, land transfer regulations
- ▶ Employment in crafts for tribal women and to help improve livelihoods
- ▶ Rehabilitation and correction of poor and destroyed pastures with the support and partnership management of nomads and villagers.

- ▶ Support packages to help nomads in grazing
- ▶ Traditional tribal councils to fill the gap in the administrative and managerial system of nomads.
- ▶ To update the country's natural resource laws to solve problems created by conflicting laws
- ▶ Educational content for the younger nomad generations to become familiar with indigenous knowledge systems and traditional nomadic systems.

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8. Status of local rice varieties and changes over time: a case study from four villages in Po E commune, Kon Plong district, Kon Tum province, Central Highlands of Vietnam

Dang To Kien

SPERI

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8.1. Introduction

The Central Highlands of Vietnam, in particular the Po E commune, Kon Plong district, Kon Tum province, have gone through many changes since the colonial period. Notably, the colonial French dominated this region from the mid-19th to the mid-20th centuries. During this period, some quite rich and highly valued anthropological and ethnological studies were documented. These studies, particularly those conducted by French social scientists, focussed on themes of ethnic indigenous minorities of the region. In those studies, in the past, the term ‘ethnic minority’ was largely used for the ‘montagnards’ (French for mountain people), sometimes referred to as ‘forest people’; but most often these descriptions were not meant to connote ‘backward’ looking or viewing of indigenous ethnic minority communities there. Some publications were in the form of photo documentation, simply photographs in black and white of the very daily lives of ethnic indigenous minority groups there. In the contemporary development context of Vietnam, there is a lack of interest in and attention to the daily lives of the indigenous ethnic communities. The raw lens of indigenous voices and field-based cultural anthropological approach is largely absent in the current Vietnamese literature and social science studies. There is also a lack of studies that examine the changes that have happened, the reasons behind these changes that have taken place, and their likely effects on people’s lives in the current and (possible) future time periods.

SPERI’s work engaging directly with local indigenous H’re community in the Central Highlands of Vietnam in this Region, was further introduced in the Chiang Mai Indigenous and Local Knowledge Dialogue for the IPBES Asia Pacific Regional Assessment. In addition to the published works on Ethno-botany for Hmong indigenous community in Lao PDR of Cory Whitney et al (2014) which was presented in Chiang Mai, we include follow-up community work focusing on the H’re indigenous minority. The H’re indigenous minority group has very limited and isolated access to infrastructure and also to information and opportunities towards enhancing their local knowledge and capacity as well as empowerment of self-ethnic-identity determination. The H’re indigenous minority community, at Po E commune, Kon Plong district, Kon Tum province, Central Highlands region of Vietnam valued the opportunity to engage through the IPBES ILK Technical Support Unit (TSU) grant.

8.1.2. The aims of the proposed meetings were:

- ▶ To inform local communities about the work of IPBES and the purpose and results of the dialogue workshop in Chiang Mai;
- ▶ To consult with local ILK holders and practitioners so as to document additional relevant ILK related information suitable for publishing as a case study for the Asia-Pacific assessment taking into account the priority themes discussed with the authors;
- ▶ To support the rapid write-up of full case study reports that were shared by participants in the Chiang Mai workshop; and
- ▶ To seek prior informed consent as appropriate for the inclusion of collectively held knowledge in the proceedings.

8.1.3. Why did we conduct this case study?

The IPBES program’s thematic, regional and global assessment (2016–2020) is currently reviewing and assessing the current status, trends and contributions to biodiversity and ecosystem services of local indigenous knowledge systems for many sites across the world. Key questions of interest include: what are the currency, losses and or changes, for the better or for worse? What are the causes of these changes? What would be the future? UNESCO as well as IPBES for Asia-Pacific region wants to hear directly from villagers on the ground and representatives’ voices and inputs.

SPERI's activities in terms of securing and defending indigenous peoples' rights towards managing land and forests for upper watershed regions placed us ideally for conducting this case study with H're minority, detailing the practices of the community with regard to rice varieties. During SPERI's ongoing work with the H're community in Po E commune, we observed certain changes in the ways in which H're people practice the cultivation of their rice varieties, especially adoption of new rice varieties. H're people's practices of cultivating their rice varieties are often interlinked with entire resources including land, water and forests from their upper watershed through to downstream areas. The changes in adopting new rice varieties have led to other changes in how they relate to and interact with their land, water and forests. In order to strengthen protection and long-term management of the land and forests, we investigated how future strategies could secure local people's resources, knowledge and wisdom. The H're community as well as the communal area face everyday challenges and complex issues with resources management in the commune. Primary among these are (1) the overall transformation of forest land to upland barren fields with largely cassava crops and (2) the gradual replacement of local rice varieties with new ones.

8.1.4. Why did we choose local rice varieties as the topic of the case study?

Despite our observations that the local rice tastes so good, people are reducing their use of these varieties. We set out to investigate why there used to be numerous hill-rice varieties that are now no longer used; and why H're indigenous people now use wet-rice rather than hill-rice cultivation. One of the local villagers recalled that they used to only produce one crop of the hill rice varieties per year and this production could feed the entire family for a year or even two years. However, when wet-rice cultivation was introduced, largely by policy/agricultural extension programs, hill-rice cultivation declined in favour of wet-rice cultivation. Additionally, people have now moved towards planting cassava crop, even clearing forests with large trees to plant cassava to feed the nearby cassava processing factory. The increasing use of herbicides in association with cassava production is causing concern among villagers, local communities, local environmental non-governmental organizations including SPERI and the Alliance, policy makers, and to a certain extent, factory processors, buyers/traders of cassava crops. The promotion of cassava as a high-income cash crop, largely by policy, has led to substantial clearing of uphill forested land for planting cassava, and to further loss of local rice varieties. The local rice varieties, from our current understanding, are not only embedded with very rich local indigenous knowledge but are part of their lives, wisdom and cultural practice such as the Ritual ceremony.

8.2. Study sites and timing

- ▶ The target community: H're indigenous minority community, Po E commune, Kon Plong district, Kon Tum province, Central Highlands region of Vietnam.
- ▶ The target villages: Violak village, Vi K Oa village, Vi Klang 2 village, and Vi Po E 2 village, of the Po E commune.
- ▶ Timing of meeting: the many meetings took place from August 10-20, 2016, coinciding with the Rice Ritual ceremonies of the H're community.

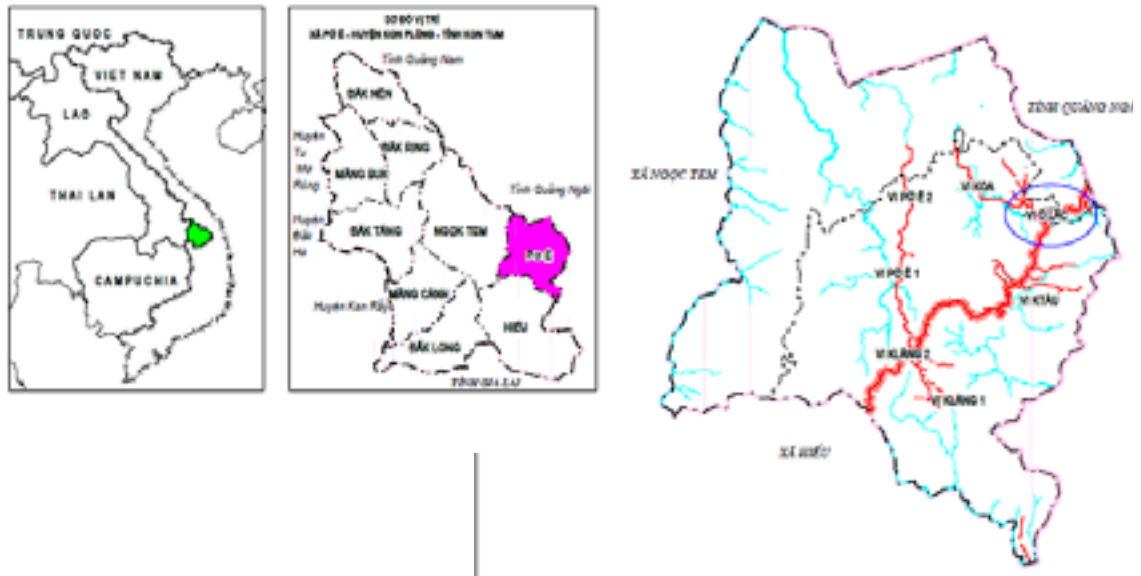


Figure 8.1 Blue circles indicate the location of the four villages of the Case Study Site (2016)

8.2.1. Case study methodology

Three people were involved in collecting information for this case study. One focused on taking photos and videos; another on learning local indigenous knowledge on rice seeds/species and varieties as well as practices during the ceremony; and the third on the entire ceremony including human interactions and practices during the ceremony and their underlying purposes. All three engaged in the ceremony to talk to village elders and other groups comprising villagers. We asked for inputs from key persons, women’s groups, youth groups and elderly groups in the villages to talk in-depth in the evenings. We also strictly followed the local customs to respect their tradition and culture.

The Ritual ceremonies were organized in four villages which are quite distant from one another. We dedicated two days to each village in order to have sufficient time to observe, asked simple questions and obtained permission to take photos and notes of events during the ceremony. We also ensured financial contributions to each village and the Po E commune to ensure benefit-sharing during the study. We obtained approval and support from all villagers and local village authorities to acknowledge all the names and knowledge from villagers who contributed to this case study.

Given the timing of the study, we considered changes that have taken place since 2010. Most often we will refer to current sources of information for matters of access to the currency of the issues in this region. This case study and write-up serves as the reflection of realities that have been encountered by this indigenous community over recent years.

8.2.2. Field-based methodology

Initially, we talked to all community authorities about our proposed case study and the IPBES program. We sought their advice and support for conducting these activities.

Field-based direct observations occurred at villages (entire landscape system, around the rice paddies, at each household visited and also their rice storage area).

Permission to document their knowledge from knowledgeable persons in the communities in terms of their local rice varieties was obtained. Deep listening and documentation of their exchanges and knowledge sharing was undertaken.

Direct interviews occurred at the rice fields (area where they harvest, where and when they dry rice, or when villagers help each other (on rotational labor exchange at harvest time, rice separation)).

Final consultation was undertaken with community authorities as well as by inviting all the village heads and their representatives including women's group.



Photo 8.1 Photographs of field based methodology during this case study (2016).

8.2.3. Limitations of our work

We simply aimed to raw-document the situation(s): which local rice varieties have changed and how, in the form of video and write-up, through listening to local indigenous villagers and key persons. We did not have time to go further into examining these traditional rice varieties themselves for assessment of qualities such as diversity or nutritional status because we have limited proficiency in this field.

Our examination of changes and the associated factors focussed on the cultural factors and were identified through a cultural anthropological approach. Our examination respects the voices of indigenous leaders and key persons from all villages. Local market analysis over the last five years helped in identifying why people's uses of local rice have changed, and also analysis of the

remoteness of the area. However, we lacked available data to support such further considerations. This was also due to remoteness and very limited access to infrastructure and also to information and opportunities in the area.

We prepared very simple questions and followed directly what happened on the ground through the narrative of the H're informant(s). We simply took notes and asked questions and documented their responses. Given most of us cannot speak the H're ethnic minority language, we could not obtain all the meaning and interpretations from the direct informants. Further study would undoubtedly provide more insights with regard to changes in using hill-rice for food and ensure food security is only one of the numerous changes affecting the community and their environments.

8.3. Case study findings

8.3.1. Rice Ritual ceremony

Our case study was conducted around the time of the Rice Ritual ceremony festival of the H're indigenous community in Po E commune. We received an invitation but also permission to go to the commune exactly at that time during mid-August, from 10th-20th August. This was the harvesting time of rice crops for the H're people. Families and villages performed Rice Ritual ceremony; largely each family performed their own ceremony associated with their rice field. The ritual is performed during the harvesting time as part of paying their thanks and gratitude to the offer from the Sky and all the spirits of Nature including the Land, the Soil, the Water, the Forests and the Rice spirit for giving them the harvest of the year. Two very detailed videos on rice ritual ceremony and native rice varieties, each with a separate theme, have been produced and posted on the SPERI webpage. One video was named 'Native rice varieties of the H're in Po E commune, Kon Plong district, Kon Tum province' with English sub-titles. The second video was named Rice Ritual ceremony of the H're people in Po E commune, Kon Tum province, also with English subtitles. The webpage to access these videos is <http://speri.org/eng/video.html>.

8.3.2. Current landscape changes in the Po E commune

Before 2010, Po E commune was an area including substantial forest with big trees, and in certain parts, some acacia tree plantations but not to a large scale. During interviews and field work, we found that there were no photos or images of the area from the past available for documentation and publication.



Photo 8.2 Photo on the left indicates mountainous areas of clearing forests for upcoming planting of acacia and cassava crops. Photo on the right indicates areas of forest and land already planted with cassava crops (2016).



Photo 8.3 Photo on the left indicates a small plot of local rice varieties, but the upper part is currently cleared for cassava planting. Photo on the right indicates an area already with cassava plantation (2016).

Po E commune is located at the entrance from Violak Pass and Quang Ngai area of Highway No. 14 leading to the Mang Den ecological tourism area. It has a total land area of 11,736 hectares. Viewing the area from Violak Pass through to the inner road along the two road-sides of the Highway No.14 passing through the main center of Po E commune, practices such as clearing of forest and land to make way for new plantations crops such as acacia and cassava are visible on various mountains, i.e. on landscape levels. Such a practice has become popular since 2013. In certain parts within the communal zone, we can see more land is now used for cassava plantations while the rice fields have decreased.



Photo 8.4 Photo on the left indicates a village - entire area is covered now with cassava plantations. Villagers planted cassava in the upper-hill while rice fields are in the lowest zone (2016).

As we go into the inner road and inter-village roads, we see that massive changes have occurred to the landscapes, with extensive clearing of forest and trees and land to make way for cassava crop plantations. Cassava plantations have covered the tops of the hills, implying that the big trees had already been cleared. From the landscape and ecosystem perspective, all of the rice fields are located in the lowest zone of the landscapes.



Photo 8.5 Photo on the left indicates another village-area with local rice varieties but the higher areas planted with cassava. Right photo is of the same message but different area (2016).

► **Changes over the three types of land uses in Po E commune**

We were able to access data over the last three years from 2014 to 2016. In 2016, the information collected by local officials has been specifically observed between the first 6 months compared with the planning for entire year.

Table 8.1 Changes over the three types of land uses in Po E commune from 2014–2016 (2016).

Land types and areas	2014	2015	2016 (early first 6 months)	2016 (planning for entire year)
Hilly areas (largely cassavas and corns)	384 ha	442 ha	419 ha	405 ha
Rice growing areas (to a certain area already affected by herbicide spraying)	320 ha	364 ha	246 ha	364 ha
Forestland areas (largely production forests such as acacia, cinnamon, bamboo)	644.6 ha	655.6 ha	655.6 ha	698 ha

The Table 8.1 above indicates that more hilly areas are now used for cassavas and corns compared to the last two years (2014 and 2015). Even in the first six months of the year 2016, the total land area for cassavas and corns was already 419 ha, well above the annual planned limit of only 405 ha. Area for planting cassava outweighs area for corn. Po E community authority has also planned to increase production of forestland for crops such as acacia, cinnamon, and bamboo types of forests. Rice growing areas have reached 246 ha out of 364 ha planned, including both local traditional varieties and also new varieties.

► **Land areas for rice-growing and cassava-growing in the four villages in 2016**

Through a series of discussions, combined with key villagers/leaders' knowledge of each village and the community's official data, we have developed a table (Table 8.2) comparing local rice growing area versus new rice growing area and a similar one for cassava crops.

Amongst the four villages, Vi O Lak village is the only village where all villagers are now planting new rice varieties. Villagers in Vi Klang 2 village have been using mixed planting between local rice and new rice varieties so that they can test which one gives better yield for their livelihoods. Vi Po E 2 is the village which keeps the highest land area for traditional varieties, followed by Vi K Oa village.

Area under cassava cultivation has also increased over the recent years. Almost all villages have now adopted the hybrid cassava species and the area for planting them is quite large.

Table 8.2 Land areas for traditional and new rice and also traditional and hybrid cassavas at the four villages in Po E commune (2016).

Land types and areas		Vi Pờ Ê 2 village	Vi Klâng 2 village	Vi K Oa village	Vi Ô Lắk village
Rice growing area	Entire rice area	43.5/40.1 ha	50/53.6 ha	45.5/53.1 ha	58 ha
	Local rice area	39.15 ha	25 ha	31.85 ha	
	New rice area	4.35 ha	25 ha	13.65 ha	
Cassava growing area	Entire cassava area	32 ha	39 ha	36 ha/41 ha	63 ha
	Local cassava area	4 ha	4 ha	4 ha	5 ha
	Hybrid cassava area	28 ha	35 ha	32 ha	58 ha
Community forestland area that SPERI/ LISO have attempted since 2014	Watershed forests, sacred forests must be protected collectively under titles	76.24 ha	215.3 ha	152.16 ha	231 ha

► Cassava growing areas with herbicides which affect rice-growing areas in the lower zones

Our observations and field trips have indicated that in land areas which were cleared for planting cassava, villagers have used herbicides such as these below (Photos 8.6 – 8.8). The cassava processing factory is located in the Quang Ngai province, beside the Kon Tum province. We could not access information about when it was established and further details. From villagers, we learned that they planted cassavas and then sold them through buyers/traders of cassava crops. In the past years, villagers were even provided the herbicides for free, but without any guidance and consideration on how to use them or the effects and impacts of these herbicides. Further details about why and how these cassavas would be used are also limited.



Photo 8.6 Herbicides found in the Vi O Lak village (March, 2016)



Photo 8.7 Herbicides found in the Vi Klang 2 village (March, 2016)



Photo 8.8 Herbicides found in the Vi Po E 2 village (August, 2016)

The large landscape level changes that have been identified, associated with use of herbicides, are highly likely to have affected the entire ecosystem from the upper land to the lower zones, including the rice fields. Villagers left behind these empty herbicide bottles on the hills after use.

8.3.3. Some concluding remarks

- ▶ Over time, through observations of the landscape and ecosystem practices in the villages, we found that:
- ▶ Rapid transition from forestland to now cassava plantations, combined with widespread use of herbicides has occurred.
- ▶ The shift towards cassava plantations and increased use of herbicides may negatively impact local native species, quality of the rice paddy, soil quality and water sources, as well as have negative health impacts on the community.
- ▶ The available land resources are not going to increase, highlighting the need for careful practices and management of the entire current land resources of the commune, to avoid negative consequences on both food production and agro-biodiversity.

8.4. Current status of rice varieties in the Po E commune

8.4.1. Status of local traditional rice varieties in Po E commune and specifically the four villages

Across the entire Po E commune, we found that all the four villages studied and the other three villages in the commune still maintain, save and use the local traditional rice varieties. Given our time limitations, we could only ask about and document the 23 traditional rice varieties. These varieties have been stored in the traditional rice-stored house, which is made of a certain timber wood and has a specific design structure in order to avoid rats which destroy and eat all the harvest.

Table 8.2 The total number of local rice varieties which still remains, is saved and used at each village (2016).

Names of villages examined for local rice varieties	The total number of local rice varieties still maintained, saved and used (till 2015–16)
Vi Pờ Ê 2 village	21 varieties documented 07 varieties without images
Vi Klàng 2 village	14 varieties documented
Vi K Oa village	11 varieties documented 05 varieties without images
Vi Ô Lắk village	07 varieties documented
Vi K Tau village	20 varieties documented
Vi Pờ Ê 1 village	
Vi Klàng 1 village	14 varieties documented

The total number of local rice varieties examined and documented was 23. However, this figure does not represent the entire diversity of rice varieties of the villages. Each local rice variety ripens at different times, some early whilst the others are late. During the last Rice Ritual we could only witness and have access to 23 varieties with certain images. We still lack images and examination of the remaining varieties.

Across the 07 villages, we see that Vi Po E 2 village keeps the maximum number of local varieties: about 21. The Vi K Tau village, was not part of our follow-up meetings but village leaders and key persons identified that this village keeps the second highest number of varieties, about 20. Vi K Lang 2 village keeps the 3rd most varieties with about 14. And during our final exit-meeting at the Po E communal house, we invited representatives of all villages to attend, listen and contribute comments. We found that the Vi Klang 1 village also keeps the same number of traditional varieties as the Vi Klang 1 village, i.e. about 14. The Vi K Oa village keeps the 5th most number of local varieties, i.e. 11 and Vi O Lak village keeps about 07 local varieties.

8.4.2. Status of new rice varieties in Po E commune and specifically the four villages

We also examined the new rice varieties being used in all the villages. Changes have taken place over the last five years since about 2010. This change resulted from the 2009 rainy season, during which villagers and villages were hit hard by a very strong rain arriving early, which caused huge losses of crops of the harvest, leading to hunger. There have also been additional new approaches from governmental agricultural programs that promote new rice varieties which they believe give higher yields compared to traditional varieties.

Table 8.3 The total number of new rice varieties recently in use at each village (2016).

Names of villages examined of new rice varieties	The total number of new rice varieties used for the last 5 years
Vi Pờ Ê 2 village	02 new rice varieties documented
Vi Pờ Ê 1 village	02 new rice varieties documented
Vi K Oa village	08 new rice varieties documented
Vi Ô Lắk village	08 new rice varieties documented
Vi K Tau village	04 new rice varieties documented
Vi Klàng 2 village	02 new rice varieties documented
Vi Klàng 1 village	02 new rice varieties documented

The total number of new rice varieties is eight. Across all villages, the Vi O Lak and Vi K Oa village use positional eight. Vi K Tau village uses four new varieties although they still continue to use the traditional rice as well. Vi Po E 2, Vi Po E 1 Vi Klang 2 and Vi Klang 1 villages also use about 02 new varieties. Those families who use the new rice varieties have also been approached to use chemical fertilizers.

8.4.3. Examination of other information relevant to status of rice varieties

From our discussions with key persons in each village, we also documented: (a) percentage of families using local varieties; (b) percentage of families using new varieties for each target village; (c) the number of families and the number of people in each village; (d) the number of women; (e) number of elders; and (f) number of knowledgeable persons who know, save and use local traditional rice varieties (Table 8.5).

Table 8.4 Examination of other related information relevant to status of rice varieties

Examining other related information	Vi Pờ Ê 2 village	Vi Ô Lắk village	Vi Klàng 2 village	Vi K Oa village
% of families using local varieties	85%	Only keep 03 local varieties: Mao Hroa, Kdút, Co	100%	30%
% of families using new varieties	15%	100%	90%	70%
Total number of families	44	57	98	69
Total number of people	128	n/a	450	248
Total number of women	48	n/a	n/a	120
Total number of elders (> 60 years)	15	22	22	14
Total number of knowledgeable persons who know, save and use local rice varieties	15	9	20	12

In Vi Klang 2 village, all families still use their local rice varieties daily, but at the same time 90% use new rice varieties. This implies that they practice rice farming on plots through cultivating both local and new rice varieties at the same time. This village has the largest number of knowledgeable persons who know, save and use local traditional varieties.

On the other hand, in Vi O Lak village, all families use new varieties but they only keep three traditional sticky rice varieties for special occasions, such as sacred rituals, for making a special local indigenous cake named ‘Banh Tet’, and for making wine.

In Vi K Oa village, up to 70 percent of the families use only new rice varieties and the rest use local traditional ones. We can still find many knowledgeable persons who know, save and use local rice varieties. Vi Po E 2 village has up to 85 percent of all families using local varieties but we can see the other 15% of families already shift to using new varieties.

8.4.4. The favourite rice varieties from the four villages

Field work and interviews identified that each village has its own specific favorite rice varieties, and they differ in the collection of their favourites. Despite coming from the same ethnic indigenous H’re and living on the same territory/commune, each has their own targets for collection of seeds and favourite varieties.

Table 8.5 The favourite rice varieties and their uses at four villages (2016).

Names of villages	Names of favourite rice varieties which continue to be used and saved	For what purposes?
Vi Pờ Ê 2	+ Mao Kdút + Mao Luốc + Mao Hroa (sticky) + Mao Tdo âng gam (black sticky rice)	More seeds and higher yield; Make wines more tasty
Vi Ô Lắk	+ Mao Hroa (sticky) + Mao Kdút (sticky) + Mao Co (sticky)	Make wine For sacred ritual (traditional New Year) Make special cake (Tép)
Vi K Oa	+ Mao Nụ + Mao Hroa (sticky)	For sacred ritual Make wine Make special cake Making young rice-cake Women eat for 3 months after delivery (Mao Nụ)
Vi Klàng 2	+ Mao Tdoâng mong + Mao Tinh + Mao Nét + Mao Mong + Mao Diu	Make special cake Make wine For daily use

The Table 8.6 above, to a certain extent, suggests that the villages with the most number of knowledgeable people are best able to conserve their agro-biodiversity, such as for this case study i.e. Po E 2 village and Vi Klàng 2 village. It is true that in these two villages, compared to the rest, they still have many villagers who know, save and use local rice varieties. The villagers also express their different ways of maintaining traditional varieties and hence using traditional ecological knowledge to cultivate these varieties, and one often varies from that of another villager/family. Many of the villagers expressed that they prefer to continue to use these traditional rice species than the newer species.

8.4.5. Some concluding remarks

The total number of local traditional rice varieties documented is 23 species: Vi P Ê 2 village keeps the most and Vi Ô L k village keeps the least.

The total number of new rice varieties documented is 08 species: Vi O Lak village uses the most (100% families) and 04 villages (Vi P Ê 2, Vi P Ê 1, Vi Klâng 2, and Vi Klâng 1) only use 02 species for now (many villagers are still testing on their rice fields)

Families which use new rice varieties already used chemical fertilizers since 2010. Most obvious is families in Vi Ô L k (since 2013, 2014) and about 2/3 of families in Vi K Oa. Very few households in Vi Klang 2, Vi Po E 2 started using new rice varieties in 2015-2016 with some chemical fertilizers (depending on families which have money to buy fertilizers).

8.5. Discussion

We have found that most of the local traditional rice varieties continue to be used and saved by all local indigenous villagers. Two villages, Vi K Oa and Vi O Lak save fewer local varieties than other villages but they still use them for sacred, special traditional ceremonies or rituals; and also specialty wine-making and cake-making processes. The reliance on externally sourced herbicides and chemical fertilizers and their impacts on hardening the soil structure and reducing productivity have begun to worry certain groups of villagers. However, there is not yet a systematic and comprehensive scientific collection of data and samples to test how use of chemical fertilizers and herbicides affects the soil productivity, rice yield productivity, and indigenous villagers' health.

Certain areas where traditional rice varieties are grown have been affected by the establishment of cassava plantations as the upper zones have been sprayed with herbicides. These plantations replace natural forests that provided nutrients and organic ecological matter from the upper mountains to feed the soil and retain water supplies for rice production in the lower zones. The landscape and ecosystem services have changed dramatically towards the continuous cassava-landscapes (or cassava-mountains), together with promotion, use and dependence on herbicides. The effects and impacts of these changes on future dynamics of biodiversity and ecosystem functions are likely to increase over time. In other parts of Vietnam, the media has already reported that use of herbicides is negatively impacting social health, well-being, livelihoods and thus the local economy.

In some villages, there are still areas of organically-grown local rice zones. Qualitative data collected in this study report that the taste and nutrition from the local rice varieties is much better, and quality oriented. One farmer shared that he may just eat one bowl of local rice variety and feel full for the entire day – which does not occur with the use of new rice variety. In other cases, people report that use of new rice variety does not give a good taste to wine. Growing local varieties supports high ecosystem functions and services for biodiversity, and also adds aesthetic values and beauty to entire landscapes.

The change in the status and trends of usage of local rice varieties is associated with the overall transformation of forest land to upland barren fields with mostly cassava crops; due largely to policy, and also the gradual replacement of local rice varieties with new ones for higher yields but with effects and impacts from use of chemical fertilizers and herbicides (also largely due to the agricultural extension program). Limited access to information and knowledge of the relevance and correct usage of these products in farming practices exacerbates their impacts on both social and ecological wellbeing.

H're people's practices of cultivating their rice varieties are often interlinked with entire resources including land, water and forests from their upper watershed through to downstream areas. The changes in adopting certain new rice varieties have led to certain changes in how they relate to and interact with their land, water and forests. During and after this case study, discussions with participants also pointed out the irrelevance of using chemical fertilizers and herbicides in their farming practices and at this stage, interviews with key leading representatives from communal authorities (see one of the videos produced) have indicated their wish to address this herbicide usage by limiting them. They also continue to ask for more collaborative support along with SPERI and the LISO Alliance's facilitation to reverse the trends and impacts i.e. to strengthen protection and long-term management of the land and forests through a strategy towards maintaining the indigenous local knowledge of the H're ethnic community to secure local people's resources, knowledge and wisdom.

Annex

Table 8.6 Schedule for meetings with the H're indigenous minority community, Po E commune, Kon Plong district, Kon Tum province, Central Highlands region of Vietnam through the IPBES ILK technical support unit (TSU) grant

Date	Activity
10 August:	Arrival.
10 August:	Evening: introduction to the group of the key persons there. Mentioned our aims of this small case study and also shared the current IPBES work at the international level; sharing as well how things were done and shared during the last ILK meeting in Chiang Mai in order to better realise the significance of Indigenous Local Knowledge. Ask for consultation on how to engage with the ceremony as well as asking questions for this case study theme.
11–12 August:	Violak village (10-20 people) participants list attached.
13–14 August:	Vi K Oa village (10-20 people) participants list attached.
15–16 August:	Vi Klang 2 village (10-20 people) participants list attached.
17–18 August:	Vi Po E 2 village (10-20 people) participants list attached.
19 August:	Summary, present findings to villagers, and evaluation (20-35 people)
19 August:	Meeting in the Po E communal people's committee office, inviting not only villagers, village representative leaders, but also other functional offices to attend as well.
20 August:	Departure.

9. Traditional agricultural knowledge for biodiversity and ecosystem management: Evidence from Rice-Fish-Duck System in Dong and Miao Terrace of China

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Background

China is a large agricultural country, with a history of thousands of years of agricultural development (DAI R et al., 2010). Chinese farmers have been searching for many agricultural practices adaptable to different natural conditions (Zhang D et al., 2012). These practices and knowledge are not only the application of traditional Chinese philosophy, but also are the foundation of modern ecological agriculture, which greatly supports the sustainable agricultural movement throughout the world (Li WH, 2001).

Traditional agricultural knowledge is a comprehensive system of technology, management pattern, wisdom, knack and experience, which was created by long-term agricultural productive practices and has been passed from generation to generation in the particular community (Li JW, 2010). This kind of knowledge has provided many ecosystem services which are important for the local environment, especially in mountainous areas. Dong and Miao people have conceived and used the Rice-Fish-Duck system for thousands of years in Congjiang County, which is located in the southeast of Qian Dongnan Miao and Dong Autonomous Prefecture of Guizhou Province, China. In the system, the traditional varieties of glutinous rice saved by Dong and Miao people are used and the fish and duck are also bred in the terrace fields. This research will review the system for ecosystem services and benefits analysis. The Rice-Fish-Duck system may contribute towards improved grain and food production levels under limited resource conditions, promote the development of indigenous culture and applied research of biodiversity conservation and aid exploration of the research of adaptability methods, approaches and management mechanisms of biodiversity conservation in ethnic groups of China. It will also facilitate the work of IPBES Asia-Pacific Assessment of Biodiversity and Ecosystem Services, especially in IPBES regional assessment themes of sustainable use, conservation, land degradation and restoration in Asia and the Pacific region as well as a case study. The study also has important significance for the protection and heritage of traditional knowledge and the protection of biodiversity and ecosystem management of ethnic regions in China.

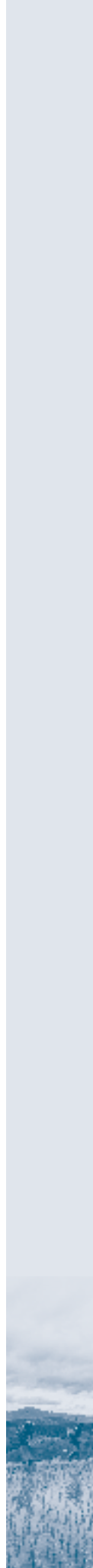
9.1. Introduction

China is a large agricultural country, and with the rapid development of economy and science and technology, thousands of years of traditional agricultural production methods will soon be replaced by modern agricultural methods (Xue DY and Dai R, 2012). The development of modern science and technology greatly promoted the growth of agricultural products, the agricultural productivity level and agricultural economy. Farmers have begun to adopt modern agricultural techniques and modes, instead of the traditional modes (Liu MC et al. 2014).

However, at the same time, large-scale use of chemical fertilizers and pesticides (Mäder et al., 2002), and discharge of many pollutants in the agricultural produce process result in a series of major environmental issues such as the destruction of agricultural ecological environment, water and soil loss, land degradation, biodiversity loss etc., but has contributed to eliminating hunger. Water pollution and other environmental problems, however, have also arisen because of the excessive application of chemical fertilizers in rice production areas. Nitrogen (N) fertilizer increases crop yields (Tilman et al. 2011), and the N fertilizer used in rice production accounts for 16% of all N fertilizer used in the world (Ladha et al. 2011). In addition, shortage of agricultural natural resources, decline of the agricultural ecological environment quality, significant loss of traditional crop varieties and poultry species resources, and food safety issues are becoming the focus of attention. Against this background, the most serious challenges for contemporary Chinese agricultural development are improving grain and food production levels under limited resources conditions, at the same time protecting and improving the rural ecological agriculture environment and, maintaining ecological balance to co-ordinate regional economic development and ecological protection.

The aforementioned problems in the agricultural development process have attracted great attentions from many Chinese scientists and agricultural workers. They emphasized that we should once again be keeping our eyes focus on traditional agricultural knowledge and practices. However, the emergence of China's traditional agricultural knowledge is not by accident, but by the accumulation of practical experience of agricultural development over thousands of years and the reflection of domestic agricultural development trajectory. China has thousands of years of agricultural production history, leaving the legacy of many excellent traditional production experiences, such as reasonable crop rotation, interplanting, intercropping, deep plowing and thorough harrowing, plowing and winter irrigation, combination of agriculture and animal husbandry, insect-resistant breeding selection, biological natural enemies, plant-based pesticides and so on, which are all the essence of traditional agriculture. They are in accordance with the principles of ecological agriculture, helpful for achieving sustainable agriculture development. These areas, where natural resources and ecological environment are not damaged or are only damaged at low levels, provide a strong foundation for the development of ecological agriculture in China.

The Rice-Fish-Duck System of the Dong and Miao people is one of the major practices of traditional Chinese agriculture. It is no longer a sole agro-production practice, but an agro-cultural pattern. This system is rationally formed according to the biological and ecological characteristics of various communities and their mutually beneficial symbiotic relations, considering the different requirements of different organisms on the space, time, material and energy. All communities with different niches fulfill their own needs, make the full use of solar energy, water and mineral elements and build a production structure which is multi-layer in space and multi-sequence in time. The traditional system efficiently uses water and land resources, provides food security, and does not harm the local environment (Hu LL et al. 2013). With the shortage of agricultural natural resources, the decline of the agricultural ecological environmental quality and significant loss of traditional crops and poultry species resources, food safety issues are becoming the focus of attention. This study expects to increase awareness of the importance of traditional Chinese agricultural knowledge for biodiversity and ecosystem management.



9.2. Study Area

Congjiang County (25°16 N-26°05 N, 108°05 E-109°12 E), located in southeastern Guizhou Province, China, is a typical traditional agricultural area with lack of arable land resources, as shown in Figure 9.1. Congjiang County is one of the poorest counties in southwestern China and also a multi-ethnic area: There are Miao, Dong and 13 other ethnic minorities (Zhang D et al., 2012). The ethnic minority population accounts for 94% of the total population of the county. Dong and Miao people conceived the Rice-Fish-Duck System thousands of years ago in this county. The county is mainly composed of low range mountains and hills, which constitute nearly 90% of the total area. The area for raising fish and duck in paddy fields is about 12,600 hm², and this practice is the main source of high protein nutritious food required for mountain villagers in remote areas. The rice-fish agriculture also has a long history in Congjiang County. The documents of national migration records show that over 1000 years have passed since the Dong and Miao people of Congjiang County began using the rice-fish agriculture. Figure 2Photo 9.1 shows that the scenery of Jiabang terrace fields in Congjiang County of Miao-Dong Autonomous Prefecture of Qiandongnan, southwest China's Guizhou Province. Jiabang terrace is home to the Miao people (The photo was taken by Xiaoshu MO). Officials and experts from the Food and Agriculture Organization of the United Nations (FAO) made a special trip to inspect Congjiang County from 30th May to 6th June 2006. Rice-Fish-Duck System in Congjiang County was listed by FAO as one pilot site of the Globally Important Agricultural Heritage Systems (GIAHS) early in 2011. A GIAHS is a living, evolving system of human communities in an intricate relationship with their territory, cultural or agricultural landscape or biophysical and wider social environment (<http://www.fao.org/>).



Figure 9.1 Location (Congjiang County)



Photo 9.1 The scenery of Jiabang Terrace Fields in Congjiang County

9.3. Materials and Methods

We conducted field research four times from June 2010 to October 2011. We selected 68 households as interviewees for the study because they cultivated rice both in the Rice-Fish-Duck system and Rice agriculture (monoculture) system with different varieties. We conducted interviews with farmers in their houses and farmlands with a prepared questionnaire. Questionnaire-based interview and participatory method was used in the study, as shown in Table 9.1.

Table 9.1 Data and methods used in the study

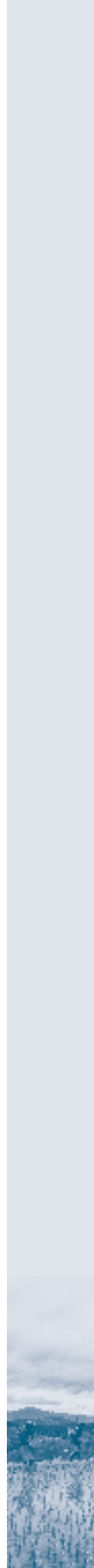
Type of agriculture	Methods	Comparing analysis	Problems
Rice-Fish-Duck agriculture	Questionnaire interview and participatory method	By comparing the two types of agriculture on economic, ecological, social and cultural benefits.	Opportunities and challenges
Rice agriculture (monoculture)	Questionnaire interview		

9.4. Results and Analysis

9.4.1. The Rice-Fish-Duck system

Rice-Fish-Duck system of Dong and Miao people, as one part of China's traditional knowledge and agricultural culture, has become the protection pilot of FAO's Globally Important Agricultural Heritage, as shown in Figure 9.2. The system is a production mode which mountain farmers depend on in Congjiang county, stemming from the limitations of natural conditions. It is also a high protein nutritious food source for the villagers. Combining cultivation of plants with animal feeding is a raising mode with form of closely integrated farming and animal feeding in the spatial dimension, with multi-level configuration, aiding a variety of biological coexistence to take full advantage of materials.

In this system, the traditional varieties of glutinous rice seedlings saved by Dong and Miao people are used and the fish is also bred in the terrace fields. Figure 4 Photo 9.2 shows that the ducklings are put into the terrace field to be raised in the system. When the fish grow up to ten centimetres long, the ducklings are put into the terrace field to be raised. The glutinous rice of the system provides shade and organic food for the fish, ducks and other aquatic animals. The fishes and ducks play an important role in weeding, cultivation, fertilization, oxygen supply and eating pests etc. This ecological cycle has achieved very good economic, ecological, social and cultural benefits. This system has strong practical significance and promotional value for solving the problems of the world's agricultural, ecological and environmental deterioration, farmland and water pollution and safety of agricultural products.



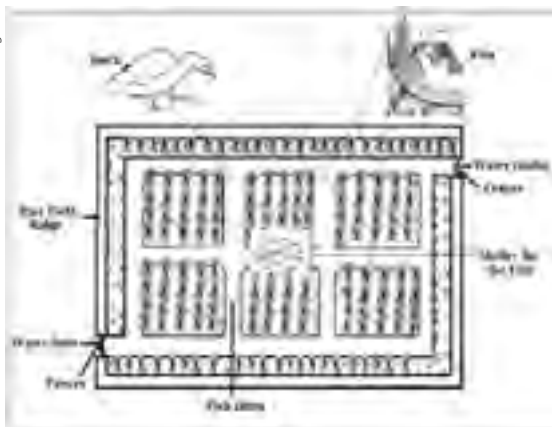


Figure 9.2. Rice-Fish-Duck system of Dong and Miao People



Photo 9.2 The ducklings are put into the terrace field to be raised in the Rice-Fish-Duck system

9.4.2. Benefit analysis

Based on previous literature, we believe that the Rice-Fish-Duck system has strong practical significance and promotional value. We would like to discuss in detail the four benefits of rice-fish-duck system over rice agriculture system (monoculture) in the following sections.

► Economic benefits

According to the interview results from 68 households, we took the average value to calculate the cost and profit between the two systems. The cost of the two systems includes the cost of seeds, fish, duck, pesticides, fertilizzser, feed and labour. The profit values of the two systems include the profit from rice, fish and duck. As shown in Table 9.2, although the glutinous rice yield of rice-fish-duck system is slightly lower than the hybrid rice systems with single species, the price of rice produced by the system is 3-5 times higher than hybrid rice. Photo 9.3 shows that the traditional varieties of glutinous rice seedlings saved by Miao people in Jiabang village, Congjiang County, China. Meanwhile, the fish and ducks in this system are typical “green food”, the prices of which are twice as high as ordinary varieties. Photo 9.4 shows that the traditional varieties of fish saved by Miao people in Jiabang village, Congjiang County, China. The manure of fish and ducks is a good organic fertilizer for glutinous rice, which can greatly reduce the input costs of pesticide, fertilizzser, feed and labour.



Photo 9.3 The traditional varieties of glutinous rice saved by Miao people in Jiabang village.



Photo 9.4 The traditional varieties of fish saved by Miao people in Jiabang village.

Table 9.2 Cost and profit analysis between Rice-Fish-Duck system and Rice agriculture system

Cost and profit		Rice-Fish-Duck agriculture (CNY/hm ²)	Rice agriculture (monoculture) (CNY/hm ²)	Notes
Cost	Seed	0	-750	traditional varieties of glutinous rice seedlings saved by Dong and Miao people are used for planting
	Fish	-1500	0	traditional variety
	duck	-2250	0	traditional variety
	pesticide	0	-1350	no pesticide for Rice-Fish-Duck system
	fertiliser	0	-3000	using farmyard manure to replace fertilizer in Rice-Fish-Duck system
	feed and labour	-1500	-3000	
	agricultural water	0	-750	
profit	Rice	+39375	+18900	Average milled rice rate 70%
	Fish	+9600	0	green food
	Duck	+6480	0	survival rate of duck could reach more than 90%
Total		50205	10050	

► Ecological benefits

Comparing the two types of agricultural systems on ecological benefits, we found that a lot of ecological principles are inherent in the rice-fish-duck system. This system is of sound design, and the flow of energy and material is recycled with the ecological system. In the system, the output (such as the discharge of discarded materials) in one production link is the input for another production link so that various kinds of discarded materials in the system can be utilized time and again in the course of production; thus a higher utilization rate of resource is created and pollution of the rural environment is effectively prevented. The ecological cycle greatly increased biodiversity, as shown in Figure 9.3, improved farmland ecosystem stability and helped achieve sustainable development and use of land, as shown in Figure 9.4.

► Social benefits

Dong and Miao people lack arable land area resources, and the area is dominated by terrace fields. The Rice-Fish-Duck system is a natural three-dimensional mode of agricultural production, which can effectively save the land, and ease the contradiction between land and people.

► Cultural benefits

The Rice-Fish-Duck system promotes the protection of its farming culture and heritage. The system has a history of thousand years, which is one of the surviving production modes for the Dong and Miao people. Not only does the system promote the traditional varieties of planting

► (1) High-quality farm products

The ecological agriculture in Congjiang County promotes the development of high quality agricultural products, thus increasing farmers' income. As the process of agricultural industrialisation continues to speed up, the characteristic agriculture has developed into the vegetable industry, virus-free potato industry, high-quality rice industry and Congjiang pigs industry.

► (2) Material recycling based on biogas

Rural biogas constructions play an important role in increasing farmers' income, promoting production development, protecting ecological environment, improving rural landscape and so on. The biogas digester is a connection to link planting and breeding, life and production, which can not only solve the needs of lighting and cooking fuel, but also the resource utilisation of human and animal faeces and other waste, improving the ecological environment of local areas.

► (3) Eco-tourism in Congjiang County

Congjiang County has a unique folk culture of the Miao and Dong, and it is preserved more completely because of the relatively isolated environment. This is an attractive point for the development of agricultural eco-tourism.

9.5.2. Opportunities and challenges

At present, Chinese agriculture has developed into a new stage. The problems of supplying adequate food and clothing have been basically solved. Agriculture should not only meet the basic needs of the people's living standards and the industrialization demand of agricultural raw materials, but also provide more increased and better quality and safer food for the society. The requirements for agricultural products and foods are not only the quantity, but also the agro-ecological environment and safety. The focus of agricultural production shifts from quantity to quality and efficiency. Organic food products with high-quality, high diversity and health safety will be preferred. Food safety and environmental concerns have become fundamental issues for international trade of agricultural products and foodstuffs. Meanwhile, it is necessary to protect farmers' livelihoods and employment, increase the farmers' income, as well as undertake the function of ecological protection, tourism and historical cultural heritage.

However, some problems have also been encountered on the developing trajectory of China's ecological agriculture. Whether these problems can be effectively solved determines the direction and prospects of the China's ecological agriculture development. These problems are related to the awareness of Chinese agricultural resources and environmental infrastructure, ideology, economic scale, science and technology, management, product marketing and the direction of sustainable development direction.

In the stride of pushing traditional agriculture forward to modern agriculture, one of the main tasks on the agricultural front is to develop ecological agriculture. China's ecological agriculture is consistent with the Chinese situation. And it accumulated knowledge and experience in the management and use of resources from Chinese traditional agricultural knowledge, which is a globally significant treasure that needs to be promoted and conserved and, at the same time, allowed to evolve.

It has strong vitality and broad development prospects. We hope that ecological agriculture will become mainstream and lead direction of Chinese agricultural development in the 21st century. Through continuous exploration and development, we believe that China's ecological agriculture will have much larger development space, achieve more and more achievements, and make positive and important contributions to sustainable development of agriculture in China and the world. Therefore, a variety of ecological agriculture methods have developed rapidly in China based on traditional agricultural practices and knowledge, becoming an effective way for sustainable agricultural development in China.

In order to further promote the development of ecological agriculture in China, modern science and technology should be based on the good understanding of current national situations and conditions, working with government support and farmer participation with to make strategy planning. In addition, there are a need to strengthen ecological agricultural policies and funding support, enact relevant laws and regulations, improve industrialization levels, reinforce extension, strengthen the theory and research of ecological agriculture and so on. When the natural resources are used for agricultural production, ecological balance should be maintained and restored to achieve the unity of the economic, ecological environmental and social benefits.

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10. Indigenous knowledge of Qanats (Aqueducts) and its role in achieving the four indicators of sustainable development: A case study from the Tangsayad – Sabzkouh Biosphere Reserve

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Abstract

As a predominantly arid and semi-arid country, Iran has always faced the problem of water shortage. Our predecessors addressed their water shortage problems using indigenous knowledge. Aqueducts (hereafter “Qanat”) are our predecessors’ long-lasting heritage hidden inside the earth and one of the scientific and cultural treasures of Iranians. It is a native solution for the management of water resources.

In fact, Qanats are one of the most important monuments of Iran and Iranian art and culture, the knowledge of which has been passed on through generations. In addition to revealing obscure native technological trends in Iran, the status of Qanats from the perspective of economic, environmental, institutional and social indicators could have been a reason for the country’s scientific, cultural and economic advancement.

Studies have shown that assessments and studies that have been done only by experts differ from assessments which take into account various aspects, especially surveys and interviews; and, in many cases, the deep knowledge of local people of the ecosystems and species that are in contact with them is not given as much value as it is worth. Therefore, the major priority of sustainable development should be centred on indigenous knowledge and on creating interactions between indigenous and formal knowledge.

This research study is a combination of bibliographical research and field work which was done using the case study methodology and a combination of qualitative and quantitative data collection techniques. The main objective of this study is to evaluate the role of Qanats and indigenous knowledge in achieving the four indicators of rural sustainable development.

In the field of social indicators, the role of Qanats in education, employment, cultural heritage, poverty and income distribution and the role of women and youth and access to natural resources and land are studied. In the field of economic indicators, financial independence, energy production and consumption patterns, economic structure, trade and productivity are explored.

In the field of environmental indicators, agriculture and food security, biodiversity and land use change, sustainable use of natural resources and sustainable tourism are examined. In the area of institutional indicators, the role of Qanats in integrated decision-making, capacity building, science and technology, government and civil society, institutional and legal frameworks and partnerships are studied.

Keywords: indigenous knowledge, Qanats, indicators of sustainable development, rural development

10.1 Introduction

Due to the climatic conditions of Iran where the average rainfall in most areas is less than the average global rainfall, it can be said that water is one of the most important concerns for the people and their biggest challenge (Haeri 2008: 11-17). Using traditional knowledge, involvement and co-operation, our predecessors had imposed the strictest form of exploitation and extraction of the water systems. Water structures of our predecessors indicate a deep understanding and command over water engineering and related knowledge (Javaheri 2007: 20). Qanat has a long-standing and well-developed engineering system that has survived over the centuries (Haeri 2008: 29). It is one of the most complex indigenous techniques and its implementation requires knowledge of natural behaviour of groundwater and geology.

It is necessary to understand the structure of Qanat considering its influence and antiquity in the history of Iran and its role in society and the community as well as cultural and socio-economic ties and indigenous knowledge. Qanats could be useful in the realisation of rural sustainable development objectives.

Qanats are not only natural capital, but also a successful model of rural participation which satisfies the people's need for water. It has created a spirit of empowerment among the rural people because they have spontaneously been able to solve one of the most important challenges of the village - water supply (Davarani and Sam Aram 2011).

Phenomena such as Qanat as a natural organization are very important in the formation of social systems. In addition to supplying the water directly, this phenomenon indirectly affects the cultural, social, economic, political, architectural and community urban planning. Fundamental impacts on urban-rural communities lead to feedback on the world at a micro and macro level (Ghods and Asghar Zade Maleki 2015).

Over time, with population growth and the effect of surface and sub-surface water reduction, communities using too-focused methods such as construction of large dams and deep wells tried to meet their needs of sufficient water and that has led to imbalance of water needs in Iran.

Now, reputable academic and research centres as well as international organizations such as UNESCO and FAO have realised the importance of local participation in water resources management and extensive studies and research have been done in this area. They make every effort to focus on the people and in involving them in all stages of project implementation and the operation of water systems and have tried to encourage governments to support and use indigenous knowledge in order to strengthen capabilities and social institutions and in the implementation of environmental management in critical areas.

In this study, we tried to investigate the role of the Qanat in achieving the goals of sustainable development indicators, taking a big step in preserving and protecting the water resources.

10.1.1. Qanat terminology

Qanats are underground ducts through which deep underground aquifers guide water to the surface so that this water meets the various needs of humans such as drinking, agriculture, cleansing and construction. Qanats can be seen in all parts of Iran.

In fact, the Qanat has mining technical features that are used to exploit ground water in the free aquifers and it is also an underground duct that drains underground water from the aquifer and guides it to the surface (Ahmadi 2006).

10.1.2. Specifications and structure of Qanat

In principle, the structure of a Qanat includes: horizontal hole or gallery or underground furnace with vertical cavities or shafts which connect the wells to the ground (Figures 10.1 and 10.2) (Maleki and Khorsandi 2006). The slope below the ground surface guides the water in a hydro layer (or layers) through highland terrain, streams, swamps and ponds to the point of consumption using the power of gravity without usage of energy.

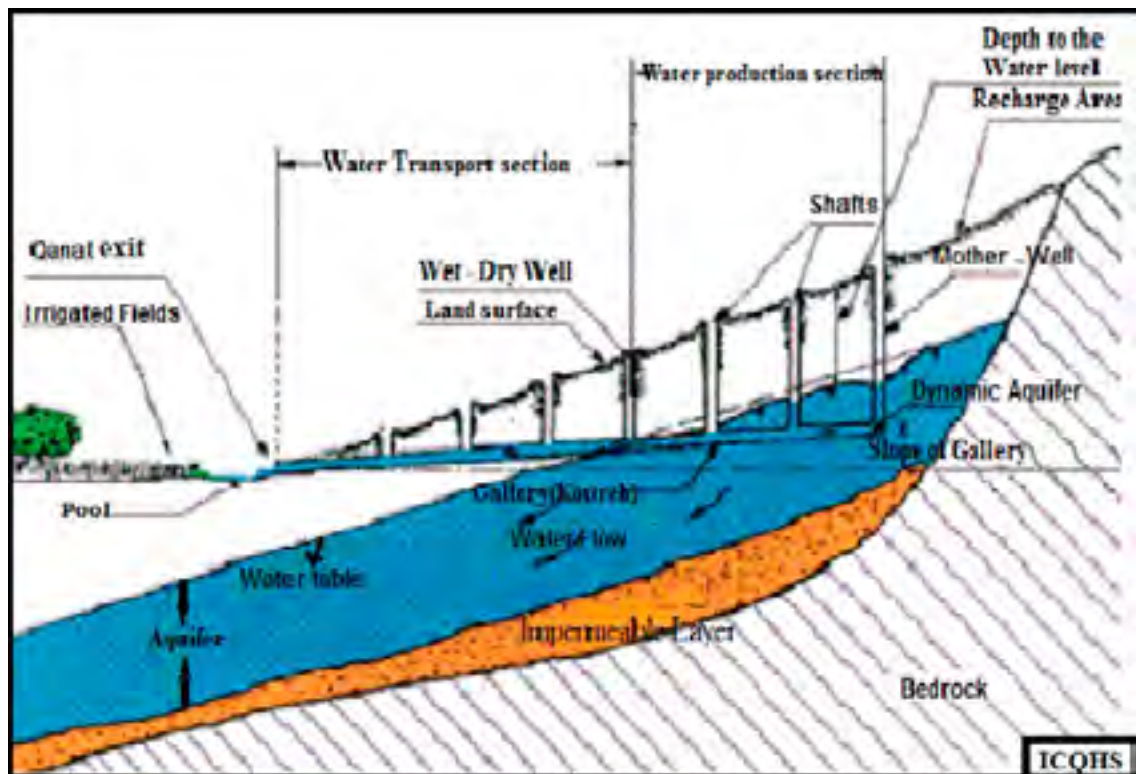


Figure 10.1 Qanat structure (source: <http://icqhs.org/SC.php?type=static&id=25>)

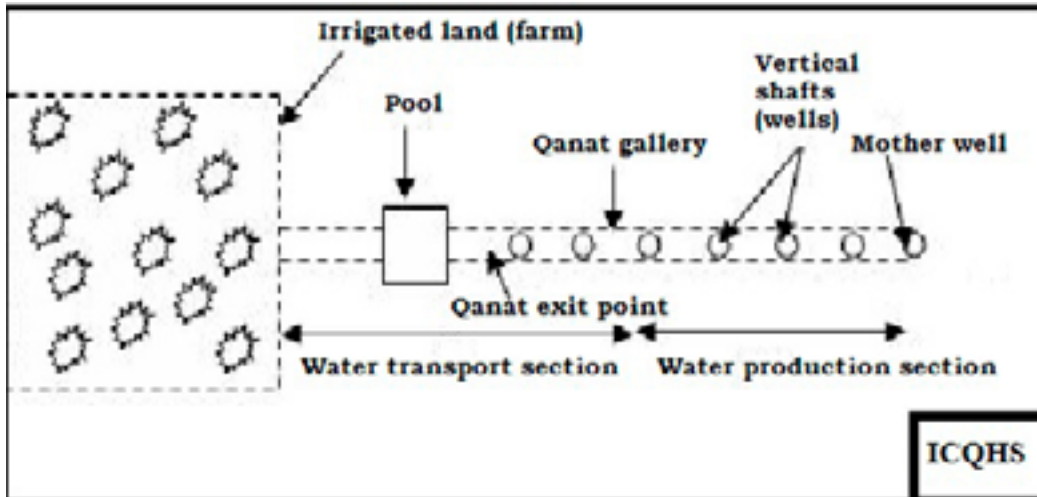


Figure 10.2 Qanat plan (source: <http://icqhs.org/SC.php?type=static&id=25>)

Table 10.1 Components of Qanats

Number	Components	Descriptions
1	Mazhar or harness (Qanat exit)	Place where underground water from Qanat appears at the surface.
2	Furnace or gallery (koureh)	Horizontal tunnel. Its slope is determined and has sufficient diameter. Furnace collects and transfers groundwater.
3	Coastal water access	Tunnel with a gentle slope that leads from the water surface to the Qanat furnace. Access to Qanat water is provided in coastal areas.
4	Paschal	Small pits on the floor of the Qanat's furnace used to repair or modify the slope.
5	Pishkar (The proxy canal)	Canal built along the Qanat's furnace after the mother well into the aquifer is called Pishkar. The proxy canal is dug to extract more groundwater and it is a variable structure in the building of the Qanat.
6	Picket (Dastak)	Sub-furnaces that are drilled to identify geology and groundwater around the original Qanat's furnace.
7	Rod (Mileh)	Vertical shafts drilled from the surface to the Qanat's furnace. Qanat's rod plays an air conditioning role and transfers debris to the surface during drilling of Qanat. It also provides access during the construction and operation of Qanat.
7	Parf	Small holes in the rod's body with geometric order meant to help the pitman go up and down from the ground to the bottom of wells and therefore have access to Qanat furnace.
8	Pshteh (Stack)	The distance between two consecutive well rods of Qanat is called Pshteh (stack).
9	Mother well	Well rod at the end of the Qanat route which is among the deepest well rods.
10	Teran	Sections of the Qanat which are located below the level of underground water saturation. Other names are Abgan, Abgen and Abgir. The bigger Qanats' pond, the greater its discharge rate. Qanat furnace in this section is drainage construct and water transmission.

11	Khoshkan (Land surface)	Parts of the Qanat structure that are located above the surface of groundwater. Qanat's furnace is water construct in this section.
12	Haranj (Pool)	Part of Qanat in the form of open channels between the Mazhar and the distribution of water into the ground.

10.1.3. Types of Qanat Ebi Zadeh in his paper (2011) stated that we can classify the Qanats in terms of position and location of the construction, building and application.

► Types of Qanats based on position and location

Qanats are of two types: mountainous and plain. Mountain Qanats are dug in the mountains and are fed by rain and snow in the highlands. The discharge of these Qanats is not fixed, this means that in the spring if there is snow and rain, the water level is high and vice versa. In summer, water levels drop and even in successive droughts, water may be reduced and the seasonal ones dry temporarily. That is why these Qanats are called Havabin and some people call them Cheshme Sar because in the spring when the water level is high and rainfall is high, amount of water increases and vice versa, during drought water reduces so that in many years, rural people migrate.

Plain Qanats are Qanats that have been drilled in the plains and emanate from deep sources of groundwater. Their depth is relatively high and the water is constant in all seasons. More than half of the Qanats in the East of Tangsayad and Sabzkouh biosphere are mountain Qanats and in many cases people have seen them dry.

Mountain and plain Qanats, depending on the geographical and topographical conditions of different regions, are mainly of three forms:

▷ a. Consecutive Qanats

Consecutive Qanats are seen mostly in mountainous areas and in valleys that have high slope. They are placed in such a way that an upstream Qanat feeds the next Qanat. In other words, the mother well of each Qanat is located upstream of the Qanat's cultivation source and benefits its penetrated water.

▷ b. Parallel Qanats

Parallel Qanats can be seen in the foothills. Accordingly, the front area is mountainous and the plain adjacent to it is relatively large. Qanats in this region are mostly along an erosion ravine or failed valley whose floor is filled with alluvial material. The water of these Qanats is supplied from the mountain water drainage. Almost equidistant from the mountain, villages are chained together and have established themselves parallel to the mountain. In these areas, towards the thalweg, water increases in the Qanat.

▷ c. Convergence Qanats

Convergence Qanats are mainly created in the plain which is surrounded by the heights. In this case, Qanats flow radially toward the centre of the plain.

► Qanats based on the length

In this category there are two types of Qanat: short and long. The higher the annual rainfall of areas, the lesser the length of the Qanat as well as the depth of the mother wells, and vice versa (Ebi Zade 2011).

► 10.1.3.3 Qanats based on the depth

In the classification in terms of depth, two types of Qanats can be defined: deep and shallow. The Qanats are called deep when we need to go more than 30 metres deep into the earth and sometimes up to 100 metres to find water. Also, in some regions, the depth of the penetrable layer relative to the earth's surface is low. Qanat construction in these areas doesn't require deep mother well or shafts. These kinds of Qanats are called shallow Qanats.

► Qanats in terms of discharge

In this category there are also two groups of Qanats: Qanats that have fixed and permanent watering throughout the year and Qanats whose discharge during the year is based on rainfall and drought. These types of Qanat in Qanat terminology are called seasonal or Havabin (Behnia 1989).

► Qanat types in terms of structure and form

Qanats can be divided into three groups in terms of structure and form: Simple Qanat, Qanat diverted from river, two-storey Qanat.

Simple Qanats include Qanat's Mazhar, duct, well rod and mother well.

Qanats diverted from river: This group includes Qanats that are diverted from the river and their job is to transfer water from the river. Contrary to the simple Qanats, they do not take water from the mountain but transfer water from river to the fields (Haeri 2008).

The third category is two-storey Qanat whose structure is unique. In two-storey Qanats, there are two horizontal tunnels instead of a general tunnel and one of them is above the other at some distance and has two lower and upper storeys from the origin to Mazhar. Just one two-storey Qanat has been discovered - this is called 'Moon' and it is in Ardestan.

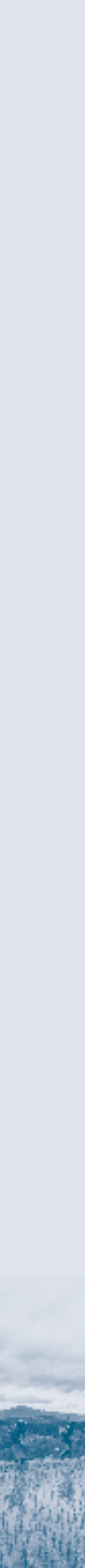
10.1.4. Qanat and rural development

The findings of Fadakar Davarani and Sam Avar (2011) indicate that the existence of Qanat aids the achievement of rural development in villages by promoting empowerment, desire to progress and participation in the affairs of the village. Considering the traditional production system, group management, indigenous knowledge, and experience of local people in the context of providing their knowledge and expertise, it can provide developmental results for society and the use of this indigenous knowledge can create a sense of safety, efficiency, and effectiveness, and value and enjoyment of the right to choose among rural people.

Maintaining the co-operative structure and traditional Qanat systems shows their developmental value in creating sustainable livelihoods and ecological balance in the territory.

Creating a collaborative atmosphere in the village to implement rural development plans cannot be realised without the resources of rural participation. The Qanat is one of these collaborative resources (Fadakar Davarani and Sam Avar 2011). Drilling Qanats, maintaining them and dredging canals in turn creates conventional systems in the rural community which needs a specific atmosphere of co-operation. Also, the role of reasonable utilisation management of water resources in rural sustainable development is so significant in a way that besides meeting current needs, the needs of future generations should not be negatively impacted (Motiei Langroudi 2004).

The operators of Qanat form another aspect of participation. Operators, including both owners and non-owners of the Qanat, create complex networks of co-operation in villages which is unique in its kind (Fadakar Davarani and Sam Avar 2011).



Therefore, to achieve sustainable development, especially in rural areas and agriculture, we should use several thousand years of knowledge and experience of indigenous peoples as an important and valuable capital and by restoring the structure and conventional systems in rural Qanats, pave the way for achieving rural sustainable development.

10.2. Statement of the problem

This article is trying to answer the question of the impact Qanat restoration could have on the realisation of objectives and indicators of sustainable development in Tangsayad and Sabzkouh Biosphere, based on research achievements and case studies of Qanats in east Tangsayad -Sabzkouh Biosphere Reserve.

The crisis of drought in the last decade has caused many problems for the mountainous regions and aquifers of Iran. One of the most water-rich regions of Iran is Char-Mahal-Bakhtiari state: although it occupies a small extent of the area in Iran, it provides more than 10% of water in Iran due to its mountainous climate and presence of rocky ecosystems and high mountains. However, during the recent drought in Iran, some parts of this region have been affected as well which has worsened the water crisis and the number of water resource management warnings in recent years. The area under study in this project includes the eastern regions of the Tang Sayyad and Sabzkouh biosphere cache which occupies more than one-third of the Char-Mahal-Bakhtiari state. This cache has recently been included among the biospheres of the world which contain a rich natural and cultural variety. The presence of three large tribes of nomads of Lor, Turkish and Arab origin and more than 200 rural communities contribute to the rich cultural variety of the region. Gathering and analysis of the native knowledge of local communities are some of the most important goals of the area managers who have performed effective procedures in the region. One of these procedures was the gathering of the native knowledge in the watershed management and agricultural fields of which Qanat reclamation is one of the sub-branches. More than 30 Qanats are present in the eastern regions of the Tang Sayyad and Sabzkouh biosphere cache, some of which have an antiquity of more than 500 years. Unfortunately, due to the unstable development of agriculture, plenty of deep wells have been excavated in recent decades as a result of which the level of underground water in these eastern areas has dramatically reduced and unfortunately there have not been any considerations for the recovery and repair of Qanats.

10.3. Methodology

Survey and research activities of this study were conducted using a combination of qualitative and quantitative data collection techniques (group discussions, focussed groups, semi-structured interviews and structured interviews through questionnaires) and for the literature review, study of literature, theoretical principles and bibliographical research has been conducted using books, publications, domestic articles, articles in reputed online journals.

The study site of the research is in the rural areas of East Biosphere of Chaharmahal and Bakhtiari Province which are parts of Shahr-e-Kord and Borujen cities. Sample population consisted of 150 people, including the elderly, middle-aged and young, both men and women over 20 years who were living in villages near Qanats and also were introduced by informed people in the Department of Natural Resources and Watershed.

To conduct this study in order to collect more information on the overall condition of the Qanats and their participation, 15 facilitators who were PhD students of natural resources and watershed, were involved. At the end of every day they analysed conversations and observations and designed programs for the next day. Furthermore, seven focussed groups with nine members

were created and a group discussion was conducted. To analyse the data, content analysis was used. In addition, through random sampling, questionnaires and interviews, required information was collected from more than 50 people for better confidence.

The main research questions are:

Is there any significant difference between villages in which Qanats are flowing against villages in which Qanats are dried in terms of:

- ▷ realisation of institutional indicators of sustainable development
- ▷ realisation of environmental indicators of sustainable development
- ▷ realisation of economic indicators of sustainable development
- ▷ realisation of social indicators of sustainable development

10.4. Results

The main hypothesis of this study is based on the idea that the existence of Qanats in a village due to the participatory system of preservation and restoration as well as the revival of indigenous knowledge leads to empowerment in institutional, economic, social and environmental areas of local communities in villages. Prominent findings of this research are that the data analysis indicates a significant difference in some of these indicators.

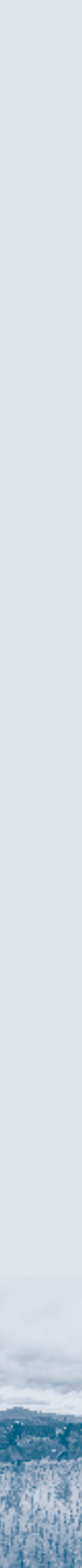
10.4.1. Role of Qanats in achieving the goals of sustainable development in institutional indicators

Research findings including results of the interviews and the analysis of the questionnaires show that the destruction of participatory and conventional systems of management and Qanat dredging is one of the major reasons for east Biosphere remaining separated and therefore resulting in the intensification of droughts and the loss and drying up of Qanats in the villages of the region.

The results show that Qanats could dry up due to lack of attention, lack of experts in matters related to the Qanats and lack of support from the government and lack of support for pitman and this profession. The drying of Qanats and lack of dredging is intensified due to old management laws passed in 1340, and death of the original owners of Qanats, the increase of landowners and their lack of co-ordination in restoration and management of Qanats.

The findings show that in villages that still try to revive and maintain the Qanats, public participation and collaboration systems and conventional systems in the management of Qanat somewhat persist and rural communities and village council have special partnerships to preserve and restore the Qanat.

Therefore, to solve challenges in the management of Qanats and prevent them from drying out, it is essential that government departments, local authorities and the private sector and non-governmental organizations give considerable importance to human resource development including pitman and their profession, enhancing institutional capacity and strengthening and development of platform and organizational structure including creating forums and classes to support the pitman. Therefore, to restore and repair Qanats and prevent their destruction, it is necessary that state and local authorities make consultations with local organizations, elders, and expert pitmen and adopt participatory management with persons with knowledge of Qanats and Qanat restoration and repair in order to learn from their experience and knowledge and to protect and promote indigenous knowledge and local social capital, and to adopt regulations and necessary legislation.



10.4.2. Role of Qanat in achieving the goals of sustainable development in social indicators

Survey results show that there is a significant relationship between local continuous training and restoration of existing Qanats in some villages. In some villages, authorities train young people by employing an experienced pitman and by paying youth in order to encourage them to participate in dredging Qanats. The important point is that young people are more interested in participation of the management system of Qanats in these villages. Due to the place of Qanats in Iranian culture, the recent actions of non-governmental organizations in some villages of holding a series of collaborative meetings with special emphasis on the role of the Qanat in the revival of Iranian culture, has encouraged youth and locals to visit the elders and older pitmen to record and collect indigenous knowledge about Qanat construction and rehabilitation. In this study, no correlation was found between participation of women and the restoration of the aqueduct. Relative to men, women in the villages have less information about the Qanats and have no specific interest in Qanat construction and rehabilitation.

Iran's lack of educational content in the formal education system on the Qanats has led to the fact that children have no information about the function of Qanats and pay little attention to the need of restoration and repair of Qanats.

In this study, a significant relationship was observed between the presence of young people in rural areas and the restoration of the Qanat. Villages in which young people stayed and continued farming as their families did, are more interested in maintaining and restoring the Qanats. In these villages, Qanats prosper. The important point is that the elders and seniors in the villages in which Qanats have dried due to lack of dredging and drought believe that the dryness of Qanats has resulted in the migration of young people because they claim that when Qanats dry, there is not enough water for farming so young people migrate to other cities such as Borujen and Shahre-e-Kord to find job opportunities.

10.4.3. Role of Qanat in achieving the goals of sustainable development in environmental indicators

Yousefi Rad in his article (2001) states that the Qanats, maintain the natural hydrological conditions of the aquifers in times of high water or in drought areas, in the case of drought by reducing water discharge and by maintaining reserves of underground water becomes consistent with the aquifers while wells change the aquifer hydrodynamic conditions through indiscriminate harvesting and cone loss making and suction. Thus, the natural regime of the aquifer changes after a while and to return to initial conditions is also not possible. Qanats' protection area is one of the compatibility establishment factors with the aquifer and controls its natural conditions.

The findings of this study and the results of interviews and analysis of the questionnaires show that there is a significant relationship between the sensitivity of people to unsustainable and illegal exploitation of wells and land use change in villages in which Qanats are still flowing. So in these villages, people have more control over the uptake of water for agriculture and provide frequent reports to regional water companies about illegal exploitation of water by farmers from underwater wells.

In villages in which Qanats are dried and not dredged, land use change is observed more frequently. That is a very important point and reports of abuse of unauthorised wells are higher.

10.4.4. Role of Qanat in achieving the goals of sustainable development in economic indicators

Research findings show that there is a correlation between increased agricultural production and the restoration of the Qanats. In interviews, the research team came to the conclusion that

farmers in villages in which Qanats are still flowing assign some costs to dredge Qanats. A more important point is that these farmers believe that dredging and restoration costs of Qanats are significantly less than drilling a well and buying new equipment in order to harvest underground water. However, they emphasise on government support to dredge and restore the Qanats. As mentioned earlier, migration rate in villages with active Qanats is less than villages in which Qanats are inactive.

10.5. Conclusions

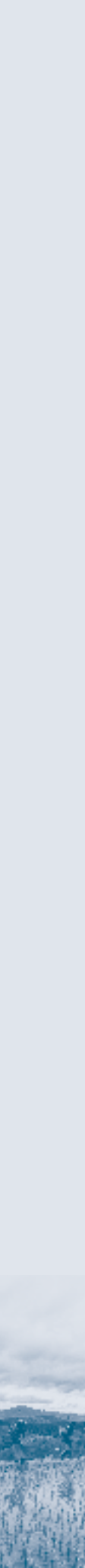
In the recent decades, due to population growth, increased consumption, changing cropping practices, drought and other reasons, water from Qanats was not sufficient to respond to the needs of rural communities. Therefore farmers and homeowners have turned to digging deep wells. Exploitation of these wells has resulted in a drop in groundwater aquifers; this has led to a decrease in yield of Qanats in those areas. Thus, attention to the Qanats should be at the heart of government programs and the private sector. Public sectors should allocate more funds for projects and research with a focus on the Qanat and speed up the recovery process.

The results of this study and other similar projects suggest that the following are among the challenges in the process of Qanat restoration and repair:

- ▶ the lack of a pitman guild as well as their insurance.
- ▶ lack of protection and safety instructions for Qanats.
- ▶ removal of mirab (foreman and supervisor of the division of waters) from the maintenance cycle.
- ▶ low interest of public sector, more than ever, in investing in the reconstruction of Qanats.
- ▶ difficulty of work and reluctance of young people in taking up the profession of pitman.
- ▶ a lack of awareness among young people and teenagers about functional significance of the Qanat.
- ▶ the lack of a comprehensive map of Qanats.
- ▶ and prioritisation of the importance and sensitivity for restoration, repair and operational management of Qanat.

Therefore, we suggest the following strategies to meet these challenges:

- ▶ 1. Allocation of more funds by the government for projects and research with a focus on Qanats.
- ▶ 2. Culture building in villages and raising awareness among farmers about the integration of scattered lands and finally optimum productivity of water in terms of irrigation.
- ▶ 3. Culture building and repair and operation of historic Qanats in order to attract tourists.
- ▶ 4. Comprehensive mapping of Qanats and allocating funds based on the number, importance and sensitivity of the Qanats in each province and city.
- ▶ 5. Determination of the apparent borders and basin of Qanats which is the biggest issue among farmers.
- ▶ 6. Updation of approximate costs of restoration of Qanats in each province according to conventional methods.
- ▶ 7. Formation of pitman association, support and maintenance, insurance, and consideration of the profession as equal to miners with retirement in 20 years.



- ▶ 8. Prevention of uncontrolled digging of deep and semi-deep wells in the basin of Qanats.
- ▶ 9. Formation and operation of the Independent Directorate of Qanats, with particular organizational chart.
- ▶ 10. Inclusion of Qanats in the educational curriculum of the country and taking into account the topic of Qanats among experts, students and scholars.
- ▶ 11. Continuous pitman professional training courses and exchange of experience of pitmen by relevant organizations.
- ▶ 12. Comprehensive legislation to reduce the gaps in management system and traditional ownership of Qanats.
- ▶ 13. Updation of equipment, materials and methods for the restoration of Qanats.

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11. Tharu indigenous knowledge and medical system

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11.1. Introduction to the Tharu medical system

The Tharu medical system still exists and is widely practised in rural Nepal. Under this medical system, the Tharu community has basically three practices: these are **Tharu mantars**, which are used by Guruwa, **medicinal plants**, which are used by Baidawa and **massage**, which is used by Sohrinya and other practice-men. All of the practices have deep influences on poor and rich Tharu families all over Nepal.

Among them, the Guruwa system takes the responsibility of protecting villagers from epidemic diseases, natural calamities, insect bites, etc. For this, they perform three basic worship rituals or poojas: namely, *Harya Gurai*, *Dhurya Pooja* and *Lawangi Pooja*. They also do *Barka Pooja* every 3-5 years and others as per their needs. In return, villagers pay “*Tihai*” on a yearly basis.

Villagers do not appoint Baidawa, people in need of medical assistance themselves go to Baidawa to obtain medical treatment. Baidawas never demand payment for providing their service and medicinal plants; they accept whatever the clients pay. One belief is that the effectiveness of medicinal plants decreases if Baidawa demands payment, so they never express it. In ancient times, Baidhya Tharus were Baidawa, whose main profession was taking care of sick people. But today, this is performed by other Tharus as well.

Villagers also do not appoint Sohrinya and other massage men/women, they themselves come into practice as and when needed as per the request of people. The main work of Sohrinya is to facilitate child delivery. They gain this knowledge from their mother or other close relatives. They also offer massages. In addition, skilled men and women also perform massages to cure stomach pain, nerve dislocation, bone sprain, etc. All these are the medical practices of the Tharu community.

11.2. Definition of Tharu medical system

As discussed, there are many types of medical practices in Tharu community from Iron age till now. So, each has a separate meaning, but in general, the meaning of Tharu medical system is the combined form of all medical practices. So, it needs to define each of the medical practices. Likewise, before defining the system, it needs to describe the meaning of medical knowledge. Definition of the subject generates the meaning of system. But till this date, people have not

defined the indigenous knowledge of Tharu. So, as per the suggestion received from group discussions, interviews and studying written documents, Tharu medical knowledge is:

“.. Tharu medical system originated by Tharu wise medicates and/or saints as per needs and priorities based on spiritual salvation, divine grace and devotion & empirical practice of using medicinal plants, which has been transferred initially through family members and now one generation to another in oral form”.

Within Guruwa family, there are also varieties and levels of Guruwa: Deshbandhya, Kesauka, Ghar Guruwa, Dhahrariya Guruwa and General Guruwa. All these types of Guruwa, Baidawa and Sohrinya practice medicine by using one of or all of the three forms of knowledge: medicinal plants, mantars and doing massage.

For this, they, at first diagnose the illness, and then provide medicinal plants or use sacred mantars or offer massage or do both of or all of the steps to restore health. This complete process is called Tharu medical system. So, under Tharu medical system, there are basically three types of indigenous knowledge, one is indigenous knowledge of medicinal plants, which relates with Baidawa, another is indigenous knowledge of sacred mantars, which relates with Guruwa/Guro and third is indigenous knowledge of practice of massage. Indigenous knowledge has its own system but that interrelates as and where needed depending upon nature of sickness or problems.

Figure 11.1 clearly shows that within Guruwa system, there are mainly 5 types of Guruwa. They at first ask sick people and/or his/her guardian about their symptoms. Afterwards, they spell sacred mantars taking rice grains or Kain with oil lamp in their hand to diagnose the causes of illness or sickness. The diagnosis provides the way to the cure, for this, they again spell next sacred antars and suggest that the patient perform worship if needed. They also provide medicinal plants to eat, if needed. After few hours or days, they do further follow up as and when needed. They also collect suggestions from sick person, guardians and from others during and after the treatment; and take corrective action as well.

Baidawa have more knowledge about the use of medicinal plants. They are the professional practitioners of medicinal plants. They carefully check sick people and study symptoms to diagnose diseases and their effect and find proper treatment. After wards, they provide medicinal plants and orient about the use of it and eating things. In most cases, they prohibit the consumption of meat, sour, oily or spicy food. The dose of medicine depends upon age of the person and nature of sickness. They never forget to collect lessons learned and feedback. This helps them to re-define mode of preparing medicine, setting doses, and frequency of use.

The third component is the massage system. Under this, there are two types of practitioners, namely, Sohrinya and other skillful men/women. They, at first, carefully examine the affected part, compare it with other similar part of the body and lay hand on and around the affected part to find out the defective parts of body. After wards, they start massage using mustard oil, turmeric, local wine, etc.; and continue it till the patient gets better.

This is the system of Tharu medical practices, which still exists in Tharu community mainly in mid and western Tarai district of Nepal.

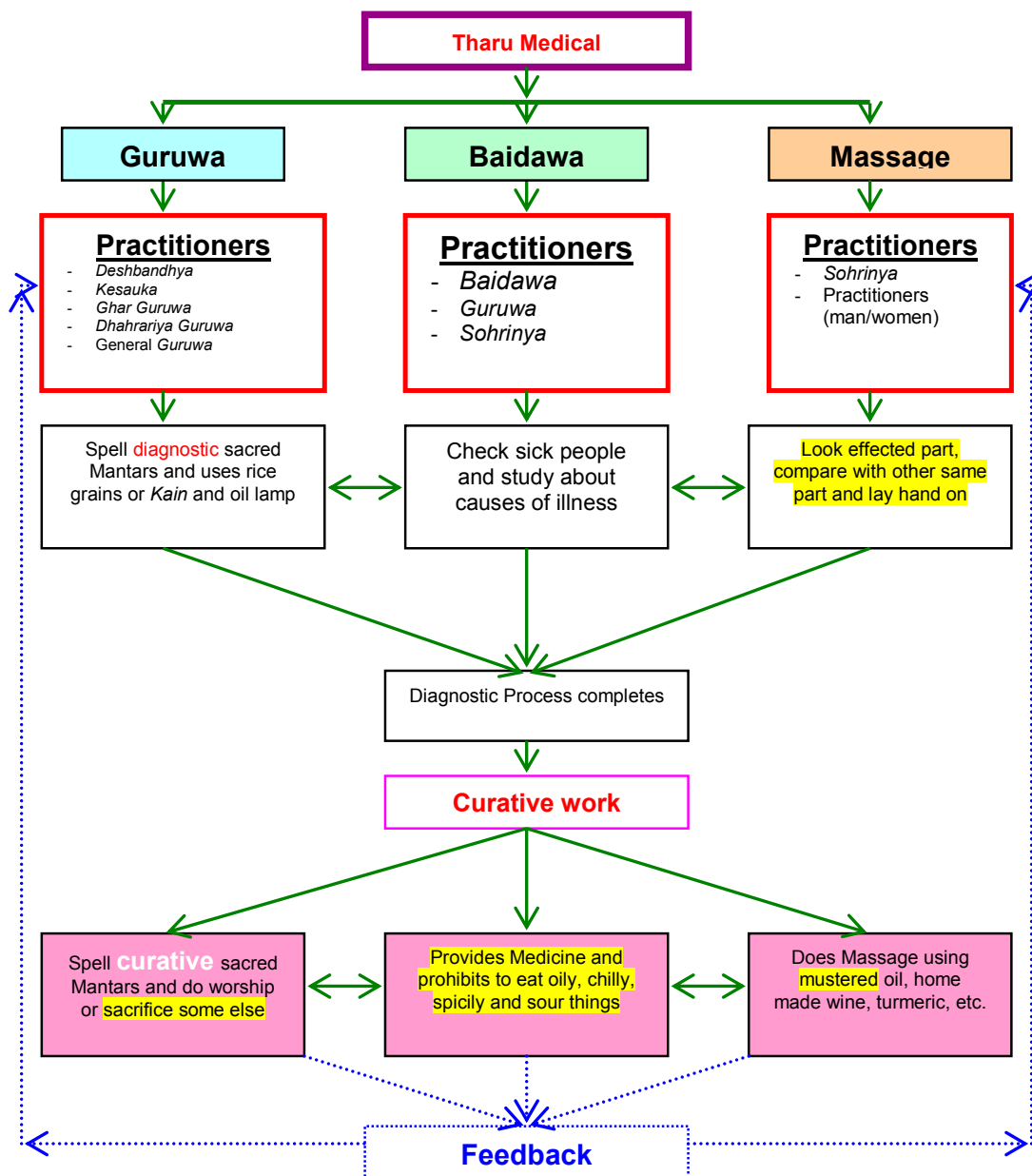


Figure 11.1 Cycle chart of Tharu Medical System

11.3. History of Tharu medical system

The medical practice is itself challenging or difficult, but it must go together with life of living beings. So, it can be imagined that the medical practice must have started from the Stone Age or earlier. At that time, they might have had limited knowledge of it, but they had practice to take care of sick people, that transferred from one generation to another and gradually broadened the practice and knowledge. Here I would like to quote four famous writers, according to them (Eliade 1964; Kalweit 1984; Grof & Grof 1989), "Shamanism is an ancient form of healing that is universal, dating from the Stone Age and found in various forms on various continents." According to the shaman's world view, animate and inanimate objects possess spirits. Man's difficulties result from an imbalanced relationship with these spirits of nature that are governed by cosmic laws (Chang & Kwang-iel 1973; Lake 1983). Chang & Kwang-iel, (1973: 667) state that the "shaman is the mediator between the world of man and of spirits."

According to Tharu myth and practice of Dang Valley, the pioneer of Tharu was called “Gurbaba”, his son was called *Ghanpat Gurwa* and he had 4 sons: *Dahit*, *Madwa*, *Demanraura* and *Pachhaldangya*. According to Tharu myth “*Gurbabak Jarmauti*”, Gurbaba created an earth and all living beings in the world. He had broad knowledge of all kinds of education and practices. So, after creating living beings, he taught medical knowledge to his son Ghanpat Gurwa. And again Ghanpat Gurwa taught all of the medical knowledge to his four sons. And all four sons went to a learning center to gain additional knowledge, and returned after learning. So, all four sons were perfect both in shaman work and in the use of medicinal plants. After long, at the time of separation, the elder son ‘*Dahit*’ was provided with the middle region of Dang, which is called *Chhilly Praganna*, second son ‘*Madwa*’ got the eastern part of Dang-Deukhuri and the youngest son ‘*Pachhaldangya*’ received the western part of Dang, which is called *Pachhalapath*. ‘*Demanraura*’ did not accept their ruling area; and requested to allow him everywhere without any restriction. Under their ruling state, each son of Ghanpat Gurwa served their people to the best of their abilities. The people were happy and healthy. So, *Dahit*, *Madwa* and *Pachhaldangya* are still respected and worshipped within their ruling area whereas ‘*Demanraura*’ is worshipped everywhere (Dahit 2004). It means that during primitive times, *Gurbaba*, *Ghanpat Gurwa*, *Dahit*, *Madwa*, *Demanraura* and *Pachhaldangya* were the only practitioners of sacred Mantar and medicinal plants. Long after, other clan Tharus learnt Mantars from Guruwa of above 4 clans of Tharus and started to practice shamanism. These days, Tharus from *Dharkatuwa*, *Katkatawa*, *Ghotaili*, *Kusamya*, and other clans have also been practicing shaman.

The Guruwa and medical practitioners called Baidawa still practice in mid and far western Tarai Tharu villages, viz., Dang-Deukhuri, Banke, Bardiya, Kailali, Kanchanpur, Surkhet, Kapilvastu and Rupandehi.

In Chitawan province, there is a Raj Gurau named Mr. Budhan Gurau, he and his descendants learned Mantars from divine grace, and not from any Guruwa. According to him, his grandfather never taught Mantars to his son; after his death, his son automatically gained that knowledge through a dream and by performing poojas or worship rituals. Similarly, his father also never taught him, and he learned them after his death. So, he is sure that after his death, his son will learn these mantars. Till date, he has not taught any mantar to any of his sons. This practice has continued from the last five generations.

11.4. Classification of Tharu medical system

Each practice is also divided into subgroups.

Baidawa is a mere practitioner of medicinal plants, a professional user of medicines to cure sick people. Guruwa uses medicinal plants side by side with sacred mantars. Somewhere they use specific types of medicinal plants only after purifying by mantars. Likewise, next is the lady practitioner, who is called Sohrinya. Her profession is to facilitate child delivery and take care of the mother and child. She uses medicinal plants for both mother and children, if needed.

Under massage system, there are also three types of medical practitioners; they are Sohrinya, male practitioners and female practitioners. Sohrinya and female practitioners perform massages for females whereas male practitioners offer massage for men who need this service. They use mustard oil, turmeric, homemade wine, juices of medicated plants, etc. to massage the affected parts of the body.

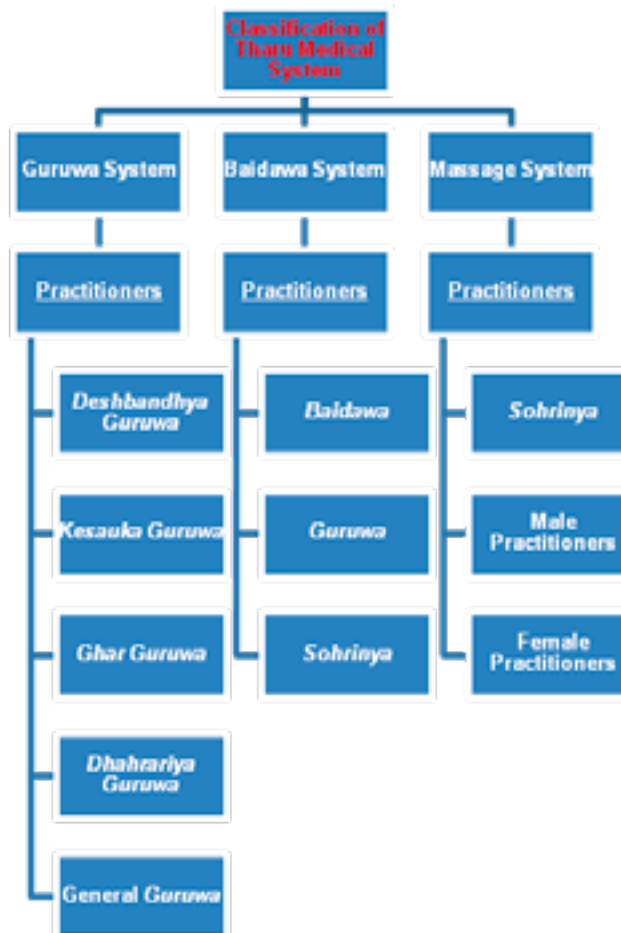


Figure 11.2 Classification of Tharu medical system

11.5. Tharu medicinal baidawa system

In the past, Baidhya Tharus had very rich knowledge about the use of medicinal plants to cure sick people. They had adopted it as their profession. They had a large inventory of indigenous knowledge about medicinal plants and its uses. But due to the death of their ancestors who had such knowledge, this knowledge is also gradually vanishing because they did not teach it or taught only some portions of their knowledge to others. Right now, some *Guruwa*, *Sohrinya* and *Baidawa* are using this knowledge but whatever knowledge is reserved is also gradually disappearing together with the death of the practitioners. One belief still exists in Tharu community, i.e., “the knowledge of medicinal plants must be kept secret otherwise their effectiveness decreases”. Because of this, the indigenous knowledge of medicinal plants is also vanishing very fast. Medicinal plants were used in all types of treatments. Tharu community has still been using many types of medicinal plants in their daily life. So, they have prepared a detailed inventory of medicinal plants especially used by the Tharu community together with its use, mode of preparation, dose, storing techniques, inventory location and profile of resource persons.

It is estimated that there are 70,000 species of medicinal plants in the world. It is also mentioned 5700 species are listed in Chinese pharmacopoeia. It is estimated that 8000 species are found in south Asia. The oldest book of medicine, named Charak has listed 340 species.

1500 species of medicinal plants have been in use in Nepal for different purposes like medical use, as spices to be mixed with vegetables, colours to dye, etc. Among them, 150 spices have special economic importance. I collected about 600 species of medicinal plants, which are still being used by Tharus but there is a possibility of collecting more species if micro and macro level research is carried out throughout east Jhapa to west Kanchanpur.

11.6. Importance of Tharu indigenous knowledge of using medicinal plants

Tharu indigenous knowledge of medicinal plants has many benefits, importance and potential for Tharu communities. It was found that they have been using them not only to cure sick people but also for other many purposes, so it has a lot of importance in the daily life of Tharu community. Important benefits are listed and described below.

- ▶ **Identity preservation perspective:** A majority of medicinal plants which are found in Tarai and Inner Tarai cannot be found in Hill and Himalayas and vice-versa. The knowledge developed for using medicinal plants in Hill and Himalaya regions belongs to Hill and Himalaya people; and that knowledge which is developed in Tarai and Inner Tarai belongs to Tharu people because they are the indigenous people of that area with a large population. There are negligible numbers of other indigenous people in limited eastern districts. But Tharus are all over Tarai and Inner Tarai districts from many thousands of years. They have been using more than 600 medicinal plants species in their daily life for medical and other purposes.
- ▶ **Culture preservation and promotion perspective:** Many plants have cultural importance because Tharus use these plants during worship to offer to home deities and to prepare items to eat during specific rites, rituals, feasts and festivals. *Mentha arvensis* (L.) (bebari), *Aegle marmelos* (L.) *Correa* (bel) and *Benincasa hispida* (thumb) *Congn.* (*Bhurkonhara*) are offered during festivals Dashya and Dewari. *Desmostachys bipinnata* (L) *Stapf* (*kush*) and *Imperata cylindrical* (L.) *P. Beauv.* (*churki*) is used to prepare brooms to offer to home deities during *Muthlihai* and *Dashain* festivals. *Colocasia esculenta* (L.) *Schott* (*ghuiya*) is cooked to feed those who thresh rice flower to make *Dhikri*. *Celosia argentea* L. Flowers of (*murgik kesar*) and leaves of *Mangifera indica* L. (*aam*) are used for decorative purposes. *Citrus limon* (L.) *Burm.f.* (*nimwa*) and *Artemisia indica* *Willd.* *Bhairopati* are used during *Astimki* festival to offer to Lord Krishna. *Shorea robusta* *Gaertn* (*Sakhuwa*) is used when grinding lintels and *Curcuma longa* L. (*hardi*) is used during weddings on the bridegroom to perform decorative rites. *Agyari* is used to light or is to produce pure fire during each festival. *Brassica napus* L. (*mustard oil*) is used in daily life to prepare food items to offer home deities. *Pawain* is mixed with grains and offered to home deities. All these are the few examples of cultural important plants.
- ▶ **Income generation perspective:** It is estimated that the profit from selling medicinal plants and scented plants is US\$ 11 billion. According to WHO, that earning will increase by US\$ 5000 billion in 2050 AD. It means that medicinal plants have great importance in generating income. Tharus have not adopted it as the profession to earn but have big possibilities.
- ▶ **Medicinal perspective:** We have already described the detailed use for treatment purposes, which justifies its medicinal importance. Tharu Baidawa, Guruwa and Sohrinya have still been using it to cure people.
- ▶ **Environment protection perspective:** Environment protection can be termed as synonymous to protection, promotion and development of medicinal plants and their sustainable use. It gives emphasis on greenery, which helps to decrease smoking, becoming extra hot and degradation of environment. It can be used without affecting or very few affecting on physical structures and biodiversity.
- ▶ **Cost effective treatments:** It is less costly than yellow peptic medicines. This is because it is locally available with minimum cost. Simple treatment can be done without paying even a single penny. You can plant some medicinal plants near your gardens, which is fresh and readily available.
- ▶ **No side effects:** It is scientifically proven that medicinal plants have no side effects. You can use it, which cures to particular needed parts and remedy exerts through toileting. So, it has no tension of side effects.

11.7. Specific issues of Tharu indigenous knowledge and medical system

- ▶ This indigenous knowledge was widely practiced from very beginning to origin of Tharu. But, now, this knowledge is endangered.
- ▶ The quality, quantity and frequency of using Tharu medical system is decreasing day to day. This is because of internal and external causes. External factors are mainly government rules and regulations, hill and southern migration, globalization, increasing use of yellow-peptic practices, etc. And internal factors are decreasing quality and strength of knowledge, not adopting modern technology and equipment, no systematic learning process, no documentation of knowledge, etc.
- ▶ Tharu medical practitioner Baidawa and Guruwa have traditional authority but no legal certificate from government of Nepal. Due to this, they have been facing lots of problems and are demoralized.
- ▶ Interested youth from the Tharu community learn mantars individually from Tharu Guruwa and Baidawa, there is no well managed school and different levels of text books. They learn through oral transmission. There is a need for legal institutions (school or Gurukul) which can manage the learning process and develop texts of different levels.
- ▶ Tharu Baidawa also teach their indigenous knowledge through oral transmission and some times by providing practical opportunity but this is not sufficient.
- ▶ Regular practice of medical practitioners is threatened by non-Tharus and sometimes by Tharus also. They also face problems from local police and administration. So, they need identity cards and legal certificates to continue their jobs.
- ▶ The diagnosis procedure and modes of preparing medicines are old and there is no use of modern technology. Capacity building, training and use of modern equipment will make the Tharu medical system more effective and impressive. But these are very expensive, they cannot afford for it, so the government should support them.
- ▶ Government has not given attention to establishing authorised institutions that can provide technical, managerial, promoting, legal and quality maintenance work.
- ▶ The quality and strength of mantars are decreasing, valuable knowledge of mantars is vanishing together with the death of qualified Guruwa and inventory is also diminishing. So it has become very essential to script or prepare written documents. It is only be possible if government prepares clear policy, rules and provide sufficient budget for study, documentation and publication.
- ▶ As per indigenous knowledge of Tharus, 600 species of medicinal plants are used. But it is not final, the inventory of species can surely increase if detailed and deep study is carried out all over Tharuhat region (Tarai and Inner Tarai districts). This study is also only possible if government and international agencies provide sufficient budget for the study, documentation and publication, qualified manpower for doing empirical study, indigenous peoples' participation for fair identification and legal authority for ownership building and benefit sharing.
- ▶ Establishment of Tharu medicinal plant production and Purification Company based on Tharu indigenous knowledge of using medicinal plants is another prioritised need. It provides many services like good opportunity for employment, good prices in medicinal plants, medicines at their door at cheap prices and bonus to Tharu community as well.

- ▶ Tharu medical practitioner Baidawas used to collect medicinal plants from nearby jungles but the forest authorities had prohibited this. It is another serious case of not affording continuity to Tharu medical practices.
- ▶ Experts from Nepal and outside Nepal come and carry out research on the medical practices and medicinal uses of Tharu system; then they registered this indigenous knowledge and plant species in their own name, not in the collective name of Tharus. This is another example of cheating Tharu indigenous knowledge and not recognising their intellectual property.
- ▶ There is a lot of room for raising awareness among the Tharu youth, systematic documentation (e.g. Indigenous knowledge data collection, digitisation, recording and repository); institutional strengthening (through revitalising Traditional Tharu Institutions such as Badghar or Guruwa).
- ▶ There is a general trend of different knowledge systems are integrating, learning and getting enriched from each other building complementary and synergy especially with modern knowledge and technology. But Tharu Medical practitioners (Baidawas) lack such connections.
- ▶ There is demand for and need to increase the standards and quality of the Tharu medicine by chemically analysing important formulations in collaboration with the Government of Nepal's Ayurvedic Department and other relevant institutions. However, such demands are not entertained by corresponding government agencies.

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12. A case study of Naxi peoples in Lijiang NW Yunnan China: An Indigenous and Local Knowledge (ILK) contribution to support the IPBES

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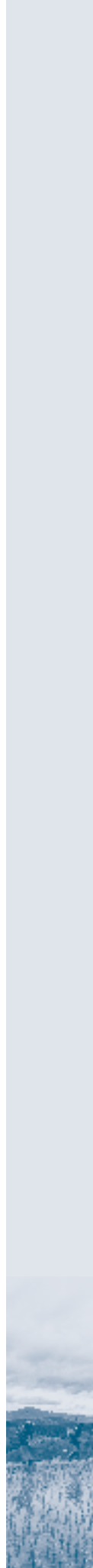
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12.1. Background

The Naxi are a Burmo-Naxi-Lolo sociolinguistic group within the Tibeto-Burman group of the Sino-Tibetan family (Matisoff 1991) that primarily inhabit the highlands of Lijiang Naxi Autonomous Region in the eastern Himalaya of China's northwest Yunnan Province. They are one of China's 55 recognised minority groups. The Naxi settled along the upper reaches of the Jinsha River from northeastern Tibet to Sichuan. Approximately 300,000 Naxi live in this area, which encompasses the region where the Himalayan biodiversity hotspot meets the Mountains of Southwest China biodiversity hotspot (WWF 2009). A strong correlation between biological and cultural diversity has been documented in this region (Stepp et al 2005). The Naxi commercial centre of Lijiang is situated along a major regional trade route, the Southwest Silk Road (also known as the Tea Horse Road), and has more than a millennia-old history of interactions with other sociolinguistic groups that travelled between Yunnan, Tibet, and India (Freeman and Ahmed 2011). Naxi monarchs semi-autonomously ruled the territory until 1723 when it was nationalised by China.

The Naxi have two scripts unique to their language and culture: a syllabic and a pictographic system. The Naxi pictographic script is customarily learned and mastered by shaman priests known as Dongba (Dto'mba), who transmit their knowledge to their sons. The Naxi pictographic system serves a mnemonic function, such as to guide ritual chants of their Bon practice (Rock 1937). The traditional Bon practice is characterised by animist and shamanistic traditions with links to pre-Buddhist and Buddhist Tibetan practice. Naxi scripts are considered to have developed in the context of cultural exchange with Tibetan writing systems, because the Naxi's strong ties with Tibet resulted in similar practices (Michaud 2006). Naxi pictograms are likely to have further developed when the Naxi moved to their present territory because the flora and fauna depicted are found around their current settlements (Rock 1937).

Lijiang city in NW Yunnan, China, now has three world heritage titles: in 1997, Lijiang old town was listed by UNESCO on the 'World Cultural Heritage' list; in 2003 'Three Parallel Rivers region' applied for the World Natural Heritage site successfully; in 2003, Dongba ancient memory literature in Lijiang was listed on the world record Million Heritage list. Lijiang thus became a rare site with



three heritage titles. In order to better protect the Lijiang tourism resource and to improve the Lijiang tourism brand, the tourism culture department further strengthened heritage protection.

12.2. Research methods

12.2.1. Analysis framework

Naxi traditional ecological knowledge (TEK), two case studies including Naxi medicinal plant conservation and papermaking, and one Naxi ILK workshop from Naxi communities have been analysed based on the IPBES framework provided by Hein et al (2006) (Figure 12.1).

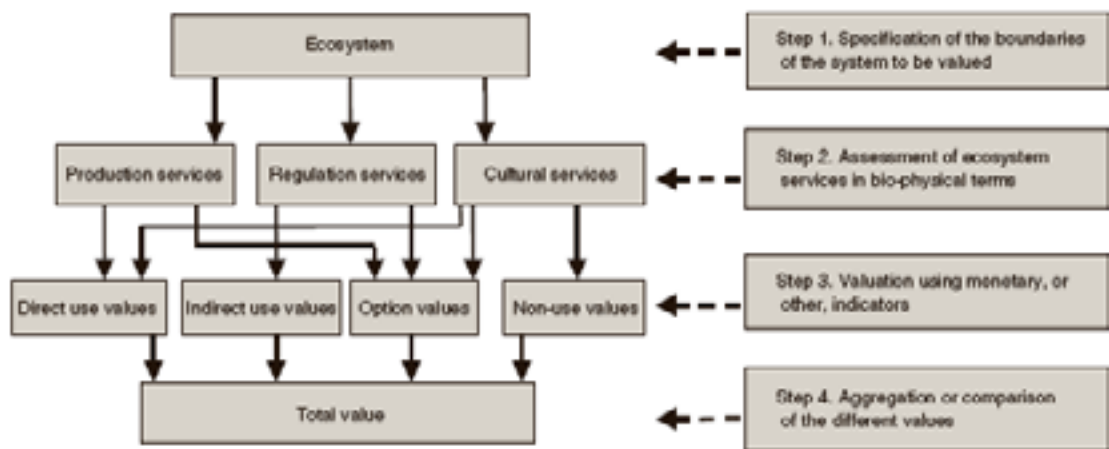


Figure 12.1 From Hein et al (2006) – A framework for considering the supply of ecosystem services.

12.2.2. Naxi traditional ecological knowledge (TEK)

The Naxi's sacred natural site includes mainly the worship of mountains and trees, water sources and lakes. This kind of sacred forest included Dongba Ritual Field Forest, Ancestral Grave Mountain, Water Source, the Sacred Forest around Taizi Cave (Reproductive Worship), Coffin Forest Mountain, YaKou bealock and so on. The protection of these forests is given priority by the prohibition of cutting of forests and recognition of sacred sites of famous mountains, cultural sacred sites of temples and shrines, and sacred nature sites of water sources. In general, the places where Naxi people worship heaven are oak forests. Though many years have passed, there are many examples which have proved that Naxi traditional ecological knowledge has also been protected in the mountain area where Naxi people used to live in dense forests. So it can be learned that Naxi traditional ecological knowledge has a positive impact on biodiversity conservation (Yang 2008). Naxi Dongba religion is a special type of traditional belief culture between primitive religion and theological religion (He 1991). From recognising, utilising, and protecting nature, the author considers that Naxi ancestors experienced three stages: initial stage, conflict stage of livelihood demands, and harmony stage with the relationship between human beings and nature. In short, human beings couldn't destroy the property that belonged to nature called Shu, the spirit of nature in Naxi traditional culture. Shu agreed that people could obtain goods from nature like animals, forests, and land resources when humans were short of the necessities of life (Li 2003). As per traditional ecological knowledge (TEK), the relationship between human beings and nature is that of equal brothers in Naxi Dongba culture. Naxi peoples' relationship with nature has been affected by this TEK when they deal with the relationship between human beings and nature as well as utilise nature.



Photo 12.1 Human beings and Nature are regarded as brothers according to the Dongba faith.
(a) Naxi Dongba Pictograph depicting this relationship drawn by Dongba He Jinggui and;
(b) Worship Shu of nature by Dongba He Zibenben in BaiShu Tan of Naxi Community. Photos by Yang Lixin.

12.3. Brief introduction to two case studies from Naxi local communities

12.3.1. Project summary of medicinal plant conservation at the community level

The diversity of medicinal plants is reducing. It is not only causing the irreversible loss of species, but is also causing a huge change in the pharmaceuticals industry. There are rich plant resources in the Himalayan region, including nearly a thousand medicinal plants and more than 100 rare and endangered medicinal plants. The general objective is to conserve medicinal plants by establishing a community participatory mechanism to manage the Medicinal Plants Conservation Area, to develop the livelihood of the local communities, and to enhance awareness of medicinal plant conservation through training workshops.

We carried out capacity building on medicinal plant conservation for project teams, held community participatory project plan meetings, carried out baseline surveys, made an evaluation of impact of harvesting on species and their conservation status, set up the development of community organization/mechanism for medicinal plant conservation and cultivation, documented local Naxi knowledge of medicinal plants and traditional practices in conservation, studied the in-situ conservation and the method of sustainable collecting and harvesting of medicinal plants, built up trial spots, including home gardens; cultivation on farmland, and cultivation of medicinal plant in natural habitats.

12.3.2. Project Summary on Naxi Indigenous Dongba Papermaking:

China's rapid economic development is influencing cultural practices and natural resource management in indigenous mountain communities throughout the country. Numerous studies have documented the loss of and change in cultural practices and environmental degradation in indigenous communities with the expansion of roads, markets, tourism, and other infrastructure development. The present study focusses on papermaking, a socioecological practice that began in China, as a case study to examine the influence of development on cultural practices and natural resource management. The Naxi people are unique in that they have the last remaining pictographic writing system in the world. The Naxi pictographic script is customarily learned and mastered by shaman priests known as Dongba (Dto'mba) who transmit their knowledge to their sons. Approximately 300,000 Naxi live in this area. The pictographic system is transmitted on paper sourced from montane forest resources, primarily *Wisktroemia delavayi*. This cultural tradition almost disappeared during the Cultural Revolution in China during the 1960s and 1970s but has recently seen a revival. Research involved both ethnographic interviews and ecological sampling. Semi-structured interviews were conducted with 100 informants between 2002–2011

to understand the management and use of *W. delavayi* for Dongba papermaking and the impact of market integration on papermaking. Sample plots were surveyed for floristic composition and structure in the three vegetation types where *W. delavayi* grows. Density, height, diameter, and number of branches of *W. delavayi* plants were recorded within each plot. Ecological importance values were calculated based on relative density, relative dominance, and relative frequency to determine the habitat where *W. delavayi* demonstrates the greatest growth. Additional plots were surveyed to understand the regeneration of *W. delavayi* after the local harvest cycle.

12.4. Naxi ILK meeting and workshop

Based on the cultural history of the Naxi ethnic group and their indigenous knowledge, biodiversity, habitat distribution and diversity of ecosystem types, as a Naxi Indigenous and Local Knowledge holder and expert, Dr. Lixin Yang was supported to attend the dialogue workshop in Chiang Mai for the IPBES regional assessment for Asia-Pacific in Thailand from 26 to 28 June 2016 following Professor Dayuan Xu's recommendation. For a follow-up workshop, Naxi Indigenous and Local Knowledge (ILK) Meeting-Workshop to support the IPBES regional assessment for Asia-Pacific in Lijiang NW Yunnan, China has been supported by UNESCO (Contract n°4500312048), the workshop of Naxi cases on biodiversity and ecosystem services assessment related to traditional knowledge was held from 12 to 13 October 2016 at the meeting room on the first floor of Lijiang Dongba Culture Research Institute. Relevant Naxi ILK holders and experts, as well professionals, managers and practitioners totalling 34 participants were invited to participate in the workshop.

12.5. Analysis of IPBES framework from Naxi ILK

12.5.1. Naxi Traditional ecological knowledge (TEK) is helping the community achieve its conservation objectives and utilisation purposes.

Lijiang tourism shares profit with people. The mountainous communities switch from living off the mountain to conservation and utilisation mainly through ecological tourism. That is to say, the tourism development in Lijiang benefits from the Naxi traditional culture conservation of the national intangible cultural heritage and the conservation of biodiversity and the ecosystem. Naxi people get the profits while they protect the traditional cultural knowledge which enhances the value of traditional knowledge. For instance, the local people achieve a reasonable utilisation of resources from the conservation of Yulong Snow Mountain which is Naxi sacred Mountain of Naxi Dongba religion through the development of ecological tourism. The development of Lijiang tourist industry promotes ecological tourism. Besides, the sustainable utilisation of biodiversity may offer a good ecological environment for planting medicinal species.

12.5.2. Analysis IPBES framework from two Naxi case studies

Two projects based on Naxi people's interests in medicinal plants (healthcare, income, culture) and papermaking plants (income, culture), have been postulated to supply motivating factors for conservation. Specific analysis for IPBES framework from two Naxi case studies follow in Table 12.1.

Table 12.1 Ecosystem services framework of two Naxi case studies

Ecosystem services		Two case studies from two Naxi communities: Baseline conditions and new initiatives and results	
		At LuDian village and Daju village	Wider systems
Provisioning	Products from wild plants	<ul style="list-style-type: none"> • Farmers selling maps at low prices; internet access provided to raise local bargaining power; • Traditional hand made paper products 	<ul style="list-style-type: none"> • Logging in natural forests banned in China (1998 floods). Emphasis on tree planting and protected areas. Government forestry policy changed during course of project (to individual responsibility system). • Traditional tourism products
	Fresh water	Ban on logging. Soil erosion, stream drying up and worse climate blamed locally on logging. Two medicinal plant conservation areas established in forest, 300 ha each (could serve as sources of germplasm for traditional doctors and for nurseries to cultivate plants for commercial production).	<ul style="list-style-type: none"> • Cultural interests in traditional healthcare and herbal medicines in China Lijiang city national technical college plans to establish medicinal plant garden and Naxi hospital • Traditional Naxi Dongba culture is listed as world memory heritage and intangible cultural heritage.
Regulating	Regulation of water flows		
	Medicinal plants in culture and healthcare	<ul style="list-style-type: none"> • Traditional medicine is popular. Some traditional doctors have species-rich herb gardens. 	<ul style="list-style-type: none"> • Cultural interests in traditional healthcare and herbal medicines in China Lijiang city national technical college plans to establish medicinal plant garden and Naxi hospital.
	Papermaking plant	<ul style="list-style-type: none"> • New herbal gardens, educational programmes on Naxi culture, workshops on potential of Internet 	<ul style="list-style-type: none"> • Traditional Naxi Dongba culture is listed as world memory heritage and intangible cultural heritage.
	Education, training and awareness raising	<ul style="list-style-type: none"> • Training workshop on traditional papermaking technique 	
Cultural	Social organization	<ul style="list-style-type: none"> • Community project team formed (Kunming institute of botany (multi-disciplinary). Community project association formed • Naxi papermaking community in Daju 	<ul style="list-style-type: none"> • Lijiang city national technical college base for forming Lijiang city ethno medicine association • In Lijiang, Naxi Dongba culture institute as base for heritage Naxi Dongba papermaking.
	Outreach	<ul style="list-style-type: none"> • Community map group formed at another site (Tibetan community). Medicinal plant conservation area, herbal gardens, training in growing medicinal plants. 	<ul style="list-style-type: none"> • District Tibetan hospital in Deqing county; Tibetan Medicine Doctor Association formed • Naxi traditional culture is part of 56 ethnic cultures of the construction of ecological civilization in China.

12.5.3. Analysis IPBES framework from Naxi ILK Meeting-workshop

a) The support mechanism for community empowerment to participate in sustainable biodiversity conservation: The Naxi traditional community requires the government to vigorously promote and increase the publicity efforts of traditional knowledge, especially to provide the publicity of more excellent traditional knowledge. For instance, the traditional ecological knowledge of Naxi nationality is the equal relationship between humans and nature. People cannot make excessive demands on nature, but should use nature moderately. These ecological values are embodied in the specific production and life of the Naxi people. In some of the traditional communities, they have become a customary law. For example, the release of live birds after worship, no washing by the mountain and river, and no cutting of water source forests and tomb mountain forests. They are traditional knowledge and customary law. To incorporate these traditional knowledge and customary law into the government policy system will be conducive to the great rejuvenation of traditional culture and the construction of ecological civilization. The decision-making management changes from implementing top-down policy of government tradition to the down-top policy of local peoples' own needs of conservation, from government organization management to self-management. The establishment and perfection of the community empowerment management and decision making mechanism is conducive to the sustainability of biodiversity conservation.

b) The protection of traditional technology and its intellectual property rights. The rise of traditional knowledge can promote sustainable development of biodiversity and reasonable utilisation can maintain stability. Excessive utilisation causes instability. The discussions are summarized as follows. However, the raw materials required for papermaking are not easy to plant in scale which limits the inheritance and further development of the traditional papermaking technology. The suggestion is to supply funds and technology, allow people to grow their own plants, to plant and not to harvest if it is not necessary, thereby increasing people's income and promoting the development of local economy. On the one hand, the local Naxi people lack traditional technology training; except the communities of project sites, many of the local Naxi people do not know the traditional papermaking technology; especially young people, they do not know the traditional medicine knowledge either. On the other hand, the local Naxi communities are also inevitably affected by the mainstream culture and rely excessively on modern tools, such as WeChat, Baidu etc. The aspiration towards traditional knowledge and technology is not strong. A similar phenomenon is also discussed in the case of the protection of medicinal plants. They are impacted by western medicine, and take it for common illnesses in Naxi communities. Western medicine has great influence on the traditional Chinese medicine. As for the traditional Chinese medicine, people should learn to use it and then know how to protect it, make healthy instructions in the communities, and reduce the use of antibiotics.

Dongba paper is moisture proof, mothproof, firm and can be stored easily; authentic herbal medicines and other traditional technologies and products are favoured by businessmen in the tourism industry. The protection of traditional intellectual property should be put on the agenda. With the development of the tourism industry in Lijiang, a fake Dongba paper has filled the tourism souvenir market. The true Naxi Dongba paper with its higher cost is in a disadvantageous position in the competition. So are the authentic herbal medicines. As for traditional doctors, healers and the holders of traditional knowledge, they see themselves more as protectors of ecological balance, who pay attention to the collection of medicinal plant parts and seasons and the sustainability of medicinal plants than as herbalists or druggists. On the one hand, market publicity requires the correct consumption concept. On the other hand, it is necessary to get the protection of the traditional intellectual property right in time. Therefore, the protection of traditional intellectual property rights is an important part of the traditional knowledge which will be brought into IPBES.

12.6. Results and discussion

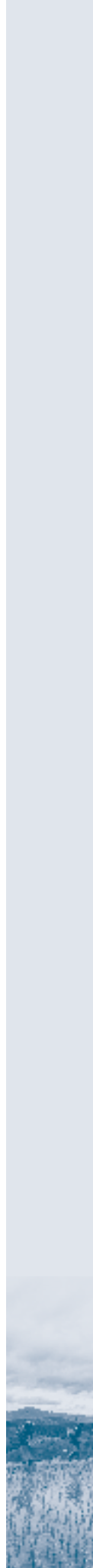
How to bring two case studies on Naxi traditional knowledge into a complete case for supporting IPBES? Some evaluation indicators or frameworks related to ILK to support IPBES follows:

- ▶ a) Does traditional knowledge on biodiversity and ecosystems increase and stabilise? If it does, there is potential for biodiversity and ecosystem to sustain. If the reduction is less, it will lead to the degradation of biodiversity and ecosystem.
- ▶ b) Does the commercial collection of wild plants decrease or stabilise? If it does, there is potential for biodiversity and ecosystem to sustain. If it increases, it will lead to the degradation of biodiversity and ecosystem.
- ▶ c) Does the degree of biodiversity utilisation in the local community increase? If it does, there is potential for biodiversity and ecosystem to sustain. If it decreases, it will lead to the degradation of biodiversity and ecosystem.
- ▶ d) Does the role of the local community in biodiversity management increase? If it does, there is potential for biodiversity and ecosystem to sustain. If it is ignored, it will lead to the degradation of biodiversity and ecosystem.
- ▶ e) Does the degree of biodiversity and ecosystem diversity increase? If it does, there is potential for biodiversity and ecosystem to sustain. If it decreases, it will lead to the degradation of biodiversity and ecosystem.
- ▶ f) The whole system should be kept in mind when undertaking work, a useful framework for considering the set of ecosystem services.
- ▶ g) Local relationships between people and plants are at the centre of analyses to determine what to do; projects based on people's interests in medicinal plants (healthcare, income, culture) are postulated to supply motivating factors for conservation.
- ▶ h) Conservation of plant diversity requires matching pattern of cultural diversity.
- ▶ i) Eco-civilization means a society living within the laws of nature. Eco-civilization concept should apply to all countries; China has a chance of becoming an exemplar with 56 ethnic groups of eco-civilizations.

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13. Bio-prospecting of plant resources for validation of indigenous knowledge and the search for novel herbal drugs in Nepal

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Abstract

Nature is a valuable source of medicinal plants rich in phytochemicals which have been used for centuries in the treatment and prevention of various diseases. Nepal is home to about 1,950 species of medicinal plants (about 28% of the local flora), including 1,614 native species. More than 80% of the rural populations of Nepal depend on herbal remedies.

The Ethnobotanical Society of Nepal (ESON), in collaboration with Korea Research Institute of Bioscience & Biotechnology (KRIBB), Central Department of Botany (CDB) and Central Department of Biotechnology (CDBT), Tribhuvan University, Nepal, conducted a study in Dhading District to find potential species for novel herbal drug development. This study documented 200 ethnobotanically important plants. Further, phytochemical screening of methanolic extracts of 23 plants for phenolic and flavonoid content and in-vitro examination for antioxidant, antibacterial and cytotoxicity in HeLa cell line were carried out in Nepal. Furthermore, 178 species were assessed at KRIBB for anti-inflammatory response in RAW 264.7 cells, cytotoxicity in six human cancer cell lines and insecticidal potential.

This study has shown ethnomedicinal relationship between the detected active compounds and bioactivities. *Scurrula elata* has potential antimicrobial, antioxidant properties, and remarkable phenolic and flavonoid content. Other potential species with such properties are *Terminalia bellirica*, *Tsuga dumosa*, *Geranium wallichianum*, *Phyllanthus emblica*, and *Desmodium gangeticum*. Similarly, highest inhibition of human cervical cancer (HeLa) cell was shown by *Symplocos lucida*. The results showed that there are many underutilised plants with huge medicinal potential, and a scientific approach integrating traditional knowledge will help in the search for novel drugs.

Key words: antibacterial, bioprospecting, cytotoxic, Dhading, ethnobotany, medicinal plants

13.1. Introduction

Nepal is home to more than one hundred ethnic communities (CBS 2012). More than 80% of the rural population of Nepal is reported to be using herbal remedies (Dani 1986). There is a record of 1,950 plants species reported for medicinal properties (Baral & Kurmi 2006; Ghimire 2008; Manandhar 2002; Shrestha & Shrestha 1999; Shrestha et al. 2002; Tiwari 1999), including 1,614 native medicinal species (Ghimire et al. 2008; Shrestha et al. 2002). Those plants have been found to be very rich in active compounds useful for the treatment of various ailments of the human body.

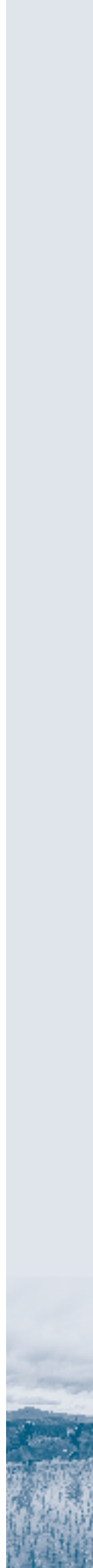
Active components such as phenolic and flavonoid groups are well known for their pharmacological potential. Polyphenols are antioxidants with redox properties, which can act as reducing agents, hydrogen donors, and singlet oxygen quenchers. The antioxidant activities of many polyphenol compounds have potential health benefits (Bravo 1998). Flavonoids are known for important biological activities against free radicals, inflammation, allergies, platelet aggregation, ulcers, tumours and hepatotoxins (Kinsella et al. 1993). Infectious diseases and drug resistance to pathogenic bacteria are a major concern all over the world (Mulligan et al. 1993; Piddock & Wise 1989; Singh et al. 1992). Therefore, there is an ever-growing need for effective antimicrobial drugs from plants for the treatment of infectious diseases, particularly multi-drug resistant microbes. Cancer is considered to be the third leading cause of death worldwide (12.4%), the first being cardiovascular disease (30%) and the second being infectious diseases, including HIV/AIDS (18.8%) (Mathers et al. 2001). Drug resistance, particularly multidrug resistance (MDR), can make many of the clinically established anti-cancer drugs ineffective (Borowski et al. 2005). In Nepal, common cancer sites reported for males are the lungs, oral cavity and stomach whereas for females they are cervix, breast and the lungs (Pradhananga et al. 2009). Inflammation is responsible for several diseases in humans including atherosclerosis, neurodegenerative diseases, obesity, metabolic syndrome, diabetes and several types of cancers (Moro et al. 2012).

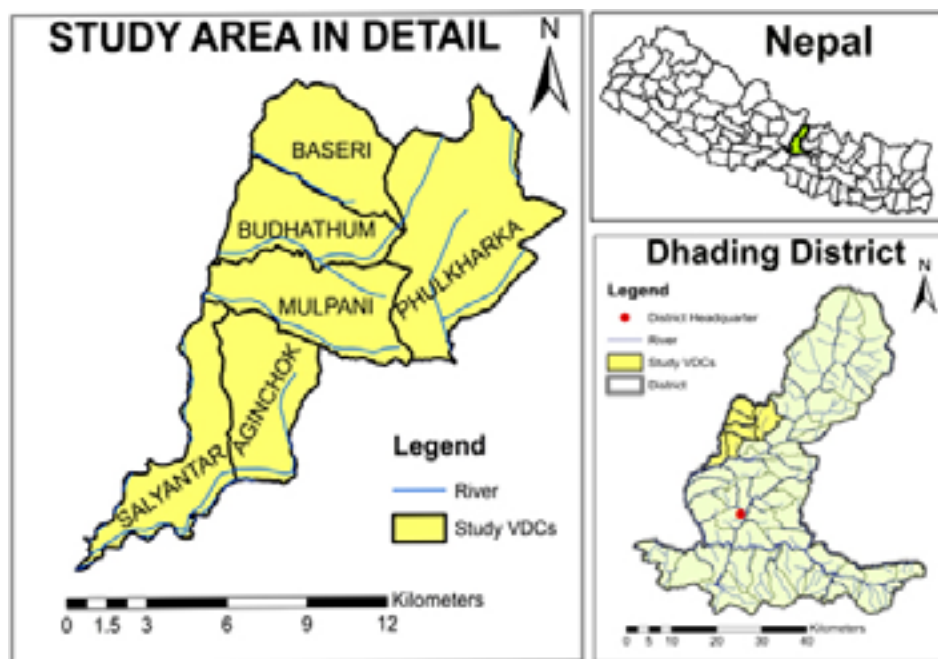
Nepal is known for the use of its medicinal plants to cure such diseases with its conserved ethnic medicinal knowledge. Still, there are many more things to explore on little known plants which are being used for medicinal value by specific ethnic populations. Our approach was to integrate Indigenous Local Knowledge (ILK) of underutilised plants in search of active natural components for bioprospecting as well as sustainable use and conservation. Therefore, we took the initiative in search of potential plant resources in Dhading District for antioxidant, antimicrobial, anticancer, anti-inflammatory and vector larvicidal properties. In this article, research carried out on 23 species in Nepal is addressed. The understanding of potential benefit can aid sustainable use and associated conservation issues for the future.

13.2. Materials and Methods

13.2.1. Study Area

Dhading district, situated in central Nepal, covers an area of 1,926 sq. km. The district is situated between the latitudes of 27°40' N to 28°17' N and longitude of 80°17' E to 84°35' E. The elevation of the district ranges from 488 m to 7,500 m above sea level. The climate is warm sub-tropical in areas below 1,000 m with alpine conditions at high altitudes (>3,000 m). The district comprises a mixed population of ethnic communities including Tamang, Gurung, Brahmin, Chhetri, and Newar. The underutilised plants from north-west part of the Dhading District comprise six village development committees (VDCs): Salyantar, Budhathum, Aagainchok, Mulpani, Baseri and Phulkharka, and these were selected as study sites (Figure 13.1).





Source: Survey Department, Ministry of Land Reform and Management, Government of Nepal.

Figure 13.1 Map of Dhading District showing study area

13.2.2. Ethnobotanical Assessment

Plants were selected on the basis of their ethnomedicinal importance with a focus on underutilised medicinal plants. Medicinal values of the plants were assessed from primary as well as secondary data. Primary data were collected from the Indigenous Local Knowledge (ILK) holders by organising community meetings, personal interviews and focussed group discussions during the study period in 2014 (FiguresPhotos 13.12-13.6)11). Secondary data were collected from the different ethnobotanical literature. During the field study, the habitat features, photography, herbarium samples and plant samples of about 200 ethnobotanically important plants were documented (Shrestha et al. 2014), and 23 important plants were selected for the first phase of investigation in 2015 (Table 13.1).



Photo 13.1 Typical forest habitat of Dhading

13.2.3. Plant Materials Processing

Fine powdered air-dried plant samples (100g) were soaked in 750 ml of HPLC grade methanol and then subjected to continuous cycle of sonication at 40 kHz for 5 cycles of 15 minutes each at 45°C. The process was carried out over three consecutive days. The resulting extracts were filtered through Whatmann No.1 filter paper filtrate and were evaporated to obtain concentrated extract.



Photo 13.2 Village elder showing dried samples



Photo 13.3 Display of fresh plants collected from the forest.

► Total Phenolic Content

Total phenolic content (TPC) of methanolic extracts was determined by Folin-Ciocalteu method (Singleton & Rossi 1965). Calibration curve was obtained using gallic acid (Moly-Chem, Mumbai, India) as standard in methanol. Total phenolic content of plant extract was then quantified by using standard calibration curve generated.

► Total Flavonoid Content

Total flavonoid content (TFC) of methanolic extracts of plants was determined by Aluminium chloride ($AlCl_3$) calorimetric test (Pekal & Pyrzynska 2014) with slight modification. Calibration curve was obtained with the help of quercetin (Sigma) as standard solution in methanol. The total flavonoid content was then expressed in terms of milligram of quercetin equivalent per gram extract (mgQE/g). All the tests were carried out in triplicates to get more accurate results.

► Antioxidant Activity

The antioxidant activity of plant extracts and standard ascorbic acid in methanol were determined based on their ability to scavenge 1, 1-diphenyl-2-picrylhydrazyl (DPPH) free radical as described by Xu & Chang (2007) and Chen & Ho (1995).

► Antibacterial Activity

The antimicrobial activities of medicinal plant extracts were tested by using agar well diffusion method (Perez et al. 1990). The individual pure culture of *Staphylococcus aureus* (ATCC 25923), methicillin-resistant *Staphylococcus aureus* (MRSA), multi-drug resistant *Klebsiella pneumoniae*, and *Salmonella Typhi* were obtained from Tribhuvan University Teaching Hospital, Kathmandu.

► MTT Assay

Cytotoxicity of plant extracts on HeLa (human cervical adenocarcinoma) cell line obtained from National Centre for Cell Science (NCCS), Pune, India, was determined by a rapid colorimetric assay, using 3-(4,5-dimethyl thiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT). The assay is based on the metabolic reduction of soluble MTT by mitochondrial enzyme activity of viable cells into an insoluble coloured formazan product (Mosmann 1983).

13.3. Results and Discussion

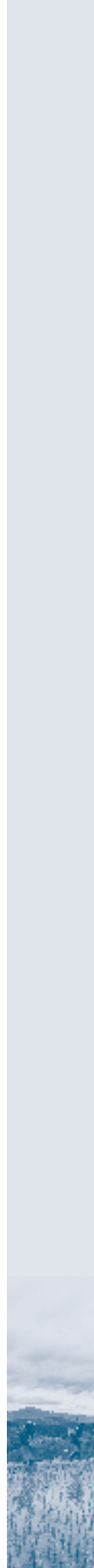
Ethnic communities in Dhading District use some underutilised plants for various remedies (Table 13.1). Many species were used for the treatment of stomach disorders which are in accordance with past reports (Manandhar 2002; Baral & Kurmi 2006). Further bioassay to find other concerned diseases are needed to elucidate further on possible use of plant species.



Photo 13.4 Specimen collections in study area

Table 13.1 Enumeration of ethnobotanical resources from Dhading District, Nepal*

S. N.	Name of plant, Latin name, 'Local name', [Plant Family]	Parts used	Mode of use	Diseases and disorders	Secondary data
1.	<i>Anemone rivularis</i> Buch.-Ham. ex DC. 'Haattipaille' [Ranunculaceae]	Whole plant	Paste, decoction	Cough and cold	Cough and fever, cuts and wounds, sinusitis (Rajbhandari 2001; Manandhar 2002)
2.	<i>Chrysopogon aciculatus</i> (Retz.) Trin. 'Kuro ghaans' [Poaceae]	Whole plant	Paste, smoke	Wound, cut, child delivery problems	Boils or wounds (Rajbhandari 2001; Manandhar 2002)
3.	<i>Desmodium gangeticum</i> (L.) DC. 'Bhatmase ghaans' [Fabaceae]	Root	Juice, paste	Gastritis	Stomach acidity, gastritis, diarrhoea, dysentery, fever, cough, asthma (Manandhar 2002; Gewali 2008; DPR 2007)
4.	<i>Desmodium heterocarpon</i> (L.) DC. 'Bhatmas ghaans' [Fabaceae]	Whole plant	Juice	Cough and cold, gastritis	Fever, cough, diarrhoea, gastritis, skin disease (Manandhar 1993, 2002; Gewali 2008; Malla et al. 2014)
5.	<i>Diospyros lanceifolia</i> Roxb. 'Tiju' [Ebenaceae]	Fruit	Powder	Diarrhoea	Sore throat (Malla et al. 2014)
6.	<i>Geranium wallichianum</i> D. Don ex Sweet 'Urmen' [Geraniaceae]	Root	Juice, powder	Gastritis and to reduce excessive menstrual bleeding	Peptic ulcer, toothache, cuts, gastritis (Manandhar 2002; DPR 2007; Thapa 2013)
7.	<i>Hydrocotyle javanica</i> Thunb. 'Ghodtapre' [Apiaceae]	Whole plant	Juice	Fever	Fever, cough, boils, indigestion, dysentery (Rajbhandari 2001; Manandhar 2002; Baral & Kurmi 2006)
8.	<i>Hypericum japonicum</i> Thunb. [Hypericaceae]	Whole plant	Juice, paste	Dysentery, fever	Asthma, dyspepsia, dysentery, fever, headache (Manandhar 2002, 2013; Malla et al. 2014)
9.	<i>Loxogramme involuta</i> (D. Don) C. Presl [Polypodiaceae]	Rhizome	Juice	Minor injuries	Cuts and wounds (Manandhar 2002)
10.	<i>Maclura cochinchinensis</i> (Lour.) Corner 'Damar kaanda' [Moraceae]	Bark	Juice, paste	Gastritis, fractures	Peptic ulcer, promote parturition, boils (Manandhar 2002)
11.	<i>Maoutia puya</i> (Hook.) Wedd. 'Pua patne' [Urticaceae]	Root	Juice	Indigestion	Cuts and wounds, indigestion, gastritis (Manandhar 2002, 2013; Gewali 2008)
12.	<i>Millettia fruticosa</i> (DC.) Baker 'Maadane' [Fabaceae]	Bark	Juice	Stomach disorder	Boils, gouts, Tinea pedis (Rajbhandari 2001; Manandhar 2002)





S. N.	Name of plant, Latin name, 'Local name', [Plant Family]	Parts used	Mode of use	Diseases and disorders	Secondary data
13.	<i>Phyllanthus emblica</i> L. 'Amala' [Phyllanthaceae]	Bark Fruit	Juice	Stomach uneasiness Cough and cold, diarrhoea, stomach disorder	Amoebic dysentery, body ache (Manandhar 2002) Diarrhoea, dysentery, haemorrhage, eye inflammation, burning sensation during urination, jaundice, common cold, constipation. (Rajbhandari 2001; Manandhar 2002; Thapa 2008)
14.	<i>Ranunculus scleratus</i> L. 'Mudule jhaar' [Ranunculaceae]	Whole plant	Juice	Blisters and Gastritis	Conjunctivitis in livestock, gastric inflammation, blisters, asthma, rheumatism, pneumonia, skin troubles (Rajbhandari 2001; Manandhar 2002; Baral & Kurmi 2006)
15.	<i>Rhododendron lepidotum</i> Wall. ex G. Don. 'Sundhup' [Ericaceae]	Aerial parts	Juice, powder, smoke	Rheumatic pain, syphilis, common cold	Blood purifier, kills bugs; fever, cough, cold, tonsillitis (Rajbhandari 2001; Rajbhandari et al. 2009; Manandhar 2002)
16.	<i>Rhodea nepalensis</i> (Raf.) N. Tanaka [Crassulaceae]	Root	Juice, powder	Cough, diarrhoea, dysentery and gastritis	Food poisoning, cough, uterine problems (Bantawa & Rai 2009; Malla et al. 2014)
17.	<i>Rubus nepalensis</i> (Hook. F.) Kuntze 'Aiselu' [Rosaceae]	Whole plant	Juice	Stomach pain	Stomach ache, wound, gastritis (Limbu & Rai 2013; Malla et al. 2014)
18.	<i>Scurrula elata</i> (Edgew.) Danser 'Liso' [Loranthaceae]	leaves	Juice	Bone dislocation	Sinusitis (Manandhar 2002)
19.	<i>Symplocos lucida</i> (Thunb.) Siebold & Zucc. 'Lodhi' [Symplocaceae]	Bark		NA	NA
20.	<i>Tadehagi triquetrum</i> (L.) H. Ohashi [Fabaceae]	Whole plant	Juice	Diarrhoea, dysentery	Diarrhoea (Manandhar 2002)
21.	<i>Terminalia bellirica</i> (Gaertn.) Roxb. 'Barro' [Combretaceae]	Fruit	Powder	Fever, anthelmintic, asthma, gastritis	Gastritis, asthma, respiratory trouble. fever; appetiser, mixed with tobacco and smoked for sedative effects, cough, cold and bronchitis (Rajbhandari 2001; Manandhar 2002; Thapa 2008)
22.	<i>Tsuga dumosa</i> (D.Don) Eichler 'Gobre sala' [Pinaceae]	Bark		NA	NA
23.	<i>Urena lobata</i> L. 'Naalu kuro' [Malvaceae]	Root	Juice	Dysentery, skin disease	Body ache, toothache, skin disease, diarrhoea and dysentery (Manandhar 1993, 2002; Limbu & Rai 2013)

* Species for which bioassay was conducted in Nepal.

The plant extracts were analysed for flavonoid content, phenolic content, antioxidant capacity and their effect were evaluated for cytotoxicity and antimicrobial effect which are summarised in Table 13.2.

Table 13.2 Summary of bioassay for ethnobotanical resources from Dhading district, Nepal*

S. N.	Latin name	Total flavonoid content mgQE/g	Total phenolic content mgGAE/g	DPPH free radical scavenging capacity IC50 mg/ml	Cytotoxicity in HeLa cell line EC50 µg/ml	Antimicrobial Activity#			
						SA	MRSA	KP	ST
1.	<i>Anemone rivularis</i>	< 15	< 50	> 15	> 100	-	-	-	-
2.	<i>Chrysopogon aciculatus</i>	> 15	< 50	> 15	> 100	-	-	+	+
3.	<i>Desmodium gangeticum</i>	< 15	> 50	< 15	NA	+	-	NA	NA
4.	<i>Desmodium heterocarpon</i>	< 15	> 50	> 15	NA	-	-	NA	NA
5.	<i>Diospyrus lanceifolia</i>	< 15	> 50	> 15	NA	-	-	NA	NA
6.	<i>Geranium wallichianum</i>	> 15	> 50	< 15	> 100	+	+	-	-
7.	<i>Hydrocotyle javanica</i>	> 15	< 50	> 15	> 100	+	-	-	-
8.	<i>Hypericum japonicum</i>	³ 15	> 50	> 15	NA	+	+	NA	NA
9.	<i>Loxogramme involuta</i>	< 15	< 50	> 15	> 100	-	-	+	-
10.	<i>Maclura cochinchinensis</i>	³ 15	> 50	> 15	NA	+	+	NA	NA
11.	<i>Maoutia puya</i>	< 15	> 50	> 15	NA	-	-	NA	NA
12.	<i>Millettia fruticosa</i>	< 15	> 50	> 15	NA	-	-	NA	NA
13.	<i>Phyllanthus emblica</i>	> 15	> 50	< 15	> 100	+	+	-	-
14.	<i>Ranunculus scleratus</i>	> 15	< 50	> 15	> 100	-	-	-	-
15.	<i>Rhododendron lepidotum</i>	> 15	³ 50	> 15	> 100	+	+	-	-
16.	<i>Rhodea nepalensis</i>	< 15	< 15	> 15	NA	-	-	NA	NA
17.	<i>Rubus nepalensis</i>	< 15	> 50	> 15	NA	+	+	NA	NA
18.	<i>Scurrula elata</i>	> 15	> 50	< 15	> 100	+	+	-	+
19.	<i>Symplocos lucida</i>	< 15	> 50	> 15	< 60	-	-	-	-
20.	<i>Tadehagi triquetrum</i>	< 15	> 50	> 15	NA	-	-	NA	NA
21.	<i>Terminalia bellirica</i>	< 15	> 50	< 15	> 100	+	+	-	+
22.	<i>Tsuga dumosa</i>	< 15	> 50	< 15	> 100	+	+	-	+
23.	<i>Urena lobata</i>	> 15	> 50	> 15	NA	-	-	NA	NA

* Species for which bioassay was conducted in Nepal

Only extracts with zone of inhibition > 5 mm at 12.5 mg/ml concentration considered

SA (Staphylococcus aureus ATCC-25923)

MRSA (Methicillin-resistant Staphylococcus aureus)

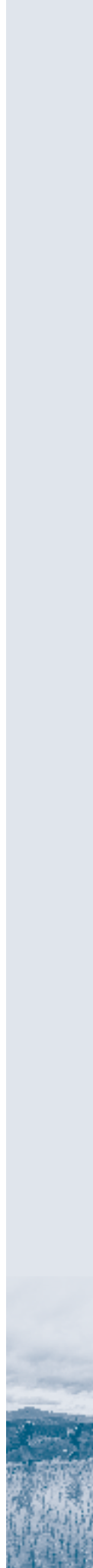
KP (Klebsiella pneumoniae, multi drug resistant)

ST (Salmonella Typhi, multi drug resistant)

NA (Not Available)

QR (Quercetin equivalent)

GAE (Gallic acid equivalent)



The results (Table 13.1 and 13.2) provided evidence of possible ethnomedicinal relationship between flavonoid and phenolic components and observed bioactivity. Among the tested species *Scurrula elata* has potential antimicrobial, antioxidant properties, and remarkable phenolic and flavonoid content. Other potential species which have such properties are *Terminalia bellirica* (antimicrobial, antioxidant, phenolic content), *Tsuga dumosa* (antimicrobial, antioxidant, phenolic content), *Geranium wallichianum* (antioxidant, phenolic content, flavonoid content), *Phyllanthus emblica* (antioxidant, phenolic content, flavonoid content), and *Desmodium gangeticum* (antioxidant, phenolic content). Similarly, highest inhibition of HeLa cell was shown by *Symplocos lucida* which might be due to its phenolic content. The plants with antioxidant and antimicrobial properties had significant presence of both phenolic or flavonoid content or either of the two (Rauha et al. 2000; Inayatullah et al. 2012). Other potential species include *Desmodium heterocarpon*, *Hydrocotyle javanica*, *Hypericum japonicum*, *Maclura cochinchinensis*, *Rhododendron lepidotum*, and *Urena lobata* (Ghimire 2016; Paudel 2016).

Altogether, 178 species from Dhading District were also assessed for anti-inflammatory response in RAW 264.7 cells, cytotoxicity in six human cancer cell lines and insecticidal potential at the Korea Research Institute of Bioscience & Biotechnology (KRIBB). The cytotoxic effect was investigated on Human promyelocytic leukemia (HL-60), Human stomach cancer cell (SNU-1), Human fibrosarcoma (HT-1080), Human lung adenocarcinoma (A-549), Human breast cancer cell (MCF-7), Human hepatoma (HepG2). Among the plant species, 16 showed cytotoxicity in various cancer cell lines, and 12 species showed significant anti-inflammatory response. Larvicidal effect was shown by 14 plant species on *Aedes aegypti*.

The most frequently cured problem was gastrointestinal issues which may be caused by poor sanitation. Indigenous knowledge in these medicinal plants has been partially supported by bioassays. The presence of bioactive compounds like phenols and flavonoids suggests reliable knowledge of the use of plants for their primary health care. Gastroenteritis is still one of the

diseases in Nepal which is known for outbreaks and even fatalities each year, particularly during monsoons (Bhandari et al. 2009). Diarrhoea still remains a major public health problem in most of the developing countries including Nepal. Several organisms such as enterotoxigenic *E. coli*, *Cyclospora* spp., *Giardia lamblia*, *Shigella* spp., *Campylobacter* spp., rotavirus and *Entamoeba histolytica* are known for causing diarrhoea and gastroenteritis and are of persistent risk to foreigners (Shlim et al. 1999). Hence, research on effective plant extracts on broad spectrum of causative agents can be a source of finding a remedy for common but major health concerns. *Staphylococcus aureus* is mainly responsible for skin infection against which a majority of the plants showed good inhibition. Although these plants were not used for skin diseases in the study area, our findings indicate it can be a new field for further research.



Photo 13.5 Village elder explaining herbal uses.

Credit



Credit

Photo 13.6 Study team collecting information from local people.

Therefore, extensive research on each species and activity guided fractionation along with the search for bioactive components in addition to phenolic and flavonoid content is required. Their mechanism in curing the ailments can give more authentic reasons in support of ethnomedicinal use and can proceed towards bioprospecting as well as finding novel use and drug leads.

Conclusion and Recommendations

The results showed an urgent need of further research to record indigenous knowledge for bioprospecting of Nepalese plant resources. In response to the current challenges of degradation of habitat as well as climate change, there is an urgent need to research and validate indigenous and local knowledge, to isolate and characterise bioactive components, and to find potential species for novel herbal drug development. To achieve the national goal for the bioprospecting of underutilised and lesser known potential ethno-medicinal plant resources, emphasis should be placed on infrastructure development, capacity building/training, exchange visits, publications, organising of conferences, and training workshops at regular intervals. A well-defined mechanism should be established to encourage ILK holders to provide their information and in return their deserved recognition. Similarly, collaboration should be extended for initiating mechanisms for sustainable harvesting, in-situ and ex-situ conservation of indigenous species with economic potential, development of high value-added natural drugs or nutraceuticals, ensuring Patent Rights (PR), and honouring Intellectual Property Right (IPR), with the mission of equitable sharing of benefits for community development, leading to economic development of a developing country like Nepal.

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Glossary

antioxidant: a molecule that can inhibit oxidation of other molecule so that free radical leading reaction can be quenched

ATCC: American Type Culture Collection

cytotoxicity: capacity to produce toxic effect on cell

Flavonoids: compounds with 15-carbon skeleton with structure that can be abbreviated as C₆-C₃-C₆

in-vitro: biological experiment done in a laboratory vessel or controlled experimental environment

methanolic extract: extract of plant done with methanol solvent

phenolic: compound with hydroxyl group (-OH) bonded directly to an aromatic hydrocarbon group

polyphenol: compound with multiple aromatic benzoid (phenyl) ring and hydroxyl (-OH) group

RAW 264.7: mouse leukaemic monocyte-macrophage cell line

14. Edibility of Wild Mushrooms in the Context of Nepal: an appraisal of Indigenous and Local Knowledge (ILK)

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Abstract

This paper highlights indigenous and local knowledge of the edibility of wild mushrooms among mycophilic communities of the Nepal Himalayas. The information presented here is based on the author's field experience of more than a decade, during which he worked on projects about wild mushrooms amongst the different communities covering wide parts of Nepal. Published literature in the context of Nepalese ethnomycology was consulted to illustrate ethnic concepts related to wild mushrooms and their consumption. This paper proposes that, although indigenous and local knowledge is a good source of information while selecting edible mushrooms, care should be taken to minimise possible poisoning.

Key words: Macromycetes, Mycoflora, Edible species, Mushrooms poisoning, Indigenous and Local Knowledge (ILK)

14.1. Mushrooms and ethnomycology

Mushrooms play a significant role in rural livelihoods and their consumption and trade is vital for such rural communities (FAO 2004). Several explorers have studied the biodiversity of the Nepalese Himalayan region enthusiastically since the 18th century. Hooker (1848-54) first undertook the collection and survey of mycoflora from this belt, in Eastern Nepal (Adhikari 2014b). The knowledge of the uses of wild mushroom in Nepal is still mainly based on observations from urban markets and suburban areas of Kathmandu and Pokhara (Adhikari 2000; Joshi & Joshi 1999; Kharel & Rajbhandary 2005; Christensen, Bhattarai, Devkota, & Larsen 2008). Few studies have been conducted in more remote rural areas (Adhikari, Devkota, & Tiwari 2005; Adhikari 2000; Aryal & Budathoki 2016; Bhandary 1991; Christensen, Bhattarai, Devkota, & Larsen 2008; Christensen, Devkota, & Bhattarai 2008; Devkota 2006, 2008, 2010; Giri & Rana 2008; Pandey, Devkota, Christensen, & Budathoki 2007) even though it is well known that people living in remote areas are generally more avid collectors of mushrooms. Till date, 131 species have been reported to be used for their culinary value in Nepal (Adhikari 2014a). Research on measuring the cultural significance of wild mushrooms is still pending in the context of Nepalese ethnomycology.

14.1.1. Current practices relating to mushroom edibility

The term 'mushrooms' applies to both edible and poisonous species of agarics such as gilled mushrooms (Miller 1984). The structures that are commonly known as mushrooms are fruiting bodies of those organisms that the mycologists call higher fungi, or macromycetes (large fungi), even though the diameter of the caps of some mushrooms may only be a few millimetres across (Rinaldi & Tyndalo 1972). People who take an interest in wild mushrooms for their social, cultural and culinary values are recognised as mycophilic communities (Bhaben, Lisha, & Chandra 2011).



Photo 14.1 A collector holds an edible mushroom *Laetiporus sulphureus* at Lokpa (2250 m), Tsum valley, Gorkha.

In Hinduism, the Manusmriti (written by Manu, 'the ancestor of humankind'), an ancient legal text, listed the names of mushrooms in Sanskrit and advised readers not to eat them. Mushrooms are known as Kavak (general name for mushrooms), Chhatrak (head with umbrella), Chhatrika (with small umbrella or cap), Shilindhram (which grows on organic materials), Swedajam (which grows in warm and humid places) or Prithavikandam (which grows in soil). These names do not provide detailed descriptions or knowledge to aid the identification of the mushrooms (Adhikari 2000, 2014b).

In the Nepalese context, there are several local names for mushrooms depending on the community: chyau (Nepali), Bammhukan (Newari), Shymo or Shyamu (Tamang), Shamu (Sherpa), Chyabo (Gurung), Muga (Magar), Pat (Limbu), Chhani (Tharu) and Kukurmutta (Hindi) (Adhikari 2014a; Christensen, Bhattarai, et al. 2008; Pandey et al. 2007).

14.1.2. Criteria: distinguishing between an edible and a poisonous species

In many parts of the world, wild, edible species have a special significance in times of catastrophic crop failures, by protecting locals from starvation (Joshi & Joshi 1999). Food hunting dates back to the origin of human beings on earth - while searching for food, they came across varieties of wild plants. To this knowledge, they added mushrooms (Das 2001).



Photo 14.2 Freshly collected mushrooms laid out to dry on flat, round bamboo trays at Namche Bazaar (3440m), Everest area, Solukhumbu.

The wild edible species in Nepal are collected from the lower plains to the highlands, but it is difficult to differentiate between the edible mushrooms and poisonous ones because there are no hard and fast rules to define toxic and edible mushrooms. Thus, mushroom hunting is also considered an art where trial and error and ‘do it yourself’ methods do not count. Moreover, this is a skill where experience and patience are of the utmost necessity (Bhandary 1991).

Irrespective of the prejudices, all collected mushroom species should be subject to detailed toxicological tests so as to determine their viability as edible food stuff. It is possible that certain geographical races of mushrooms may be poisonous, while others may not be. Possibly, a species may be edible when it is young and fresh and may be poisonous when it is over matured and has started decaying (Svreck 1975). There is no general rule for the identification of poisonous and non-poisonous mushrooms in the world. There are many traditional methods for testing these fungi but they are not reliable. Views related to the consumption of wild mushrooms (Table 14.1) are as follows (Adhikari 2014a; Christensen, Devkota, et al. 2008; Devkota 2008; Singh 1966):

Table 14.1 General beliefs about the edibility of mushrooms (Species presented here are reported from Nepal)

S.N.	General belief	Status	Edible species	Poisonous species
1.	Spring mushrooms are edible.	False	Morchella sp.	Helvella sp.
2	Autumn mushrooms are edible.	False		Amanita phalloides, A. muscaria
3	All mushrooms growing on live trees are edible.	False	Pleurotus sp. Lentinus sp. Laetiporus sp.	Clitocybe olearius
4	All the mushrooms growing on decaying straw or manure are poisonous.	False	Coprinus comatus	Stropharia sp., Psilocybe sp., Paneolus sp., Coprinellus disseminates
5	All soil inhabiting species are deadly poisonous.	False	Morchella esculenta, Russula delica, Amanita caesarea	Amanita verna, Amanita phalloides, A. muscaria

S.N.	General belief	Status	Edible species	Poisonous species
6	Bright coloured mushrooms are poisonous.	False	<i>Amanita caesarea</i> , <i>Cantharellus cibarius</i>	<i>Amanita pantherina</i> , <i>A. muscaria</i> , <i>Russula emetica</i> , <i>R. fragilis</i>
7	Mushrooms with rough warty cap and texture are poisonous.	False	<i>Amanita rubescens</i> , <i>Macrolepiota procera</i>	<i>Amanita cokeri</i>
8	Mushrooms with smooth caps are edible.	False		<i>Amanita</i> sp., <i>Hygrophorous</i> sp., <i>Lepiota</i> sp.
9	Mushrooms whose flesh changes after touching and brushing are said to be poisonous.	False	<i>Gyroporous</i> sp.	<i>Boletus luridus</i>
10	Mushrooms bearing annuli are edible.	False	<i>Agaricus bisporus</i> , <i>Amanita caesarea</i> , <i>Armillaria mellea</i>	<i>Amanita citrina</i> , <i>A. muscaria</i>
11	Mushrooms bearing vulva are poisonous.	False	<i>Amanita caesarea</i> , <i>A. hemipha</i> , <i>Volvariella</i> <i>volvacea</i>	<i>Amanita muscaria</i> , <i>A. pantherina</i>
12	Mushrooms which cause milk or egg to coagulate are said to be poisonous.	False	<i>Amanita caesarea</i> , <i>Boletus edulis</i>	
13	Mushrooms that produce latex on being injured are said to be poisonous.	False	<i>Lactarius deliciosus</i> , <i>L. volemus</i>	<i>Lactarius torminosus</i>
14	Mushrooms with bitter, acrid or pungent taste are poisonous.	False	<i>Lactarius piperatus</i>	
15	Poisonous mushrooms can be detoxified by boiling in water with or without salt or vinegar.	False		Deadly <i>Amanita</i> sp. retain their poisonous chemical even after prolonged and repeated boiling.
16	All mushrooms lose their poison through exsiccations.	False	This is true for <i>Gyromitra esculenta</i> , which, when fresh cause serious intoxication but after exsiccations become completely harmless. However, this is not true for the deadly <i>Amanita</i> spp. which remains deadly even after exsiccation.	
17	Mushrooms that are consumed by flies, squirrels, cats and monkeys are edible to humans.	False	The digestive abilities of these animals are quite different from those of human beings.	
18	Poisonous mushrooms tarnish a silver spoon, onion, and garlic pieces.	False	In the case of deadly <i>Amanita</i> spp. like <i>Amanita phalloides</i> , <i>A. verna</i> and <i>A. muscaria</i> , the colour of spoon, onion and garlic does not change while cooking.	

Depending upon the places and countries, the above prejudices vary - for example, *Scleroderma citrinum*, *S. cepa*, and *S. verrucosum* are edible in Nepal while these species are considered poisonous in Europe and Japan (Adhikari 2000). *Ramaria aurea* and *R. flava* are considered edible in Nepal but the same species have been reported as poisonous in Japanese literature (Imazeki, Otani, & Hongo 1988).

14.2. Mushroom poisoning: existing preventive and curative practices

I have noted that local people (of every study site in Nepal that I have visited during the last 14 years of my research career) normally used *Parish polyphylla* (Satuwa), *Xanthoxylum armatum* (Aakhen Timur), *Allium sativum* (Lasun) to minimise possible poisoning along with vinegar. Similar findings were also reported by the following researchers: Adhikari et al. 2005; Pandey et al. 2007. Addition of vinegar is a method used worldwide to minimise mushroom poisoning (Adhikari 2000; Chube 1995; Purukayastha & Chandra 1985; Ramsbottom 1954).

The popularity of mushrooms in high-altitude areas was related to a lack of poisonous mushrooms as observed in Annapurna Conservation Area (Christensen, Devkota, et al. 2008), Sagarmatha National Park (Giri & Rana 2008), and Shey-Phoksundo National Park and surrounding areas (Devkota 2008). The studies mentioned also reported a very low frequency of poisonous mushrooms in the *Pinus wallichiana* forest compared to the forest types at lower altitudes.

14.3. Seasonal collections: the spiritual values and customs

The favourable season for the collection of mushrooms is the rainy season. Some Tithis (in Vedic timekeeping, a tithi is a lunar day) such as Aausi (new moon day), Purnima (full moon day), and Domasey (last day of the month) are the best Tithis in which local mushroom hunters prefer to go hunting. This may be because during the rainy days, the moisture content in the atmosphere rises, facilitating favourable conditions for mushroom growth (Adhikari et al. 2005; Adhikari 2000; Aryal & Budathoki 2016).

A very common proverb in Nepal states, "If the Brahmins had eaten the mushrooms, they would have known the actual taste of mushrooms". This also prevails in every part of Nepal. However, nowadays Brahmins have also started to eat mushrooms due to their different tastes and modern knowledge of mushrooms. The reason behind this proverb was found to be almost the same in every study area when we asked local people. They thought that this was because Brahmins are of a higher caste and they are forbidden from eating mushrooms and from consuming fermented products like alcohol.

While documenting the uses of mushrooms in Lumle village of Kaski district, Western Nepal, I have noted a very interesting story about why Brahmins were forbidden from eating wild mushrooms in early days (Pers. communication: Mrs. Radha Devi Devkota). The story goes thus:

Once upon a time, farmers were busy in planting rice and almost all the hours of the day were spent in fields. There was an elderly sick person lying on the bed. In the morning when all the family members were just leaving for the field, they found that he was dead. Having no time to cremate his dead body, they covered that body with a straw mat. After completing their farming, while they were gathering to cremate him, at that time they found that mushrooms were growing on the mat. After that event Brahmin discarded mushrooms as food."



Photo 14.3 An old man collects an edible and locally available mushroom (*Termitomyces clypeatus*) that is highly valued in a forest near the district headquarters of Dadeladhura (1653 m), Nepal.

The Brahmin community in Western Nepal believe that the youngsters and elders can both eat edible mushrooms up to Shrawan (mid of August) and after this month only elderly people may eat them and youngsters are not allowed to consume them. According to their beliefs, consumption of mushrooms after Shrawan by youth may cause some sort of unpleasant events in the home.

With regard to the collection of mushrooms, people of Lumle believed that, particularly with *Termitomyces clypeatus*, the central black part of pileus should be left behind in the hole made by its stipe after picking it from the ground, so that during the following season, the same collector could harvest them. This is a gentle thought for mushroom conservation since leaving some portion of pileus behind means leaving spores for future life. Similarly, they believed that if a person hit a mushroom with his or her leg, he or she would have lame children. In this way, people of the region had superstitions about mushroom conservation.

14.4. Knowledge transmission

Oral transmission of mycological knowledge on edibility of wild mushrooms is transferred from older generations to younger generations. Children aged 8-12 years collect as many species as adults (Christensen, Bhattarai, et al. 2008). Young generations learn several aspects of collection from their parents starting from mushroom habitat, appropriate time of collection, identification and uses for culinary, medicinal, aesthetic and other values. Young collectors from mountainous districts (Taplejung, Solkhumbu, Gorkha, Manang, Mustang and Dolpa) were more familiar with the collection of mushrooms than the collectors from mid-hills or Terai districts of Nepal. Cultural, ecological and socioeconomic importance of mushrooms among the different communities plays a crucial role in the transmission of ethnomycological knowledge (Adhikari 2014b; Santiago et al. 2016).



Photo 14.4 Author documenting the collections made by monks at Lho settlement (3200 m), Samagaun valley, Gorkha (In background – Lho monastery).

14.5. The way forward

Efforts should be made by the government to make detailed surveys of wild mushrooms, their consumption practices and documentation of indigenous and local knowledge among the mycophilic communities. Awareness should be raised about the palatability of wild mushrooms, and training should be provided to local community groups to identify edible species. Preventive and curative measures should be delivered to the mushroom lovers through different media and related sources.

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15. Documentation of Indigenous and Local Knowledge of Medicinal plants in the Rahim Yar Khan district of Pakistan

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Abstract

The present study has been carried out in the Rahim Yar Khan District of Punjab province in Pakistan from September 2015 to October 2016. The study was aimed at preparing an ethnobotanical database with the aim of analysing the medicinal value of plant species identified by the local communities. The research methodology opted for the study was an extensive survey with 70 respondents from the drug market as well as local people and local healers. In this regard, a questionnaire was adopted to interview local healers called Hakims, local herbal traders called Pansaries and people working at indigenous local medicine manufacturers or Dawa Khanas in Rahim Yar Khan City. In total, 105 recipes practised by local people have been documented; this is part of the indigenous local knowledge of 65 medicinal plant species utilised belonging to 32 families and 59 genera at 4 study sites. Fabaceae and Poaceae families were predominantly used. Based on indigenous and local knowledge, most important medicinal plants found to be in use were Aloe vera, *Calotropis procera*, *Coriandrum sativum*, *Ficus carica*, *Phoenix dactylifera*, *Tamarix aphylla* and *Ziziphus jujube* while plant species having the lowest medicinal value were *Bombax ceiba*, *Convolvulus arvensis*, and *Eucalyptus globules* etc.

15.1. Introduction

In Pakistan, a majority of the population lives in remote areas (villages, tribes and desert communities) and benefits from local medicinal plants in many ways. Rahim Yar Khan is situated between 27°40'–29°16' northern latitudes and 60°45'–70°01' eastern longitudes. It is a district in the Punjab province of Pakistan. It is situated in the south of the irrigated area up to the border between India and Pakistan. The district comprises an area of 11,880 square kilometres.



Figure 15.1 Map of study area

The total population of Rahim Yar Khan District was 3.3 million out of which 19.6% lives in urban areas (ASER 2008). The climate of the district is hot and dry in summer, on the other hand, cold and dry in the winter season. The summer is relatively longer than other seasons in this particular region. It starts in April and continues until October. The winter lasts from November to March. The average annual rain fall is about 100 millimeters. The major tribes in the area under study are the Arain Jat, Rajput and Gujjar. They all originate from the adjoining districts of East and West Punjab. The old settlers are the Joya, Wattoo, Daudpota, Balouch, Syed and Pathan. The study area is geographically diverse containing three main physical features: riverside area, canal-irrigated area and desert area which is called Cholistan. Therefore, it is ecologically diverse as well.



Photo 15.1 Water logging and salinity is a major ecological problem in the desert area of the district

The local people have indigenous local knowledge of medicinal plant use but this is unfortunately documented poorly and has not attracted the attention of any researcher with modern tools and technologies. Through this study, a baseline record has been built which will be available for interested researchers as a primary data source. The main objective of the study was to document indigenous local knowledge of medicinal plants and trigger the development of a database and to evaluate the medicinal value of the selected plants used by the local people as herbal medicine. In the past, various studies have been carried out to document indigenous knowledge of medicinal plants in diverse parts of Pakistan (Ahmed et al. 2015; Ahmed et al. 2014; Bibi et al. 2014; Qasim et al. 2014; Mahmood et al. 2013; Murad 2012; Qureshi 2012; Noor & Kalsoom 2011; Mahmood et al. 2011; Sher et al. 2011; Alam et al. 2011; Hameed et al., 2011; Abbasi et al. 2010; Ibrar et al. 2007; Qureshi & Bhatii 2008; Shinwari et al. 2007; Shinwari and Khan 2000).

15.2. Methodology

The study area was divided into four main physical sites (Tehsil Rahim Yar Khan, Sadiq-a-bad, Khan Pur and Liaqat Pur) including the riverside area, canal irrigated area and desert area. All these sites were located in different administrative subdivisions called tehsils. The desert area is found near the Qsre-Abu Dahbi, canal-irrigated area near Chowk Shabaz Pur, Chani Goth and the riverside area site was located at Malkani Zahir Pir City.

The specimens or botanical samples were collected from the study sites. The voucher specimens (specimens used to keep an identification record) were pressed, dried, pasted on the herbarium sheets and labeled. Their identification was determined with the help of existing literature and specimens in the herbarium. The interviews were conducted in Urdu, Punjabi and Saraiki languages. The interviews included questions about age, gender, local recipes, processes and other indigenous local knowledge and the interviewees were the people involved in the herbal medicine business, i.e., Hakims (local healers), homeopathic doctors and Pansaries (local medicinal plant traders).

The collected data was analysed through two formulae. The first one was the Relative Frequency of Citation (RFC) which gave the significance of each plant species. It was calculated from frequency of citation (FC, the number of informants



Photo 15.2 *Acacia jacquemontii*
Benth.(Kiker)



Photo 15.3 *Calotropis procera*
Linn (Ak)



Photo 15.4 *Capparis deciduas*
(Forssk.) (Kareer)

mentioning the use of plant species) divided by the total number of informants (N) who participated in the survey with no used categories for consideration (Tardío & Santayana 2008). $FC = (FC/N)$.

The second is the MUV (Medicinal Use Value) which demonstrates the relative medicinal importance of plants. The medicinal use value was calculated with little modification (Tardío & Santayana 2008) through the formula: $MUV = \sum(XMU_i/N)$ (where XMU_i is the number of mentioned medicinal uses by each informant for a given plant species and N is the total number of informants included in the survey). Medicinal value of the medicinal plants utilised in the study area was tested through local hospital surveys. In this regard, a questionnaire was adopted to interview the Hakims, Homeopathic doctors, Pansaries and Dawa khanas (indigenous local medicine manufacturers) in the main Rahim Yar Khan City. For the qualitative approach, a questionnaire was adopted to investigate the number of patients, most frequent diseases and most commonly used medicines (Phillips and Gentry 1993; IUCN 2001). According to the Red Data Book of IUCN, the status of commercially important indigenous species (threatened to be 'extinct') in the study area was determined through four parameters: availability, collection, growth and part of the plant used, providing a total score for each species (IUCN 2001). The relative importance of indigenous plants was classified as Rare, Infrequent and Common/Dominant species. Quadrature method was chosen for the phytosociological classification of the plant species.

15.3. Results

In total 65 medicinal plant species utilised belonging to 32 families and 59 generas at 4 study sites (Tehsil Rahim Yar Khan, Sadiq-a-bad, Khan Pur and Liaqat Pur) were analysed. Fabaceae and Poaceae families were predominant (Table 15.1).

Table 15.1 Local knowledge of Selected Indigenous Medicinal Plants in Rahim Yar Khan District

No.	Species with (Family) Voucher Sp. No.	Local Names ¹	Habit	Occurrence	Part used ²	Local uses of Medicinal of Plants against Diseases
	<i>Acacia jacquemontii</i> Benth. (Mimosaceae)11	(UR) Babuli; (SN) buber (PB) Kiker; (EN) Acacia	T	Common	BN, ST, LT	Against dysentery and gastric problems in children and men.
	<i>Albizia lebbek</i> (L.) Benth. (Mimosaceae)34	(UR) Sars; (PB) Sharenh (SN) Siraahun	T	Rare	WP	Against diarrhoea, dysentery and skin diseases. Enhancement of sight.
	<i>Alhagi maurorum</i> Medic. (Papilionaceae) 33	(UR) Kandera; (PB) Jowahan;	H	Common	WP	The decoction of the plant is useful against skin diseases as a bath.
	<i>Allium cepa</i> Linn. (Alliaceae) 44	(UR) Piyaz; (PB) Gundha (SR) Vassal; (SN) Baser	H	Common	RZ, S	Aphrodisiac, syrup is used to cure flu, cough and fever.
	<i>Allium sativum</i> Linn. (Alliaceae) 59	(UR) Lehse; (SN, PB) Thom; (EN) Garlic	H	Infrequent	L, BU	Used to treat Anorexia, Flatus, Hepatitis and Splenomegaly. Also used to maintain the cholesterol level and blood pressure.
	<i>Aloe vera</i> (L.) Burm. f. (Asphodelaceae) 29	(UR) Ghakwar; (PB) Kanwar Gndal; (SN) Kanwar Boti	H	Rare	L	Treatment of jaundice. Also used as liver tonic.
	<i>Amaranthus viridis</i> Linn. (Amaranthaceae) 2	(UR) Jangli cholai; (SN) Mrerho; (PB) Paneer	H	Rare	WP, S	Chronic constipation. Stops bleeding in menstruating girls.
	<i>Avena fatua</i> Linn. (Poaceae) 63	(PB, UR) Jai; (SR) Juwi (EN) Oats	H	Common	WP	It is used to treat infertility and increases sperm count.
	<i>Azadirachta indica</i> A.Juss. (Meliaceae) 26	(UR) Neem, (PB) Nim (EN) Indian Lilac	T	Common	L, S, FL, LT	Treats burnt skin. Antiseptic and used for ulcer and wounds of the skin.
	<i>Bombax ceiba</i> Linn. (Bombacaceae) 84	(PB) Sumbal (EN) Silk Cotton tree	S	Rare	FL	Blood purifier. Powdered root is taken with water twice a day in case of leucorrhoea.
	<i>Brassica nigra</i> Linn. (Brassicaceae) 41	(UR) Kali Sarsoon; (SN) Sarhiyon; (PB) Saroon	H	Common	WP, S	Stomach ache and indigestion. Seed oil is used to massage the body to relieve muscular pain.
	<i>Calotropis procera</i> Linn. (Asclepiadaceae) 51	(UR, PB) AK (SN, SR) Akh	S	Common	R, ST, FL, WP	Whole dried plant in powder form is employed as a good energiser and anthelmintic. Used against cholera and indigestion.
	<i>Cannabis sativa</i> Linn. (Cannabaceae) 73	(UR) Bhang; (PB) Pung (SR) Saavi	H	Common	L	Paste made from crushing 3 masha of leaves is used to cure whooping cough, digestive disorders and asthma.

¹ Sindhi=SD, Siraiki=SR, Urdu=UR, English=EN, Punjabi=PB

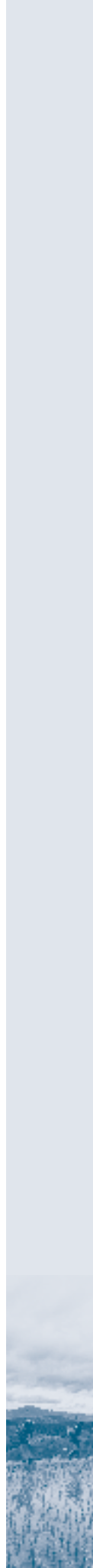
² Bark=BK, Branches=BN, Bulb=BU, Flower=FL, Fruit =FT, Latex=LT, Leaves=L, Rhizome=RZ, Root=R, Seed=S, Stem=ST, WP =Whole Plant

No.	Species with (Family) Voucher Sp. No.	Local Names ¹	Habit	Occurrence	Part used ²	Local uses of Medicinal of Plants against Diseases
	<i>Capparis decidua</i> (Forssk.) Edgew. (Capparidaceae) 8	(UR) kraal, Krear; (PB) Dela; (SN) Karurjodun	H	Common	BN, FT, WP	Against backache and joint pains, muscular injuries and ulcers.
	<i>Capsicum annuum</i> Linn. (Solanaceae) 65	(UR) Surkh Mirch (SN,SR) Garha Mirch	H	Rare	FT part	Used for the treatment of cholera.
	<i>Chenopodium album</i> Linn. (Chenopodiaceae) 42	(UR) Batho; (SN) Nibho boto; (PB) Bthwa; (SR) Jo sagbuto	H	Common	S, WP	Used against jaundice and hepatitis.
	<i>Cichorium intybus</i> Linn. (Asteraceae) 39	(UR, PB) Kasni (EN) wild endive	H	Common	L, S	Decoction is used to treat jaundice and hepatitis (very common disease of study area).
	<i>Cirsium arvense</i> (L.) Scop. (Asteraceae) 45	(UR) Jangli Bengun; (PB) Ili; (SN) Aaderi	H	Infrequent	L, ST, FL, R	Used against mild fever and chronic headache.
	<i>Citrus limon</i> (Linn.) Burm.f. (Rutaceae) 64	(PB) Nimbo; (UR) Lemo (SN) Neebo	T	Infrequent	FT, S	Used for digestion and as a good cooling agent. Used to treat cholera.
	<i>Convolvulus arvensis</i> Linn. (Convolvulaceae) 62	(SR) Wanvehri, Galvehri (PB) Hirankhuri; (UR) Lehli	H	Common	WP	Whole plant in the powdered form is used to cure chronic constipation.
	<i>Cordia dichotoma</i> Forster. f. (Boraginaceae) 74	(SN, PB) Lesora; (EN) Glue berry	T	Infrequent	FT	Used to soften throat and chest cavity to cure cough and asthma. Ash of leaves is used on the open wounds of skin.
	<i>Coriandrum sativum</i> Linn. (Apiaceae) 44	(UR, PB) Dhania; (SN) Dhana; (EN) Coriander	H	Common	WP	Used to improve digestion and effective against sunstroke.
	<i>Coronopus didymus</i> Linn. Smith (Brassicaceae) 1	(UR) Jangli Halon; (PB) Chairni boti; (SR) Chrihatha	H	Common	WP, S	Applied on burnt skin or over body rashes. Smoke from its plant is used as insect repellent.
	<i>Dalbergia sissoo</i> Roxb. (Papilionaceae) 24	(UR) Shesham; (PB) Tahli;	T	Common	L, FT, S	Used against stomach disorders. Used as hair wash by women to strengthen the roots of hair and increase length.
	<i>Datura stramonium</i> Linn. (Solanaceae) 20	(UR, SR) Dhatura;	H	Common	L, S	Used as tonic and febrifuge (Precaution: Taken with care as it is poisonous in higher concentrations).
	<i>Daucus carota</i> Linn. (Apiaceae) 58	(UR) Gajar; (EN) carrot	H	Common	RZ	Taken to reduce burning sensation of liver and stomach. Fresh carrots are used as salad



No.	Species with (Family) Voucher Sp. No.	Local Names ¹	Habit	Occurrence	Part used ²	Local uses of Medicinal of Plants against Diseases
	<i>Desmostachya bipinnata</i> (L.) Stapf. (Poaceae) 77	(SR) Drub, Talla; (PB) Khabbal Kha;	S	Common	WP	Extract of whole plant used by the local Hakims to control vomiting and vaginal discharges in the unmarried girls.
	<i>Ipomoea batatas</i> (Linn.) Lam. (Convolvulaceae) 56	(UR,PB) Shkar qandi (EN) white yam	H	Infrequent	RZ	It increases the sperm count and is good for infertility.
	<i>Eucalyptus globulus</i> Labill. (Myrtaceae) 30	(UR,PB) Sufaida (EN) Blue Gum Tree	T	Common	L, S	Tea made of its leaves is used to treat cold, cough and influenza.
	<i>Ficus benghalensis</i> Linn. (Moraceae) 18	(UR) barh, bohar; (EN) Banyan tree; (PB) Borh	T	Infrequent	L, LT, FT, R	Used to cure diarrhoea. Fruit is used as anti-diabetic. Paste used to cure piles.
	<i>Ficus carica</i> Linn. (Moraceae) 22	(UR,PB) Angeer (EN) Fig	T	Rare	FT	Used as bandage over wounds and abscesses.
	<i>Ficus religiosa</i> Linn. (Moraceae) 52	(UR) Peepal, (SN) Pupper, (EN) Sacred fig	T	Rare	ST, FT, R	Used to treat asthma. Root ash is used to treat dysentery. Decoction of stem is used as antiemetic in gastric problems of children.
	<i>Foeniculum vulgare</i> Mill. (Apiaceae) 61	(UR,PB) Sonf, (EN) Fennel	S	Common	S	Taken against weakness of eye sight.
	<i>Grewia asiatica</i> Linn. (Tiliaceae) 72	(UR, PB) Falsa	T	Infrequent	FT, S	Drink used to give relief from heat and thirst.
	<i>Hibiscus rosasinensis</i> Linn. (Malvaceae) 27	(UR) Ghrhilli; (SR) Hodil, Ghorhan;	H	Rare	FL	Extract from flowers is used in the treatment of dysuria.
	<i>Hordeum vulgare</i> Linn. (Poaceae) 49	(SR, PB) Jo (EN) Barley	H	Common	WP	Bread made from its flour is used to remove extra fat from the body.
	<i>Lathyrus sativus</i> Linn. (Papilionaceae) 40	(UR,PB) jangli mater (SR) Matri, (EN) grass pea	H	Infrequent	WP, S	Used to soothe the severe body pain. Powder made from whole plant is applied to skin burns externally.
	<i>Magnifera indica</i> Linn. (Anacardiaceae) 12	(UR) Aam, (PB,SR) Anb (EN) Mango	T	Common	FL, FT, R,L	Used for digestion and gastric problems. Powder made from flower is used to increase the sperm count.
	<i>Melia azedarach</i> Linn. (Meliaceae) 25	(UR) Bkayien, (SN) Bkayien Nim, (PB) Bkain	T	Infrequent	L, S	Used as anthelmintic. Applied on the skin to cure rheumatism.

No.	Species with (Family) Voucher Sp. No.	Local Names ¹	Habit	Occurrence	Part used ²	Local uses of Medicinal of Plants against Diseases
	<i>Meliolotus indica</i> Linn. (Papilionaceae) 7	(UR) Sr Sinjhi (SN) Sinjhi	H	Infrequent	WP, FL, L	Used for relaxation of the mind. The cooked leaves in water are usually used for bandaging wounds.
	<i>Mentha longifolia</i> (L.) L. (Lamiaceae) 21	(UR) Podina, (PB) Podna (SN) Phowanu	T	Common	L	Used to treat stomach and liver in case of hepatitis A, B or jaundice.
	<i>Moringa oleifera</i> Lam. (Moringaceae) 36	(UR,PB) Suhanjana, (SN) Sohanjro, (EN) Moringa Tree	T	Infrequent	WP	Taken against body aches, gastric problems and blood pressure.
	<i>Morus nigra</i> Linn. (Moraceae) 50	(UR,PB) Toot-i-Siah (EN) Black Mulberry	T	Rare	FT, ST, L	Eaten for digestion and constipation. Used for skin softening by women. Stem is used as anthelmintic and seeds are used against flu, fever and sore throat.
	<i>Musa paradisiaca</i> Linn. (Musaceae) 79	(UR,PB) Kaela, (SN) Kaelo, (EN) Banana	T	Infrequent	FT	Fruit used to regulate bowel in case of constipation.
	<i>Ocimum tenuiflorum</i> Linn. (Lamiaceae) 86	(UR,PB) Rehan, Nazbo (EN) Holy Basil	H	Rare	L, WP	Used against whooping cough.
	<i>Oxalis corniculata</i> Linn. (Oxalidaceae) 54	(UR) Khithi mithi boti (PB) Meeni booti	H	Common	WP	Decoction of root is used to treat mild temperatures and scurvy.
	<i>Phalaris minor</i> Retz. (Poaceae) 6	(UR,PB) Dumbi Sittee, Gandum Dewana	H	Common	WP	For weak eye sight and black spots of the cornea and for tinnitus.
	<i>Phoenix dactylifera</i> Linn. (Palmae) 32	(UR) Khajoor; (PB) Khaji; (SN) Kati;	T	Infrequent	FT, S	Used as antibacterial, against worms and as an energiser for body. Used to strengthen the body muscles.
	<i>Phyla nodiflora</i> Linn. (Verbenaceae) 75	(PB) Toot Boti (EN) Match weed	H	Common	L	Used to treat bleeding haemorrhoids. Decoction of leaves mixed with sugar to cure fever.
	<i>Punica granatum</i> Linn. (Punicaceae) 23	(UR,PB) Anar (SN) Darthon	T	Infrequent	L, FT, S	Fruit used to cure hepatitis and for proper digestion.
	<i>Raphanus sativus</i> Linn. (Brassicaceae) 43	(UR,PB) Moli, (SN) Mori	H	Common	WP, RZ, S	Used to treat amenorrhoea. Used to remove stone from kidney and bladder. Rhizome used against constipation and haemorrhoids.
	<i>Rosa chinensis</i> Jacq. (Rosaceae) 83	(UR,PB) Gulab, (SN) Jarphal, (EN) Rose	S	Infrequent	FL	Used for stomach disorders and mild fever. Extract of the flower petal (Rose water) is used as cleanser and tonic for facial skin.



No.	Species with (Family) Voucher Sp. No.	Local Names ¹	Habit	Occurrence	Part used ²	Local uses of Medicinal of Plants against Diseases
	<i>Saccharum bengalense</i> Retz. (Poaceae) 78	(SR) Bota; (PB) Kanha (UR) Sarkanda	S	Common	R	Used to treat kidney stones.
	<i>Saccharum officinarum</i> Linn. (Poaceae) 9	(UR,PB) Ganna, Kamad (SN) Kumand,	S	Infrequent	BN, FT,ST	Used against heat stroke and for stomach and liver. Juice applied against malaria and cholera.
	<i>Sesbania bispinosa</i> Jacq. W.F.(Papilionaceae) 3	(PB) Jantar; (SR) Jaeter (EN) Prickly Sesban	T	Infrequent	R, BK	Paste made from root and bark is used to ease throbbing and swelling related to arthritis and gout.
	<i>Solanum nigrum</i> Linn. (Solanaceae) 76	(SN) patperon; (PB) Kanwan; (UR) Mako	S	Common	FT, L, R	Used to treat the swelling of liver and stomach. Leaves are chewed in the treatment of phtthisis.
	<i>Solanum surattense</i> Burm.f.(Solanaceae) 4	(UR) Katai Klan, (PB) Bari Kandayari,	H	Infrequent	L	Applied externally for the treatment of scabies and ringworm twice a day. Used against the treatment of cough, fever and flu.
	<i>Sorghum bicolor</i> (Linn.) (Poaceae) 55	(SR, PB) Jowar (SN) Joeir	H	Common	WP	It is used as anthelmintic.
	<i>Spinacia oleracea</i> Linnaeus	(UR,PB) Paluk (EN) Spinach	H	Common	L	Used to treat anaemia and heavy bleeding during menstruation.
	<i>Syzygium cumini</i> Linn. (Myrtaceae) 15	(UR,PB) Jaman; (SN,SR) (EN) Jambul	T	Rare	BN, S, FT	Extract of the fruit is mixed in equal parts with mango extract and given to patients of diabetes.
	<i>Tamarix aphylla</i> (Linn.) Karst. (Tamaricaceae) 35	(UR) Farash, Gazesurkh (PB) Athel tree; (SN, SR) Jal	T	Common	L, WP	Used against chronic diarrhoea and dysentery. Steam of leaves is used for the treatment of ulcer and piles.
	<i>Trigonella foenumgraecum</i> Linn. (Papilionaceae) 47	(UR,PB) Maithi (EN) Fenugreek	H	Common	L, S	Used as hair wash for long and shiny hair and against black dots and spots of skin.
	<i>Vitis vinifera</i> Linn. (Vitaceae) 10	(UR,PB) Angor (EN) Grape	H	Rare	FT	Used as tonic and to treat cough, flu and fever.
	<i>Ziziphus jujuba</i> Mill. (Rhamnaceae) 82	(UR) Unab (PB, SR) desi beri	T	Rare	FT, R	Used to treat jaundice and mild fever.
	<i>Ziziphus mauritiana</i> Lam. (Rhamnaceae) 31	(UR) beri (PB) Jungli beri	T	Infrequent	L, FT	Fruit recommended for diabetic patients. Used externally to relieve spinal pain.



Photo 15.5 Indigenous herbal medicines manufactured locally

15.4. Discussion

According to the interviews of the local herbalists, the medicinally important plants found were: Aloe vera, Calotropis procera, Coriandrum sativum, Ficus carica, Foeniculum vulgare, Mentha longifolia, Ocimum tenuiflorum, Phoenix dactylifera, Rosa chinensis, Tamarix aphylla and Ziziphus jujube. These species obtained the highest MUI value, while plant species with the lowest MUI values were Bombax ceiba, Convolvulus arvensis, Dioscorea melanophyma, Eucalyptus globules., Hibiscus rosa-sinensis, Hordeum vulgare, Lathyrus sativus, Melilotus indica, Oxalis corniculata and Phalaris minor (Table 2 – see annex). A previous study carried out around the study area, i.e. Bahawalnagar district, has reported 63 plants as effective in the local healthcare system, belonging to 56 genera and 34 families (Ahmed et al. 2015). While 70 medicinal plants belonging to 27 families distributed among 60 different genera have been reported from Cholistan desert adjacent to the present area studied (Ahmed et al. 2014).

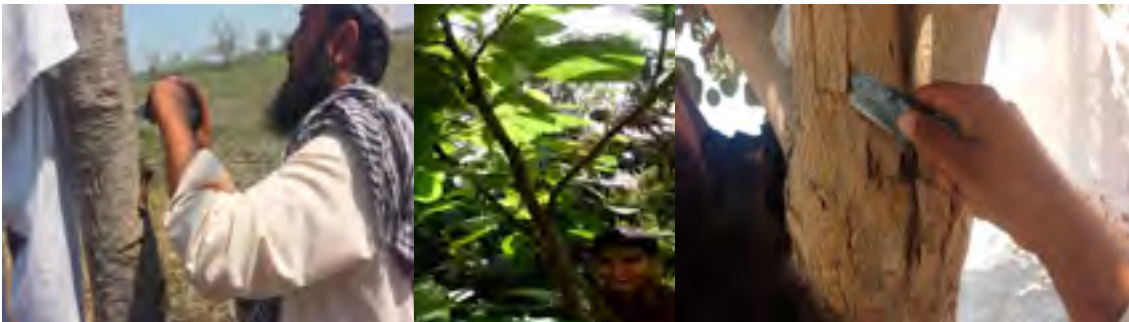


Photo 15.6 Collection of indigenous medicinal plant parts for medicine preparation

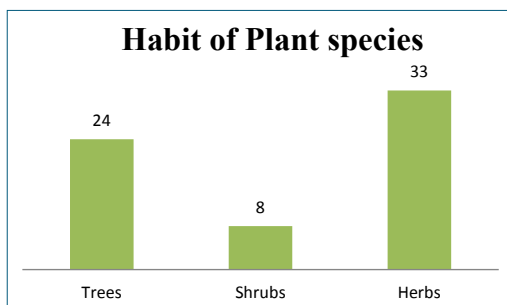


Figure 15.2 Habits of medicinal plant species in the study area.

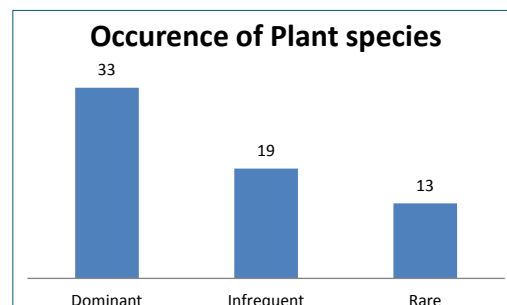


Figure 15.3 Occurrence of medicinal plant species at the study site

Conclusion

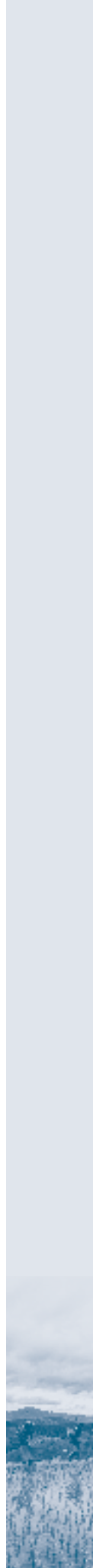
It has been concluded that local knowledge of indigenous plant species plays a very important role in the life of inhabitants of District Rahim Yar Khan as these are the main source of indigenous local herbal medicines. As the targeted study area is predominantly rural, the inhabitants rely on herbal treatment options rather than the modern allopathic system. The most abundant medicinal plant species was *Calotropis procera* and *Ziziphus jujuba* was found to be rare. There is a need for detailed research and restoration of the natural habitat of these medicinal indigenous plants and traditional knowledge under threat. Over-expanding population has unfavourably influenced the indigenous habitat. Endeavours for botanical asset protection in the study area would not be fruitful if the population increases at the present rate. Loss of habitat is the single biggest contributing element for the loss of different species, the main cause of which is urbanisation.

Acknowledgement

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Table 15.2 The MUV, RFC and FC of the plant species at the study site Rahim Yar Khan.

S/ No.	Botanical Name	MUV	RFC	FC
1	<i>Acacia jacquemontii</i>	0.36	0.32	23
2	Albizia lebbek	0.35	0.34	24
3	<i>Alhagi maurorum</i>	0.56	0.61	43
4	<i>Allium cepa</i>	0.57	0.65	46
5	<i>Allium sativum</i>	0.81	1.00	70
6	Aloe vera	1.00	0.67	47
7	<i>Amaranthus viridis</i>	0.32	0.38	27
8	<i>Avena fatua</i>	0.23	0.40	28
9	<i>Azadirachta indica</i>	0.54	0.33	23
10	Bombax ceiba	0.10	0.30	21
11	<i>Brassica nigra</i>	0.55	0.31	22
12	<i>Calotropis procera</i>	1.00	0.61	43
13	<i>Cannabis sativa</i>	0.59	0.33	23
14	Capparis decidua	0.81	0.34	24
15	<i>Capsicum annuum</i>	0.43	0.65	46
16	<i>Chenopodium album</i>	0.48	0.69	48
17	<i>Cichorium intybus</i>	0.91	0.69	48
18	Cirsium arvense	0.39	0.61	43
19	<i>Citrus limon</i>	0.74	0.39	27
20	<i>Convolvulus arvensis</i>	0.14	0.35	25
21	<i>Cordia dichotoma</i>	0.38	0.37	26
22	Coriandrum sativum	0.91	0.38	27
23	<i>Coronopus didymus</i>	0.22	0.31	22
24	<i>Dalbergia sissio</i>	0.55	0.33	23
25	<i>Datura stramonium</i>	0.60	0.32	22
26	Daucus carota	0.62	0.65	46
27	<i>Desmostachya bipinnata</i>	0.31	0.39	48
28	<i>Dioscorea melanophyma</i>	0.13	0.66	46
29	<i>Eucalyptus globulus</i>	0.14	0.32	22
30	Ficus benghalensis	0.64	0.65	45
31	<i>Ficus carica</i>	1.00	0.38	26
32	<i>Ficus religiosa</i>	0.77	0.39	27
33	<i>Foeniculum vulgare</i>	1.00	0.31	22

S/ No.	Botanical Name	MUV	RFC	FC
34	<i>Grewia asiatica</i>	0.41	0.38	27
35	<i>Hibiscus rosas-inensis</i>	0.13	0.35	25
36	<i>Hordeum vulgare</i>	0.12	0.36	25
37	<i>Lathyrus sativus</i>	0.14	1.00	70
38	<i>Magnifera indica</i>	0.67	0.39	27
39	<i>Melia azedarach</i>	0.85	0.38	27
40	<i>Melilotus indica</i>	0.19	0.31	22
41	<i>Mentha longifolia</i>	0.97	0.39	27
42	<i>Moringa oleifera</i>	0.53	0.38	27
43	<i>Morus nigra</i>	0.21	0.39	27
44	<i>Musa paradisiaca</i>	0.21	0.63	47
45	<i>Ocimum tenuiflorum</i>	1.00	0.35	25
46	<i>Oxalis corniculata</i>	0.15	0.32	22
47	<i>Phalaris minor</i>	0.39	1.00	70
48	<i>Phoenix dactylifera</i>	1.00	0.37	26
49	<i>Phyla nodiflora</i>	0.59	0.39	27
50	<i>Punica granatum</i>	0.42	0.32	22
51	<i>Raphanus sativus</i>	0.78	0.34	24
52	<i>Rosa chinensis</i>	1.00	0.37	26
53	<i>Saccharum bengalense</i>	0.40	0.35	25
54	<i>Saccharum officinarum</i>	0.47	0.36	26
55	<i>Sesbania bispinosa</i>	0.19	0.36	26
56	<i>Solanum nigrum</i>	0.91	0.35	25
57	<i>Solanum surattense</i>	0.36	0.38	27
58	<i>Sorghum bicolor</i>	0.24	0.31	22
59	<i>Spinacia oleracea</i>	0.63	0.32	22
60	<i>Syzygium cumini</i>	0.84	0.35	25
61	<i>Tamarix aphylla</i>	1.00	0.68	48
62	<i>Trigonella foenum-graecum</i>	0.89	1.00	70
63	<i>Vitis vinifera</i>	0.91	0.69	48
64	<i>Ziziphus jujuba</i>	1.00	0.61	43
65	<i>Ziziphus mauritiana</i>	0.89	1.00	70

16. Indigenous and local knowledge of conservation and sustainable use of Himalayan Giant Nettle (*Girardinia diversifolia* (Link) Friis) in Eastern and Far-Western Regions of Nepal

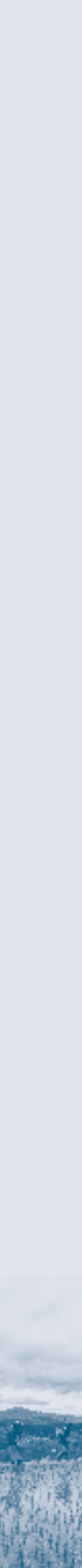
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Abstract

Indigenous knowledge and practices of indigenous peoples and local communities (IPLCs) play an important role in the conservation and sustainable use of biodiversity. Himalayan giant nettle (*Girardinia diversifolia* (Link) Friis), locally known as 'allo', has economic and cultural values for IPLCs living in the Kailash Sacred Landscape (KSL-Nepal) (comprising Humla, Darchula, Baitadi, Bajhang Districts) of Far-Western Nepal; and Makalu Barun National Park (comprising Shankhuwasabha and Solukhumbu Districts) of Eastern Nepal. This research discusses indigenous and local knowledge of the traditional use and practice of 'allo' linked with the sustainability of resources. The study investigated the cultural linkage among 'allo' harvesting and processing techniques, traditional medicinal practice as well as conservation practice adopted on 'allo' by IPLCs of Far-Western and Eastern regions of Nepal. Different parts of the 'allo' plant species are traditionally being used by local healers (Vaidhya) and local communities such as Bohora, Dhimi, Thagunna of Darchula District use 'allo' as medicine for treating gastritis, joint pain, headache, tuberculosis and asthma. The Kulung Rai people of Sankhuwasabha district use clothes made of 'allo' fibre in their rituals. The study revealed that IPLCs use the fibre of 'allo' as primary material to make ropes, fishing nets, coats, pants, bags, shawls, purses and many more items to sustain their livelihoods. The traditional harvesting techniques; use of locally available materials such as wood ash, white soil; and locally made equipment like hand spindle, wooden hammer, wooden handloom help in sustainable use and conservation of 'allo'. Increasing market demand had led to a higher supply of 'allo' products, hence, people started to harvest it extensively. The natural resource 'allo' has been declining due to high habitat competition with cash crops like *Amomum subulatum*. Therefore, this study identifies the existing status of 'allo' for management and sustainable utilisation to meet the increasing demand for resources, and attempts to share the management practices followed in two different regions of Nepal.



16.1. Introduction

Himalaya giant nettle (*Girardinia diversifolia* (Link) Friis) locally known as 'allo', has economic and cultural values for indigenous peoples and local communities (IPLCs) living in the Kailash Sacred Landscape (KSL-Nepal), which comprises four districts in Far-Western Nepal - Darchula, Baitadi, Bajhang and Humla Districts (Zomer and Oli 2011); and in Sankhuwasabha District of Eastern Himalaya in Nepal. *G. diversifolia* belongs to family Urticaceae. It is a fibre-yielding plant locally known as 'allo' in Nepali language. 'Allo' grows in the Eastern to Far-Western regions of Nepal between the altitudes of 1,200 to 3,000 metres a.s.l. Its range also extends to China, India, Bhutan, and East Africa including Madagascar (Friis 1981; Shrestha and Hoshion 1998; Chen et al. 2003). The plant is shade loving, grows to 1.5 to 3 metres tall and has a perennial root. Stem and leaves consist of stinging spikes. Fibre is present in the inner bark of the stalk and has high strength and length. Allo has cultural, economic and medicinal values for many communities like Rais, Gurungs, Tamangs, Sherpas, etc. Indigenous peoples and local communities utilise the fibre of this plant to make different articles for daily use. Kulung Rais use cloth made of 'allo' in their religious ceremonies, offer cloth to God during Nagi Puja and also present 'allo' cloth to their daughters during the wedding ceremony (Barakoti and Shrestha 2008). Different parts of the plant species are traditionally utilised as medicine. 'Allo' products have both national and international market value. Resources management, sustainable harvesting, conservation, and fair and equitable sharing of benefits enhance equity among the communities. The harvesting and processing system of 'allo' followed by the people of Bala, Sisuwa, Tamku (Village Development Committee) VDCs of Sankhuwasabha district and medicinal use of different parts of 'allo' followed by communities at Khar, Katae, Yerkot, Sipti VDCs of Darchula district living in KSL-Nepal are important for the sustainability of the resources.



Photo 16.1 Local people harvesting 'allo'

This research, combining cultural and economic values, investigated the indigenous knowledge on uses and practices linked with the sustainability of resources. The study investigated how local communities have established cultural linkages with harvesting practice, processing techniques and medicinal use of 'allo' in different regions.

16.2. Study area

The study sites Khar, Airkot, Katae, Septi, Sitola VDCs of Darchula District, Api-Nampa Conservation Area, Kailash Sacred landscape (KSL), Nepal are located in the Far-Western region; Bala, Sisuwa, Tamku VDCs of Sankhuwasabha District in Makalu-Barun National Park are in the Eastern region of Nepal (Figure 16.1).



Figure 16.1 Study area with KSL-Nepal in Far-Western region and Sankhuwasabha District in Eastern region of Nepal.

16.3. Materials and Methods

A field survey was conducted in the study areas following focussed group discussions, informal meetings and field observations as primary methods of data collection. Semi-structured questionnaires were followed after establishing informed consent with the communities. Information was also collected from websites and published articles in journals. Non-timber forest product (NTFPs) collectors, traders, traditional healers (Vaidhya), 'allo' processers and community members were consulted through focussed group discussions and informal meetings. Elderly people, forest guards, local traders, men and women representing different ethnic groups, castes and occupations were encouraged to participate.

16.4. Results and Discussions

16.4.1. Cultural use and practice

Indigenous and local communities like Rais, Gurungs, Sherpas, Magars and Tamangs value *G. diversifolia* economically and culturally. A particular community of Rai (Kulung Rai) peoples offer 'allo' cloth to god during the cultural ceremony of Nagi Puja. 'Allo' and its cloth are the most important requirements during housewarming, wedding and funeral ceremonies. It is also the source of livestock feed, bedding material and firewood (Barakoti 2008). The traditional fibre extraction technology developed by IPLCs helped them to meet the basic requirement of the people by selling their products in local markets.

16.4.2. Traditional medicinal use and practice

The present study revealed that 'allo' is a medicinal plant and has been used by the local communities in Far-Western and Eastern regions of Nepal. Local people use 'allo' as medicine for treating gastritis, joint pain, headache, tuberculosis and asthma (Table 16.1).

Table 16.1 Traditional use of *G. diversifolia*

Parts used	Traditional use
Root	Juice of roots is used to treat gastritis and constipation and is applied on swellings. Paste of the root is applied on aching joints. Root juice with water is used for stomach ache. For the treatment of gastritis, it is mixed with the plant Ghodtapre (<i>Centella asiatica</i>) and boiled for 10 minutes, strained and the liquid (about 4 teaspoons) is given twice a day. Juice of the root, about 6 teaspoons twice a day, is given for constipation (Manandhar 2002).
Bark	Fibre obtained from the bark is used to make different articles such as ropes, fishing nets, bags, sacks, clothing materials, weaving rugs, jackets (Barakoti 2008).
Leaf	Juice of leaves is used to treat headache, joint aches and tuberculosis. It is also used as a vegetable (Barakoti 2008; Gurung et al. 2012; Malla et al. 2014).
Stem	The stem is heated and wrapped around the leg or hand to treat fractures.
Inflorescence	It is used as a vegetable and soup for its high nutrient value (Malla et al. 2014).

The study revealed that IPLCs of Eastern and Far-Western regions of Nepal use 60% bark, leaves 15%, roots 10%, Stem 8%, Seeds 4%, and inflorescence 3% of 'allo' (Figure 16.2).

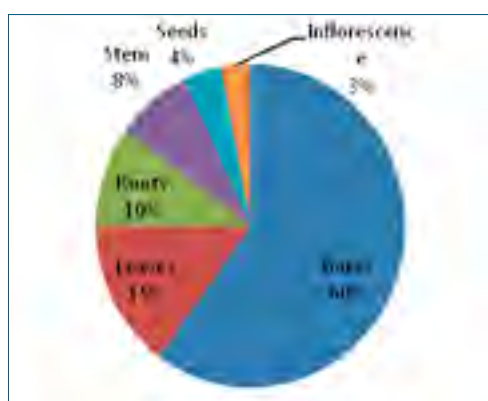


Figure 16.2 Percentage of plant parts use by IPLCs

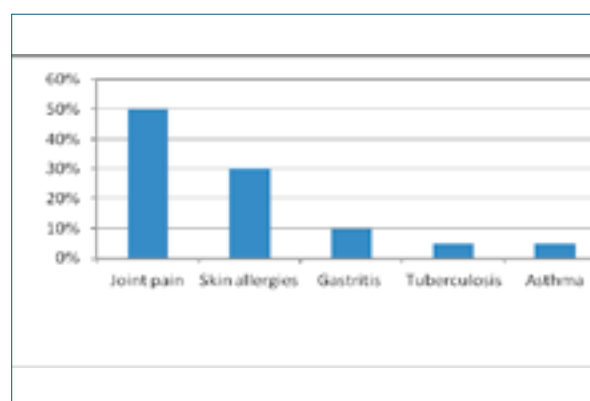


Figure 16.3 Percentage therapeutic use of *G. diversifolia*

The study also showed that more than 50% of people use 'allo' for joint pain; 30% in skin allergies; 10% to treat gastritis followed by tuberculosis and asthma (Figure 16.3).

16.4.3. Indigenous knowledge of allo processing held by IPLCs of study area

During October-November, local communities harvest the 'allo' shrubs. Well-developed stems are selected and the bark is removed manually by using iron sickles and hand gloves. The harvested bark is soaked in water for 24 hours.



Photo 16.2 Allo processing techniques in Far-Western and Eastern Region of Nepal:

- (a) Cooking of 'allo' bark in iron drum.
- (b) Allo bark drying with white clay (Kamero).
- (c) Wooden hammer (Mungro).
- (d) Spinning 'allo' fibre with Katuwa.

Degummed barks are dried, bundled and stored. The cooking process takes place for about 2-3 hours in an iron drum with wood ash. To cook 2.5 kg of 'allo', 5.38 kg of wood ash is needed to remove non-fibrous 'allo' bark and 7.45 kg of white soil (Kamero) is needed to soften the 'allo' fibre.



Photo 16.3 Allo cloth weaving with wooden hand loom.

Wooden hammer (Mungro) is still in use – it is a traditional method of processing of fibre. Plenty of water is required to remove the non-fibrous bark and this is usually carried out in a stream or river. The beating process is the primary traditional method for the removal of debris of 'allo' bark in both Eastern and Far-Western regions of Nepal. The clean bundles of fibre are left to dry in the sun and soaked in water with locally available white soil.

Both men and women are involved in all the stages of collection and processing. The traditional spinning method by hand spindle is still practised. Hand spindle (Katuwa) and wooden spinning machine (Charka) are used for spinning of the yarn. A hand spindle is a portable yarn spinning equipment which is used to spin fibre. The study revealed that IPLCs of Eastern and Far-Western regions use fibre of 'allo' as the primary source to prepare different types of products such as porter straps (Namlo), ropes for domesticated animals (Damlo), coats, pants, bags, shawls, purses and many more items. IPLCs have made their own groups and rules for harvesting of 'allo' from the forest. People go together to the forest and collect 'allo' bark from the mature plant, after the ripening of fruit during the months of October and November. They allow the ripened seeds to disperse around the ground for the regeneration of plants. They collect 'allo' bark in groups from different forest areas and share the resources in equal amounts. While harvesting 'allo' stem, they leave about four inches of stem above the ground so that new buds may arise easily from the root. Mostly women were involved in 'allo' processing, thus it acts as a source of income for the women, and they utilise the income generated from 'allo' for their daily use and also for the welfare of their children.

16.4.4. Loss of natural habitat

G. diversifolia generally grows from Eastern to Far-Western regions of Nepal between the altitudes of 1,000 to 3,000 m above sea level. It commonly grows in moist and shady areas. During the study, most of the respondents reported that natural habitat of 'allo' is decreasing year by year. This may be due to decrease in the traditional livestock domestication practices in barren lands which acts as one of the major sources of organic fertiliser for 'allo' germination and growth. Studies showed the community response on the present situation of natural habitat: 85% responded that they had observed a loss or decrease of natural habitat; 13% responded that there was increase in natural habitat; only 2% responded that they observed no change in the natural habitat (Figure 16.4).

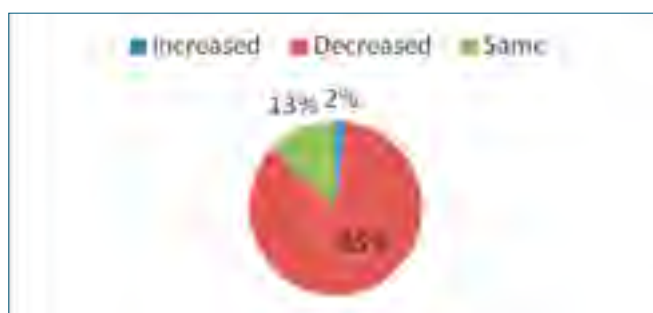


Figure 16.4 Community response on change in natural habitat of 'allo'

About 38% of the respondents reported that the loss of natural habitat of 'allo' was due to decrease of livestock domestication practices on barren land; 32% responded that the loss of habitat was due to decrease of sheep numbers and sheep herders, because sheep excreta acts as a good source of fertiliser for 'allo' plants. 'Allo' seeds also anchor on sheep wool which helps in seed dispersal in forest areas and barren lands. About 13% responded that the loss of 'allo' habitat was due to the increase in cardamom cultivation in the same lands where 'allo' grows; 8% responded that this was due to plucking out of whole plant to support fodder grass regeneration for domesticated animals; about 7% responded that there was no effect on the natural habitat and about 2% reported that the reason for loss of habitat was destruction by wild animals (Figure 16.5).

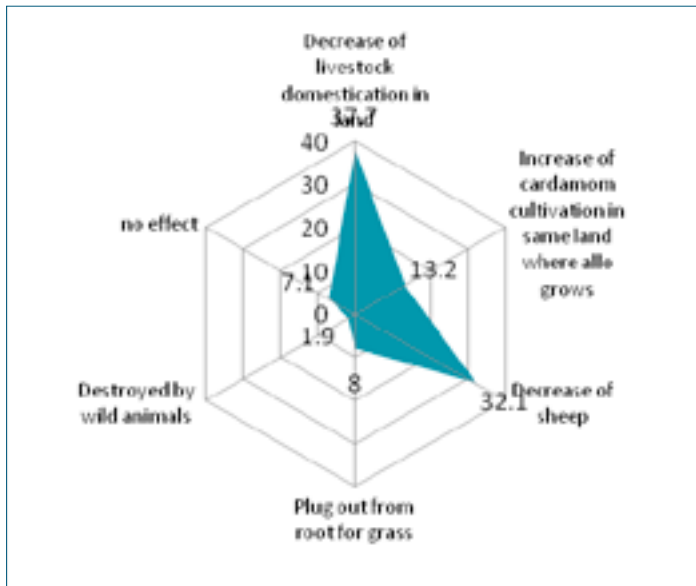


Figure 16.5 Causes of decrease of natural habitat of 'allo'.

Collection, processing, spinning and weaving of *G. diversifolia* is a tradition of IPLCs, and has long been used in the textile history of Nepal. Jackets, coat and, caps made of 'allo' are popular in Nepal and abroad. The IPLCs have their own traditional practice of collection, processing, spinning and weaving, where they utilise locally available materials. These days, the traditional processing practices are altered by the use of caustic soda in place of ash. Though caustic soda removes non-fibrous parts faster than the ash, it pollutes water, affects fibre quality and health of 'allo' farmers. So, the indigenous and local knowledge adopted by Kulung Rais of Sankhuwasaha, Dhimi and Thangunna communities of Darchula district is environmentally safe. Generations upon generations of people are harvesting 'allo' from the forest though very few people are aware of the availability and sustainability of raw material in the natural habitat. People have to travel long distances and spend a week in the forest to collect 'allo' bark. Another risk is the massive plantation of large cardamom *Amomum subulatum*: people pluck out 'allo' plants and plant large cardamom in their place. Cultivation of *A. subulatum* has been one of the income generation options which has had adverse impacts on the habitat of *G. diversifolia*. So, on the one hand exploitation rate of 'allo' is high and on the other, destruction of natural habitat indicates the need for sustainable management. Thus, plantation, cultivation and conservation should be encouraged to preserve the natural habitat. Tax policy on transport of raw 'allo' bark and finished products from villages to national and international markets is unclear. Farmers/collectors have to pay taxes at several points while carrying both 'allo' bark as well as its products. Therefore, it is recommended that the Government provides a clear policy of one-door taxation for raw material and finished products.

Conclusions

Indigenous and local communities of Nepal have their own traditional way of harvesting, processing and conservation of *G. diversifolia*, which has cultural, economic and medicinal value among the people living in Api-Nampa Conservation Area of Kailash Sacred landscape, in Far-Western Nepal and Makulu-Barun National Park in Eastern Nepal. Economic importance has led to higher demand of 'allo' products. Hence, the residents of Darchula and Sankhuwasabha districts have started to harvest it extensively. The study emphasises the importance of sustainable harvesting, conservation of natural resources, preservation of the traditional knowledge and formulation one door taxation policy on the use of *G. diversifolia*.

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