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## Political Ecology of Medicinal Plant Use in Rural Nepal: Globalization, Environmental Degradation, and Cultural Transformation

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POLITICAL ECOLOGY OF MEDICINAL PLANT USE IN RURAL NEPAL:  
GLOBALIZATION, ENVIRONMENTAL DEGRADATION, AND CULTURAL  
TRANSFORMATION

by

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A thesis submitted in partial fulfillment of the requirements  
for the Honors in the Major Program in Biology  
in the College of Sciences  
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## ABSTRACT

Findings from 2016 fieldwork conducted in Dumrikharka, Nepal and Tutung, Nepal are compared to existing literature to describe the political ecology of medicinal plants in rural Nepal. Prior to the advent of biomedicine, rural communities in Nepal relied on phytochemically active compounds in medicinal plants as their primary source of medicine; however, ethnobotanical practices have shifted over time due to economic, environmental, and sociocultural stimuli.

Anthropogenic climate change threatens individual plant species and ecosystem biodiversity. Globalized markets unabated by weak conservation programs place increasing demands on medicinal plants. As indigenous plants become overharvested and more difficult to access, Nepalis incorporate non-indigenous plants into the local pharmacopeia. Novel use of non-indigenous plants illustrates both the dynamic, resilient nature of traditional medicine systems and a loss of biodiversity.

Social changes, including outmigration to other countries, notions of modernity, and preference for pharmaceutical drugs, reduce potential candidates to learn and preserve ethnobotanical knowledge. Waterborne pathogens caused by inadequate sanitation infrastructure continue to endanger Nepali populations. The dearth of clinical facilities throughout rural areas, when coupled with the decline ethnobotanical knowledge and traditional healers, poses a gap in healthcare jeopardizing vulnerable, marginalized populations. These factors reinforce the unequal distribution of resources in one of the world's poorest countries, buttressing power inequalities and economic inequities.

## DEDICATION

To Marta Schwartz, who spent countless hours of her childhood concocting plant-based potions and remedies with me in her treehouse.

To Dr. Rani, who invited my whimsical childhood pastimes into the realm of academia and introduced me to ethnobotany.

To mom, dad, Jenna, Ian, and Lucy who fostered my curiosity and supported my decision to fly 8,000 miles from home for a summer.

To Allan, who combed through each excerpt of field notes and ensured I got enough sleep and coffee.

And finally, to the Thapa family, who invited me into their lives, shared their knowledge of plants, and made me feel at home in Nepal. Thank you for feeding me endless dal bhat, rubbing healing leaves into my leech bites, and comforting me with warm buffalo milk.



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Thank you to my committee members, Dr. Neil Duncan, Dr. Elizabeth Harris, and Dr. Joanna Mishtal for their time, guidance, and patience in helping me develop my thesis. Your courses, research, and advice help inform both my thesis and worldview.

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## INTRODUCTION

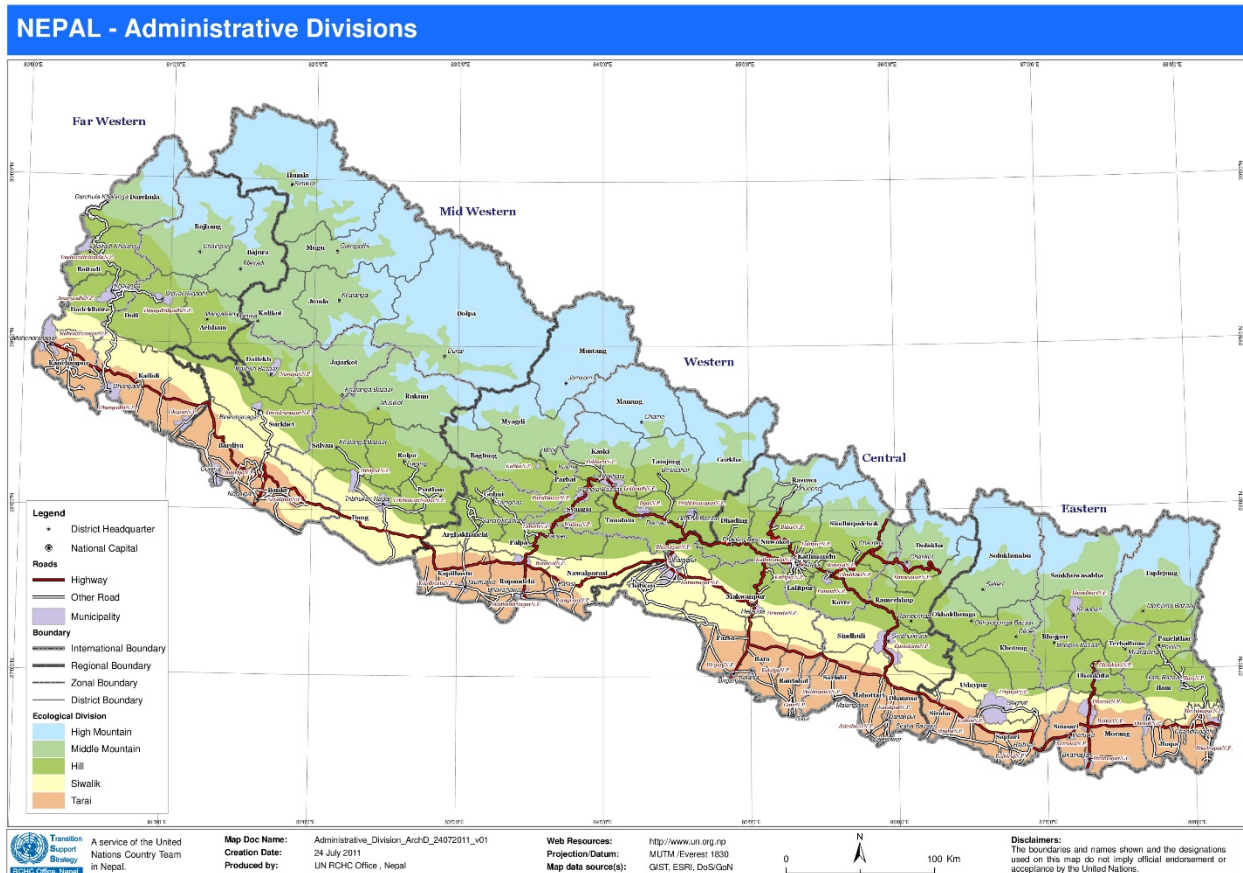


Figure 1: 2011 Map of Nepal's Administrative Divisions (United Nations, 2011)

### Nepal's Geography

Nepal is a culturally heterogeneous country bordered by two geo-political giants: China to the north and India to the south. Its topography is divided into three general areas: Terai, Hill, Mountain. Political and ethnic relationships are strongly engrained in Nepal's geography. The Terai region is a flat plain along the southern border. Terai populations often intermarry and interact with populations from India. Large amounts of foreign goods are imported from this area. Foothills of the Terai border Nepal's hill region (Jha, 2014; Whelpton, 2005). During the 1700s, the nascent state of Nepal emerged in the hill region as the small kingdom of Gorkha (Whelpton, 2005). Despite the now illegal caste system, ethnic and power divides between

Terai, hill, and mountain castes persist. Kathmandu Valley, located in the hill region of Nepal, houses the capital, Kathmandu and imposes hegemonic power over other areas (Jha, 2014; Whelpton, 2005). Population pressures, environmental degradation, and improved technology have resulted in an influx of the population to the Terai region where half of Nepal's population now lives. Above the hill region are the Himalayas whose rocky peaks comprise the mountain region. Home to the famous Sagarmatha or Mount Everest, the highly ranged topography makes trade with China difficult (Whelpton, 2005).

### *Political Ecology*

Interactions between humans with other humans and humans with other species cannot be fully understood without first understanding power and inequality (Townsend, 2009). The processes which influence inter-group relations are a "battleground of contending forces;" these processes are more clearly understood when jointly situated in the ecological, economic, social, historical, and political contexts of their society (Wolf, 1972, p. 202). Thus, the lens of political ecology allows researchers to investigate the power structures in which the environment and marginalized populations operate (Anderson, Pearsall, Hunn & Turner, 2011). When situated in the economy of the current capitalist world system, production and distribution are not only market activities, but environmental ones. Akin to pillaging, conquest, and colonialism, exploitation of ecosystems services for the benefit of dominant powers manifests itself as ecological imperialism (Baer & Singer, 2009).

China and India exhibit ecological imperialism over Nepal's rivers, competing for influence over the abundance of flowing water. Despite Nepal's landlocked position, abundant



snow melt from the Himalayas feeds rivers and tributaries. Both China and India exploit rivers in Nepal as a source of hydroelectric power (“Nepal, China ink \$2.42B hydropower agreement,” 2017). Paradoxically, Nepal’s inadequate energy infrastructure provides electricity to only 72% of Nepalis in rural areas (World Factbook, 2017). Those with access to electricity, even in urban areas, are subject to scheduled load shedding and frequent brown-outs.

Nepal’s botanical commodities, particularly medicinal species that are non-cultivated and harvested in the wild, experience similar pressures from globalization (Kunwar, Mahat, Acharya & Bussman, 2013; Kunwar et al, 2016). International entities subject subsistence farmers to various economic pressures. Primary forest is degraded when converted to arable land and endangers the areas where many of Nepal’s medicinal plants flourish (Malla, Gauchan, & Chhetri, 2015). If the environment is understood as a commodity, the act of undervaluing ecosystem services poses the risk of overexploitation and subsequent environmental degradation (Blaikie, 1995). Throughout the body of this thesis, political ecology provides a medium for exploring these political, environmental, and ethical issues.

### *Water and Sanitation*

Denizens of rural Nepal utilize the most convenient water resource regardless of its quality or microbial load (Pradhan, Gruendlinger, Fuerhapper, Pradhan & Pradhanang, 2005). Therefore, a lack of sanitary water exposes consumers to parasitic and bacterial pathogens. Lack of education regarding proper hygiene and sanitation worsens the effects of waterborne illness. Nearly one third of households in the southern, Terai plains of Nepal report the occurrence of waterborne diseases like diarrhea, dysentery, jaundice, typhoid, or cholera

(Atreya, Panthee & Sharma, 2006). Water purification is not a common practice; however, families report occasionally boiling water for ill family members. Boiled water is likely a result of treating illness using the hot and cold system gleaned from Chinese traditional medicine and not as a water purification method (Rainey & Harding, 2005).

In areas where tube wells have not been installed, collecting groundwater in mountainous areas is not as convenient as collecting stream water or rainwater. Due to varying levels of rain throughout the year, streams are the most accessible water source and are traditionally considered an asset to rural communities (Osti, 2005). Despite their convenience, animal fecal matter and untreated sewage infiltrate streams, posing threats of microbial contamination.

Several studies suggest solar disinfection or SODIS as a potentially successful water purification method in Nepal (Pradhan et al., 2005; Rainey & Harding, 2005). In sunny areas, SODIS is a simple, low-cost, and effective method of disinfecting small quantities of water. A transparent glass or plastic container is filled with water. It is then placed on its side and allowed to sit in the sun for at least six hours. Disinfection occurs when bacterial, viral, and parasitic pathogens are exposed to prolonged UV-A light radiation and subsequently killed. Solar disinfection is more effective at removing pathogens than pouring water through fabric prior to consumption, a practice which is common in Nepal (Rainey & Harding, 2005). Solar disinfection is also a promising water purification method for reducing environmental degradation. No boiling is required, therefore there is no increased environmental pressure due to fire wood collection or production of carbon emissions due to burning biomass.

### *Access to Medical Treatment and Medicinal Plants*

In areas where traditional herbal medicine is utilized in Nepal, users cite personal preference, low cost, and poor access to modern healthcare facilities as reasons why they prefer medicinal plants (Shrestha, Prasai, Shrestha, Shrestha & Zhang, 2014). Two common reasons cited for not visiting government-provided health care services include insufficient drug availability and too far of a distance (Paudel, Upadhyaya, & Pahari, 2012). When analyzing availability of health care practitioners from a strictly numerical sense, there is a 1: 5,000 ratio of patients to general physicians and a 1:650 ratio of patients to traditional healers in Nepal (Kohrt & Harper, 2008). Furthermore, biomedical facilities are clustered in urban areas, so the shortage of general physicians is more acutely experienced in rural Nepal.

A high proportion of documented medicinal plants in Nepal treat gastrointestinal diseases. One study conducted in farwest Nepal found that of 66 ailments treated by traditional medicine, dysentery, diarrhea, and skin problems had the greatest number of medicinal plants used for treatment (Kunwar, Acharya, Chowdhary & Bussman, 2015). Another study used meta-analysis techniques and found 947 plant species that are used to treat gastrointestinal disorders in Nepal (Rokaya et al., 2014). A separate study in the Parbat district of western Nepal found that of that 132 ethnomedicinal plants analyzed, 61 plants were used for gastrointestinal, parasitic, and hepatobiliary disorders which accounted for more medicinal plants than any other ailment category. Other categories in this study included blood/lymphatic, cardiovascular disorders, cough/cold, cuts/wounds/burns, dermatological infection, gynecological disorders, headache/fever, neurological disorders, ophthalmological disorders, respiratory disorders,

skeleton-muscular disorders, and tonic/stimulant (Malla, Gauchan, & Chhetri, 2015). Examples from this study are provided in Table 1.

Table 1: Sample of Medicinal Plants Used to Treat Gastrointestinal Ailments in Western Nepal

**Sample of Medicinal Plants Used to Treat Gastrointestinal Ailments in Western Nepal**

Plant Species	Local Name	Treatment
<i>Berberis aristatica</i> , <i>Berberis asiatica</i>	Pichyar	Root bark decoction for curing diarrhea
<i>Bergenia ciliata</i>	Bramendo	Rhizome crushed, mixed with water for fever and diarrhea; treatment of roundworm infections
<i>Delphinium himalayae</i>	Bhongmar	Roots used for diarrhea
<i>Fritillaria cirrhosa</i>	Kaakoli	Plant juice for stomach pain and gastritis
<i>Hippophae salicifolia</i>	Govo, Taru	Fruit juice to treat diarrhea
<i>Jurinea dolomiaea</i>	Dhupjadi	Root paste consumed during diarrhea
<i>Lonicera myrtillus</i>	Taktak	Root extract treats stomach disorder
<i>Paris polyphylla</i>	Satuwa	Rhizome decoction anthelmintic
<i>Pieris formosa</i>	Pra pra	Leaf and stem extract consumed to rid intestinal worms
<i>Rheum spiciforme</i>	Yayuchawa	Root paste to treat diarrhea
<i>Rhododendron anthopogon</i>	Sunpati	Tea of dried flowers taken to treat gastritis and stomach disorders
<i>Rhododendron arboretum</i>	Paramendo	Flowers chewed to prevent profuse diarrhea; flower juice to treat amoebic dysentery
<i>Rubus ellipticus</i>	Ainsela	Ripe fruit decoction treats dysentery
<i>Thalictrum foliolosum</i>	Bathuri	Root powder mixed with water to treat gastritis and stomach disorders
<i>Zanthoxylum armatum</i> , <i>Zanthoxylum nepalense</i>	Tamur	Fruit powder consumed during stomach disorder

(From Malla et al., 2015, p. 1207-1209)

### *Environmental Degradation*

Medicinal plant populations are threatened by numerous forces: deforestation, habitat fragmentation, overgrazing due to livestock, fire, and unsustainable harvesting practices (Malla et al., 2015; Shrestha et al., 2012). The multi-use nature of certain plants (i.e. firewood, timber, medicine, and fodder) raises demand and intensifies their harvest, which subsequently increases risk of overexploitation. Without sustainable harvesting methods, plants with various uses are at greater risk of severe population decline (Rokaya et al., 2014). For instance, the species *Bombax ceiba* and *Pterocarpus marsupium* are used in the treatment of multiple ailments and also serve as a source of fire wood (Rokaya et al., 2014).

Unlike cultivated staple food crops such as pulses and grains, medicinal plants are usually collected from wild populations. Phytochemical variation occurs in individuals across a species leading to the preference of plants from certain areas (e.g. in a forest) over other areas (e.g. in an agricultural field). Some variation occurs due to genetics, but environmental factors including seasonality, light availability, and nutrient availability also alter phytochemical properties and a plant's ethnomedicinal efficacy. Additionally, the production of alkaloids, plant defense chemicals which often have medicinal value, is often induced by herbivory (Anderson et al., 2011). Socioeconomic factors, including land ownership, harvest time, and religious holidays also determine when and where medicinal plants are collected (Anderson et al., 2011).

Regardless of whether the factors determining harvest preferences are genetic, environmental, or socioeconomic, limited cultivation of medicinal plants fosters dependency on wild resources (Kunwar, Acharya, Chowdhary, & Bussman, 2015). External pressures from

domestic and international markets place higher demands on medicinal plants. Depletion of wild plant populations occurs without sustainable harvesting techniques that leave enough of individuals of a plant population to reproduce (Shrestha et al., 2014). Medicinal plant species in which the roots, rhizomes, or entire plant are collected are particularly vulnerable to overharvesting because the entire plant is destroyed in the process (Shrestha & Shrestha et al., 2012). If wild populations of medicinal plants fall to critically low numbers, localized or widespread extinction of these plants can occur and in turn destroy portions of Nepal's pharmacopeia.

Medicinal plants in mountainous areas are threatened to a higher degree than those in other areas of Nepal's ecological belt (Shrestha & Shrestha, 2012). Climate change places significant stressors on montane agro-ecosystem services and alters their ability to be utilized in subsistence activities and generation of economic income (Baer & Singer, 2009; Bhatta, van Oort, Stork & Baral, 2015). It is predicted that as environmental conditions shift and grow warmer, medicinal plants will respond to anthropogenic climate change by shifting up along an altitudinal gradient (Kunwar et al., 2015). Poor infrastructure in montane areas impedes community resilience. Limited communication, transportation, and access to resources exacerbates issues related to changes in ecosystem services. Lack of adaptability to anthropogenic climate change further marginalizes vulnerable populations (Bhatta et al, 2015). The potential outcomes are troubling from both an environmental degradation standpoint and for the welfare of Nepalis living in these areas. Waning access to medicinal plants worsens healthcare gaps and reduces income received from selling said plants to outside markets.

### *Cultural Transformation*

Globalization and foreign markets exhibit increasing influence over Nepal. Discrepancies between government records of medicinal plant sales and independent studies exist (Kunwar et al., 2013). When compared to independent studies, official government records of medicinal plant sales detail only 25%-50% of the actual quantities traded. One independent study in far-west Nepal found 67% medicinal plants harvested were destined for the market and only 33% were used for subsistence (namely for food and herbal remedies) (Kunwar et al., 2013). Profit from foreign markets proves lucrative in the short term and bolsters the economy; however, unabated resource consumption and waning ecosystem services burdens future generations and impedes their productivity.

Emigration to cities and outmigration to other countries, including India and the United Arab Emirates for menial labor, produces a suite of effects on Nepali medicinal plants. The population decline in rural areas limits the pool of new, potential traditional healers. Although medicinal plant harvesting increased in recent years, the number of professional healers decreased about 7% annually (Kunwar et al., 2016). Outmigration also reduces the labor available for harvest and leaves fields fallow. The human-disturbed nature of fallow fields are apt for introduction of non-indigenous plants (Kunwar et al., 2015; Kunwar et al., 2016). Cultural erosion and environmental degradation concomitantly interact in rural Nepal. Introduction of non-indigenous medicinal plants into local practice underscores the adaptive, non-stagnant nature of systems of traditional medicine; however, the interaction occurs in tandem with loss of indigenous species and biodiversity.



As generations change, so do healing and healthcare preferences. Younger generations move into cities where they are more exposed to the biomedical facilities concentrated in urban areas (Kunwar et al., 2016). Research on traditional healing practices in eastern Nepal revealed a statistically significant discrepancy existed between older people (age >40) and younger people (age <40). The findings were clear: older people utilized medicinal plants significantly more, whereas younger people utilized medicinal plants significantly less (Shrestha, Shrestha, Koju, Shrestha, & Wang, 2016).

In a separate study on access to health care services in rural Nepal, researchers found that distance was a greater deterrent from accessing government health care facilities than the presence of traditional healers and use of home remedies. While 27% of participants cited too far a distance as being the reason for not seeking treatment in a government facility, only 11.1% of participants cited receiving care from home remedies. Even fewer participants, 3.7%, cited receiving care from traditional healers as their reason for not seeking care in government health care facilities (Paudel et al., 2012). Distance, not preference for traditional healers, prevented more people from accessing an allopathic, biomedical facility in rural Nepal.

Medications, which comprise a large portion of the material culture of biomedicine, were more quickly adopted into Nepali culture than other aspects of Western medicine (Heydon, 2011; Worboys, 1997). When the country opened its border to foreigners in the mid-twentieth century, it was commonplace for Europeans exploring the Himalayan region to bring medications with them. Medications were used to keep the travelers, hired Sherpas, and hired porters healthy. Foreigners also used medications as a tool to promote the system of modern

medicine to locals. In time, the short-term interactions with travelers extended the influence of biomedicine beyond the long-term interactions provided by missionaries and government initiatives. As visitors to Nepal increased, so did the awareness of Nepalis who had heard of, but never personally interacted with or used, allopathic medications. Medications used for malarial treatment gained significant clout throughout Nepal. Prior to the establishment of hospitals providing healthcare for locals and pharmaceutical retail in Nepal, medication served as a “central and visible symbol of an encounter between travelers and local people” (Heydon, 2011, p. 520).

Globalization transforms Nepal’s cultural landscape through the spread of both material cultural and ideology. In a compelling analysis of global modernity and Tibetan traditional medicine, Craig Janes (1999) argues:

There is, generally speaking, a tendency for biomedicine, as a significant instrument of modern social transformation, to assume both structural and cultural dominance over indigenous medical systems. This dominance is one dimension of a larger process of globalization, and from the perspective of healing, foreshadows the demise of locally salient and independent healing resources (1999).

In addition to contributing to the spread of medications, globalization contributes to the spread of scientism and the Western scientific epistemology. Justification and validation of modern medicine through science allows biomedicine to assert its dominance over indigenous medical systems (Janes, 1999). The act of choosing a pharmaceutical product over a medicinal plant remedy or frequenting a physician instead of a traditional healer demonstrates an

internal validation, whether conscious or subconscious, of the efficacy of Western medicine.

Internalization of such notions on a countrywide scale decreases the salience of ethnobotanical knowledge and practitioners who utilize medicinal plants in rural Nepal.

## BRIEF BACKGROUND ON CONTEMPORARY NEPAL

### *The People's War and Nepal's New Constitution*

Discontented members of the Communist Party of Nepal, also referred to as the Maoists, opposed Nepal's constitutional monarchy. Growing weary of unsuccessful civil disobedience campaigns, they launched "the people's war" in February of 1996 (Whelpton, 2005). A decade of bloody conflict and failed interim governments formally ended when the Comprehensive Peace Agreement was signed in 2006. An estimated 13,000-16,000 Nepalis perished in the conflict (BBC, 2017; Jha, 2014).

Despite the formal agreement, civil unrest in the Terai region and Maoist held far-west persisted. In 2007 parliament finally abolished the monarchy, the Constituent Assembly was formed, and Nepal became a republic in 2008 (BBC, 2017; Jha, 2014). After failing to pass a successful draft of the constitution, the Constituent Assembly was dissolved and elections were held to form a new one (BBC, 2017; Zeldin, 2015).

The same geological forces which gave rise to the Himalayas caused disaster in April 2015. A catastrophic 7.8 magnitude earthquake struck Kathmandu, killing 8,000 and leaving millions homeless. Just months later, in September 2015, a new constitution was finally voted on and approved. The new constitution declared Nepal a secular republic. The cow was retained as the symbolic national animal for the 81% of the country who identifies as Hindu. New administrative divisions of the country into seven states instead of five regions proved contentious, as populations worried about border definitions and lack of representation. Nearly 40 people were killed in protests over the new constitution (BBC, 2017). An amendment was made in January of 2016 to grant more representation to the Madhesi community (Zeldin,

2015). Today, two-thirds of the country remains subsistence farmers with a notable lack of skilled labor. With one-quarter of its population below the poverty line and a \$2,500 gross-domestic product (GDP) per capita, Nepal remains one of the poorest and least developed countries in the world (World Factbook, 2017).

### *Nepal Census Information*

The 2011 National Population and Housing Census or National Report signifies one-hundred years of census taking in Nepal. As of June 2011, Nepal's population stood at 26,494,504. Terminology in this document follows the same nomenclature used by the 2011 census. The terminology does not reflect administrative divisions redefined by the constitution ratified on September 16, 2015 due to lack of census data for the newly defined borders (Zeldin, 2015).

2011 National Population and Housing Census divisions are as follows:

- Urban or Rural
- Three areas of the Ecological Belt: *Mountain, Hill, Terai*
- Five Development Regions: *Eastern, Central, Western, Mid-Western, and Far-Western*
- Fourteen Zones: *Mechi, Koshi, Sagarmatha, Janakpur, Bagmati, Narayani, Gandaki, Lumbini, Dhawalagiri, Rapti, Karnali, Bheri, Seti, Mahakali*
- Fifteen Eco-Development Regions: *Eastern Mountain, Eastern Hill, Eastern Terai, Central Mountain, Central Hill, Central Terai, Western Mountain, Western Hill, Western Terai, Mid-Western Mountain, Mid-Western Hill, Mid-Western Terai, Far-Western Mountain, Far-Western Terai*

- Seventy-Five Districts: See *2011 National Population and Housing Census* for full list of districts.

The 2011 census divides Nepal into development regions and then into zones. Zones are further sub-divided into districts. Areas within districts are then categorized as village development committees, municipalities, or metropolitan areas (2011 National Population and Housing Census, 2011). The 2021 National Population and Housing Census will reflect the new constitutional administrative standards. These standards divide Nepal into seven states, instead of regions and zones, and redefines existing districts (Zeldin, 2015).

#### *A Note on Usage: Rural*

Use of the word “rural” follows the rural versus urban dichotomy established by Nepal’s National Population and Housing Census 2011. Both villages referenced in my fieldwork were predominantly agricultural and serviced by a seldom used dirt road.

#### *A Note on Usage: Nepali versus Nepalese*

Although the words “Nepali” and “Nepalese” are both commonly used to describe the national language of Nepal and someone or something from Nepal, I exclusively use the word “Nepali”. The decision embodies the personal preference of many Nepalis I encountered during fieldwork. Furthermore, the *National Geographic Style Guide* recommends writers to “Use Nepali for a native of Nepal (the plural is Nepalis), as the adjective referring to the country, and for the language” and “Use Nepalese (noun and adjective) only in proper names that have not changed to follow current usage: Royal Nepalese Army” (“Nepali, Nepalese”, n.d.).

## RESEARCH DESIGN AND METHODOLOGY

### *Methods*

Research was conducted through semi-structured interviews and participant observation in the villages of Dumrikharka, Nepal in June of 2016 and in Tutung, Nepal in July of 2016. Locations were selected per the advising and consent of coordinators at the non-governmental organization Nepal Orphans Home-Volunteer Nepal.

### *Nepal Orphans Home-Volunteer Nepal*

I elected to research and volunteer with Nepal Orphans Home-Volunteer Nepal after an extensive internet search. Volunteer Nepal is an affiliate of the broader organization, Nepal Orphans Home (NOH) whose mission is to bring “individuals with diverse skills and backgrounds who are committed to serving the poor and who seek profound and often life-changing experiences” to Nepal (Nepal Orphans Home, 2017). Volunteers are provided room and board in a Kathmandu suburb or with homestay families if they leave the capital for their placements.

I contacted the organization, explicitly sharing my interest to both conduct research and volunteer. Following preliminary approvals, I emailed the research proposal to the director of NOH and was granted written permission to conduct research. I submitted written permission from NOH, the proposal, and other supplemental materials to the Institutional Review Board (IRB) at the University of Central Florida. The IRB designated the documents as “Not human research determination.” In Dumrikharka I functioned in the capacity as both a researcher and volunteer English teacher. In Tutung, I functioned only as a researcher and member of the homestay cultural exchange program. All translators were accessed and paid for their services through NOH. Accommodations and food were provided by the homestay family

in each village and arranged through NOH. Transportation services, including bus rides and hiking guides, were also coordinated and provided by NOH.

#### *Participant Selection and Recruitment*

As outlined within the IRB proposal approved for exemption status, adult speakers of Nepali or Nepali and English were eligible to participate in the focus groups. The language criterion accounted for my fluency in only English and the fluency of available translators, who spoke at minimum Nepali and English, and often additional, regionally specific languages. The criteria barred speakers of the other 123 languages in Nepal who did not also speak English and/or Nepali; however, during the research this was not an issue (National Population and Housing Census 2011). All of the adults who participated spoke Nepali and many were polyglots. Participants in Dumrikharka were recruited with the help of my homestay family. After arriving and explaining my research, they arranged a village meeting where I interviewed a group of community members. Due to the expedited time I spent in Tutung, participants were only recruited from within the homestay family.

#### *Semi-Structured Interview Design*

Through the lens of ecology and anthropology, semi-structured interviews explored the relationship between unsanitary water, medicinal plant usage, and environmental degradation in rural Nepal. Inquiries were made into decisions regarding water collection, sanitation methods, and healthcare choices. Upon conclusion of pre-determined questions, participants were asked if there was any other information they thought relevant and wanted to share.

Although the questions were originally designed for use in semi-structured interviews



with one individual, they were conducted as focus groups in both Dumrikharka and Tutung. This change accounted for participant preference and time constraints during harvesting season. In Dumrikharka, one focus group of 12 participants from the village was conducted. In Tutung, one focus group of two participants from the homestay family was conducted.

A translator from NOH, fluent in both English and Nepali, sat beside me to conduct the focus groups. A physical copy of the interview guide was provided in English and Nepali. Participants had access to the interview guide before, during, and after focus group sessions; they were also provided a copy if they wished to keep the material. Written translations from English to Nepali were provided by Tomedes, a professional translation service, and confirmed by Nepali staff members at NOH prior to commencing fieldwork. During the focus groups, I asked the question in English and the translator asked the same question in Nepali. Answers and any subsequent questions were then conveyed to me through the translator.

#### *Fieldwork and Participant Observation*

Participation observation provided details into how those living in Dumrikharka and Tutung interacted with water and healthcare treatment on a regular basis. The bulk of fieldwork consisted of time spent with homestay families at their houses, water sources, and agricultural fields. In Dumrikharka, a considerable amount of time was also spent at the local primary school due to my position as volunteer English teacher. In Tutung, I spent significant time walking through transition areas between my homestay family's house and their fields. Special outings, including those to markets, hospitals, and shops, comprised another portion of the fieldwork. These outings allowed for conversations with neighbors, shop keepers,

government doctors, and copious amounts of spiced tea, or *chiya*, served in searing hot metal cups.

### *Research Complications*

Illness and monsoon season stymied original research plans. Despite my best efforts to filter or treat all drinking water, I encountered either a parasite or an antibiotic resistant bacterium and a subsequent infection. My infection became apparent after a week and a half in Dumrikharka, where bathroom access entailed a pit toilet and the nearest water source required a 60-90 minute roundtrip walk. After taking a full course of ciprofloxacin and an absurd amount of rehydration salts, my illness partially subsided, then relapsed after a bout of heat exhaustion. The lack of plumbing and easily accessible medical treatment resulted in my early return to Kathmandu. The originally planned research time of two months was halved to one, allowing for treatment and recovery time. Thus, the intended five weeks in Dumrikharka was prorated to three weeks. After recovering, overcoming my hesitation to stay in another village, and waiting on heavy rains to allow bus transportation, the intended three weeks in Tutung shortened to one.

An earnest suggestion for future researchers in Nepal is to avoid unwashed produce and properly treat water prior to consumption, as well as street foods, particularly *pani puri*. The round, airy, fried *puri* stuffed with chutney and then drenched in spiced water, or *pani*, displays an innocuous guise, but insidious microbes may be lurking within.

### *Reflexivity Statement*

My childhood adoration of medicinal plants blossomed after enrolling in Ethnobotany at the University of Central Florida. Subsequent courses, including Medicinal Botany, Plants and People, Anthropology of the Amazon, and Environmental Anthropology, further intensified and informed my interest. I was formerly a member of the Burnett Medical Scholars program, which allows for undergraduates at the University of Central Florida to directly matriculate into the medical school. One of the requirements is completion of an Honors in the Major Thesis. While taking Medicinal Botany, I wondered what kind of system(s) of traditional medicine exist in Nepal. The small, mountainous country is bordered by two countries with well-studied systems of medicine: Traditional Chinese Medicine (TCM) to the north and Ayurvedic Medicine to the south. As an avid hiker and outdoors person who longed to experience the Himalayas, I decided to investigate the role of medicinal plants in Nepal for my thesis.

## DUMRIKHARKA



*Figure 2: Homestay house and maize fields in Dumrikharka*

### *Locating Dumrikharka*

The village of Dumrikharka is located in the Ramechhap District of the Janakpur Zone in the Central Development Region. It is in the hill portion of Nepal's ecological belt. Manthali is the nearest municipality and the district headquarters. Dumrikharka is located at approximately 27°21'18" N, 86°3'36" E. The village can be accessed via a six-hour bus ride from Kathmandu to Manthali and a subsequent two to four-hour hike up a dusty hill with scarce shade. A faster (and highly unlikely) option is befriending a helicopter pilot retrieving Everest Base Camp trekkers at the Lukla airport. The flight path to the infamous runway of the Tenzing-Hillary Airport passes directly over Dumrikharka and is the source of regular air-traffic.

### *Duration of Stay*

I stayed in Dumrikharka for 21 days, from June 7, 2016 to June 27, 2016. While in Dumrikharka I was engaged as both a researcher and volunteer for NOH.

### *Dumrikharka Focus Group*

Responses represent the collective answer of 12 denizens of Dumrikharka as interpreted by the translator. The group meets regularly to discuss pertinent issues, namely water scarcity, and on the morning of the focus group two women and ten men were present. Due to time constraints of harvest season and translator availability, individual interviews were not feasible.

*Table 2: Dumrikharka Focus Group Responses*

Questions	Responses
1. How do you collect your water?  Possible Probe: How far away is your water source?	We walk an hour and a half [to a pipe with water flowing downwards from village higher up]. 45 minutes there, 45 minutes back with the heavy containers. Sometimes we must sit in a queue.
2. Do you clean your water before drinking it? If you do, please explain how.	No cleaning methods, rely on what comes from the pipe  Just get from the bucket and drink
3. Are you familiar with solar disinfection?	No, not familiar
4. How do you make fire?  Possible Probe: If you use plants to make fire, what plants do you use?	With firewood from local trees.  During some months, pick branches from community forest. Sometimes their own land if the community forest does not have enough  Every Saturday there is a meeting and they pick up dead wood from the community forest
5. What illnesses are most common in your area?	Normal stomach ones like diarrhea and typhoid  Hepatitis [points to skin], kids with yellow skin
6. How do you treat these illnesses?	Only treat when seriously sick.

	<p>Go to hospital by walking slowly, slowly three-four hours down the hill to the hospital in the developed areas [Manthali, the municipal headquarters of the Ramechhap District]</p> <p>Sometimes call another district for their ambulance, but it costs 1000-1500 rupees [\$10-\$15 USD]</p>
7. What health care provider do you visit most often?	Go to the hospital
8. Do you use plant or herbal preparations to treat illnesses?	Do not use nowadays [confirmed by oldest members of the group with affirming head nods]
9. If so, what is your source of medicinal plants?	[Laughs] We don't use them
10. If you collect plants for your treatment, do you uproot them or leave the roots in the ground?	---question not asked due to previous responses
11. How often do you seek help from local medicinal plant experts?	---question not asked due to previous responses
12. If you believe they are experts, what makes you trust their knowledge?	---question not asked due to previous responses
13. How far are you from the nearest health outpost or government clinic?	Walk down three to four hours when sick, slowly, slowly
<p>14. Do you prefer seeking medical treatment from local healers or doctors in healthcare clinics?</p> <p>Possible probe: Does cost play a role in choosing which doctor to visit?</p>	<p>Only use hospital</p> <p>Expensive to visit doctor; only go when very sick</p>

Possible probe: Does distance play a role in choosing which doctor to visit?	
15. Are there conservation efforts in your area?	Yes. They gather together and discuss like today the community forest, when to harvest, and when to plant trees. As a group they plant trees in baron lands during monsoon season
Additional Questions Asked Not in the Interview Guide	
16. What is the biggest problem in Dumrikharka?	<p>Scarcity of water. For a very long time there is no raining. Very much suffering.</p> <p>The government gives very little and expects a huge amount from people [to build a proper water tap] who cannot pay for it themselves.</p> <p>It is very difficult to farm, feed their family, and make money with no irrigation</p>
17. How many families are in this village?	80-90 families

*Excerpts from Fieldwork and Participant Observation in Dumrikharka*

The following descriptions are edited versions of entries in a field and personal journal.

Names used without permission have been removed.

Welcome to Dumrikharka

I stare down at the hill below and lament the inimical sunshine (**Figure 4**). Under my heavy pack and blistering heat I am no longer sweating. Naema, another volunteer, and I are led by Rabindra, our guide and translator from NOH. Thanks to a brief cell phone conversation, the school's principal joins us for the rest of the walk. With a smile, he wipes his brow. The principal explains he makes this hike to and from the municipal headquarters of Manthali twice daily. I immediately feel guilty over the complaints streaming about my thoughts. Most of the teachers make this same climb six days per week. The community of Dumrikharka consists largely of those in the Dalit caste, or the untouchables. Although the government formerly outlawed discrimination on caste lines, there is no government-built primary school in this community of 600 people. NOH funds the infrastructure for the school, the teachers' salaries, and the students' hot lunches.

As we round the final turn, a large, shady tree welcomes us into Dumrikharka. A rooster provides fanfare for the occasion and announces its presence. Unimpressed by the newcomers, a handful of bovine stare blankly at us. Imbued into everything here is a markedly orange tinge. The dry, dusty road matches the rocky, rust-colored soil of the maize field. An outhouse and a two-story clay home sit just beyond the field. A few smaller structures reside on the property (**Figure 5**). We wave to Eliza, another volunteer from NOH who arrived a few days prior.



Members of our homestay family welcome us: grandmother, grandfather, son, daughter-in-law, two granddaughters, and a grandson. The grandmother (**Figure 6**), who summarily greets us with tea, points to her chest and warmly says “*aama* [grandma].” She plucks two small limes from a tree in front of the house and squeezes them into our drinks. Behind us, a goat farts—the first of many.

### Morning Routine

I awake the next morning greeted by faint shouts and the shuffling of hooves. The sun is shining faintly and the air has a welcome coolness. Drawn to the menagerie of sounds, my curiosity overrides my reluctance to leave the safety of my bug net. I walk onto the balcony outside and watch as the goats hurry from the safety of their locked, nightly home to their fenced-in pen. *Buba* [grandfather] throws a small tree’s worth of foliage to the goats. The hungry creatures excitedly wag their tails and I find myself missing my dog.

Exhausted from the hike yesterday I want to crawl back into bed, but *aama* looks up from her place in the field and sees me standing on the balcony. She shouts to me “*Khanna?* [Food?]” and motions to her mouth—*Khanna* was one of my favorite Nepali words I learned while hiking the Annapurna Circuit. She emerges from the maizefield carrying a bundle of green vines and disappears into the kitchen below. Twenty minutes later *aama* resurfaces with three cups of sweet, spicy *chiya* or tea and a plate of snack mix. A large helping of puffed rice is mixed with dry chana masala. The other volunteers are awake now and I question, “Is this breakfast?” I whisper my inquiry, not wanting to offend *aama*’s kind gesture. Eliza, who was here a few days prior, says breakfast is normally around 9am and we walk to school at approximately

10am. I feel lazy sitting there and snacking while the rest of the family works, but I am unsure of what else to do (**Figure 7**). Naema suggests we use the time before breakfast to plan lessons for school.

Just before 9am Eliza, Naema, and I walk down to the kitchen and sit atop woven floor mats. In the front corner is an open wood-burning stove. Dense smoke burns my eyes and thickens the air. The room lacks a chimney, so the smoke inundates the space until it eventually escapes through the front door and small holes in the wall. Although we are far from the heavily polluted Kathmandu I find it incredibly difficult to breathe. I consider going back upstairs to grab my inhaler. Scars from the wood burning stove are evident throughout the kitchen. What I initially mistook for a layer of dark paint is actually layer upon layer of soot.

We are given gargantuan portions of food on metal plates. Unsure of how to eat with my hands I am thankful when *aama* hands each of us spoons. As guests we are served first while the rest of the family waits for us to finish. As someone accustomed to eating with everyone simultaneously, a sense of dissonance washes over me. How odd it feels to respect someone's customs when the very act would be considered rude back home. I push the thought away as *aama* urges us to eat. The mysterious green vine from earlier makes an appearance on the plate—*parsi saag* or pumpkin greens. Our breakfast, *dal bhat tarkari* (**Figure 8**), is the staple of Nepal. A thin, curried lentil soup or *dal* is poured atop cooked white rice, or *bhat*. Each meal is accompanied by a mix of curried vegetables, *tarkari*, and often a side of *saag*, or cooked dark, leafy greens. The food is flavored predominantly with curry powder, turmeric powder, and salt.

*Aama* holds a cloth over her mouth as she stirs the pot of vegetables. Like the walls, her lungs are undoubtedly scarred by the sickening smoke (**Figure 9**). Her cough is a pernicious hallmark of Nepali women who cook their family's meals under such conditions. I feel acutely aware of how privileged I am to have an electric stove back home. I wonder, how many undiagnosed upper respiratory infections has *aama* suffered? What carcinogens are causing wounding her tissues due to something as simple as breakfast? The meal is a sobering reminder of how costly it is to be poor.

#### Tikka Ceremony

"Hi miss!" "Good morning miss!" "Naamaste *didi*!"

As Eliza, Naema, Rabindra, and I walk towards Shree Shram Primary School, a dozen or so excited children greet us. Some want to hold our hands. Other want high-fives—a sure indicator of past volunteers. Quite a few of the children running past clutch handfuls of crumpled up flowers. Our group is ushered onto a bench by the principal and the students organize into lines for the morning routine: performing light exercises, following commands, and singing the Nepali national anthem (**Figure 10**). The bench sits front and center before the students and the air buzzes with excitement.

The two school-aged children of the homestay family walk up to our group and adorn each of us with flower necklaces. Their toothy smiles are contagious. Our new ornamentation appears to be bougainvillea bracts strung into a necklace with thread. Working single file, other students now walk up and say the word "*Namaste*" to welcome us. Some of the youngest only manage a coy smile and a giggle or two. Each student dips their fingers into a bright red *tikka*

powder and stamps our foreheads with the damp powder.

We are gifted more bougainvillea necklaces and the occasional handful of flowers dropped onto our heads (**Figure 11**). Given the giggles that arise with each handful of flowers I suspect it is simply a silly game and I play along. About halfway through I notice a spider has wandered onto my arm! I do my best to stay composed and not embarrass myself on the first day of school. As the ceremony progresses, the tikka powder stretches from the center of my forehead up to my hairline and dips down past my nose. When the last child has their chance to welcome the new volunteers, the ceremony concludes and the children run off to class. For hours after the ceremony I find myself absentmindedly wiping a bright red mixture of sweat and tikka off of my face. (I never did find the spider.)

\*Although the word *didi* translates to “older sister,” it is commonly used to refer to a non-related woman who is older than oneself in Nepal. When leaving a shop run by a woman or being served by a waitress, one might say “*Dhanybhad* [Thank you] *didi*.” The term can also be used as a friendly sign of endearment. For instance, when one of the children of the homestay family wanted to play with me, he or she would get my attention by calling “*Didi, didi!*” (If I did not respond fast enough I was often greeted by a kickball or some other toy playfully thrown in my direction.) In school, the phrase “Emily *didi*” would translate approximately to the respectful, but not overly formal connotation of “Ms. Emily.”

### Pani, Pani [Water, Water]

The man from the village development committee squats down next to a black pipe crisscrossing the earth along the hill (**Figure 12**). I see the ground is flooded and soapy, but I am not sure where the water originated (**Figure 13**). For want of a closer water source, many villagers bring soap to bathe and clean their clothing here. He locates a portion of the pipe where two pieces are joined together and twists it apart. Water gushes out. We walked 30 minutes on the dirt road to reach this source. I can only imagine how much longer the walk would take while shouldering heavy containers. Although I was previously informed about the extreme water scarcity in the area, it is shocking that such a crude system is Dumrikharka's main water supply. While trekking throughout other areas of Nepal I used dozens of water taps. Most taps were centrally located and equipped with a spout and handle, lending a more formal appearance to the apparatus. Here, a loosely constructed pile of rocks supports the conjoined pipes.

The man steps aside, allowing a woman carrying a heavy metal vessel to take his place (**Figure 14**). She looks warily at me and fills it with water from the pipe. The water is untreated for microbes, so the government provides each household with chlorine drops. I know from speaking with my homestay family that their chlorine bottle is collecting dust on the kitchen shelf. The family tells me they prefer the cool water streaming from the pipe. Chlorine treatment adds not only a strong taste but also allows the water to warm while the drops take effect. Without public infrastructure to sanitize the water, the family is exposed to a suite of pathogens.

### Focus Group Under the Tree

Laptop and microphone in hand I sit on the ground under the largest tree in Dumrikharka (**Figure 15**). I am joined by the translator, a man from the village development committee, far too many ants, ten men and two women from Dumrikharka. The focus group interview concluded with a resounding no. I learned no one in the village recognized or used plants as a source of medicine. A man gestures towards me, and according to the translator, teases “Plants for medicine? Who does that?” Chuckles abound.

A red blur in a tree catches my eye from across the field. Upon closer inspection, I realize the red blur is *aama* gathering firewood for breakfast (**Figure 16**). Unimpeded by her sandals, long red skirt, and shirt which bares her midriff she has managed her way across one of the largest branches. Although there are no medicinal plants used in Dumrikharka, those living here surely have a solid understanding of the food-related vegetation around where they live.

### Shree Sham Primary School

As I enter the principal’s office before school, a stranger and a small line of children greet me. The school never had more than 45 children each day, so it surprises me that I do not recognize any of the ones standing before me. Upon closer inspection, I realize the students are jaundiced and the stranger has a syringe in his hand. He draws their blood and puts it into test tubes. Clearly invading their privacy, I stand up to leave, but the man motions for me to sit. I take a seat in the corner and listen to the morning start-of-school routine outside: toe-touches, standing at attention, the Nepali national anthem, and running off to class. The last of the mysterious children leave and the man introduces himself as a doctor. A result of drinking the

village's untreated water, 15 children, a quarter of the entire school, are out sick with hepatitis A or hepatitis E. The doctor is testing their blood to determine which.

Resting behind the test tube rack on the principal's desk is a plastic, orange cup. The cup has a shallow spout on one side and a handle on the other. Curiously the cup reminds me of others like it found in bathrooms across Nepal. Cups are accompanied by buckets of water next to the toilet; together, they act as an inexpensive bidet or toilet paper of the liquid variety. Although plenty of posters and banners sponsored by USAID provide some clue as to how the process generally works, I am too shy to ask anyone exact details.

This cup is not used in the toilet. Instead, it serves as the water fountain at Shree Shram Primary School. The entire village lacks convenient access to running water and the school is no exception. Any water consumed by thirsty students or used for preparing lunch is carried in daily. Although a few students bring their own small, plastic bottles that once held soda or juice, most rely on a couple of two-liter bottles brought in each day by different families. In lieu of drinking straight from the bottle, water is poured first into the orange cup.

Most of the older students have perfected the art of pouring a steady stream into their mouth. The youngest ones try their best but spill the entire cup or put both of their lips on the rim (**Figure 17**). I remember high school marching band. Inevitably someone in the band forgets their water bottle, someone else lends them their bottle, and by the following Tuesday half of the clarinet section is out sick. The water cup, which undoubtedly helped contribute to the spread of hepatitis, provides a stark juxtaposition next to the tray of test tubes.

### Ramechhap Bazaar

*Aama* glows with excitement—even through the language barrier she clearly anticipates our trip to the bazaar. Unsure of how long we will be gone Eliza and I ready our bags and water treatment supplies. We walk down the hill along the dirt road and pass only a single vehicle, a motorcycle, the entire time. Despite the overall poor nature of the area, there are distinct differences in the levels of relative wealth. Most families are maize farmers with some animal husbandry. Few families own as many bovine, goats, and land as my homestay family does. Many properties consist of a single, two-story structure in which the family's living quarters are directly over their animals' living quarters.

About 30 minutes into our morning trip I notice a home with colorful prayer flags and a small pile of burning wood. I recognize the practice as one often encountered when trekking mountainous, culturally Tibetan areas of the Annapurna Circuit. Tibetans use this method to purify the air, so it is clear the area is not as culturally isolated as I imagined. I am curious if I asked the family living there what medicinal plants they use if they would have a different response than I received during the focus groups. I begin to worry the responses I received were not representative of Dumrikharka. I want to ask *aama* if the area was still considered Dumrikharka, but my Nepali consists mostly of telling people I feel sick and reassuring them their food tastes good. *Aama's* English consists mostly of food-related words, so my question goes unanswered.

The route itself is generally flat and leisurely to walk along. Along the sides I notice buildings enveloped by tarps touting the names of international aid organizations. *Aama*



notices me lingering and stops to pantomime earthquake-like motions. A few steps away our trio takes a break and rests under a large peepal or bodhi tree (**Figure 18**). Although there have been plenty of shady trees to stop under, *aama* picks this one. For Hindus in Nepal these beautiful *Ficus religiosa* trees are the symbol of the Hindu god Vishnu, creator and preserver of the world. Although peepal trees grow in both urban and rural communities, it is the rural areas where they commonly serve as areas of respite for weary travelers. I marvel at the tree's ability to withstand an earthquake where a nearby building could not.

As we near the bazaar, the homes become larger and more colorfully painted. All of the houses, even the most affluent looking ones, are surrounded by agricultural fields. A number of homes have rice fields instead of maize, thus indicating access to an irrigation system or ample rain to support the thirsty crop. The farmers in Dumrikharka are limited to maize due to the lack of water infrastructure in the area. The lack of water limits the area's economic activity, forcing farmers to grow food for subsistence only or find menial work in other countries to earn higher, but unfair, wages. The son of the homestay family left to drive trucks in India, where he met his wife, but was forced to return after a car accident injured his leg.

The loud rumbling of a bus is a telltale sign of our proximity to the market. Our odd trio, two foreign blondes and a Nepali grandmother, warrant stares as we walk into the city. Upon reaching the Ramechhap Bazaar, I immediately am attracted to a cart of samosas but *aama* scolds "*Naramro! Naramro!* [Bad! Bad!]" Feeling a mixture of shame and confusion, I walk away. We scurry in the opposite direction towards a small pavilion of produce vendors. Each vendor is seated on the floor with scales hanging from the ceiling (**Figure 19**). *Aama* buys small

eggplants, tomatoes, and shallots. Each item would be dwarfed by their much larger, and less flavorful, American cousins. Determined to purchase bananas, Eliza and I look for a vendor, but *aama* intervenes again. We end up with a delicious bag of red plums instead. A line of spice and herb vendors extends from outside of the pavilion along the sun baked ground (**Figure 20**). Chickens humorously poke their heads out of baskets unaware of their soon to be fate on dinnerplates. We stroll through the rest of the market past tents selling clothing, tikka, and metal kitchenware. After weeks of eating almost exclusively *dal bhat tarkari*, I gaze longingly at the forbidden samosas.

As we leave I notice a handful of shops selling packaged foods like cookies and candy bars. A small pharmacy is sandwiched in between the shops. Boxes of clove oil sit on the shelves next to antihistamines and antibiotics. A small fridge holds vaccinations. Hanging in the most prominent location of the entire pharmacy is a box emblazoned with the bright pink word “Unwanted.” I know from stopping at other pharmacies to pick up medication that it is a box of an emergency contraception pill similar-to Plan-B in the United States. A prescription is not required for any of the medications, nor is a pharmacy degree necessary to vend such goods.

### *Analysis and Interpretation*

Although unsanitary water increased the disease burden in Dumrikharka, it did not raise the likelihood of villagers using medicinal plants. Zero, even when multiplied by millions of microbes, remains zero. Of all the participants interviewed, there was no living-memory in Dumrikharka of medicinal plants being used for healthcare treatment. A related and potentially fruitful topic to investigate when applied to Dumrikharka is food as medicine. Depending on the method of preparation used (e.g. raw versus cooked), certain foods possess inherent medicinal qualities. Although prepared and consumed for nourishment or pleasure, foods can aid in alleviating illness and blur the lines between what is a meal and what is medicine (Totelin, 2014). One such culturally salient food Dumrikharka is garlic. In addition to its widespread use in the culinary realm, garlic also boasts antimicrobial activity when consumed raw.

My experience in Dumrikharka led me to question the often-cited statistic that 80% of the population of Nepal used herbal medicine as its primary form of health care. Dates of original sources of the statistic range from 1991-2002, and appear outdated when applied to current populations (Rokaya et al., 2014; Shrestha et al., 2014; Shrestha & Shrestha, 2012). There is a need for future research to gauge how Nepalis currently rely on medicinal plants as a source of medicine, primary or complementary to biomedicine, and as a source of income. Extraction pressures, or lack thereof, on medicinal plants alters the productivity of ecosystem services and biodiversity in an area. When compounded with the negative impacts of climate change, over-harvesting of medicinal plants for business may jeopardize Nepalis who are reliant on those same plants for medical treatment.

The inadequate availability of medical and pharmaceutical facilities, particularly for those who have no other source of healthcare, underscores the insufficient healthcare infrastructure for poor, marginalized populations in Nepal. Although speculative in nature, NOH coordinators are doubtful about the motivations of the government officials overseeing Dumrikharka. The village's status as predominantly Dalit, or the untouchable caste, may contribute to the insufficient water infrastructure and healthcare services provided by the government.

When *aama* fell ill, her son walked two hours down to Manthali to pick up medicine from a pharmacy. Her son then stayed overnight with his brother who lives in the city and returned just before breakfast the next morning. The walk alone required four hours and the entire trip for medicine lasted over twelve. *Aama*, who had a fever, rattling cough, and aching body was unable to consult a doctor. Her treatment was exclusively reliant on how a pharmacist interpreted her son's descriptions. The pharmacist gave her son amoxicillin without confirming the pathogenic agent. With no medium available to confirm if the infection was viral or an antibiotic resistant bacterium, the pills pose the threat of worsening antibiotic resistance in Nepal. Moreover, without a proper patient history, *aama* had no way of confirming with a medical professional if she had an allergic reaction to her medications in the past.

Prior to receiving antibiotics, *aama* spent two days taking frequent naps and greatly reduced her physical activity. Her daughter-in-law took over duties cooking breakfast and dinner, so *aama* could rest. As guests of the family, Naema, Eliza, and I were unsure of the proper way to help. The only feasible option was to offer *aama* doses of ibuprofen and

acetaminophen we brought for personal use. Without any hesitation *aama* took the pills and her comfort levels improved. Like the fleeting “trekker medicine” provided by itinerant doctors and tourists in the Everest region, our efforts entailed only short-term commitment and did nothing to provide continuous or comprehensive medical care for *aama* (Heydon, 2011).

*Aama’s* illness underscored the inaccessibility of biomedicine and the absence of traditional medicine in Dumrikharka. It is curious that in Dumrikharka traditional medicine has not filled the existing healthcare gap. If traditional Nepali medicine was previously practiced in Dumrikharka, the desire for biomedicine usurped its salience; this desire persists even though rural infrastructure is not conducive to accessing government healthcare facilities. The health care incongruity is likely rooted in globalization and modernization. The 2011 National Population and Housing Census provides insight into other facets of Nepali society which reflect the expectation of modernity and influences of globalization. According to the census, nearly 60% of rural Nepali households have access to mobile phones (National Population and Housing Census 2011). Furthermore, one in every four households has a family member who is absent or living out of the country, likely to pursue education or find higher wages (National Population and Housing Census 2011). The experience of these family members who go abroad provide additional exposure to modernity and in turn influence healthcare expectations.

## TUTUNG



*Figure 3: Homestay and rice fields in Tutung*

### *Locating Tutung*

Tutung a village is located in the Nuwakot District of the Bagmati Zone in Nepal's Central Development Region. It is centrally positioned in the hill portion of Nepal's ecological belt. For reference, the Bagmati Zone also houses Kathmandu Valley. The village is located at approximately 27°57'4" N, 85°19'10" E, just north of the Kathmandu District.

Depending on the monsoon rains, the village can be accessed via a four to six-hour bus ride followed by a two-hour hike crisscrossing dirt roads, heavily vegetated areas, and other villages. Transport to and from Tutung around festivals may require passage on the roof of the bus to accommodate for large crowds.

### *Duration of Stay*

I stayed with the homestay family for a short period of eight days, from July 12, 2016- July 20, 2016. Unlike Dumrikharka, I did not double as a volunteer in Tutung.

### *Tutung Focus Group*

The letter “D” indicates responses from the familial patriarch and local medicine man, Dharma Thapa and the letter “G” indicates responses from his adult son, Geeban Thapa. Responses lacking a D or G designation represent the collective response of both men as interpreted by the translator.

*Table 3: Tutung Focus Group Responses*

Questions	Responses
1. How do you collect your water?  Possible Probe: How far away is your water source?	In a container from the tap outside the house during monsoon season.  Other times of the year it is a ten-minute walk to the river.
2. Do you clean your water before drinking it? If you do, please explain how.	No. [Stated jokingly]. Only if my name is Emily.
3. Are you familiar with solar disinfection?	No. .
4. How do you make fire?  Possible Probe: If you use plants to make fire, what plants do you use?	With wood from the trees outside.
5. What illnesses are most common in your area?	Gastric [stomach upset] and sore knees, back from farming.
6. How do you treat these illnesses?	G: Herbal medicine, medicine from a doctor.  D: Herbal medicine.
7. What health care provider do you visit most often?	G: The doctor in the hospital [the hospital is a 1.5-2 hour walk away through farmland].
8. Do you use plant or herbal preparations to treat illnesses?	D: Yes. Coconut, chokra, ghee [clarified butter] from buffalo, curry, setoghar.

	G: Titepati [mugwort, <i>Artemisia indica</i> ] for high blood pressure.
9. If so, what is your source of medicinal plants?	Around the house, village.
10. If you collect plants for your treatment, do you uproot them or leave the roots in the ground?	Some leaves only, some roots.
11. How often do you seek help from local medicinal plant experts?	G: Sometimes I ask my dad. D: [Smiles]
12. If you believe they are experts, what makes you trust their knowledge?	G: My father taught me, so sometimes people ask for help when I am checking on cows in the jungle.
13. How far are you from the nearest health outpost or government clinic?	1.5-2 hour walk to Raluka South Health Post/mini-health post [also referred to as the hospital in separate conversations].
14. Do you prefer seeking medical treatment from local healers or doctors in healthcare clinics?  Possible probe: Does cost play a role in choosing which doctor to visit?  Possible probe: Does distance play a role in choosing which doctor to visit?	G: Sometimes one, sometimes the other. D: Only herbal, not the doctor. [I] don't charge money, free for my patients I visit.
15. Are there conservation efforts in your area?	No.



*Excerpts from Fieldwork and Participant Observation in Tutung*

The following descriptions are edited versions of entries in a field and personal journal.

If one were to imagine a blond Snow White in hiking boots who attracted orphaned birds, baby goats, and leeches, they would gather some semblance of my time in Tutung, Nepal. Permission to use names was granted with verbal approval.

Arrival

Upon arriving in Tutung, I am overwhelmed by the lush, verdant vegetation. Water from the monsoon rains trickles through rice terraces blanketed with grass. Nascent soybeans sprout to life between terraces (**Figure 21**). Saroj, the NOH staff member who accompanied me to Tutung, leads me down a path to a house enveloped in trees and other foliage (**Figure 22**). Pepper bushes line the front of the house and fruit trees dot the sides. Just steps from the house, the water tap flows with abandon thanks to the monsoon rains (**Figure 23**).

I am whisked inside and introduced to the matriarch and patriarch of my homestay family. Bhagabati Thapa, in the fashion of grandmothers everywhere, offers me food and instructs me to call her *aama* or grandma (**Figure 24**). Her husband and the village medicine man, Dharma Thapa, tells me to call him *buba*, or grandpa (**Figure 25**). We are joined by their grandsons, Dildash Thapa (16) and Utsab Thapa (15), who arrive from the fields shortly before their parents. Their mother, Saraswati Thapa, is hidden in a human-sized bundle of grass supported by a tumpline. Her husband, Geeban Thapa, the son of Dharma Thapa, or *buba*, appears from behind the monstrous grass bundle as Saraswati feeds it to their buffalo and buffalo baby. Saroj introduces me and explains my wishes to learn about the family's medicinal

plant usage. I learn that although *aama* and *buba* speak little English, Geeban and his son are quite proficient.

### Leeches

Regretting my choice of footwear, I gaze warily into the bushes and ferns which composed our path ahead. Strapping on Tevas seemed like a good decision for an easy, ten-minute walk to the river. Everyone else was wearing flip-flops after all. The “ten-minute” and “easy” part of the plan is apparently lost in translation. “Eat this,” Geeban smirks. Resting on his palm are two plant parts that tinged his fingers red (**Figure 26**). I oblige. Too preoccupied by the slippery ground and disconcerting foliage, I forget to ask what it is.

Geeban and Dildash guide me through the dense shrubbery towards the river’s shore. Grateful to be on ground where my feet are visible, I look down in dismay: Both feet are dripping with blood. I watch in horror as I undo my sandal-straps and reveal what appears to be seven little boogers coated in soot. “Leeches,” Dildash said, scrunching up his nose. In an action that can only be described as tickling, they coax the leeches off and we continue. Walking back up the hill we balance on the walls of rice terraces and narrow paths to return home. A butterfly startles me when it lands on my bloody toe. Feeling embarrassed about being frightened over a mere butterfly, I cannot help but laugh at myself. Geeban tears a leaf off a plant and tells me to rub it into my bites. I learn later that this plant, *Artemisia indica*, is called *titepati* (**Figure 27**).

### Slow Drive, Long Life

“Slow drive, long life,” Geeban teases as he helps me up from the ground. I had often seen the phrase inscribed in bright paint on the side of buses (although I doubt the drivers ever heeded the advice.) Geeban, Saraswati, Utsab, Dildash and I are walking down after breakfast to their fields. The fifteen-minute trip requires crossing a gravel road then maneuvering down slippery ground and slick, wet rocks. Even though I am the sole member of the group walking in boots and unimpeded by a heavy object, I am also the only one who falls. (Earlier this same day I was informed I eat *makai* [maize] “like a baby bird.” The family gave me an intensive lesson in how to properly knock the roasted kernels off and eat like a proper Nepali adult.) Deemed incapable of walking properly, let alone using a sickle or heavy shovel, I sit on a large rock and watch the Thapa family at work.

From my perch, I notice vast quantities of lemongrass surrounding the field and plenty more *titepati*, the plant which rescued me from leech bites just days prior (**Figure 28**). Across the field, Geeban places a large basket over his head and walks between the flooded rows of maize. It is the same basket I watched *buba* weave a few days before. He skillfully picks the ears off the stalks and throws them backwards into the basket. Behind him Saraswati slices the top three-quarters of the maize stalk off with a sickle and throws it into a pile. I watched their concerted, graceful motions in a trance.

Geeban carries the pile of stalks to the back of the field and joins his sons in building the terrace walls (**Figure 29**). Utsab and Dildash hoist clumps of mud up from the flooded field and use it as building material for the walls. The mud is piled one to two feet high then smoothed to

a rounded edge with their bare feet. Slight indents are occasionally inserted to determine which way the water flows (**Figure 30**). Soon these fields will be ready for rice planting. Geeban reaches down and grabs something in the ankle-deep water, waves to get my attention, then walks over to me—a freshwater crab is sandwiched between his fingers! He throws the offending crustacean into the neighboring fields and it disappears from my sight. I am grateful for my dry perch on the boulder and astonished everyone but me is either barefoot or wearing sandals.

Saraswati continues working deftly with the sickle, amassing an incredible amount of grass springing from the terrace walls (**Figure 31**). The large pile of foliage will be fed to the buffalos. She skillfully plucks long strands of grass from the walls and twists them into a makeshift rope. The grass rope is then looped around the pile of buffalo food and secured by a knot. Utsab walks over to his mother with a tumpline which she secures along his body to support the pile of foliage (**Figure 32**). Dildash collects the heavy shovels and his parents each balance a full basket of maize with their foreheads and backs. I excitedly spy a pumpkin in the field and am trusted enough to carry it home for tomorrow's dinner.

When we arrive *aama* is finishing dinner. *Buba* is seated on a floormat next to her smoking tobacco from his hookah pipe. He has been gone all day visiting people in need of healing. As in Dumrikharka, the stove top consists of an open wood fire and the kitchen lacks a chimney; however, the smoke lingers here for only a moment thanks to the cross-breeze from two different points of entry. Dinner is *dal bhat tarkari* complete with *achar* [spicy pickle] made from peppers and shredded unripe mango harvested just steps from the porch (**Figure 33**).

In Tutung, unlike in Dumrikharka, I eat with the rest of the family. As the sole guest and a slow-eater I am grateful to be freed from the pressure of eating first. Knowing that I do not eat meat, *buba* specially prepares an egg for me each evening. I am served a spoonful of ghee and a cup of fresh *bhainsiko dudh* [buffalo milk]. I have a casein allergy, but I hope the buffalo milk will not cause too much trouble during my week there; the Thapa family is clearly proud of their buffalo and I hope to show how appreciative I am of their hard work by eating their food.

#### Raluka South Mini-Health Post

A hungry baby bird sits on my knee while I wait for breakfast. Orphaned by its mother, the bird flies to any human when it wants more rations of cooked rice soaked in buffalo milk. Like the baby bird, I am also having buffalo milk with breakfast. *Aama* sets down a bowl of flat, dried rice, spoons in some sugar, and hands me a glass of freshly boiled buffalo milk (**Figure 34**). The unusual morning meal is an unexpected nod to my sugary childhood breakfast cereals. There is no *dal bhat* this morning because we are taking a special trip to the Raluka South Mini-Health Post with Geeban's sister.

Thankfully no one is sick or injured. Geeban's sister is simply dropping off data for a UNICEF project. Beaming with pride, his sister takes out a flexible plastic strip from the purse UNICEF gifted her then pretends to measure my arm with it. It is a mid-upper arm circumference (MUAC) tape used to measure children's arms and identify malnutrition. The red, yellow, and green sections of the MUAC tape serve as indicators community health workers use to report back to UNICEF. Geeban tells me his sister is very proud because none of the children she measured in Tutung are malnourished.

Thanks to my ill-fated, leech filled trip to the river, Geeban makes sure I have on my hiking boots before we leave. Only four of us are going: Geeban, his sister, Saraswati, and myself. Soon after beginning our walk it begins to rain and the dirt road transforms into slippery mud. Monsoon season is well underway, so we wait out the storm on the front porch of a small shop. While everyone else sips hot tea I snack happily on a package of cookies. The shop keeper is kind enough to run home in the rain and make black tea for me because I am allergic to cow's milk. In classic Nepali fashion the sweet, spiced, *chiya* [tea] is served in a metal cup without handles. Drinking the hot beverage without searing your tongue, singeing your fingers, and burning your mouth is an acquired skill.

The rain dissipates and we continue through hills carpeted in rice terraces (**Figure 35**). To my untrained eye the foreign terrain seems impassable without damaging the crops; however, to those familiar with the land, narrow, grassy strips reveal themselves as walking paths (**Figure 36**). We cross field after field, occasionally jumping over creeks or balancing on flat rocks to stay out of areas with quickly flowing water. Farmers plowing fields with their buffalo stop to say hello. Our group frequently steps aside to allow others carrying handfuls of rice to pass by.

In the cool, overcast day, I find the walk incredibly pleasant. The little waterfalls rushing down from one terrace to the next fill the air with mellifluous tunes. Despite the beauty, I realize this is the fastest path to the mini-health outpost. I hear the Thapa family often refer to this place as the "hospital." How awful to be sick, injured, or pregnant and walk this far to a hospital.

The walk provides time for self-reflection. I recall a situation from earlier in the summer while in Nayapul, Nepal. My guide Mohan and I were on the final day of the Annapurna Circuit when we rounded the corner and saw a visibly pregnant woman wailing in pain. She was no older than me, perhaps twenty or twenty-one. Mohan ran over to the older woman clutching her and asked what was wrong. The older one says her daughter is in significant pain and needs to go to the hospital, but they cannot afford the 2,000 rupees (about 20 USD) for the ambulance. Heartbroken, I reached for my wallet but before I could remove it from my pack a noisy truck rounded the corner.

What happened next was surreal enough to be a sequence in my dreams or a scene out of a movie. The truck rattled and kicked up dust over the gravel road. It was carrying dozens of chicken cages and losing feathers as it drove. Its driver pulled over to the side of the road where the two women stood and offered them a ride. The pair carefully climbed into the front seat and were whisked away. This was the first and most shocking experience that underscored how poor Nepal's healthcare infrastructure in rural areas is—a woman quite literally relied on transportation in a chicken truck to get to the hospital and deliver a baby. A woman from Tutung would share similar troubles if she faced any complications during pregnancy. The bucolic walk to the health-outpost hides its sinister undertones well.

After about two hours of walking we finally arrive at the mini-health outpost. There are two buildings. One building has a small open floor plan with an empty maternity ward and the other is a slightly larger structure with a few open rooms and empty beds. A doctor greets us in the office at the end of the building; he is the only one currently working. Geeban and his family

chat away with the doctor as I silently study the room. In the corner is a Sawyer water filter connected to a bucket displaying the logo of an NGO. I am abundantly familiar with these filters because I use one myself to remove microbes from my water while camping. Although the contraption was probably donated by a well-meaning NGO to benefit sick patients, the layer of dust on top suggests the water treatment system takes up more space than it is worth to the small facility. I think of the unused chlorine bottle in Dumrikharka.

As a post-hospital meal we stop for cooked Wai Wai noodles. Empty packages of these noodles and their metal flavor sachets are ubiquitous litter in Nepal. Most shops sell them and Nepalis frequently eat them uncooked as fast food. Today, we are in for a treat, because the woman in the shop will cook them for us with onions, peppers, tomatoes, and eggs. Her baby is rocking in a bassinet hanging from the ceiling and begins to cry when her mother leaves to prepare our meals. I walk over to the bassinet and rock the baby slowly. The mother nods approvingly but her other little one wraps his arms around her leg and watches me suspiciously. I wonder if he has ever seen a blond woman before.

The baby dozes off again but wakes up abruptly when the woman adds peppers to the pan. These peppers are the same spicy variety which grow outside of the Thapa's kitchen. I had eaten them raw plenty of times but now the smell alone stings my throat. My eyes involuntarily tear up and I notice the baby and I are the only two crying. Saraswati points up at the steam drifting above me. With a warm smile, she taps the bench beside her and I escape from the culprit causing my tears.



### *Analysis and Interpretation*

I learned after returning to the NOH volunteer house in Kathmandu that the Thapa family does not eat the rice they harvest. Instead, they sell it to a vendor who in turn sells it to a distributor in India. The family buys cheap, lower quality rice, imported from India. Harvested maize, on the other hand, is dried and eaten by the family—it would not sell for a high enough profit on the market. Despite the seemingly remote, idyllic subsistence lifestyle, pressures from market and globalization play an important role in Tutung. The circumstances surrounding grain cultivation and sale are another form of ecological imperialism in Nepal. Although the grains are not wild like the medicinal plants commodified in other communities and sold to international markets—poor Nepali communities put in significant time, effort, and resources into projects where they are inadequately compensated.

An age differential in views on medicinal plants exists in the Thapa family. *Buba* uses exclusively herbal remedies, his son uses a combination of both herbal and pharmaceutical, and his oldest grandson rolls his eyes at mention of medicinal plants. Although this may not be the case for all families in Tutung or Nepal at large, it indicates a generational, cultural transformation occurring in one family. As generations progress in the Thapa family, ethnobotanical knowledge of medicinal plants becomes less salient. Research on traditional healing practices in eastern Nepal revealed a similar trend in which older people utilized medicinal plants significantly more than younger people (Shrestha et al., 2016).

The health care choices for the Thapa family function in a state of medical pluralism. Medical pluralism involves selectively using and moving between different systems of medicine

available (Woryboys, 1997). Members of the Thapa family choose between the system of biomedicine and the system of Nepali traditional medicine to treat ailments. A case study of the Khunde Hospital in the Kumbu area of Nepal demonstrated “Western medicine was seen to treat the symptoms rather than the cause and so the different medical systems were seen to have varying areas of effectiveness” (Heydon, 2011, p.513). Members of the Thapa family sometimes choose to use the two systems of medicine in a concurrent, synergistic manner. Geeban Thapa illustrates an excellent example of concurrent uses in his treatment of gastric pain. To lessen his pain, Geeban alternates medicinal plants prepared by his father and pharmaceutical drugs throughout the day. His answers from the focus group reinforce these actions. Geeban stated he uses both herbal medicine and medicine from a doctor as methods of healthcare treatment.

A plant of ethnomedicinal salience to the Thapa family is *titepati* or *Artemisia indica*. Ethnobotanical research in other rural areas of Nepal corroborates the medicinal utility plants in the *Artemisia* genus. Ethnomedicinal research in the highlands of central Nepal found villagers apply a leaf decoction of *Artemisia indica* to the skin as treatment for both scabies and ring worm. In the villages of Syaphru and Langtang *Artemisia indica* is referred to by the ethnic Taamang communities as *Chhuwenti* (Shrestha et al., 2014). Unlike Tutung, which is in the hill portion of Nepal’s ecological belt, the Syaphru and Langtang village communities are in the mountain portion. Although medical access in Tutung is less than ideal by western standards, access to modern medicine is even more difficult in remote Himalayan villages like Langtang and Syaphru. The remoteness of mountain communities necessitates the use of plant-based

medicines (Shrestha et al., 2014).

Tragically, on April 25, 2015, a 7.8 magnitude earthquake and the subsequent aftershocks resulted in a deadly landslide. Loosened by the earthquakes, an explosive force of ice and rock debris decimated Langtang village. In total, 283 Nepalis and 43 foreign trekkers in the central part of the village perished (“One year after quake,” 2016). Rebuilding Langtang village, accessible only by helicopter, is a slow and costly process, underscoring the area’s remoteness. The tragedy in Langtang village brings to light the fleeting nature of ethnobotanical research and stresses the fragility of human life.

In the lesser Himalayan area of Tinjure-Milke-Jaljale (TMJ) in eastern Nepal, both *Artemisia indica* and *Artemisia dubia* have documented ethnomedicinal uses (Shrestha et al., 2016). The fresh leaves of *Artemisia indica*, known by the local name of *gandhe jhar*, are ground and directly applied to cuts and wounds. This use of *Artemisia indica* is directly analogous to the Thapa family’s application of the leaves to my fresh leech bites. In the TMJ area, *Artemisia dubia*, not *Artemisia indica* as in Tutung, is called by the local name of *titepati*. The discrepancy may originate from regional differences or differences in the identification by researchers. The leaves of *Artemisia dubia* are made into an extract to expel intestinal worms. Similar to the use of *Artemisia indicia* by the Himalayan communities of Syaphru and Langtang village, *Artemisia dubia* leaves are boiled with water and made into a decoction to treat scabies and other skin diseases.

Neither study on traditional healing practices of central or eastern Nepal documents treating high blood pressure with *Artemisia indica* (Shrestha et al., 2014; Shrestha et al., 2016).

Making a decoction of *Artemisia indica* leaves to lower blood pressure appears to be a novel use of the plant by the Thapa family. Analogous use of other *Artemisia* species as antihypertensive treatment is found outside of Nepal. In Traditional Chinese Medicine, a burning roll of *Artemisia vulgaris* and other herbs is prepared then applied to acupuncture points. A review of multiple randomized controlled trials of *Artemisia vulgaris* suggested application of the herb in this way can be an effective hypertensive treatment (Yang, Xiong, Yang, & Wang, 2014). In eastern Morocco, an ethnopharmacological study on the chemical properties of *Artemisia campestris* demonstrated antihypertensive and vasorelaxant effects in rats (Dib et al., 2017).

A number of factors could account for the novel use of *Artemisia indica* in Tutung. For example, its use could indicate hypertension is a prevalent ailment in Tutung. The prevalence of the ailment then necessitated a treatment. Furthermore, the novel use of *Artemisia indica* may have occurred do to its relative abundance in the area. Although I did not formerly quantify what percentage of the total vegetation *Artemisia indica* represented, it seemed that wherever I fell (which was embarrassingly often), the plant was always there to cushion my fall. Other reasons which led to the species novel use may include personal preference or ease of accessibility over other plants which are also consumed as hypertension treatment.

Without more information, it is difficult to identify the etiology of hypertension in Tutung; however, it is important to discuss the issue so gaps in health care can be improved. Both obesity and lack of physical activity likely play minor roles as nearly everyone living in Tutung leads a lifestyle which necessitates frequent lifting and walking. Although the Thapa

family recognized the familial pattern of high blood pressure, genetic and thyroid disorders remain potentially undiagnosed due to lack of nearby primary care physicians and the low salience of preventive care.

Acculturation of high sodium Western diets and of cigarettes are both potential culprits of hypertension in Tutung. As evidenced by my field observations, there is frequent consumption of the high sodium, high monosodium glutamate Wai Wai noodles. Smoking of tobacco products, in the form of hookah and cigarettes, is also commonplace. Alcohol, packaged tobacco products, and salty, sweet, and fatty processed foods all preserve well and have a long shelf-life, so many rural shops sell them. Unlike fresh produce, which is not always in season, these hypertension-inducing products are available year-round. Trends of decreased use of medicinal plants, when coupled with adoption of deleterious Western lifestyle choices, has the potential to lead to epidemic levels of untreated hypertension and other heart diseases.

## COMPARATIVE ANALYSIS AND INTERPRETATIONS

When situated in the socioeconomic and environmental context of Dumrikharka and Tutung, medicinal plant usage manifests in different ways. In Dumrikharka, water scarcity limits subsistence activities to dry farming of maize. The dearth of water resources forced one member of the homestay to leave the household and work abroad for more income. Family members walk long distances daily for the basic necessity of water. Although frequently exposed to waterborne pathogens, the homestay family, like the rest of the village, does not have convenient access to government healthcare facilities. Without medicinal plant knowledge, residents of Dumrikharka are severely limited in their healthcare choices and are forced to walk four or more hours while sick, pay for an unaffordable ambulance, or rely on family member to relay their symptoms to a pharmacist without ever seeing a doctor.

In Tutung, water is significantly closer to the Thapa family than the homestay family in Dumrikharka. During monsoon season, the water source is seconds away from the house and during seasons with less rain, the water source is a 10-minute roundtrip walk. These 10 minutes, although inconvenient by Western standards, are a fraction of the 90 minutes required to collect water by their counterparts in Dumrikharka. Additionally, summer rains in Tutung allow the growth of both rice and maize. Rice provides enough income so a member of the family does not have to work abroad and send money back home. The medical pluralism exhibited in Tutung offers more healthcare options to the Thapa family and provides a buffer when treating illnesses. Although not utilized for every ailment, medicinal plants safeguard health when the four-hour roundtrip walk to the mini-health outpost is not an option.

## FUTURE DIRECTIONS

Significant changes to Nepal's cultural landscape shape the foundation which informs research on medicinal plants. In only two decades the country experienced a civil war and a catastrophic earthquake. The People's War was a period of rapid cultural change in which researchers were circumscribed to Kathmandu Valley due to the inherent dangers of the insurgency. As a result, a decade of potential ethnobotanical research and documentation was lost to time. Furthermore, the new constitution poses the pragmatic issue of redefined regions and borders. Thus, areas previously known by one name may now be known as another, so future researchers must be vigilant when examining studies published prior to this change.

Applying future research on Nepali medicinal plants to global problems allows researchers to aid a broader audience. For example, ethnobotanical knowledge can serve as a platform for environmental conservation (Schultes, 1994). Similarly, application of traditional resource and environmental management (TREM) to the preservation of biodiversity and ecosystem services provides a model for coping with the demands capitalism places on natural resources (Anderson et al., 2011). As antimicrobial resistant pathogens become more deadly and pervasive, lifesaving solutions may exist in ethnobotanical knowledge.

Finally, researchers investigating medicinal plants in rural Nepal should make a concerted effort to understand the native epistemologies from which ethnobotanical practices originate. Without doing so, culturally specific ways of understanding and interpreting health risk being reduced to mere "repositories of herbal concoctions" under the structurally dominant Western epistemology of scientism (Janes, 1999, p. 1804). Using medicinal plants as

mere phytochemical templates for new pharmaceuticals is too narrow an application for the wider body of knowledge which informs their use.



## CONCLUSION

Political ecology provides a lens through which to understand medicinal plant dynamics in rural Nepal. After a decade of insurgency, a catastrophic earthquake in 2015, and years of interim constitutions, the government of Nepal has failed to provide water sanitation or healthcare infrastructure in Dumrikharka and Tutung. Fieldwork in Dumrikharka highlights the detrimental health and economic consequences of water scarcity, poverty, and waterborne pathogens. Fieldwork in Tutung illustrates medical pluralism and incorporation of pharmaceutical drugs to existing ethnobotanical knowledge.

It is irrational and unfair to expect rural communities to remain unchanging and stagnant. Rural communities do not exist in a time capsule; however, the finding of this study demonstrate that alterations to traditional practices without modern counterparts can prove detrimental. Pharmaceutical drugs, despite their cost and difficulty to access for those living in rural communities, have replaced or are replacing the use of medicinal plants in some areas. If pharmaceutical drugs are preferred, but unaffordable or inaccessible, illnesses go untreated.

Influences from globalization, including market pressure on ecosystems services, demand for menial labor, and the influence of modernity, have transformed rural communities. Harvesting medicinal plants for market sale provides the positive benefit of increased income and economic stability in the short-term; however, in the long-term it also poses the risk of environmental degradation when done unsustainably. Without equitable distribution of resources, government support, and policies are needed to ensure protection of the environment, otherwise social inequalities in Nepal will persist through a variety of channels.

## APPENDIX A: IRB NOTIFICATION LETTER



University of Central Florida Institutional Review Board  
Office of Research & Commercialization  
12201 Research Parkway, Suite 501  
Orlando, Florida 32826-3246  
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276  
[www.research.ucf.edu/compliance/irb.html](http://www.research.ucf.edu/compliance/irb.html)

## **NOT HUMAN RESEARCH DETERMINATION**

From : **UCF Institutional Review Board #1**  
**FWA00000351, IRB00001138**

To : **Emily Dovydaitis**

Date : **April 27, 2016**

Dear Researcher:

On 04/27/2016 the IRB determined that the following proposed activity is not human research as defined by DHHS regulations at 45 CFR 46 or FDA regulations at 21 CFR 50/56:

Type of Review: Not Human Research Determination  
Project Title: Implications of Insufficient Access to Sanitary Water on  
Medicinal Plant Usage in Rural Nepal  
Investigator: Emily Dovydaitis  
IRB ID: SBE-16-12240  
Funding Agency:  
Grant Title:  
Research ID: N/A

University of Central Florida IRB review and approval is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are to be made and there are questions about whether these activities are research involving human subjects, please contact the IRB office to discuss the proposed changes.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

A handwritten signature in black ink that reads "Kanille Chay" followed by a horizontal flourish.

IRB Coordinator

APPENDIX B: NEPAL ORPHANS HOME/VOLUNTEER NEPAL-APPROVAL OF RESEARCH  
LETTER



March 31<sup>st</sup> 2016

To whom it may concern,

This letter is confirm that Emily Dovydaitis has been accepted to take part in a volunteer home stay programme with Volunteer Nepal to take place in the summer of 2016. While volunteering in several remote locations she will also be undertaking interviews with various members of the community.

Emily has shared her research design and methodology and I am impressed by the thoroughness and care she has taken to approach her work in a respectful manner. Volunteer Nepal has a good ongoing relationship with the communities Emily will be working with and the families she will stay with, which are likely to include Tutung, mentioned in her proposal, and a village in Ramechhap where villagers must walk 20 minutes each way to the nearest water source.

I have asked my Nepali colleagues to read over Emily's proposal and they not only approve, they are very interested in her work and excited to help. We look forward to working with Emily this summer.

If any further information is required, please feel free to contact me at [volunteern@gmail.com](mailto:volunteern@gmail.com).

Sincerely,

Eileen Witham  
Program Director, Volunteer Nepal

## APPENDIX C: HRP508-EXPLANATION OF RESEARCH-ENGLISH



### **EXPLANATION OF RESEARCH**

**Title of Project:** Implications of Insufficient Access to Sanitary Water on Medicinal Plant Usage in Rural Nepal

**Principal Investigator:** Emily Dovydaitis

**Other Investigators:** Rani Vajravelu, PhD.

**Faculty Supervisor:** Rani Vajravelu, PhD.

You are being invited to take part in a research study. Whether you take part is up to you.

The purpose of this research is to examine how health problems caused by drinking unclean water have the ability to damage the environment and alter the use of medicinal plants.

**What you should know about a research study:**

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you.
- Feel free to ask all the questions you want before you decide.

**What you will be asked to do in the study:** You will be asked to participate in an interview. The interview should take between 45-60 minutes and will take place at a convenient location for both the investigator and the participant. You will discuss topics like water collection, disease treatment, and medicinal plant harvesting.

**Location:** Interviews will take place at locations deemed appropriate by the non-governmental organization (NGO) Volunteer Nepal, including Tutung and Ramechhap, in an area where the participant feels comfortable being interviewed.

**Time Required:** Approximately 45-60- minutes will be required. The participants will be asked to participate in an interview at a time that is convenient for the participant.

**This study is confidential:** A pseudonym will be assigned to you in order to ensure confidentiality, unless you request that your name be used in this study.

You must be 18 years of age or older to take part in this research study.

**Study contact for questions about the study or to report a problem:** If you have questions, concerns, or complaints please contact: *Emily Dovydaitis, Undergraduate Student, Biology and Anthropology Programs, College of Sciences, +001 (407) 547-9787 or by email at emily.dovydaitis@knights.ucf.edu. Or please contact Dr. Rani Vajravelu, Faculty Supervisor, Department of Biology at +001 (407) 823-0090 or by email at rani.vajravelu@ucf.edu.*

**IRB contact about your rights in the study or to report a complaint:** Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

## APPENDIX D: HRP508-EXPLANATION OF RESEARCH-NEPALI





### अनुसन्धानको वर्णन

**परियोजनाको शीर्षक:** नेपालको ग्रामिण क्षेत्रमा जडिवुटी प्रयोगमा सफा पानीको अपर्याप्त पहुँचको परिणाम

**प्रमुख अनुसन्धाता:** इमिली डोभिडेस

**अन्य अनुसन्धाताहरू:** रानी बज्रभेलु, पीएचडी.

**फ्याकल्टी सुपरिवेक्षक:** रानी बज्रभेलु, पीएचडी.

तपाईंलाई एउटा अनुसन्धान अध्ययनमा भाग लिन निमन्त्रणा गरिएको छ । भाग लिने वा नलिने तपाईंमा निर्भर छ ।

यो अनुसन्धानको प्रयोजन फोहर पानी पिउनाले उत्पन्न भएका स्वास्थ्य समस्याहरूले कसरी वातावरणलाई नोक्सान गर्न र जडिवुटी बनस्पतिको प्रयोग बदल्न सक्छ भनी जाँच गर्नु हो ।

अनुसन्धान अध्ययनको बारेमा तपाईंले के थाहा पाउनुपर्छ:

- कसैले यो अनुसन्धान अध्ययनको बारेमा तपाईंलाई वर्णन गर्नेछ ।
- अनुसन्धान अध्ययन तपाईंले स्वयंसेवा गर्ने कुरा हो ।
- यसमा भाग लिने वा नलिने तपाईंमा निर्भर छ ।
- तपाईंले चाहेर मात्र यो अध्ययनमा भाग लिनुपर्छ ।
- तपाईंले अनुसन्धान अध्ययनमा भाग नलिने छनोट गर्न सक्नुहुन्छ ।
- तपाईंले अहिले भाग लिन सहमत भएर पछि विचार बदल्न पनि सक्नुहुन्छ ।
- तपाईंले जे निर्णय गरेपनि तपाईंको विरुद्ध केही हुनेछैन ।
- तपाईंले निर्णय गर्नुअघि तपाईंले सोध्न चाहेको सबै प्रश्नहरू सोध्न नहिचकिचाउनुहोस् ।

**तपाईंलाई अध्ययनमा के गर्न भनिनेछ:** तपाईंलाई एउटा अन्तर्वार्तामा सहभागी हुन भनिनेछ । अन्तर्वार्ता 45-60 मिनेटको हुनेछ र प्रश्नकर्ता र सहभागी दुबैका लागि अनुकूल हुने ठाउँमा सञ्चालन हुनेछ । तपाईंले पानी सकलन, रोग उपचार र जडिवुटी बनस्पतिको खेतीलगायतका विषयमा छलफल गर्नुहुनेछ ।

**स्थान:** अन्तर्वार्ताहरू टुटुङ र रामेछापसहित गैरसरकारी संस्था भोलुन्टियर नेपालले पहिचान गरेका सहभागीहरूले अन्तर्वार्ता गर्न सहज महशुस गर्ने स्थानहरूमा हुनेछ ।

**आवश्यक समय:** अनुमानित 45-60 मिनेटको समय चाहिनेछ । सहभागीलाई अनुकूल हुने समयमा अन्तर्वार्ता दिनका लागि अनुरोध गरिनेछ ।

**यो अध्ययन गोप्य हुनेछ:** तपाईंले यो अध्ययनमा तपाईंको नाम प्रयोग गर्न अनुरोध गरेको अवस्थामा बाहेक गोपनीयता कायम गर्न तपाईंलाई एउटा छद्मनाम अर्थात उपनाम दिइनेछ ।

यो अनुसन्धान अध्ययनमा भाग लिनका लागि तपाईं 18 वर्षभन्दा धेरै उमेरको हुनुपर्छ ।

**अध्ययनको बारेमा प्रश्न सोध्न वा समस्याको उजुरी दिन अध्ययन सम्पर्क:** यदि तपाईंको कुनै प्रश्न, चासो वा शिकायत भएमा, कृपया सम्पर्क गर्नुहोस्: इमिली डोभिडेस, *अन्डरग्राजुएट विद्यार्थी, बायोलोजी र एन्थ्रोपोलोजी कार्यक्रमहरू, कलेज अफ साइन्सेज, +001 (407) 547-9787 वा इमेलद्वारा [emily.dovydayitis@knights.ucf.edu](mailto:emily.dovydayitis@knights.ucf.edu) मा । वा कृपया डा. रानी बज्रभेलु, फ्याकल्टी सुपरभाइजर, बायोलोजी +001 (407) 823-0090 मा वा इमेलमार्फत [rani.vajravelu@ucf.edu](mailto:rani.vajravelu@ucf.edu).*

**अध्ययनमा तपाईंको अधिकार वा शिकायत उजुरी गर्न आईआरबी सम्पर्क:** युनिभर्सिटी अफ सेन्ट्रल फ्लोरिडामा मानव सहभागी हुने अनुसन्धान इन्स्टिच्युसनल रिभ्यू बोर्ड (UCF IRB) को निगरानीमा हुन्छ । यो अनुसन्धान आईआरबीले समीक्षा र अनुमोदन गरेको हो । यो अनुसन्धानका सहभागीहरूको अधिकारबारे जानकारीका लागि, कृपया सम्पर्क गर्नुहोस्: इन्स्टिच्युसनल रिभ्यू बोर्ड, युनिभर्सिटी अफ सेन्ट्रल फ्लोरिडा, अफिस अफ रिसर्च एण्ड कमसियलईजेसन, 12201 रिसर्च पार्कवे, सुट 501, अलान्डो, फ्लोरिडा 32826-3246 वा टेलिफोनमार्फत (407) 823-2901.

## APPENDIX E: INTERVIEW GUIDE-ENGLISH

*Tutung; Ramechhap, 2016: PI Emily Dovydaityte; Faculty Advisor Rani Vajravelu, PhD.*

## Interview Guide for Research Project “Implications of Insufficient Access to Sanitary Water on Medicinal Plant Usage in Rural Nepal”

Thank you for taking the time to speak with me today. I’m Emily Dovydaityte from the University of Central Florida, and I’m the Co-Investigator for the research project, titled: “Implications of Insufficient Access to Sanitary Water on Medicinal Plant Usage in Rural Nepal.” I would like to interview you about your experiences with and insights into water consumption, health care, and medicinal plants. All of the information you give me will be confidential. The interview is voluntary, will take between 45 and 60 minutes, and will be audio recorded. I may also request to do a follow-up interview. I would like to start now; is that okay?

Date: \_\_\_\_\_ Interviewee Number/Pseudonym : \_\_\_\_\_

**I’d like to ask you a few questions that would help me clarify and understand your experiences.**

1. How do you collect your water?

Possible probe: How far away is your water source?

2. Do you clean your water before drinking it? If you do, please explain how.

3. Are you familiar with solar disinfection?

4. How do you make fire?

Possible probe: If you use plants to make fire, what plants do you use?

*Tutung; Ramechhap, 2016: PI Emily Dovydaitis; Faculty Advisor Rani Vajravelu, PhD.*

5. What illnesses are most common in your area?
6. How do you treat these illnesses?
7. What health care provider do you visit most often?
8. Do you use plant or herbal preparations to treat illness?
9. If so, what is your source of medicinal plants?
10. If you collect plants for your treatment, do you uproot them or leave the roots in the ground?
11. How often do you seek help from local medicinal plant experts?

*Tutung; Ramechhap, 2016: PI Emily Dovydaitis; Faculty Advisor Rani Vajravelu, PhD.*

12. If you believe they are experts, what makes you trust their knowledge?

13. How far are you from the nearest health outpost or government clinic?

14. Do you prefer seeking medical treatment from local healers or doctors in healthcare clinics?

Possible probes:

- a. Does cost play a role in choosing which doctor to visit?
- b. Does distance play a role in choosing which doctor to visit?

15. Are there conservation efforts in your area?

Possible probes: Are there tree planting programs in your area?

**Thank you very much for your time. Please don't hesitate to contact me if there's anything else that you would like to add that you have not had a chance to say during this interview.**

**Here's my contact information:**

*Emily Dovydaitis*- Phone: +1 (407) 547-9787

Email: [emily.dovydaitis@knights.ucf.edu](mailto:emily.dovydaitis@knights.ucf.edu)

## APPENDIX F: INTERVIEW GUIDE-NEPALI

टुटुङ; रामेछाप, 2016: पीआई इमिली डोभिडेसि; फ्याकल्टी एडभाइजर रानी बज्रभेलु, पीएचडी.

## “नेपालको ग्रामिण क्षेत्रमा जडिवुटी प्रयोगमा सफा पानीको अपर्याप्त पहुँचको परिणाम” अनुसन्धान परियोजनाका लागि अन्तर्वार्ता गाइड

मसँग आज कुरा गर्ने समय दिनुभएकोमा धन्यवाद । मेरो नाम इमिली डोभिडेसि हो । म युनिभर्सिटी अफ सेन्ट्रल फ्लोरिडाबाट हो र म “नेपालको ग्रामिण क्षेत्रमा जडिवुटी प्रयोगमा सफा पानीको अपर्याप्त पहुँचको परिणाम” शीर्षकको अनुसन्धान परियोजनाको सहअनुसन्धाता हुँ । म तपाईंसँग पानीको खपत, स्वास्थ्य हेरचाह र जडिवुटी वनस्पतिको बारेमा तपाईंको अनुभव र अन्तर्दृष्टिबारे अन्तर्वार्ता गर्न चाहन्छु । तपाईंले मलाई दिएको सबै सूचना गोप्य रहनेछ । अन्तर्वार्ता स्वेच्छिक हो र यसका लागि 45 देखि 60 मिनेटसम्मको समय लाग्नेछ र अडियो रेकर्ड हुनेछ । मैले अर्को एउटा फलोअप अन्तर्वार्ताका लागि अनुरोध गर्न पनि सक्छु । म अहिले शुरू गर्न चाहन्छु; ठीक छ?

मिति: \_\_\_\_\_ अन्तर्वार्तादाताको संख्या/उपनाम: \_\_\_\_\_

**म तपाईंलाई केही प्रश्नहरू सोध्न चाहन्छु जसले मलाई तपाईंको अनुभव स्पष्ट पार्न र बुझ्न सहयोग गर्नेछ ।**

1. तपाईंले पानी कसरी संकलन गर्नुहुन्छ?

सम्भावित थप प्रश्न: तपाईंको पानीको स्रोत कति टाढा छ?

2. के तपाईंले पिउनुअघि तपाईंको पानीलाई सफा गर्नुहुन्छ? गर्नुहुन्छ भने, कृपया कसरी गर्नुहुन्छ भनी वर्णन गर्नुहोस् ।

3. के तपाईं घामबाट पानी स्वच्छ पार्ने विधिसँग परिचित हुनुहुन्छ?

टुटुङ; रामेछाप, 2016: पीआई इमिली डोभिडेसि; फ्याकल्टी एडभाइजर रानी बज्रभेलु, पीएचडी.

4. तपाईंले आगो कसरी बाल्नुहुन्छ?

सम्भावित थप प्रश्न: यदि तपाईंले आगो बाल्न काठ प्रयोग गर्नुहुन्छ भने, कुन जातको काठ प्रयोग गर्नुहुन्छ?

5. तपाईंको क्षेत्रमा सबैभन्दा धेरै मानिसलाई के रोग लाग्छ?

6. त्यो रोगलाई तपाईंहरूले कसरी उपचार गर्नुहुन्छ?

7. तपाईं सबैभन्दा धेरै जाने स्वास्थ्य हेरचाह प्रदायक को हो?

8. के तपाईंले विरामी भएको बेला उपचार गर्न वनस्पति वा जडिबुटी प्रयोग गर्नुहुन्छ?

9. हो भने, जडिबुटीको लागि तपाईंको स्रोत के हो?



टुटुङ, रामेछाप, 2016: पीआई इमिली डोभिडेसि; फ्याकल्टी एडभाइजर रानी बज्रभेलु, पीएचडी.

10. यदि तपाईंले तपाईंको उपचारका लागि वनस्पति संकलन गर्नुहुन्छ भने, के तपाईंले त्यसलाई जर्दैदेखि उखेल्नुहुन्छ की जरालाई जमिनमै छोडिदिनुहुन्छ?
11. तपाईंले स्थानीय जडिबुटी विज्ञहरूबाट कतिको सहयोग माग्नुहुन्छ?
12. यदि तपाईंलाई उनीहरू विज्ञ हुन् भन्ने लाग्छ भने, तपाईं उनीहरूको ज्ञानलाई के कारणले विश्वास गर्नुहुन्छ?
13. तपाईं तपाईंको सबैभन्दा नजिकको स्वास्थ्य संस्था वा सरकारी स्वास्थ्य चौकीबाट कति टाढा हुनुहुन्छ?
14. तपाईंले स्थानीय उपचारक वा स्वास्थ्य क्लिनिकका चिकित्सकमध्ये कोसँग उपचार गर्न चाहनुहुन्छ?  
सम्भावित थप प्रश्नहरू:
  - a. कुन डाक्टरकहाँ जाने भनेर छान्न लाग्ने खर्चले भूमिका खेल्छ?
  - b. कुन डाक्टरकहाँ जाने भनेर छान्न कति टाढा छ भन्ने कुराले भूमिका खेल्छ?

टुटुङ; रामेछाप, 2016: पीआई इमिली डोभिडेडिस; फ्याकल्टी एडभाइजर रानी बज्रभेलु, पीएचडी.

15. के तपाईंको क्षेत्रमा संरक्षण प्रयासहरू गरिएका छन्?

सम्भावित थप प्रश्नहरू: के तपाईंको क्षेत्रमा वृक्षारोपण कार्यक्रमहरू छन्?

तपाईंको समयका लागि धेरै धन्यवाद । तपाईंको अन्तर्वार्ताको क्रममा तपाईंले भन्न नपाएका केही कुरा थप्न

चाहनुहुन्छ भने मलाई सम्पर्क राख्न नहिचकिचाउनुहोला । मेरो सम्पर्क विवरण यसप्रकार छ:

इमिली डोभिडेडिस - फोन: +1 (407) 547-9787 ईमेल: [emily.dovydaitis@knights.ucf.edu](mailto:emily.dovydaitis@knights.ucf.edu)

## APPENDIX G: PHOTOGRAPHS OF DUMRIKHARKA



*Figure 4: The sparsely shaded hike up to Dumrikharka, as viewed from a neighboring hill.*





*Figure 5: Maize field, outhouse (small clay structure with roof on the front left), goat pen (bamboo structure in the front right), homestay family's house with blue balcony.*



*Figure 6: Aama watches over the goats.*





*Figure 7: Morning tea before breakfast in the guest bedroom.*



*Figure 8: A half-finished plate of dal bhat tarkari.*





*Figure 9: Aama in the kitchen. Note the charred wood and black soot covering the surface of the pots and the walls.*



*Figure 10: Morning routine at Shree Shram Primary School.*





*Figure 11: The welcome ceremony, complete with flower necklaces and a student adding red tikka to our foreheads.*



*Figure 12: The black pipe which supplies water in Dumrikharka. Note how it lacks a tap and first be separated to access the water.*





*Figure 13: The area below Dumrikharka's water pipe is laden with water and clouded by laundry soap.*



*Figure 14: Buba carrying a heavy metal container commonly used by many Nepalis to collect water.*





*Figure 15: View from the homestay overlooking the large tree where Dumrikharka's village group meets.*



*Figure 16: Aama harvesting firewood in a tall tree before preparing dinner.*





*Figure 17: Communal water cup at Shree Shram Primary School.*





*Figure 18: A large peepal, Ficus religiosa, tree.*





*Figure 19: Inside the produce pavilion at the Ramechhap Bazaar.*



*Figure 20: Produce and spices for sale at the Ramechhap Bazaar.*

## APPENDIX H: PHOTOGRAPHS OF TUTUNG





*Figure 21: Nascent soy plants sprout between flooded rice terraces.*



*Figure 22: The Thapa family's home surrounded by plants, including many edible varieties.*





*Figure 23: The Thapa family's water supply (a red nozzle and black pipe filling a metal container in the lower right corner) is located just steps from their house.*





*Figure 24: Bhagabati Thapa, aama, welcomes me into to her home with a plate of dal bhat.*



*Figure 25: Dharma Thapa, buba, weaves a basket.*





*Figure 26: "Eat this!"*



*Figure 27: Artemisia indica, known locally as titepati, is used to treat leech bites and hypertension in Tutung.*





*Figure 28: The Thapa family's fields are planted with rice during monsoon season.*



*Figure 29: Geeban Thapa removes maize stalks from a flooded field to make room for rice.*





*Figure 30: Dildash Thapa builds the terrace walls required for rice planting.*





*Figure 31: Saraswati Thapa amasses a large pile of grasses and herbs for the buffalo.*





*Figure 32: Utsab Thapa carries the buffalo food back home using a tumpline.*



*Figure 33: Geeban Thapa prepares the achar, or spicy pickle, for dinner using fruits from the plants surrounding the house.*





*Figure 34: Flat, dried rice and buffalo milk for breakfast.*



*Figure 35: A family preparing their rice fields.*





*Figure 36: A walking pathway is hidden amongst the rice terraces.*

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