RISK AND UNCERTAINTY ATTITUDE AND CLIMATE CHANGE PERCEPTION OF FORESTRY PROFESSIONALS IN NEPAL IN LINE WITH IPBES NFF NARRATIVES

A thesis submitted in partial fulfillment of the requirement for the degree of Master of Science in European Forestry

By

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Abstract

Forestry decisions are vital to address global forestry issues like the adverse effects of climate change and provide multiple value benefits of nature to humans. However, little research efforts have gone into understanding the factors affecting those major forestry decisions. The impact of forestry professionals' risk and uncertainty aversion attitude and their perception of climate change over adaptation decisions and forest management behavior were investigated in Nepal. It also explores the impact of adaptative behavior on the priority given to forests during management. Here, the theory of Planned Behavior and the New Ecological Paradigm forms the foundation for this study. This was done by an online survey (N=117) following the methodology of Holt and Laury's lottery choices to quantify their risk and uncertainty attitude combined with a questionnaire study about climate change and Nature Future Framework value. The study tested the hypothesis higher the risk and uncertainty aversion, the higher the tendency toward making adaptive decisions. It further tests forest management equally fulfills each Nature Future Framework value goal and climate change adaptation enhances those value goals. Results found that foresters on average are risk averse (5.12) and risk-neutral (5.7). The result falsifies the research hypothesis and shows that risk and uncertainty is not the main factor determining adaptation decisions, yet a risk-averse attitude helps to intensify adaptation decisions (0.037, p=0.075) already made. It is argued that adaptation behavior is affected by the legal barrier (42.3 percent) from policies and programs that limit the boundaries of decision-making authority provided to forest professionals. The result shows despite having a positive perception, forest professionals do not adapt until they have enough information to adapt. The result also found that Nature for Nature value goals are given more priority (43.12 percent) and climate change adaptation has a negative impact on the value of Nature for Society (-4.3, p=0.09). It is argued that Nature for Nature is more valued because Nepal's forest management follows protection-oriented and subsistence-based forest practices. The study concludes that having access to new information about the expected impacts of climate change, considering legal barriers, and allowing enough authority may convince forestry professionals to adapt in the future by redirecting forest management in such a way that it provides multiple benefits.

Keywords: Climate Change Adaptation, Risk Aversion, Uncertainty Aversion, Lottery choice, Forest, Perception, Nature Future Framework, Theory of Planned Behavior.

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Statutory Declaration

Karuna Karki

Name of the Student

Herewith I confirm that the submitted master thesis, titled “Risk and uncertainty Attitude and Climate Change Perception of Forestry Professionals in Nepal in line with IPBES NFF Narratives” is my own independent work and that I only used sources and resources listed therein and I have not made use of any inadmissible help from any other third party. I have clearly identified matters from other works, cited verbatim or paraphrased, as such. The submitted thesis of parts thereof has not been presented at any institution or higher education for the examination procedure.

Sep 1, 2022, Freiburg im Breisgau

Date, Place

Signature

Chapter 1: Introduction

Chapter 1 serves as an introduction to the study in which the background of the problem, context of the problem, theory and rationale of the research including overall research objectives along with hypothesis tested under the study are present. It additionally discusses the limitations of study and methodology chosen to accomplish the goals.

1.1 Research Background

Climate change is one of the major global challenges and has adverse impacts on forest ecosystems from rising in the frequency and intensity of natural disturbances (Van Aalst 2006), threatening forest ecosystems, altering the provision of goods and services and forest-dependent communities around the world (CIFOR & FAO, 2019) which has created a dilemma for policymakers and the public to relate and react appropriately to the uncertainties of climate change (Yousefpour and Hanewinkel 2016). Governments are under pressure to enact policies and investment initiatives for climate change adaptation in an environment where forests play a greater role, particularly as a carbon sink (Van Aalst 2006; Hochrainer-Stigler et al., 2014). Adaptation modifies forest management and practices, and forestry professionals can be reluctant to adopt it (Yousefpour et al., 2017). Proactive adaptation is the most frequently mentioned adaptive response (Berrang-Ford et al., 2011),which requires updated knowledge about climate change and its effects on forest ecosystems (Yousefpour et al., 2012) to optimize and may need modifications in the adaptive management actions at each decision point. To create management plans that may help in decreasing adverse effects and sustain productive forests, forest decision-makers ought to be aware of the nature and implications of climate change (Spiecker, 2003; Yousefpour & Hanewinkel, 2009).

Forest resource planning is a very complicated issue, owing to the multitude of broad-ranging criteria involved in the fundamental decision-making process, which affects criteria of various types, such as economic concerns (e.g., timber, forage, livestock, hunting, etc.), environmental concerns (e.g., soil erosion, carbon sequestration, biodiversity conservation, etc.) and social concerns (e.g., recreational activities, level of employment, population settlement, etc.)(Diaz-Balteiro & Romero, 2008). Forestry decisions involve huge areas, prolonged time horizons, and various stakeholders, which exacerbates the uncertainty associated with forest management planning (Kangas & Kangas, 2004). Apart from the uncertainty involved due to climate change and induced modifications in traditional forest management to adapt to CC, people relate to nature in multiple ways (Pereira et al., 2020) and with a wide variety of desirable nature futures, with different goals and visions which can be synergistic or in conflict with one another which makes the forest management challenging. The value of forests for which they are managed can be either complemented or compromised due to the alternation in the forest while adapting to climate change. Realizing the multiple value perspective of nature, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Expert Group on Scenarios and models develop the Nature Futures Framework (NFF) which distinguishes three broad value perspectives: Nature for Nature, Nature for Society, and Nature for Culture (Pereira et al., 2020). Further translating the NFF value goals of managing the forest as Nature for Nature, Nature for Society, Nature for Culture, and actions preferred to reach those goals to the local condition of Nepal will help to identify diverse values for nature and embrace the diversity of human forest relationships that reflect three primary value perspective of forest (i.e., intrinsic, instrumental and relation) and management decisions to reach the preferred future of forest values. Moreover, whether such management decisions are influenced by the risk attitude of decisions markers are barely studied.

This study is guided by two main theories: The theory of Planned Behavior (TPB) (Ajzen, 1991) and the New Ecological Paradigm (NEP) (Dunlap et al., 2000). The TPB (Ajzen, 1991) is a widely accepted behavioral decision-making theory and NEP is developed by Dunlap et al., 2000 to specifically reveal respondents' perception on climate change are applied in this study to establish relationships between perceptions, attitudes, and behavior. Informing decision-makers about climate change and potential adaptation measures seems also to be crucial, it is observed that adaptation is not sufficiently implemented by foresters (Andersson & Keskitalo, 2018), and it is believed this lack of implementation can be explained by their attitudes towards risk and uncertainty, perception of climate change and knowledge about adaptative measures. Once it involves decision-making concerning global climate change, environment conservation, and resource allocation for the future, knowledge of risk attitudes becomes crucial for effective policy actions (Wouter Botzen et al., 2014; Vollmer et al., 2016). Decisions under global risks are influenced by the risk attitude of the decision-maker (Blennow et al., 2012; Sauter et al., 2018a). The impact of foresters' risk aversion on a variety of decisions, including rotation length (Alvarez & Koskela, 2006; Clarke & Reed, 1989; Gong et al., 2003), forest investments (Kangas,1994), the decision to replant or not after clear-cutting (Lien et al., 2007), and climate change decisions (Brunette et al., 2015 are investigated till date. Foresters' perceptions of climate change and adaptation options are becoming increasingly important (Blennow et al., 2012; Lawrence & Marzano, n.d.; Sousa-Silva et al., 2016; Yousefpour et al., 2015) as they play a critical role in the development and implementation of adaptation strategies, policies, and actions (Keenan, 2015). Risk attitudes and their interaction with other aspects is a crucial driver, especially in the context of increased application of models for policy and market scenario analysis (Lönnstedt & Svensson, 2010; Sauter et al., 2018a).

The forestry sector in Nepal is state-controlled and forest management is community-based where the foresters professionals play an important role as a facilitator in the natural resource management sector but the attitude, perceptions, and behaviors of the foresters are barely studied. Particularly, in Nepal, forestry professionals’ risk and uncertainty preferences has not attracted sufficient attention as well as there has been minimal attempt to see the relation of attitude and perception of forestry professionals on their adaptation decisions. Additionally, translating IPBES NFF values in local conditions and exploring the major goals under each value and preferred strategies in Nepal will form baseline for further research in forestry values in relation with IPBES NFF. Furthermore, the impacts of climate change on multiple values of forest especially here with NFF values in the changing forest-human nexus has not been considered earlier. It is expected that forest professionals’ role to be crucial in managing forests while coping with climate change adaptation as well as managing the forest to reach the preferred future with values to each goal of the IPBES NFF triangle. It is also expected that forest professionals’ risk and uncertainty attitudes and climate change perceptions and knowledge have impacts on their adaptation decision as well as managerial decisions. Therefore, this study aims to explore and establish the relationship between them along with perceived barriers in the adaptation.

1.2 Research Objectives

In this study, government forest professionals working in forest divisions and protected areas of Nepal were focused as a sample who are directly involved in forest management activities and in decision-making. The main objectives of the research were:

a. To explore the effects of risk, and uncertainty attitude and the climate change perception of the forest professionals on their CC adaptive behavior (adaptative decision making and adaptation intensity) and management behavior in relation to IPBES NFF value perspectives narratives in Nepal.

b. To visualize the nature future framework narrative in the case of Nepal on three broad value perspectives: Nature for Nature, Nature for Society, and Nature for Culture for a preferred future of nature as well as its relationship with the CC adaptation interventions.

It was done by developing the questionnaire using lottery choices to measure preferences towards risk and uncertainty attitude. For this data about the general characteristics of forest professionals, the forest they manage, their climate change perceptions, climate change adaptations, and values as Nature for Nature, Nature for Society and Nature for Culture as well as goals and strategies at the local condition of Nepal were also collected.

Specifically, this study was focused on testing the following hypotheses:

1. Higher the risk and uncertainty aversion of respondents, the higher the trend toward changing management objectives and making adaptive decisions.

2. Informed forest professionals about climate change tend to practice adaptive activities.

3. Preferred future of nature management in Nepal equally fulfills the goals of Nature for Nature, Nature for Society and Nature for Culture and climate change adaptation practices enhances such values.

1.3 Limitations of the Study

Although the research has reached its goals, there were some unavoidable limitations. First, because of online questionnaire survey, it might not represent all age groups of forest professionals, professionals from all the districts and respondents with very limited internet access. This might have discouraged participants who are not comfortable with online platforms. Therefore, to generalize large the results for large group, the study should include more participants working in all the districts of Nepal and all the age groups. Second, this data collection time coincides with the closing period of Fiscal year when forest professionals are mostly very busy which might have limited foresters' participation in the survey. Finally, the survey focusses mainly forest professionals working in the field level offices and does not include professionals working in policy level.

Chapter 2: Literature Review

This chapter reviews existing literature on the topics included in this study. It starts with the existing literature on risk and uncertainty aversion, discusses the methodologies used in previous studies and findings. Additionally, it focuses on climate change situation globally and locally in Nepal, previous studies relating to adaptation decisions to cope with climate change and discusses the adaptation strategies practiced in different parts of the world. This adaptation strategies also forms the basis for the questionnaire. This section ends by introducing Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and Nature Future Framework (NFF) and studies done using this framework.

2.1 Risk and Uncertainty

The frequent economic decisions made by foresters involve risk which makes a thorough understanding of risk attitudes crucial for comprehending and modelling their choices as well as for creating customized policies (Sauter et al., 2018a). Methods for eliciting individual risk attitudes typically involve economic experiments or questionnaires. Economic experiments have become the most widely used methodology for eliciting risk attitudes due to several advantages (Lönnqvist et al., 2015). The Holt and Laury (HL) task (2002) has been established as a "gold standard" in determining participants' individual constant relative risk aversion (CRRA) coefficient (Anderson and Mellor, 2009) because it comprises several decision situations, each of which presents a choice between two lotteries: one being a rather safe option and the other a rather risky option. This methodology was largely used in the forest economics literature (Musshoff & Maart-Noelck, 2014; Sauter et al., 2018). (Musshoff & Maart-Noelck, 2014) used the decision-maker's risk attitude measured by a Holt and Laury lottery is explicitly considered for determining the normative benchmark. Sauter et.al 2018 compared the elicited risk attitudes of foresters in the incentivized tasks according to Holt and Laury (2002) and Eckel and Grossman (2002). Brunette et al., (2020) also used the Multiple Price List (MPL) procedures as proposed by Holt and Laury (2002) to elicit the forestry professional's preferences towards risk.

Musshoff & Maart-Noelck, (2014) surveyed 79 decision-makers from German forestry organizations and find that they are mostly risk averse. On samples from German foresters, Sauter et al. (2016a) and Sauter et al. (2016b) confirmed this result. Brunette et al., (2017a) analyzed the risk attitude of French foresters and finds that French foresters are risk-averse on average and characterized by a relative risk aversion coefficient of approximately 1. It is possible to determine the relative risk aversion coefficient on the hypothesis that the von Neumann-Morgenstern expected utility function accurately represents the behavior of foresters. The strength of the risk attitude is represented by this coefficient, which has a null value for risk neutrality, a positive coefficient for risk aversion, and a negative coefficient for risk-loving behaviors. They demonstrate that the probability of harvesting increases along with increase in risk aversion. Sauter et al., (2018) recently compared the risk preferences of 116 foresters and 150 farmers in Germany. They show that foresters are more risk averse than farmers on average. Brunette et al., (2015) also provides a literature review on risk attitude measurements in resource economics. They found no significant differences in risk attitudes between farmers and foresters using a meta-analysis. Due to the small number of research that has examined foresters' risk attitudes to date (Brunette et al., 2015), it has been difficult to come up with clear statements and assumptions about their risk attitudes. It is extremely difficult to quantify foresters' uncertainty preferences. In a study on the willingness to pay for forest fire insurance, Brunette et al. (2013) discovered that French foresters are risk averse. Brunette et al. (2017b) demonstrated in a theoretical article that foresters' uncertainty preferences play a role in defining a forest insurance contract and Brunette et al. (2020) found uncertainty aversion has no effect on climate change adaptative decisions. In Nepal, Begho, (2021) studied the effect of risk attitude of farmers on the adoption of improved crop varieties and found that risk-tolerant farmers have the lowest propensity to adopt new improved rice varieties. But risk and uncertainty attitude and their impacts on forestry decisions studies with forest professionals has not been done yet in Nepal.

2.2 Climate Change Adaptation Decisions

Climate change has serious consequences for forest ecosystems, affecting the provision of goods and services globally. Forests experiencing unusually high tree mortality rates can experience irreversible ecosystem changes of uncertain trajectory and such mortality occurs even in ecosystems that historically have been considered relatively resistant to hotter-drought climate extremes has raised concerns about global forest health under ongoing climate change (Hartmann et.al., 2022). Climate change, specifically rising temperatures, shifting precipitation patterns, and extreme weather events, will inevitably have far-reaching consequences forestry. The upward shifting of vegetation and species range in the northern mountains, changes in phenological cycles, such as flowering, fruiting, and leaf shedding of plant and tree species, and changes in the availability and regeneration patterns of forests and non-timber forest products (NTFPs) have all been observed as effects of climate change on forests and biodiversity in Nepal (MoFE, 2021). Because of their reliance on climate-sensitive livelihood options and limited adaptive capacity to adapt to adverse climatic changes, rural hills and mountainous communities are expected to be hit hardest (Mainali & Pricope, 2019). In terms of the South Asian country Nepal, greenhouse gas (GHG) emissions account for only 0.027 percent of global emissions (MoPE, 2016); however, the country has experienced the harsh consequences of climate-induced disasters (MoHA, 2019). According to the climate change vulnerability index, Nepal is one of the most vulnerable countries to floods, landslides, erratic rainfall, or glacial lake outburst floods (GLOF) (Eckstein et.al, 2019). According to (Omerkhila et al.,2020), the hilly and plain zone has a severe climate and is particularly susceptible to pest and disease outbreaks due to their high frequency. Additionally, CC had an impact on greater temperatures and more erratic rainfall.

Adaptation is required to deal with adverse climatic stresses and hazards, as well as to seize opportunities such as new innovations, which can be applied to current, actual, or projected conditions (Smit et al.,1999). Management strategies are suggested to adapt forests to upcoming environmental changes and lessen their negative effects to deal with how the climate change impacts forests (Yousefpour et al., 2012). Meanwhile, the Government of Nepal introduced the National Adaptation Program of Action (NAPA) (GoN, 2010), the Local Adaptation Plans for Action (LAPA) (GoN, 2011), and the Climate Change Policy, (2019) to adapt to the effects of climate change and establish institutional arrangements (GoN, 2019 b). These plans and policies also emphasize the preservation and sustainable management of forest resources to mitigate the effects of climate change (Rijal et.al, 2021a). Community forest user groups (CFUGs) are prioritized as local institutions that can play a critical role in climate change adaptation and mitigation (Regmi et.al., 2013). CFUGs engage in protection-oriented programs like preventing forest fires, combating encroachment and the illegal logging of forest products, regular monitoring and awareness-raising campaigns, and sustainable silvicultural techniques to ensure the sustainable utilization of the forest resources based on operational plans (legal documents with legitimized provisions for forest management) (Acharya, 2002; Dhungana, 2018). The Divisional Forest Officer (DFO), as well as national and state government agencies, are authorized to monitor and assess the plan's operations.

Community-based fire risk reduction through monitoring and managing fire control lines has been one of the most effective strategies that communities have put in place (Rijal et.al, 2022). Many studies recommend using non timber forest products (NTFPs) as one of the major options for climate change adaptation for agro ecosystems (Ali et al., 2017; Ingxay et al., 2015; Macchi et al., 2015). People consume and trade NTFPs to adapt to the changing climate (Ingxay et al., 2015; Macchi et al., 2015) as NTFPs buffer the loss of income from low crop yields (Ali et al., 2017). Removal or use of invasive plant species in preparation of organic manure and bio-briquette can be also an adaptation strategy (Adhikari et al., 2018). To successfully restore degraded lands, foresters must reconsider the selection, production, and out-planting of native trees in a dynamic context rather than the monoculture exotic plantation to create connectivity across landscapes and adaptability to changing climates (Rehfeldt et.al, 2015). Community-based restoration and conservation of water ponds were other examples of community-level adaptation to water shortage (Adhikari et.al 2018). People's perceptions of climate change frequently reflect their concerns about the specific threat of climate change on their daily lives (Ayal and Leal Filho 2017). Understanding climate change adaptation problems and delivering potential solutions thus requires an understanding of public perception of climate change (Weber 2010).

Van Gameren and Zaccai (2015) conducted a qualitative study with semi-structured interviews of 32 private forest owners in Wallonia, Belgium to examine the measures that have already been put in place or are being planned for adaptation to climate change, as well as the ability of the owner to adapt. Sousa-Silva et al. (2016) conducted an online survey of 220 private forest owners and 171 public managers in Belgium to learn how they view the role of their forest management in the context of climate change. They discovered that private owners are, on average, less likely than public managers to have modified their management practices. When

836 Swedish private forest owners' adaptation processes were examined by Vulturius et al. (2018), they discovered that cognitive elements are the only ones that statistically significantly explain the forest owner's intention to adapt to climate change. Sousa Silva et al. (2018) evaluated how forest owners and managers in seven European nations perceived their role in adapting forest management to climate change using data from online surveys of 1131 forest owners and managers. Brunette et al. (2020) assessed forest managers' attitudes about risk and uncertainty and its effects on climate change decisions and adaptation intensity by an online survey of 88 forest managers from Germany and France. Eriksson and Fries (2020) gathered responses from 1251 Swedish private forest owners to a postal questionnaire aimed at examining the current knowledge, confidence, and value basis of forest management behaviors, including different management strategies and management activity, and found that different knowledge dimensions and value priorities were jointly important for forest management behaviors.

2.3 IPBES NFF Narrative

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is actively promoting the creation of new narratives about desired nature futures around the world. The IPBES Task Force on Scenarios and Models is responsible with facilitating the development of new nature-centered multi-scale scenarios that are grounded on positive visions for human relationships with nature, based on the findings of the IPBES Thematic Assessment on Scenarios and Models. (IPBES 2016, 2019b). The conception of the Nature Futures Framework (NFF) has been a significant accomplishment thus far. This heuristic tool is used for the collaborative development of visions and narratives to open a variety of perspectives on people-nature relationships, while also providing a structure for consistency in the development of nature scenarios across multiple scales and diverse contexts (Pereira et al., 2020). The Nature Futures Framework is designed to be applied flexibly and in a variety of ways, ranging from structuring participatory visioning processes to quantitative modelling assessments and ex-post evaluations of existing scenarios (IPBES, 2021).

The Nature Futures Framework is a heuristic tool that may be used to create a variety of nature-centered scenarios. The framework incorporates people's values into narratives that may be translated into collective action (Pereira et al., 2020). It distinguishes three broad value perspectives: a) Nature for Nature, in which nature has value in and of itself. Nature should maintain its ability to function autonomously, and the preservation of nature's diversity and functions is of primary importance; b) Nature for Society, in which nature is primarily valued for the benefit for humans; c) Nature as Culture, in which humans are perceived as an integral part of nature, where societies, cultures, traditions and faiths are intricately intertwined with nature, and relational values, such as those that reflect cultural identities and ways of life, are dominant (Pereira et al., 2020).

While most people recognize all three types of values, contrasting perspectives can be identified at the corners of a ternary plot where one value type dominates each corner (Figure 1): (i) Nature for Nature (eco-centric intrinsic values of nature dominate) where nature has value in and of itself without direct human benefits and the preservation of nature's functions is of primary importance; (ii) Nature for Society (utilitarian values dominate) is a perspective leading to a set of multiple uses of nature for the benefit of people (Pascual et al., 2017); (iii) Nature as Culture (relational values dominate) is a perspective, often expressed in local knowledge systems where nature is shaped by culture and vice versa and where people's identity is associated with nature (Chan et al., 2012, 2016).

Other classifications of human-nature links are used in the Nature Futures Framework. For instance, (Mace 2014) identifies four major stages in the current conservation: Nature for itself, Nature despite people, Nature for people, People and nature; (Chan et al. 2016) define three important value kinds underlying nature conservation as instrumental, intrinsic, and relational, which are also central to IPBES' guide on multiple values (IPBES 2015).The NFF is based on an in-depth analysis of a wide range of visions of positive futures for biodiversity and people (Lundquist et al. 2017; Pereira et al. 2020) and embraces the diversity of human-nature relationships that reflect three primary value perspectives of nature (i.e., intrinsic, instrumental, and relational).

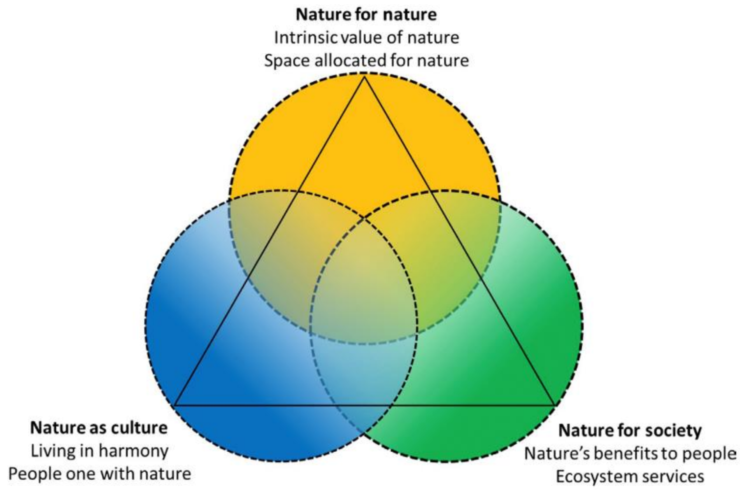

Figure 1. The Nature Futures Framework triangle (Source: PBL, 2018)

Nature assessments frequently focus on natural sciences or economics without considering why and how people care about nature (IPBES, 2019; Millennium Ecosystem Assessment, 2005; UNEP, 2019). The NFF approach, in contrast, emphasizes reciprocal links between people and nature within the entirety of the triangle space as opposed to only people's impact on nature, or nature's impact on people. As discussed in the IPBES conceptual framework, it highlights the significance of a pluralistic notion of values in contrast to monistic approaches to human-nature relationships that are dominated by a single worldview (and may overemphasize only one target, such as the conservation of biodiversity, economic growth, social development, or poverty alleviation, or the inclusion of indigenous knowledge) (Díaz et al., 2015; IPBES Plenary, 2016; Pascual et al., 2017).

It is feasible to adapt the NFF to many circumstances and identify various behavioral changes connected to specific political, legal, and sociocultural perspectives by accepting value pluralism. It is hoped that the case study insights will be used to refine the global scenarios further, as well as to develop more diverse sets of indicators to assess progress toward the goals for nature that incorporate more diverse value perspectives (IPBES/7/INF/112). Several studies have used IPBES NFF framework to explore pluralistic perspectives on nature's future. Mansur et.al ,2021 used NFF framework for exploring urban relations with people, Kuper et.al 2022 explored desirable futures for nature and people in National Park Hollandse Duinen in the Netherlands and Payne et.al 2020 have explored interactions between nature and people in the Andes, the East African mountains, the Alps, and the Himalaya. Place-based applications of the NFF may offer insights into the similarities and differences between desired visions of nature around the world and their translation into goals and targets; identify scalable policies and actions that enable pathways towards these desired futures; and develop more diverse sets of indicators that reflect these visions and pathways, as well as the diversity of value perspectives they represent, to assess progress along these pathways (Pereira et al. 2020).

The United Nations agreed on 17 Sustainable Development Goals to be achieved by 2030 in 2015, and how forests are managed has implications for several of these goals, including clean water and sanitation (goal 6), affordable and clean energy (goal 7), climate action (goal 13), and life on land, including sustainable forest management (goal 15) (UN,2015). In this context, there is an increasing societal demand to use and manage the forest for production, biodiversity conservation, carbon sequestration, and people's health and well-being (Bellassen and Luyssaert 2014; Jactel et al. 2017; Lagergren and Jönsson 2017; Trivino et al. 2017). Management decisions are based on value priorities given like foresters (owners) emphasizing the interests of others and placing less emphasis on more traditional values tend to be more likely to participate in conservation programs (Drescher et al. 2017), and who value production as well as ecological forest values, have been found to be associated with climate change adaptation (Eriksson 2018b).

Chapter 3: Materials and Methods

This chapter explains in brief the materials and methods used in conducting this research. It starts with the description of study area. Additionally, it focuses on the method used in data collection. It further explains the questionnaire designs in detail, elicitation methods and econometrics used in data analysis. Moreover, it also presents the IPBES NFF framework translated in the context of Nepal. Finally, it presents the framework of the study for each hypothesis.

3.1 Study Area

Nepal has a total land area of 147,516 km^2 and is in the Central Himalaya. Hills and high mountains in the north cover approximately 86 percent of the total land area, with the remaining 14 percent being Terai flatlands in the south with altitudes ranging from 67 m in the south-eastern Terai to 8,848.86 m (NMA,2020) at the peak of the world's highest mountain, Sagarmatha (Mount Everest) in the north (MFSC, 2009). Forest covers (shown in Figure 2), 5.96 million ha in Nepal, making up for 40.36 percent of the country's total land area. Other Wooded Land (OWL) encompasses 0.65 million hectares (4.38 percent). Forest and OWL cover 44.74 percent of the country's total land area. (DFRS,2015). Nepal has established a very good network of Protected Areas system with 12 National Parks, 1 Wildlife Reserve, 1 Hunting Reserve, 6 Conservation Areas, and 13 Buffer Zones extending from lowland Terai to high mountains, covering 23.39 % of the total country's land, which contribute to in-situ conservation of ecosystems and biodiversity across the country (DNPWC,2022).

The country's unique geography, with dramatic changes in elevation along the relatively short (150- 250 kilometers) north-south transect, and associated variability in the physiographic and climatic conditions have resulted in an extremely rich diversity of flora and fauna in Nepal. The country's standing at the crossroads of two major biogeographic regions of the world (Indo-Malayan to the south and Palearctic to the north) has made Nepal a mixing place of species originating in both regions (Stainton, 1972). The climate of Nepal greatly varies from north to south and east to west. In general, climatic zones in Nepal are categorized by temperature regimes based on altitudinal ranges. These climatic zones are sub-tropical (<1,000 m elevation), warm-temperate (1,000–2,000 m elevation), cool-temperate (2,000–3,000 m elevation), alpine (3,000–4,000 m elevation) and arctic (>4,500 elevation). Phyto-geographically, Nepal is in the Oriental Region (Polunin, 1964). Tropical forests (< 1,000 m.) in Nepal are widely dominated by *Shorea robusta*, commonly called 'Sal Forest'. The Sal Forest is extended into subtropical region or foothill of the Himalayas up to 1,500 m (Gautam, 1990; Tewari, 1995).

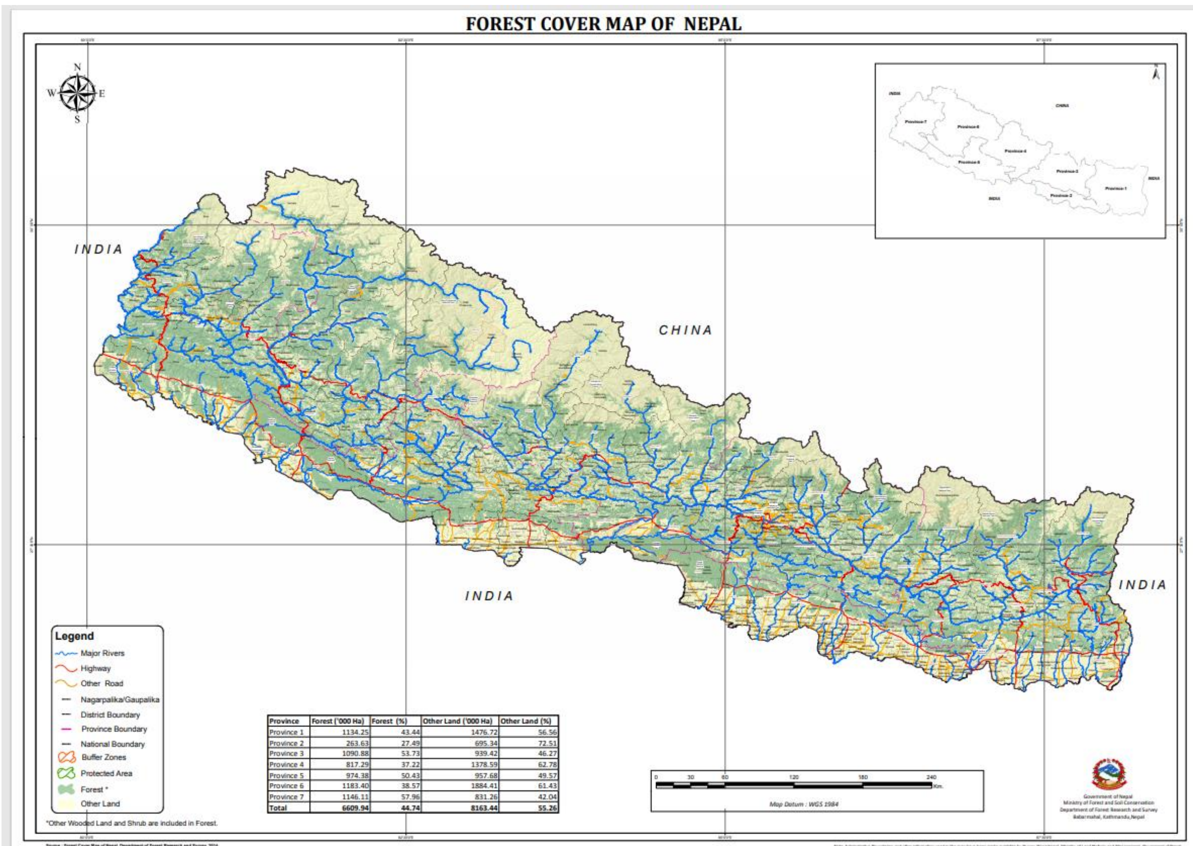

Figure 2 : Map of Nepal (*Source: FRTC 2020)*

The Ministry of Forests and Environment (MoFE) is a governmental body of Nepal responsible for the conservation of forests and managing the environment in the country at the central level with its 4 departments and 2 centers and the province forest ministry in all the 7 provinces at in provincial level where provincial forest directorates (FD) and 84 Division Forest Offices (DFOs) subordinate to provincial ministries. Protected areas are managed under the Department of

National Park and Wildlife Conservation (DNPWC) under MoFE. Each province has seven provincial ministries responsible for forests and the environment, with the goal of leading national forest management and regulating private forestry (MoFE,2019). Considering 80% of the population relies on natural resources for their daily needs, including food, fiber, fresh water, and medicine, and because forests provide approximately 90% of the country's energy needs, forests are crucial to Nepal's economy (BCN and DNPWC 2012). Nearly 40% of Nepalese people actively participate in the preservation and management of forest (Paudyal et al. 2017a). As of now, more than one-third of Nepal’s forests is managed by local communities under different community-based institutional arrangements. Nepal has been implementing Community Based Forest Management (CBFM) approach for the forest programs since 1976, with the formulation of National Forestry Plan, 1976. Recently, various modalities of forest management have been categorized as CBFM, which covers approximately 2.3 million hectares of forest, or 38.5 percent of total forest in the country, and involves more than 3.8 million households (DOF, 2015; Pathak, Yi and Bohora et.al 2017). Nepal appears to be at the forefront of CBFM practice globally (Ojha et al., 2007). Nepal has developed a successful system for community management of its forests in the Himalayan foothills, which are some of the most densely populated areas of the country, over the last quarter-century (Nagendra 2004).

3.2 Data Collection

Online based questionnaire data collection method was followed for this study. The questionnaire was sent to 250 government forestry professionals working in all the 77 districts of Nepal, especially those working in division forest offices and protected areas of Nepal in May 2022. Remainders were sent after 15 days to all the participants. Forestry professionals working in the forestry sector and protected areas were selected because of the similarity in forest types, impacts of climate change, and their difference in the management priority. The questionnaire was computerized, and participation was voluntary. A total of 220 forestry professionals connected to the questionnaire, 63 read the first page and did not answer any questions, 40 partially answered the questionnaire, and then finally we retained 117 individuals who completed the questionnaire in its entirety.

3.3 Questionnaire Design

This study follows the two theories: Theory of Planned Behavior and New Ecological Paradigm. Here, the risk and uncertainty aversion attitude and climate change perception are considered to explain the adaptation behavior. For that the questionnaire was composed of five parts: characteristics of the forestry professionals and the forest they manage (Part 1), elicitation of preferences towards risk and uncertainty (Parts 2 and 3), questions on adaptation decisions (Part 4), and IPBES nature future framework (Part 5). The first part of the questionnaire gathered information about the characteristics of the forest professional (gender, age, position, work experience, organization) and of the forest they manage (forest management type, species composition, dominant species, management objective). The fifth part of questionnaire focus on exploratory data on the NFF in the case of forestry in Nepal.

3.3.1 Elicitation of preference

For the second part of questionnaire, classical Multiple Price List (MPL) procedure proposed by Holt and Laury (2002) to elicit the forestry professional's preferences towards risk was used. This study follows a similar methodology to previous studies (Musshoff and Maart-Noelck, 2014; Sauter et al., 2016a; Sauter et al., 2016b; Sauter et al., 2018, Brunette et.al., 2019). This methodology was largely used in the forest economics literature (Musshoff and Maart-Noelck 2014; Sauter et al. 2016a; Sauter et al. 2016b; Sauter et al. 2018, Brunette et al.2019) and is more generally considered as a "golden standard" to elicit risk preferences (Anderson and Mellor 2009). In such a method, participants must choose ten lottery choices between two options, Option A and Option B. Option A is considered safe, while Option B is considered risky (Appendix 1 Table 4). For this purpose, a similar table to Brunette et al.2019 was used but the price in euros were converted to Nepali rupees to the nearest 500 range. The measure of the preferences is represented by the number of safe choices (ranging from 0 to 10), where the higher the number, the greater the risk aversion will be. Four safe choices are considered neutral. Less than four safe choices correspond to risk-loving at different degrees, while more than four safe choices characterized risk-averse foresters, from slight risk averse (five safe choices) to stay in bed (nine and ten safe choices).

The preferences toward uncertainty are elicited through an extension of the above procedure proposed by Chakravarty and Roy (2009) and was also used recently by Brunette et al.2019 to elicit uncertainty aversion of forest professionals from France and Germany. The forestry professional must choose between two options, Option A being risky and Option B being uncertain. Here, uncertainty is represented through urns. In the risky case (Option A, urn A), the distribution of probabilities is known with 50% of black balls and 50% of red ones. In the uncertain urn (Option B, urn B), the distribution of probabilities is not known.1 The measure of the preferences is represented by the number of risky choices (ranging from 0 to 10) with the higher the number, the higher the uncertainty aversion where five risky choices are considered neutral. Less than five risky choices correspond to uncertainty loving, while more than five risky choices characterized uncertainty-averse forestry professionals, from slight risk averse (six risky choices) to extremely uncertainty averse (ten risky choices).

3.3.2 Econometrics strategy

The data relating to risk and uncertainty preferences and those about the characteristics of the forestry professional and forest were used as explanatory variables for adaptation decisions. The individual's adaptation decision is composed of two parts. First, the study focuses on the climate change perception of forest professionals with multiple choice questions about the statement on climate change to understand their beliefs. The variable equals to 1 if they believe that statement, and otherwise stated 0. Then it focusses on the adaptation decision to climate change. The variable equals 1 if the forestry professional indicates having already modified the forestry practices to adapt to climate change, and 0 otherwise.

Figure 3 shows the framework for risk and uncertainty aversion, climate change perception and adaptation decisions along with the reasons for not adapting with barrier perceived in adaptation. The second part of the adaptation decision is the intensity of adaptation, i.e., the number of strategies selected by the forestry professional among the possible ones. This variable is then comprised of between 1 and 10. For this, we focus only on the respondents who have already adopted. The idea is that the higher the number is, the higher the intensity of the adaptation will be. To study the potential determinants of this intensity, a Poisson model for counted data was runed. In this analysis, the number of strategies were treated as the response, and the risk preference, uncertainty preference, and the characteristics of the forestry professional and forest were treated as predictors.

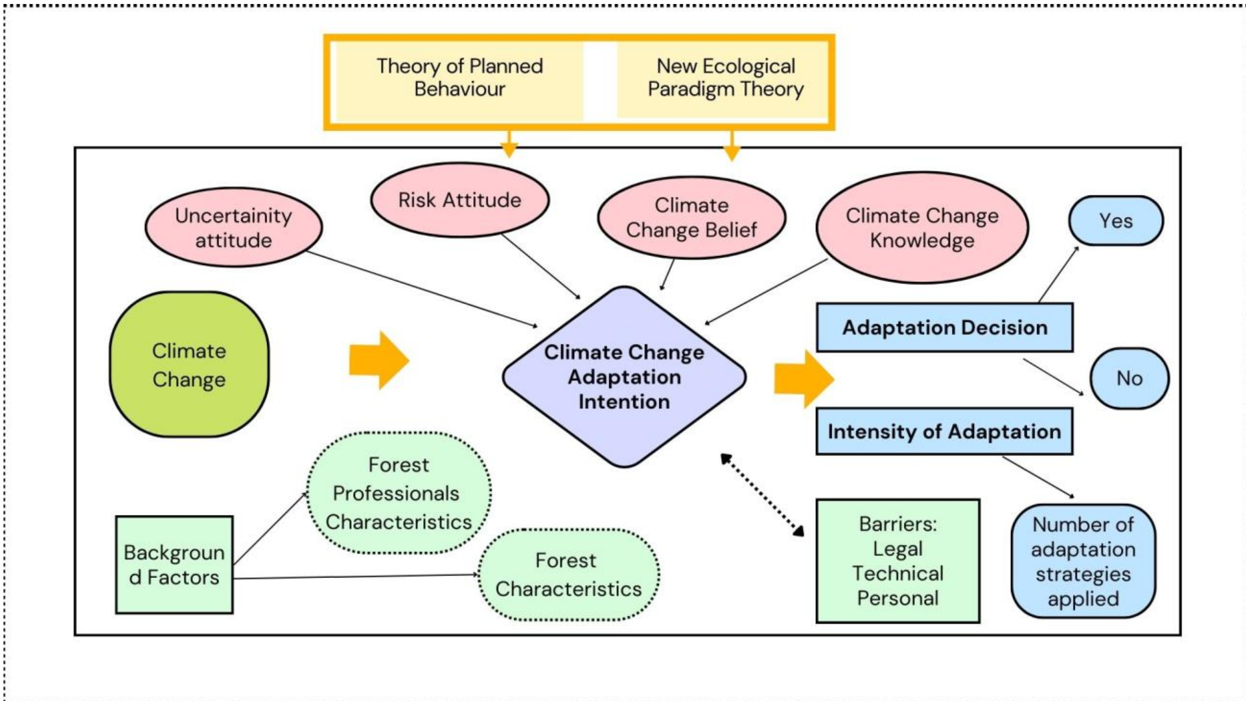

Figure 3. Framework for risk and uncertainty attitude, climate change perception and their impact on the adaptation behavior based on theory of planned behavior (Ajzen, 1991) and the new ecological paradigm (Dunlap et al., 2000).

3.3.3 IPBES NFF

This 5th part of the questionnaire consists of IPBES NFF Narratives, managing forest as Nature for Nature, Nature for Society, and Nature for culture. For this, the respondents were asked to give a value (percentage) to each of them (NN, NS, NC) based on the priority they give while managing a forest so that sum of the value makes 100%. This study further identifies the factors affecting the value given to each of them among the potential explanatory variables, risk uncertainty attitude and climate change perception. For the desirable future of the forest, goals of managing forests at each corner of the NFF framework triangle were explored for the local condition of Nepal. It also serves as the basis for the questionnaire where respondents were asked to rank all the goals at each triangle individually based on the priority given while managing the forest and achieving the goals. Further, based on the Figure 4 (NFF narrative translated to the scenario of Nepal), respondents are provided with a different set of goals while managing forests as Nature for Nature, Nature for Society, and Nature for culture and strategies to fulfill those goals. Each goal is given as a rank question, 1 being the most priority goal and 8 being the least priority goal. Managing Nature for Nature has 8 goals, managing Nature for culture has 8 goals, and managing Nature for society has 6 goals as shown in the figure 4.

Figure 4 : Value of Forest in Nepal with relation to IPBES NFF Narratives

The strategies to fulfill the above-mentioned goals respectively are given as multiple-choice questions. The variable equals 1 if the adaptation strategy is selected and 0 otherwise. Figure 5 shows the framework for managing forest as multiple value in relation to IPBES Nature Future Framework Narratives along with goals within each value and strategies preferred to reach each goals while managing Nature for Nature, Nature for Society and Nature for Culture based on figure 4.

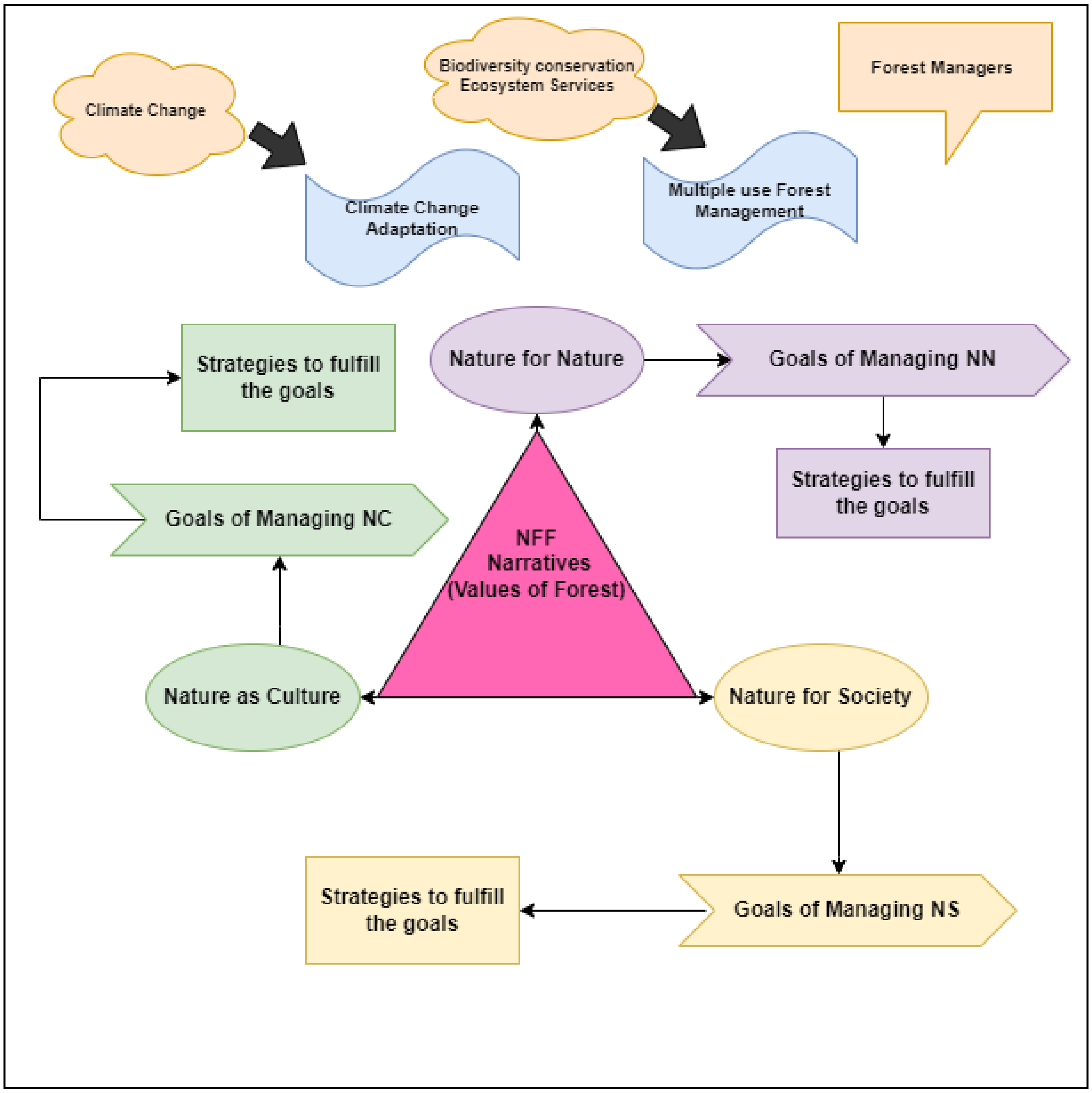

Figure 5. Framework of NFF narratives along with goals and actions to reach those goals in the context of climate change adaptation and multiple use forest providing biodiversity conservation and ecosystem services.

Chapter 4: Results

This chapter presents the results of the questionnaire, initially assessing the descriptive results of the sample. This is followed by the description of the forest they manage. It further presents the research results of risk and uncertainty preferences and present the results of regression analysis for the risk and uncertainty aversion with other explanatory variables. Similarly, it presents result for adaptation decisions and factors affecting the adaptation decision. It also identifies the preferred adaptation strategies and justification for not adapting to climate change. Then, the perceived barriers of climate change adaptation are also presented. Moreover, the values of managing forest as nature values based on IPBES NFF framework is presented along with factors affecting those value preference. Finally, it presents the goals of managing forest as Nature for Nature, Nature for Society and Nature as Culture and strategies to reach those goals.

4.1 Descriptive Analysis of Sample

4.1.1 Characteristics of Forest Professionals

The sample consists of 117 government forest professionals working in Nepal in division forest offices from 56 districts and 8 protected areas. Table 1 shows the descriptive results of the sample. The average age of the forestry professionals was 31 years (SD= 4.57) and the average work experience was 8 years (SD=5.29). Here, the age and work experience of sample forester professionals are highly positively correlated (0.884), *p*=0.01).

Table 1. Descriptive Results of Forest Professionals

Characteristics	Category	Frequency (N)	Percentage (%)
Sex	Female	41	35 %
	Male	76	65 %
Age	0-30	46	39.31 %
	30-40	64	54.7%
	Above 40	7	5.9%
Position	Officer Level	32	27.4%
	Assistant Level	85	72.6%
Experience	0-5	44	37.6%
	5-10	52	44.44%
	Above 10	21	17.9%
Organization	Forest	93	79.5%
	Protected Areas	24	20.5%

4.1.2 Characteristics of Forest

The respondents were asked to select multiple options from four given options that would indicate the type of forest they manage. Types of forests managed by the respondent are presented in table 2. It shows most of the respondents manage the community managed type of forest. Pearson bivariate correlation shows that the forest type community managed forest and private forest (0.370, p=0.01); community managed forest and plantation forest (0.332, p=0.01) are highly and positively correlated while community-based forest and protected area and buffer zone are highly negatively correlated (-0.806, p=0.01).Private forest (-0.179, p=0.53) and plantation forest (-0.189, p=0.041) are highly and negatively correlated with protected areas and buffer zone. It means that forest professionals managing community forest are more likely to manage private forest and plantation forest too. And forest professionals managing protected areas and buffer zone are less likely to manage private and plantation forest.

Table 2. Forest Type

Type of Forest	Responses		Percent of Cases
	N	Percent	
Community managed forest	94	44.5%	80.3%
Private forest	42	19.9%	35.9%
Protected areas and buffer zone forest	32	15.2%	27.4%
Plantation forest	43	20.4%	36.8%
Total	**211**	**100.0%**	**180.3%**

The main objective of the forests is the protection, management, and utilization of the forest (95.7%). Only 4.3% manage the forest as strict protection. Figure 6 (a) shows most of the respondents manage mixed forest (both broadleaved and conifer) while very few manage pure forest. The forest species composition differs very much from one part of Nepal to other due to its altitude difference. It is observable from figure 6 (b) that half of the respondents manage the forest with *Shorea robusta* as a dominant species. It is found in tropical to sub-tropical climate especially in the lowlands of southern Nepal to mid hills up to 1000 m altitude. *Pinus roxburgii* and *Schima-castanopsis* forms the other major dominant species. They predominately found in sub-tropical forest of mid hills of Nepal (1000-2000 m altitude). *Quercus spp* are found in lower temperate (2000-3000) forest and *Pinus wallichiana* are found in upper temperate to sub alpine (3000-4000) forest in high hills of Nepal.

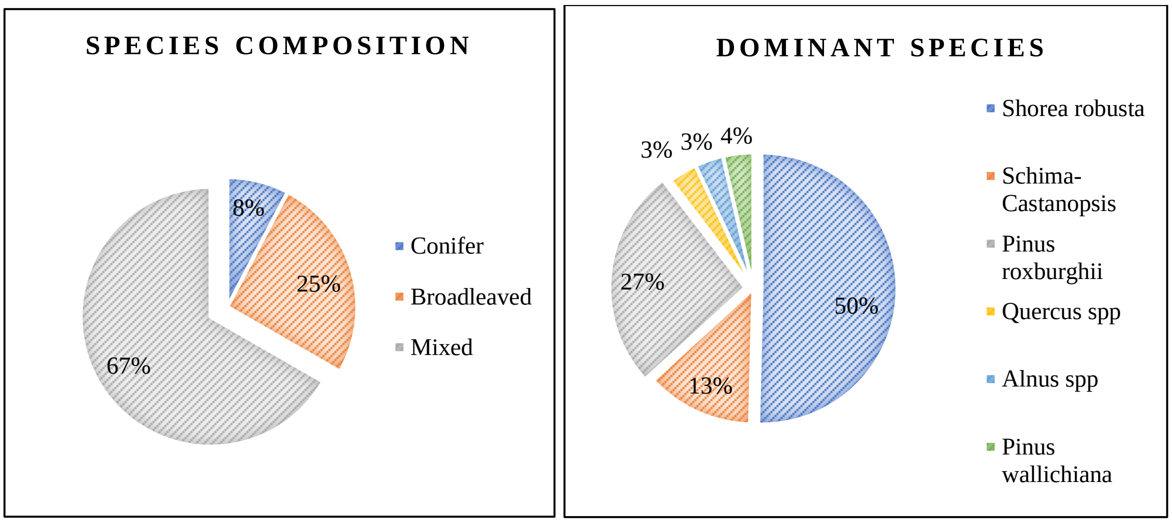

Figure 6. a) Species composition and b) dominant species in pie charts

4.2 Elicitation of Preference

The results for the preference of risk and uncertainty are summarized according to sex, position, age, and experience in Table 3. The average number of safe choices for risk aversion is 5.12 (SD=2.91). On average, the result shows, that forest professionals are slightly risk averse. Similarly, the average number of risky choices under uncertainty is 5.7 (SD=3.31) indicating that the sample forest professionals are uncertainty neutral (no of risky choices =5).

From the Table 3, based on the average number of safe choices under risk it appeared that males are risk neutral while the female is slightly risk averse. It also shows that younger people are risk neutral and with experience, the forest professionals are more slightly risk averse. Officer-level Forest officials are risk neutral while assistant-level professionals are risk averse.

Table 3. Average number of safe choices under risk and average number of risky choices under uncertainty.

	Choices Under Risk		Choices under Uncertainty	
	Safe	Risky	Risky	Uncertain
	(Average number of Choices by forest professionals)			
Sex				
Male	4.93	5.064	4.86	5.14
Female	5.475	4.52	5.13	4.865
Position				
Officer	4.765	5.235	5.529	4.470
Assistant	6.0625	3.93	6.125	3.875
Age				
>30	4.70	5.30	5.47	4.521
30-40	5.35	4.65	5.76	4.23
<40	5.86	4.14	6.42	3.57
Experience				
Up to 5 years	4.86	5.14	5.47	4.52
5-10	5.13	4.865	5.73	4.26
More than 10	5.61	4.380	6.04	3.95
Total	**5.12**	**4.8**	**5.7**	**4.3**

Table 4 presents the classification in terms of attitude towards risk and uncertainty function of the number of safe and risky choices realized, respectively. It shows that higher numbers are in the extremes and neutral. Looking at the distribution of the numbers of safe reveals that the higher number of safe choices are for slight risk averse i.e., 5. It represents 20.5% of the sample followed by 18.8% of the sample indicating are for the stay in bed (9&10).

But looking at the numbers of risky choices under uncertainty reveals that the higher number of risky choices are for neutrality to uncertainty and extremely averse to uncertainty. Each of them represents an equal percentage i.e., 24.8% of the total sample.

Table 4. Classification of Risk and Uncertainty Aversion

No. of Choices	Risk Aversion		Uncertainty Aversion	
	Classification	**Frequency of Safe choices**	**Classification**	**Frequency of Risky choices**
0	Highly Risk loving	6	Extremely Uncertainty loving	14
1		7	Highly Uncertainty loving	4
2	Very Risk loving	5	Very Uncertainty loving	2
3	Risk Loving	18	Uncertainty loving	3
4	Risk Neutral	17	Slightly Uncertainty loving	16
5	Slightly Risk averse	24	Uncertainty Neutral	29
6	Risk-averse	8	Slightly Uncertainty averse	5
7	Very Risk averse	4	Uncertainty Averse	3
8	Highly Risk averse	6	Very Uncertainty averse	9
9	Stay in bed	4	Highly Uncertainty averse	3
10		18	Extremely Uncertainty averse	29

Preference was categorized as Holt and Laury's (2002) classification table for Risk and Reynaud Couture's (2012) for uncertainty.

For both number of safe choices under risk and number of risky choices under uncertainty, the poison count model was run to see how risk and uncertainty correspond to the explanatory variables (forest professionals characteristics and the forest characteristics). Only the variables statistically significant are presented in the table 5.

To conclude, according to the statistical models presented, forest professionals are more risk averse when they are working in the assistant-level, managing community-based forests and protected areas - buffer zone forests are more risk-loving and have many years of experience. Similarly, the forest professionals are more uncertainty averse when they are female.

Table 5 Estimations of the parameters of the Poisson count model for Risk and Uncertainty

Risk	Parameter	Standard error	Sig.
Constant	3.413	0.5543	0.000 ***
Male	-0.095	0.922	0.305
Officer level	-0.250	0.1083	0.021 **
CBFM	-0.959	0.2963	0.001***
PABZ	-0.622	0.2148	0.004 ***
Experience	0.038	0.0158	0.016***
Uncertainty			
Intercept	1.516	0.5221	0.004***
Male	-0.171	0.873	0.050**

* Significant at 90% CI

** Significant at 95% CI

*** Significant at 99 % CI

4.3 Climate Change Adaptation Decisions

4.3.1 Climate Change Perception

To explore the perception of the respondents about the climate change and its adverse effects on the forest climate change, respondents were asked several multiple questions, as shown in figure 7. Here, no represent positive perception and yes represent negative perception. This shows almost all the respondents have positive perception towards climate change. All the respondents who respondents yes to both options were females.

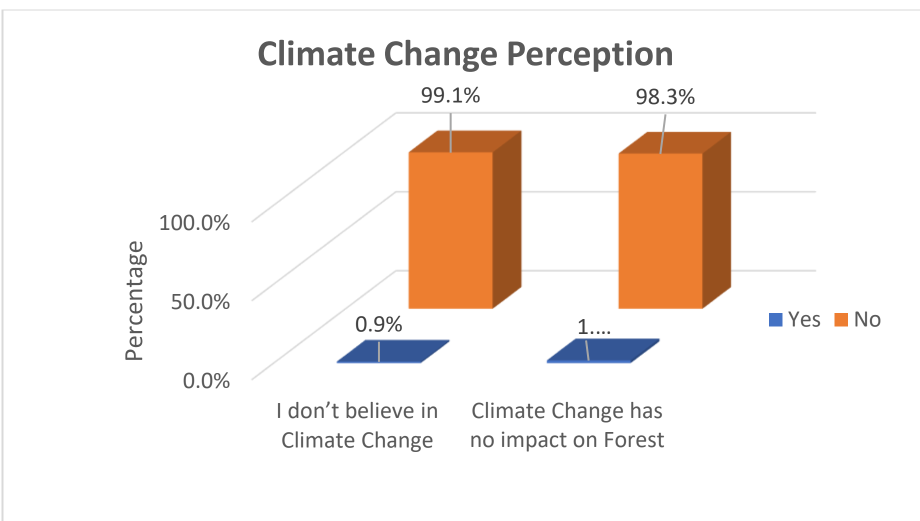

Figure 7: Climate Change Perception

Similarly, to explore the knowledge of the respondents about the climate change and its impacts, respondents were asked several multiple questions. Here, yes represent that they agree to the statement and no represent their disagreement. From the figure 8, it is observable that most of the respondents have a good knowledge about the climate change and its impacts.

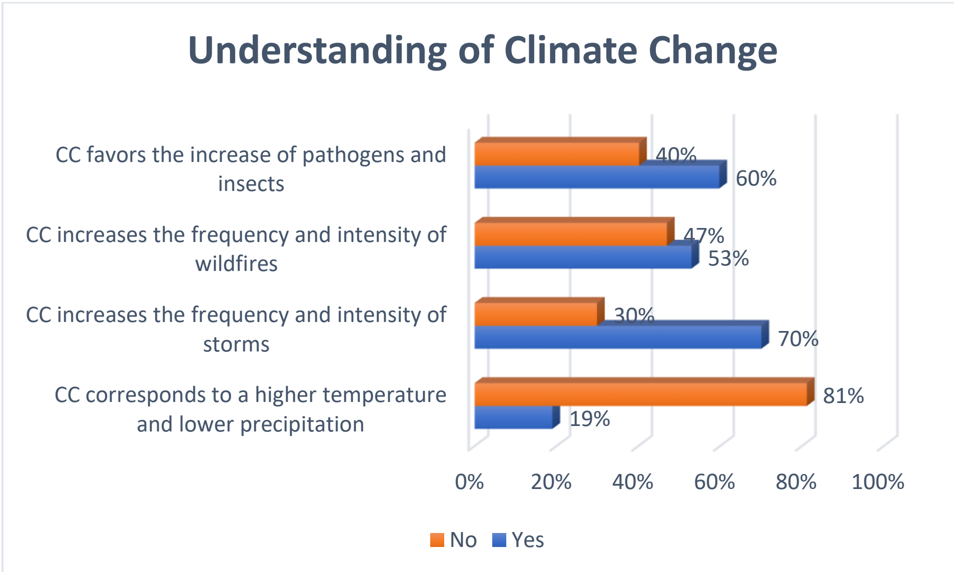

Figure 8: Understanding of Climate Change

4.3.2 Adaptation Decisions

The Table 6 below shows the adaptation behavior of the forest professionals and it is observed that two-thirds of the respondents have already adapted to climate change and among which 34.2% were female and 65.8% were male.

Table 6. Adaptation Decision

	Adaptation Decision	Frequency	Percentage	Total (N)
Past	Yes	76	65%	117
	No	41	35%	
Plan in Future (Who said no in past)	Yes	16	41.5%	41
	No	10	19%	
	Don't know	15	39.5%	

A logit regression was run to ascertain the effect of the explanatory variables forest professional's characteristics (age, sex, position, experience, and organization), forest characteristics (forest type, species composition, and objective of forest management), the number of safe choices under risk and number of risky choices under uncertainty on the likelihood of the forest professionals to make the adaptation decisions to climate change. The model was not significant and there is no significant relation between adaptation decisions with the explanatory variables (Table 7). It has a positive parameter value with the number of safe choices but is not statistically significant.

Table 7. Logit model regression for adaptation decision

Parameters	B	SE	Sig
Intercept	-2.541	2.629	.334
Risk Aversion	.111	.077	.151
Uncertainty Aversion	-.025	.066	.707
Knowledge of CC	-.073	.389	.851
Work Experience (Years)	-.098	.082	.403
Age	.075	.090	.235
Positive Perception	1.530	1.308	.242
Not being community-based forest type	-.578	.604	.33
Male	.119	.478	.80
Assistant level	.199	.553	.71
Conifer	-.727	.748	.43
Mc Fadden = 0.041			

4.3.3 Adaptation Strategies

For both groups of the respondents who already adapted to climate change and those who plan to adaptation climate change soon were given multiple choices of adaptation strategies. The proposed 10 adaptation strategies were based on the adaptation strategies practiced in the local context of Nepal and practiced in global context which were identified through literature review. Not all the proposed adaptation strategies are complementing each other, some are contrasting too. Here, Table 8, shows the adaptation strategies frequency of already adapted adaptation strategies and planned adaptation strategies to be implied in future.

It is observable that among the 10 proposed adaptation strategies, community-based fire control and conservation ponds in forests are the most widely selected adaptation strategy which is highly and positively correlated with each other in the Pearson correlation test (0.303, p=0.01). The forestry professionals that have not adapted yet but plan to adapt have similar choices of strategies as the professionals that have already adopted. Furthermore, they are interested in integrated watershed management, rangeland management at high altitudes and wildlife management to climate stress.

Table 8. Adaptation Strategies

Already Adapted Frequency N=334	"Adaptation Strategy"	Planned Adaptation Frequency N=78
22	Introduce resistant tree species	5
44	Artificial regeneration	7
8	Forest pathogen control	4
40	Control of alien and invasive species	11
62	Conservation ponds in forests	12
36	Integrated watershed management	10
18	Wildlife Management about Climate Stress	6
26	NTFP/Herb management	5
13	Rangeland conservation in high altitude	8
65	Community-based Forest fire control	10

Table 9 shows the result for the Poisson count model with the number of adaptation strategies adapted by the sample respondents as a dependent variable with age, sex, position, the experience of the forest professionals, forest types, number of safe choices, and number of risky choices as an explanatory variable. The number of adaptations was significant with the number of safe choices and community-based managed forest types. Here the higher number of adaptations indicates the higher intensity of adaptation, the Poisson count model with the explanatory variables shows a higher number of safe choices, and community-based forest type has more likely to have high intensity of adaptation.

Table 9. Poisson count model for number of adaptation strategies

Parameters	B	SE	Sig
Intercept	1.046	0.4100	0.011
Community managed forest	0.268	0.1542	0.083 *
Risk Aversion	0.037	0.0210	0.075*
Uncertainty Aversion	0.023	0.0177	0.198

* Significant at 90% CI

4.3.4 Reasons for not adapting to climate change

Table 10 presents the justifications that forest professionals chose for not adapting to climate change. The main reason invoked behind not adapting to climate change includes no visible impact to react, lack of evidence of successful adaptation, the high cost of adaptation, and lack of information to adapt. Only one respondent mentioned that they receive too much information to react. Other reasons for not adapting to climate change include lack of budget, lack of specific climate adaptation policy, programs, and working TOR was the justification for not adapting to climate change. The forestry professional who has no plan and who are unsure about their adaptation plan because they haven't seen evidence of successful adaptation (50%) and thinks the cost of adaptation is too high (38%). In both justifications for not adapting in the past and future high cost of adaptation is seen as highly selected while I don't believe climate change was never selected.

Table 10. Reasons for not adapting to climate change

Frequency Not adapted in Past N=69	Reasons for "No adaptation" N	Frequency No plan to Adapt in Future N=13
7	Forest will adapt by itself	1
11	High cost of adaptation	3
12	No visible impact to react	2
12	Lack of enough information to decide	1
1	Too much information to decide	0
9	Lack of knowledge to operationalize adaptation strategies	2
12	Lack of evidence of successful adaptation	4
5	Others	0

Adaptation, particularly adaptation at local scales, generally requires that forest management practitioners have the authority, mandate, and autonomy to identify and implement forest management adaptations (Keenan, 2015; Johnston et al., 2010). To the question, does the current forest management legislation, policies, and standards enable adaptation, 65% of the respondents agreed that current forest management legislation, policies, and standards enable adaptation by forest management practitioners, while 35% responded said it doesn't. Among three proposed barriers to the respondents who said the current forest management legislation, policies and standards does not enable adaptation by forest management practitioners as shown in Table 11, majority selected insufficient authority, mandate, and autonomy to identify and implement adaptation at local scales.

Table 11 : Tables showing perceived barriers to adaptation from existing forest policies

Barriers To Adaptation	Responses		Percent of Cases
	N	Percent	
Lack of personal knowledge, expertise, or ability	23	29.5%	56.1%
Lack of guidance, standards, or best practices	22	28.2%	53.7%
Insufficient authority, mandate, and autonomy to identify and implement adaptation at local scales	33	42.3%	80.5%
Total	78	100.0%	190.2%

4.4 Nature Future Framework

4.4.1 Managing Forest as Nature Future Framework Narratives

Table 12 presents the descriptive study of the objective of managing forests about IPBES NFF narratives, showing the goals of managing forests as nature for nature, nature for culture, and nature for society are not equally fulfilled. Nature for nature is given more priority while goals of nature for culture are least achieved.

Table 12. Priority of managing forest as IPBES NFF narratives

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Nature for Nature	117	85	10	95	43.12	15.231
Nature for Culture	117	60	0	60	22.08	9.500
Nature for Society	117	66	4	70	34.89	13.384

We also run simple regression to see the effect of the explanatory variables forest professional's characteristics, forest characteristics, the number of safe choices under risk and number of risky choices under uncertainty to the decisions of managing forest and achieving goals of nature for nature, nature for culture, and nature for society individually. There was no significant effect of risk and uncertainty in making NFF narrative decisions.

Table 13 presents the results of simple regression to explain nature for society with explanatory variables (number of safe choices, number of risky choices, characteristics of forest professionals, characteristics of forest, and climate change adaptation). For valuing forest as Nature for Nature and Nature as Culture, there was no significant effect of the explanatory variables on decision making regarding NFF narratives while climate change and community managed forest type have a significant effect on deciding as managing Nature for Society.

Table 13. Regression model for Nature for Society with explanatory variables

Parameter	B	SE	Sig
Constant	14.30	16.00	0.374
Community managed forest	15.33	7.3	0.040**
CC adaptation	-4.3	2.6	0.096*

P value 0.064, R2 0.415

* Significant at 90% CI

** Significant at 95% CI

4.4.2 Goals of Managing Forests as NFF Narratives

The different goals of managing forests as nature for nature, nature for culture, and nature for society respectively were proposed based on the IPBES NFF narratives for local cases in Nepal. Based on the priority given to achieving the goals as well as which goal have been achieved with high importance while managing the forest were chosen and ranked in order 1-6 for Nature for Society goals and 1-8 for Nature for Culture and Nature for Nature goals. 1st as the most priority and 6^{th}/8^{th} as the least priority goal. Table 14 shows that provision for food, fodder and fuel is the main goal while managing the forest as Nature for society, biodiversity conservation while managing Nature for Nature and community-based forest management while managing nature for culture.

Table 14. Goals ranked based on priority while managing forests as Nature for Nature, Nature for Culture, and Nature for Society respectively

Rank	Goals of managing forest as NFF narratives		
	Nature for Nature	**Nature for Society**	**Nature as Culture**
1^{ST}	Biodiversity Conservation	Provision of food, fodder, and fuel	Community-based Forest Management
2^{ND}	Ecological Functions	Drinking water	Community-based biodiversity conservation
3^{RD}	Soil Conservation	Timber Productions	Traditional medicinal herbs collection
4^{TH}	Climate Regulations	Livelihood options	Local ownership
5^{TH}	Water level recharge	Bioeconomy	Homestay tourism and Recreation
6^{TH}	Landscape Conservation	Creation of nature-based jobs (guide, tourism)	Religious and spiritual values
7^{TH}	Carbon Sequestration		Physical and psychological experiences (Bird watching, nature walk)
8^{TH}	Wilderness		Indigenous fishing culture

4.4.3 Strategies to fulfil the goals while managing Nature for Nature

Figure 9 shows the strategies chosen to achieve the goals stated in table 6. All the combinations of proposed strategies were chosen to achieve the goals. Habitat management is the most preferred strategy to achieve the goals of managing forests as nature for nature. On average 5 strategies were selected by the sample forest professionals to achieve the goals (Range: 1-8).

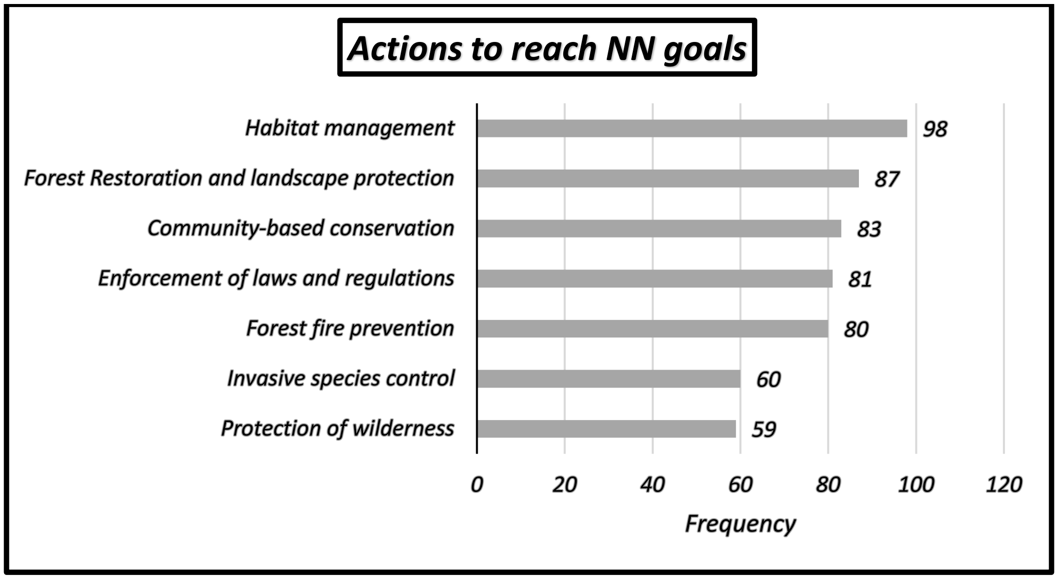

Figure 9. Actions to reach the goals of managing forest as Nature for Nature

Figure 10, shows that sustainable forest management is the most preferred strategy to achieve the goals of managing forest as nature for society. All the proposed strategies were selected by the sample forest professionals but there is no combination of all the proposed strategies. On average 4.64 strategies were selected by an individual with range of (1-7).

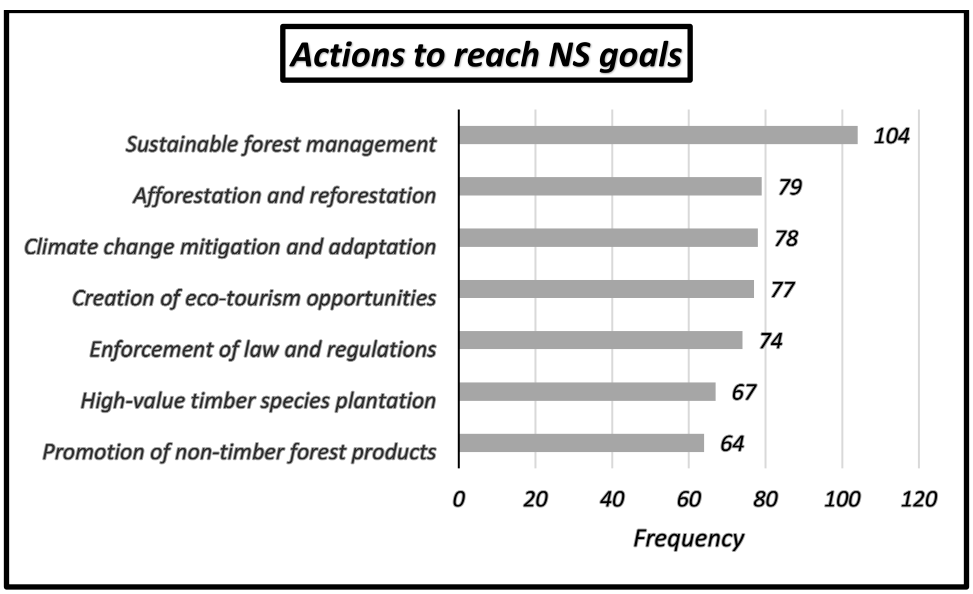

Figure 10. Actions to reach the goals of managing forest as Nature for Society

Figure 11 shows that people's participation forms the major strategy to reach the goals of managing forests as nature for culture. Here all the strategies were selected and the combination of all the proposed strategies was used to reach the goals. On average 3.7 strategies were selected by an individual with a range of (1-5).

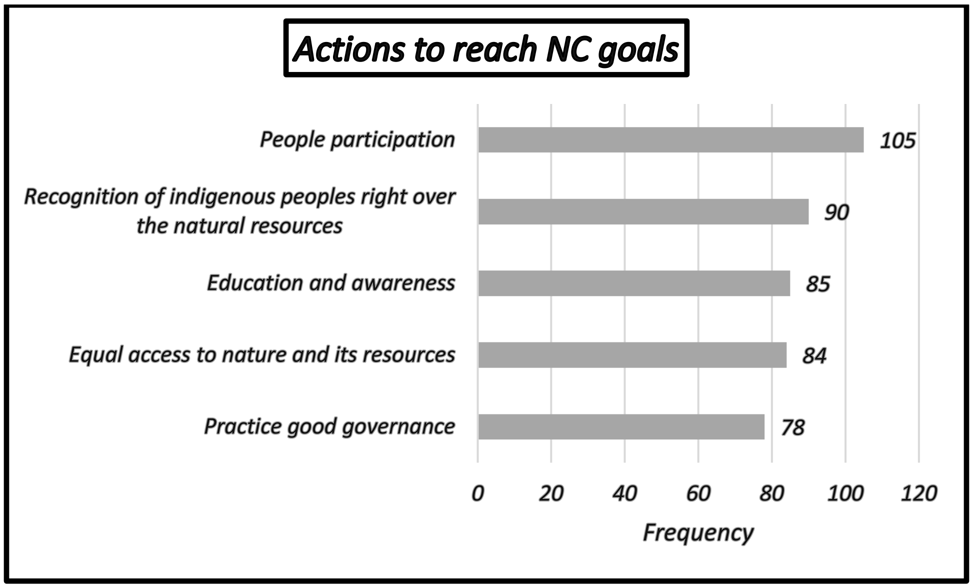

Figure 11. Actions to reach the goals of managing forest as Nature for Culture

Chapter 5: Discussion

This chapter provides the discussion for the results of this study. In this, the results obtained for each hypothesis tested in this study are discussed separately. It further compares the results with another similar existing research. Finally, it presents the justifications for the findings of the study with supporting literature.

5.1 Hypothesis 1: Higher the risk and uncertainty aversion of respondents, the higher the trend toward changing management objectives and making adaptive decisions.

5.1.1 Risk and Uncertainty Aversion

From the analysis of the risk and uncertainty preference, the study found most of the forest professionals to be slightly risk averse and uncertainty neutral. The average number of safe choices (HL value) of forest professionals is 5.12 indicating they are slightly risk averse. Musshoff and Maart-Noelck (2014) consider foresters and found an average HL value of 5.9 from ten decision situations, which represents a risk-averse attitude. This finding was also in line with the findings by Sauter et al. (2016b) using an HL task with German foresters. Sauter et al. (2018) found in their study that foresters are predominantly risk-averse with an average of 4.57 safe choices by using a similar method. Brunette et.al (2019) found the average number of safe choices of German respondents is 5.08 for German,5.98 for French, and 5.58 for the total sample (N=88) of forest professionals using the same methodology indicating French professionals are risk-averse and German ones as slightly risk averse.

The risk aversion (HL) value was tested with the explanatory variables and found a significant effect on the position of a forester, forest type, and experience. Females are found more risk averse than males but it’s not significant. The result implies professionals managing community-based forests and protected areas and buffer zone (community-based modality) tends to be risk-loving. This could be justified as in community-based modality forest, the role of forest officials is as a facilitator and the community users are the main actors of forest management and necessary modifications. In community based forest management modality, the part of national forest handed over to Community Forest User Groups (CFUGs) for its development, conservation, utilization and management which are legitimized as independent, autonomous and self-governing institutions (GoN, 2019a; Pokharel and Nurse, 2004).With position, assistant-level forest professionals are likely to be risk averse which could be explained as the forestry sector follows command approach from the senior authority which restrict the boundaries of decisions the forest professionals at certain level can take. Similarly, with increase in experience years, forest professionals tend to be more risk averse. The uncertainty aversion was tested with an explanatory variable and was found significant effect only with sex which implies females are more uncertainty averse than males.

5.1.2 Risk and Uncertainty aversion effect on Climate Change Adaptation

As opposed to our hypothesis, our study did not find any significant effect of risk and uncertainty on climate change adaptation decisions. The parameter values of the risk preferences were positive for the adaptation decision indicating adaptation increases with risk aversion while parameter values of uncertainty preference were negative indicating adaptation decision decreases with uncertainty, but both were not significant. Regardless of the perception of all forest professionals being almost positive as well as foresters being slightly risk averse it has no significant effect on the adaptation decision. The results were completely different from the results obtained by Brunette et.al, 2019, for European foresters, where they found risk aversion hinders climate change adaptation. We can argue that climate change adaptation decisions in Nepal are more policy dependent. Sousa-Silva et al., 2018 underline that adaptation behaviors are country-dependent and that the observed difference between countries could be linked to their socio-economic and political contexts. This could be explained as the Nepalese forest professionals being guided by forest policy and strategies. Some academics even argue that Nepal's policy-making process is top-down and influenced by a small number of political leaders and bureaucrats (Gautam et al., 2004a; Khatri, 2012; Basnyat et al., 2018). This policy and strategies are made at the ministry level and cabinet level and government officials dominate policy implementation (Aryal et.al 2021) which makes the forest professionals risk-neutral to slightly averse and uncertainty neutral. This also explains adaptation decisions not being affected by the risk and uncertainty aversion of forest professionals. An increase in risk aversion with experience also justifies the risk being insignificant to climate change adaptation and we argue that with an increase in the number of years of work experience, foresters tend to know the legal process of working and making decisions as a public forester and identify their boundaries of making decisions. Moreover, it is also stated that National Adaptation Plan of Action (NAPA) is developed in a top-down approach in complying with funders' guidelines rather than engaging in thorough debate and political deliberation with those locally impacted and their political representatives (Ojha et al., 2016) which also explains the climate change adaptation process.

5.1.3 Risk and Uncertainty aversion effect on Adaptation Intensity

Additionally, the effect of risk and uncertainty along with forest professionals' characteristics and the forest they manage on the intensity of adaptation were analyzed with the Poisson count model. However, risk aversion has a significant impact on the intensity of adaptation, while uncertainty aversion has no effect. That means with risk aversion, adaptation intensity increases. On contrary to our result, Brunette et.al, 2019 found French foresters as compared with Germans has a significant and negative impact on the number of adaptation strategies selected by the individual indicating lower intensity of adaptation with risk aversion. But our findings were in line with Yousefpour et al. (2017) argument that the higher the risk aversion, the higher be the need for adaptation.

From this study, community-based fire control and conservation ponds (also known as recharge ponds) construction in the forests were the two preferred strategies in the forest of Nepal while Sousa-Silva et al. (2018) and Brunette et al. (2019) found that species mix and the assistance in tree regeneration were the two preferred adaptation strategies of foresters in different European countries. Adaptation strategies are situation-specific and change over time and from place to place, and even vary within specific communities (Singh et al., 2018; Smit and Wandel, 2006), and thus, local level adaptations cannot be based on global level studies (Thakur et al., 2020). It is also observable from our result, on average 4.39 strategies were selected by forestry professionals among 10 strategies proposed which shows forest professionals like to apply combination of adaptation strategies. In similar study by Brunette et al. (2019), observe that on average, forestry professionals choose 2.41 strategies among the 13 proposed.

5.1.4 Risk and uncertainty aversion effect on preferred future values as Nature for Nature, Nature for Society, and Nature for Culture

Furthermore, our study attempted to investigate the effect of risk and uncertainty on the decision-making of the preferred future valuing the forest as Nature for Nature, Nature for Society, and Nature for Culture. This study result showed there was no significant effect of risk and uncertainty in making NFF narrative decisions which fail to accept our research hypothesis. It is argued that the decision of managing forests by valuing Nature for Nature, Nature for Society, and Nature for Culture is also dependent on the forest policies that govern the forest management objectives in Nepal. This can be argued in the same way as for adaptation decisions. Forest professionals dominated the forest management policy landscape through coercion, expertise, and incentives, which has recently been reversed by the federation putting political actors at the forefront of the policy process (Aryal et.al., 2022).

5.2 Hypothesis 2: Informed Forest professionals about climate change tend to practice adaptive activities.

As a prerequisite to climate change adaptation decisions, forestry professionals' climate change perception was also studied. Most of the study respondents believe that climate change is happening, and only a few think that climate change is not there and has no impact. This result is in line with the survey conducted by Yousefpour and Hanewinkel (2015) where most of German forestry professionals view climate change as a reality and Brunette et.al (2019) where most of the respondents believe that climate change is real and have several impacts. Decisions are influenced by perception since it is acknowledged as an active understanding process that enables people to create their own interpretation of reality (Pickens, 2005). But, in this study, the adaptation decisions were not influenced by the perception of the individual.

In addition, this study aims to investigate the reasons for not adapting to climate change. The main reasons invoked behind not adapting to climate change despite having positive perception includes no visible impact to react, lack of evidence of successful adaptation, the high cost of adaptation, and lack of information to adapt. Brunette et.al (2019) also found lack of information as the main reason for not adapting to climate change. It seems that forestry professionals prefer not to adapt at all when they have not received enough information to take a relevant decision. This result was obtained in Belgium (Sousa-Silva et al. 2016), Germany (Yousefpour and Hanewinkel, 2015), France, Portugal, Belgium, Slovakia (Sousa-Silva et al., 2018), and elsewhere (FAO, 2012). For example, Yousefpour and Hanewinkel , 2015 found that 72% of the German forestry professionals indicated being under-informed.

Furthermore, this study explored the barriers to making adaptation decisions and showed that most respondents responded to forest management legislation, policies, and standards as a major barrier. Apart from the legal barriers, the lack of technology and technical knowledge (Bastakoti et al., 2017; Heyojoo et al., 2017; Loria and Bhardwaj, 2016) also form a significant barrier to climate change adaptation. The Forest Act 2019 has a clear intention that CFUGs are regulated and monitored by the Division Forest Office (a provincial government's entity), operationalize with an operation plan that is approved by DFO while Climate change adaptation and mitigation are implemented by different institutions like Hariyo Ban Programme in Nepal developed and implemented 331 community adaptation plan of action (CAPA) and 90 LAPAs (WWF, 2017) brings the legal as well as institutional barrier.

5.3 Hypothesis 3: Preferred future of nature management in Nepal equally fulfill the goals of Nature for Nature, Nature for Society, and Nature for Culture and Climate Change Adaptation increases these values.

Our study attempted to translate the IPBES NFF narratives preference for the local case of Nepal and measured the value given to the main axes of value at each corner of the triangle and NFF. The third hypothesis was rejected which means the preferred future of nature management in Nepal does not equally fulfill the goals of Nature for Nature, Nature for Society, and Nature for Culture. The study found that the preferred future of nature management dominates the value as Nature for Nature followed by Nature for Society. Value for Nature as Culture is the least prior goal while managing nature. This could be argued that forest management in Nepal is protection-based management. Community forestry programs in Nepal have had significant success with protection-oriented forest management, but they are not without criticism for being inactive and underutilizing forest resources (Aryal et al., 2020a, 2020b; Maraseni et al., 2019) compromising major portion of value as nature for society and nature as culture. Further communities' involvement in forest management and conservation programs has helped broaden the conservation agenda more widely, which is manifested through a sense of conservation stewardship among local people and other stakeholders (MoFE, 2018) giving more value as Nature for Nature. Moreover, different knowledge dimensions and value priorities are jointly important for forest management behaviors (Eriksson and Fries, 2020)

The production-oriented and protection-oriented management agendas in many nations, especially developing ones, have conflicted with the global normative perspective of ecosystem services and local economic considerations of forest resources (Miura et al., 2015). In rural Nepal, forests continue to be crucial sources of subsistence. However, since the 1990s, there has been a gradual but significant shift away from subsistence farming making the farm-forest links very weak as farmers dependency on forests for fodder, leaflitter, fuelwood and farming implements has decreased sharply showing how the relationship between the forest and society is changing (K.C. et al., 2021). Accordingly, weak interaction with forest resources and decreasing share of forests' contribution to the household economy as well as livelihoods has weakened community forest members' interests in investing in forest management (Paudel et al. 2021). Further, due to a political regime change and significant alterations in the socio-economic environment brought on by a shift in the agrarian economy, the relationship between the forest and society is at a new crossroads (Ojha & Hall, 2021; Pain et al., 2021).

Changing community forestry contexts and the dynamics of forest-people relationships are important arenas to consider when developing climate-responsive community forestry (Paudel et al. 2021). It can also be argued that passive and underutilized forest management in Nepal despite improved forest conditions (Gurung et al., 2013; Gilmour, 2016; Luintel et al., 2018; Baral et al., 2019b; Oldekop et al., 2019), protection-oriented mindset of communities and minimal financial and livelihood incentives from the forest (Baral et al., 2019b; Poudyal et al., 2020) have compromised the value for society. Recognition of customary rights on forest management and other concerns of Indigenous Peoples and local communities also offers opportunity for inclusive and equitable practices in community forestry (Poudyal et al., 2020) enhancing the forest value as nature for culture.

Behaviors are also influenced by value priorities (Rohan 2000). The most prior goal while managing forest valuing as Nature for Nature was biodiversity conservation and habitat management, forest restoration and community-based conservation were the major three strategies preferred by the forest professionals in achieving the goal. This goal coincides with the goals of protected areas of Nepal as well as the Division Forest Offices. Similarly, the most prior goal while managing forest valuing as Nature for society was provision of food, fodder and fuel from the forest and sustainable forest management, afforestation and reforestation and climate change mitigation were the preferred strategies. Community based forest management goals relate very closely with value as Nature for Society. The main goal while managing forest valuing as Nature as Culture was community-based forest management and people participation, recognition of indigenous people right and awareness were the preferred strategies. Local people's involvement in forest management is a traditional practice in Nepal. Participatory forest management has been effective in both providing socio-economic development through income generation and community development as well as forest conservation.

The goals of managing forest are interrelated to each other and policies also supports managing forest with the multiple goals from the forest at the same time. The new Constitution of Nepal includes special provisions for the protection, promotion, and use of natural resources which encourages the conservation and sustainable use of forests, wildlife, and biodiversity in general by reducing potential environmental risks from industrial and physical development. (GoN,2015). Forest Sector Strategy (2016–2025) aims at managing the forest resources, biodiversity, and watersheds in a sustainable manner so that they can contribute to national prosperity (MoFE, 2016). Forest Policy (2019) is the most recent forest policy document, formulated after the new federal structure which has more emphasis on community participation aiming at managing forests, protected areas, watersheds, biodiversity, wildlife, and plant resources with a sustainable and participatory approach to enhance production, the value of forest base products and services, and their equitable distribution (MoFE,2019). Provincial-level

Forest Acts are also formulated by provincial governments, aiming at sustainable use of forest resources, and enhancing the economic contribution from the forestry sector. In this situation the strategies to achieve one goal contribute to the fulfillment of other goals unless the goals are in contrast with each other. These policies also further help in the priorities given to each goal while fulfilling the national forestry goals.

This study also tests the NFF decisions with other explanatory variables (forest professional characteristics, forest characteristics, and climate change adaptation decisions) and found the value as Nature for Society is negatively and significantly affected with climate change adaptation decisions and practices and positively and significantly affected with community managed forest. This could be explained as climate change responses threaten locally established community forestry mechanisms, for example, Poudel et al.,2014 and Khatri et al., 2018 observed a restriction on grazing and forest products removal from Reducing Emission from Deforestation and Forest Degradation (REDD+) pilot sites in Nepal. Some of the globally designed mechanisms like the REDD+ program is expected to have co-benefits in the form of maintenance and enhancement of biodiversity ((REDD-IC, 2018)). This can also be argued that the climate change adaptations may contradict the overall objectives of managing forests with value as nature for society. Conflicts in objectives may require a substantial deviation of existing management practices which might eventually exacerbate the lives and livelihoods of forest-dependent communities compromising the social values. An overemphasis on carbon and climate mitigation in community forests may exacerbate the multifunctional outcomes of ecosystem services and resilience (Ojha et al., 2019).

The result showed Nature for society is given high value while foresters are working in the management, protection, and utilization of community-managed forest types. This is justified as the community-managed forest has been widely acclaimed and recognized for its contribution to forest conservation and supply of forest products such as firewood, litter, fodder, and timber and its potential in generating several ecosystem services (Gautam et al., 2004; Chowdhary et al., 2017).

Chapter 6: Conclusion

This study focuses on forestry professionals' preferences toward risk and uncertainty and their impact on climate change adaptation and managing forests as value for NFF narratives. The study showed that on average forest professionals are slightly risk-averse and uncertainty neutral. Females were risk averse compared to males and being assistant level makes the forester risk averse. This study tackled three main research questions about the effect of risk and uncertainty attitude, climate change perception on climate change adaptation behavior along with preferred future value as NFF narratives goals and strategies to achieve those goals. Our result reveals that risk and uncertainty aversion of forest professionals does not determine the adaptation decisions as well as the preferred future management decisions. However, risk aversion increases the intensity of climate change adaptation, while uncertainty has no significant impact. Therefore, from this study, we conclude that risk and uncertainty is not the main factor determining the adaptation decisions, yet a risk-averse attitude helps to intensity the adaptation decisions already made. Furthermore, the study found legal barriers, especially from unclear policies and institutions being the major barrier to adaptation to climate change. It seems foresters are being limited to and guided by the government norms, policies, programs as well as budget allocations rather than making decisions by themselves based on their knowledge and experience making them neutral to slightly averse to both uncertainty and risk respectively.

In addition, the study showed despite having positive perception people do not adapt to climate change and there were several other reasons like lack of visible impact of climate change, lack of evidence of successful adaptation, the high cost of adaptation, and lack of information to adapt responsible for not adapting. It seems that forestry professionals are hesitant to adapt to climate change unless the policies and programs guide and give them enough authority to do so as well as they have enough information to take the adaptation. It appears that the adaptation strategies that they have been adapting to are already supported by the policies and yearly program with budget allocations on those adaptation practices before dealing with climate change and that, therefore, forestry professionals are well-informed on them and are not afraid to implement them. It is also equally important to spread knowledge about efficient adaptation, and its results and inform forestry professionals about them to encourage adaptation. Above all, enabling policies and budget allocations for adaptation activities as well as capacity development is crucial.

Furthermore, this study also explored the preferred future value of the forest as Nature for Nature predominates compromising the value of Nature for Society and Nature as Culture. It is likely that the preferred future of nature's value for Nature for Nature is more valued because Nepal's forest management follows protection-oriented and subsistence-based forest practices. The community-based forest management, biodiversity conservation and provision of food, fodder and fuel were the most preferred goals while valuing of forest in Nepal in all three corners of triangle as NFF narratives. In addition, the study also reveals the climate change adaptation activities hindering the value of Nature for Society. In the changing context of forestry and forest-society dynamics, it becomes crucial to redirect the forest policy and management goals such that they provide multiple benefits. Therefore, more attention is needed in making forestry decisions regarding the implementation of climate change adaptation strategies along with its reassessment and redesign in such a way that the preferred future value of forest as IPBES NFF narratives is not compromised.

The research results highlight the need for further research to better understand the adaptation behavior of forest professionals in the changing context of forestry in Nepal. More research is recommended considering the risk and uncertainty aversion of forest professionals when addressing the problems of forest management. Many countries have already applied IPBES NFF framework to develop scenarios of the positive future for nature which guides the decision-making taking account the multiple values of nature and its contribution to people. Future research on IPBES NFF framework with case study may help to better understand the multiplicity of relationship between people and forest especially in changing nexus between people and forest. It can also form as foundation for creating the desired future of forest and facilitate the translation of new knowledge into practical outcomes that can be applied to obtain the multiple values of nature.

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Appendices

Appendix A : Questionnaire

Forest and forest professionals' characteristics

1. Name:
2. Position
3. Organization:
4. District:
5. Sex:
   a. Male
   b. Female
6. What type of forests do you manage?
   a. Community Managed Forest
   b. Protected Areas and Buffer Zone Forest
   c. Private Forest
   d. Both A and C
7. What is the species composition of the forest you manage?
   a. Pure Broadleaves
   b. Pure Coniferous
   c. Mixed
8. What is the dominant species that you manage?.......................
9. What are the management objectives of the forest you manage?
   a. Production, management, and utilization
   b. Protection
   c. Other

Section 1: Lottery Questions

Part 1: Risk

It is composed of 10 Questions. For each question, you have two choices option 1 and option 2. Choose the option you prefer.

1. Which do you prefer?
    a) 90% chance to have NRs 2200 and 10% chance to have NRs 2700.
    b) 90% chance to have Rs 135 and 10% chance to have Rs 5000.
2. Which do you prefer?
    a) 80% chance to have NRs 2200 and 20% chance to have NRs 2700
    b) 80% chance to have NRs 135 and 20% chance to have NRs 5000
3. Which do you prefer?
    a) 70% to have NRs 2200 and 30% chance to have NRs 2700.
    b) 70% to have NRs 135 and 30% chance to have NRs 5000
4. Which do you prefer?
    a) 60% to have NRs 2200 and 40% chance to have Rs 2700.
    b) 60% to have NRs 135 and 40% chance to have NRs 5000.
5. Which do you prefer?
    a) 50% to have Rs 2200 and 50% chance to have Rs 2700.
    b) 50% to have NRs 135 and 50% chance to have NRs 5000
6. Which do you prefer?
    a) 40% to have NRs 2200 and 60% chance to have NRs 2700.
    b) 40% to have NRs 135 and 60% chance to have NRs 5000
7. Which do you prefer?
    a) 30% to have NRs 2200 and 70% chance to have NRs 2700.
    b) 30% to have NRs 135 and 70% chance to have NRs 5000.
8. Which do you prefer?
    a) 20% to have NRs 2200 and 80% chance to have NRs 2700.
    b) 20% to have NRs 135 and 80% chance to have NRs 5000.
9. Which do you prefer?
    a) 10% to have NRs 2200 and 90% chance to have NRs 2700.
    b) 10% to have NRs 135 and 90% chance to have NRs 5000
10. Which do you prefer?
    a) 0% to have NRs 2200 and 100% chance to have NRs 2700.
    b) 0% to have NRs 135 and 100% chance to have NRs 5000.

Part 2: Uncertainty

The second part consists of 10 questions, for each question you have two choices option 1 and option 2. Choose the option you prefer. Here, there are 10 balls in a bowl of Red and Blue.

Option A: 5 blue and 5 red balls (50%-50%) chance

Option B: 10 balls but the number of blue and red balls is unknown. The probability is unknown.

For example: If you Choose Red,

a) Option 1: 50% chance to have NRs 5000 and 50% chance to have NRS 0
b) Option 2: If the red ball is drawn, you win NRs 3000 and if blue is drawn, if win NRs 0

Before you start, choose one color

1. Red
2. Blue

1. Which do you prefer?
   a) 50% chance to have NRs 5000 and 50% chance to have NRS 0
   b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown
2. Which do you prefer?
   a) 50% chance to have NRs 4500 and 50% chance to have NRS 0
   b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown
3. Which do you prefer?
   a) 50% chance to have NRs 4000 and 50% chance to have NRS 0
   b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown
4. Which do you prefer?
   a) 50% chance to have NRs 3500 and 50% chance to have NRS 0
   b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown
5. Which do you prefer?
   a) 50% chance to have NRs 3000 and 50% chance to have NRS 0
   b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown
6. Which do you prefer?
   a) 50% chance to have NRs 2500 and 50% chance to have NRS 0
   b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown

7. Which do you prefer?
    a) 50% chance to have NRs 2000 and 50% chance to have NRS 0
    b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown
8. Which do you prefer?
    a) 50% chance to have NRs 1500 and 50% chance to have NRS 0
    b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown
9. Which do you prefer?
    a) 50% chance to have NRs 1000 and 50% chance to have NRS 0
    b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown
10. Which do you prefer?
    a) 50% chance to have NRs 500 and 50% chance to have NRS 0
    b) Having NRS 3000 or NRs 0 but the associated probabilities are unknown

Section 2: Climate Change Perception and Attitude

1. Please select answers from your opinion:
    a) I don't believe in climate change
    b) Climate change has no impact on forest
    c) Climate change corresponds to a higher temperature and lower precipitation
    d) Climate change increases the frequency and intensity of storms
    e) Climate change increases the frequency and intensity of wildfires
    f) Climate change favors the increase of pathogens and insects
2. Have you already modified your forestry practices to adapt to climate change?
    a) Yes
    b) No

If yes, these modifications were about:

a) Introduce resistant tree species
b) Artificial regeneration
c) Forest pathogen control
d) Control of alien and invasive species
e) Conservation ponds in forests

f) Integrated watershed management

g) Wildlife Management about Climate Stress

h) NTFP/Herb management

i) Rangeland conservation in high altitude

j) Community-based Forest fire control

k) Others, if so, what?............................

If no, please select a proposition explaining your choice:

a) I thought there is no climate change

b) I thought that the forest will adapt by itself

c) The cost of adaptation was too high

d) There has not been a visible impact on the forest to react

e) I did not receive enough information to decide

f) I receive too much information to be able to take a decision

g) Other, if so, what?......................................

3. Do you plan to modify the forestry practices to adapt to climate change shortly?

a) Yes

b) No

c) Don't Know

If yes, how?

a) Introduce resistant tree species

b) Artificial regeneration

c) Forest pathogen control

d) Control of alien and invasive species

e) Conservation ponds in forests

f) Integrated watershed management

g) Wildlife Management about Climate Stress

h) NTFP/Herb management

i) Rangeland conservation in high altitude

j) Community-based Forest fire control

Others, if so, what?............................If no, please select a proposition explaining your choice:

a) I thought there is no climate change
b) I thought that the forest will adapt by itself
c) The cost of adaptation was too high
d) There has not been a visible impact on the forest to react
e) I did not receive enough information to decide
f) I receive too much information to be able to take a decision
g) Other, if so, what?.....................................

4. Do current forest management legislation, policies and standards enable adaptation by forest management practitioners?

a. Yes
b. No

5. The biggest barriers I face in working to minimize the impacts of climate change

a) Lack of personal knowledge, expertise, or ability
b) Lack of guidance, standards, or best practices
c) Insufficient authority, mandate, and autonomy to identify and implement adaptation at local scales
d) All

Section 3: IPBES NFF Narratives

1. What is the priority of nature (Forest) you manage? Give value to each of them such that the sum of three is equal to 100%)

a. Nature for Nature
b. Nature for Society
c. Nature for culture

2. What is the goals while managing nature for society (Priority ranking 1 to 6)

a) Provision of food, fodder, and fuel
b) Bioeconomy
c) Drinking water
d) Livelihood options

e) Timber Productions

f) Creation of nature-based jobs (guide, tourism)

3. What is the goals while managing nature for nature? (Priority ranking 1 to 8)

a) Biodiversity Conservation

b) Ecological Functions

c) Climate Regulations

d) Soil Conservation

e) Water level recharge

f) Carbon Sequestration

g) Wilderness

h) Landscape conservation

4. What is the goals while managing nature for culture? (Priority ranking 1 to 8)

a) Community based forest management

b) Community-based biodiversity conservation

c) Traditional medicinal herbs collection

d) indigenous fishing culture

e) Homestay tourism and Recreation

f) Physical and psychological experiences (Bird watching, nature walk)

g) Local ownership

h) Religious and spiritual values

5. What are the set of actions you choose to reach the goal of managing nature for nature? (Multiple choice)

a) Habitat Management

b) Enforcement of laws and regulations

c) Carbon storing tree species plantation

d) Forest Restoration and landscape protection

e) Community based conservation

f) Forest fire prevention

g) Invasive species control

h) Protection of wilderness

6. What are the set of actions you choose to reach the goal of managing nature for culture? (Multiple Choice)

a) People Participation
b) Education and awareness
c) Practice good governance
d) Equal in access to nature and its resources
e) Recognition of indigenous peoples right over the natural resources

7. What are the set of actions you choose to reach the goal of managing nature for society? (Multiple Choice)

a) Enforcement of law and regulations
b) Sustainable Forest management
c) Climate change mitigation and adaptation
d) High value timber species plantation
e) Promotion of Non timber forest products
f) Creation of eco-tourism opportunities
g) Afforestation and Reforestation