Values, Risk Perceptions and Social Adaptation Mechanisms

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# Values, Risk Perceptions and Social Adaptation Mechanisms

## Environmental Concern in Tigray Community

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with

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**CODESRIA Monograph Series**

**ISBN**: 978-2-86978-781-0



Typesetting: Sériane Camara Ajavon
Cover Design: Ibrahima Fofana

Distributed in Africa by CODESRIA
Distributed elsewhere by the African Books Collective, Oxford, UK.
Website: www.africanbookscollective.com

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CODESRIA would like to express its gratitude to the Swedish International Development Cooperation Agency (SIDA), the Carnegie Corporation of New York (CCNY), the Andrew W. Mellon Foundation, the Open Society Foundations (OSFs), Oumou Dilly Foundation, Ford Foundation and the Government of Senegal for supporting its research, training and publication programmes.

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# Acknowledgements

This project was funded entirely by the Council for the Development of Social Science Research in Africa (CODESRIA), a Pan-African research organisation established in 1973. It is, therefore, a pleasure for us to acknowledge the financial contribution of CODESRIA which made this research possible. Most importantly, we appreciate the management of the National Working Groups at CODESRIA. Apart from the great facilitation of the writing of this Work by CODESRIA, we have also enjoyed tremendous support and guidance from the College of Social Sciences and Languages at Mekelle University. We are also thankful for the staff members of the Department of Psychology of the same university for their great moral support to make this research work possible. Besides, we acknowledge Dr Wolbert Smidt for his helpful comments and thorough discussion on the earlier draft. Last but not least, we would also like to appreciate the Tigray people in the research sites for their sincere cooperation throughout the field research.

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# 1

# Introduction

## Background and justification

Environmental problems and accelerating changes in the living conditions of people have become key challenges in the world today (Kalantari *et al.* 2007). Environmental issues that were previously regarded as purely technical problems have recently gained such greater public attention that people's attitudes towards the environment have become one of the areas of interest for psychologists, geographers and sociologists.

There is an increasing awareness that the quality of the environment is threatened by the greenhouse effect, depletion of the ozone layer, water pollution, the decline of biodiversity, and desertification (De Groot & Steg 2007). These problems stem from human behaviours (Kalantari *et al*. 2007). Hence, it is important to study the factors that influence environmental changes as well. In the past decades, scholars have emphasised the importance of studying relationships between human values and environmental behaviour (Dunlap, Gallup & Gallup 1993). Values are important because they are general and, therefore, may affect various beliefs and behaviours simultaneously (Rohan 2000; Rokeach 1973). Some studies have attempted to identify values that provide a basis for environmental attitudes and behaviour (Stern *et al*. 1999).

Research has shown that the self-transcendent (altruistic or biospheric) versus self-enhancement (egoistic) dimension is related to different types of environmental beliefs and behaviours, because environmental behaviour often involves a conflict between immediate individual gains and long-term collective interests (Nordlund & Garvill 2003; Stern 2000). Many studies have found that people with a dominant self-transcendent value orientation have stronger pro-environmental beliefs and are more likely to engage in pro-environmental behaviour than people who strongly prefer self-enhancement values (Bardi & Schwartz 2003; Gärling *et al.* 2003; Nordlund & Garvil 2003) even though the existing results are mixed.

Values influence environmental behaviour indirectly, through behaviour-specific beliefs, attitudes and norms (Stern 2000; Gärling *et al.* 2003). Personal norms, in particular, seem important in this respect. Personal norms refer to feelings of moral obligations to behave pro-environmentally (Gärling *et al.* 2003). Personal norms originate from values (Schwartz 1977); that is, people feel morally obliged to act according to their prevalent values. In fact, Nordlund and Garvill (2003) found that self-transcendence values were positively related to personal norms toward a willingness to reduce specific environmental problems. Moreover, personal norms mediated the effects of values on a willingness to reduce specific environmental consequences or risks.

Values may also affect the extent to which people are aware of the environmental problems associated with their behaviour (i.e., awareness of consequences). This awareness will increase if important environmental values are threatened, forcing people to adjust their behaviour accordingly in order to reduce the threat (Groot & Steg 2007). Some studies have validated the relationship between values and awareness of consequences (Stern *et al.* 1999; Nordlund & Garvill 2003).

Values such as altruism, self-interest, traditionalism, and openness to change, are key correlates of pro-environmental behaviour and environmental concern (Dietz, Kalof & Stern 2003). Dietz, Kalof and Stern (2003) examined differences in factor structure of values for a group of 145 men and 200 women from USA adults using confirmatory factor analysis and differences in mean value scores using multivariate analysis of variance. No substantial differences are noticed in value factor structure, but differences exist in value priorities, with women ranking altruism more importantly than men did (Dietz, Kalof & Stern 2003). This analysis supports investigations that focus on mean differences in environmentalism across genders without examining gender differences in factor structure, although further examination of gender differences in factor structure is warranted. The results also highlight the importance of gender differences in altruism as a basis for gender differences in environmentalism. The first main objective of this project, therefore, is to examine the value orientations of communities in the selected region and the relative importance of the values predominantly held by the community and its relationship with personal norms and individual awareness of environmental concerns.

Another important psychological issue of environmental concern is risk perception. Defined as people's judgments and assessment of hazards or danger that might pose immediate or long-term threats to their health and well-being, risk perception has gained attention in psychological research since the 1980s (Tierney 1999; Rohrmann & Renn 2000; Strydom 2002). Several researchers (for example, Mohai1 2003; Satterfield *et al.* 2004) have suggested that the concern about environmental risks has spread throughout the different segments of the society. While environmental risks and their adverse effects on humans, the physical

environment and other species have received the attention of the world, risk perceptions are not uniform across various groups of population (Adeola 2007). As people have become more sensitised and concerned about environmental hazards, perhaps due to their location within the social structure and perceived sense of control, they have downplayed ecological risks at the local and national levels (Kempton *et al.* 1995).

Recent studies have suggested that males generally tend to have lower perceptions of risks relative to females (Satterfield *et al*. 2004; Finucane *et al.* 2000). According to Finucane *et al*. (2000), males scored lower on risk perception relative to women because they are most likely to be actively involved in creating, managing, controlling and benefiting from technologies producing most of the risks. This is because perceived vulnerability to the consequences of undue exposure to environmental and technological hazards tends to shape minority risk perceptions (Allen 2003; Lerner 2005). Also, the analysis of social theories of gender points out some relations and distinctions which should be considered in such a perspective (Gustafson 2004). It is argued that gender structures, reflected in gendered ideology and gendered practice, give rise to systematic gender differences in the perception of risk. In Ethiopia, the linkage between gender and environmental risk perceptions have not been aggressively dealt with and remain invisible (Mulubrhan & Kelemwork 2013). Therefore, the other main objectives of this research are to determine the possible existence of gender differences in the risk perceptions of environmental concerns, and deal with the extent and nature of variation observed.

While the importance of indigenous knowledge has been realised in the implementation of sustainable development, little has been done to incorporate this formally into the climate change adaptation strategies (Nyong, Adesina & Elasha 2007). There is also very little evidence about indigenous knowledge for livelihood resilience and adaptive capacity for climate variability and the corresponding environmental concern. Besides, the economic, social and ecological systems in which we live are so complex and interconnected that we cannot fully understand how the overall system will respond to new conditions. Thus, policies designed to operate within a certain range of conditions are often faced with conditions outside that range. On the other hand, adaptive policies are robust across a variety of possible futures and able to deal with emerging circumstances. Despite such dynamic interplay, research dealing with the potential impact of indigenous adaptation on environmental risks is very scanty and remains invisible in Ethiopia (Mulubrhan & Kelemework 2013). The third main objective of this study therefore is to examine how communities' adaptive responses are related with the current pace of policies and strategies and resilience in the face of uncertainty and surprise arising from climate change and its impact on available natural resources.

## Statement of the problem

Environmental problems and how to accelerate changes in people's living conditions have become fundamental concerns of every nation of the world. Consequently, public attitudes, values and behaviour as well as their environmental consequences have been investigated in developing and developed countries during the last few decades (Kalantari *et al.* 2007). These issues have also increasingly been generating more policy attention in Ethiopia in recent decades. In particular, the increasing population size and density in Ethiopia has been putting pressure on the country's environmental protection capability. Specifically, deforestation, land degradation, environmental pollution and water pollution constitute the most serious environmental problems threatening public health and well-being.

Values differ in the extent to which they are central to a person's life (Verplanken & Holland 2002). According to the Cognitive Hierarchy Theory (CHT), values are understood as enduring and fundamental beliefs that guide behaviours (Rokeach 1973). Behaviours, in turn, are understood as the intention of action and as being directly influenced by attitudes (Rokeach 1973). Despite its theoretical strengths in linking values and behaviour with environmental actions, the CHT does not explicitly include important factors such as risk perceptions. Risk perceptions are influenced by mental mechanisms, such as evaluation of potential hazards or a threat to life (Slovic 1999). These cognitive processes are more likely to generate biases and lead to attitudes that misinterpret the severity of risks (Burgman 2005). Kahan *et al.* (2009) confirmed the relationships between value systems and risk perceptions. An individual's values and fundamental beliefs explain how the individual perceives potential environmental risk-situations that may result in negative consequences (Slimak & Dietz 2006). Therefore, integrating risk perceptions with CHT can further help to clarify interpretations and evaluations of potential hazards, which also affect the construction of awareness of environmental consequences (Slovic 1999; Lazo *et al.* 2002).

Concurrently, people may respond to risks through manipulative behaviours that seek to avert only current problems at the expense of natural assets. These are most often called protective strategies. Adaptation to such risks becomes meaningful if successful adaptation measures are taken consciously given changing conditions (Mortimore & Adams 2001). Guided by cultural and social differences, people respond differently to environmental risks. People's acceptance or rejection of a certain adaptation strategy is largely shaped by their cultural orientation (Fazey *et al.* 2011). Hence, assessing the social adaptive measures of local community makes sense if they are understood in the totality of the natural and cultural environment in which they exist. Within the conceptual and theoretical framework of environmental behaviour, the social dimensions of environmental problems are salient social issues in Ethiopia. Hence, the focus of this research is to examine

values, risk perception and indigenous adaptation mechanisms to environmental concerns in the context of those communities of Tigray region and its implication on the continued support for the improvement of environmental protection policy by addressing the following basic research questions:

1. What values do respondents/communities hold towards environmental concerns?
2. How are communities sensitive to and how do they perceive the risks inherent in the environment?
3. Are there relationships between value orientations, personal norms, and awareness of consequences of environment? Which values predict risk perception, personal norms and awareness of environmental consequences?
4. Do contextual attributes (age, educational status, occupation, residence, income level) and gender differences have a significant effect on values and risk perceptions of environmental concern?
5. What sorts of indigenous knowledge/social adaptive mechanisms do communities have for coping with changes in environmental risks? How is such knowledge related against the current pace of change?
6. What social adaptation mechanism do communities use to cope with environmental risks?

## Objectives of the study

This study has the following objectives:

1. To assess the values people hold about environmental problems;
2. To examine the extent of risk perceptions of specific environmental problems within selected communities;
3. To examine the relationships between value orientations, risk perceptions, personal norms and awareness of consequences of environmental problems;
4. To identify the values that predicts risk perceptions, personal norms, and awareness of environmental consequences;
5. To assess the main and interaction effects of gender and other contextual dimensions on the value orientations and risk perceptions of environmental concerns;
6. To examine whether there is evidence of social adaptive mechanisms and their implication on an adaptive and friendly environment-human dynamic; and
7. To suggest alternative adaptation mechanisms for environmental dynamics.

## Limitations of the study

This research is based on a sample of communities from three zones of the Tigray Regional State. The samples are, to a lesser extent, biased in terms of representation of the entire population of the region. The study was also conducted largely by quantitative research methods. The scales slightly constrained people's risk responses. However, we supplemented the quantitative with qualitative data where people's values of environment and risk perception processes were explored deeply through interviews and focus group discussions (FGDs), giving enough space to express any ideas outside of the survey questions. This study also used descriptive and cross-sectional research methods where the values and risk perceptions of communities were examined as a function of temporal and spatial variations. The values and risk perceptions are influenced by a number of variables. For example, the local cultural understanding and linguistic expression of environmental issues might affect people's conceptions of the environment and the environmental risks involved.

## Organisation of the study

This study is organised into five chapters. The first chapter exhaustively describes the justifications and problem statement of the study, and how the objectives and basic research questions are set out. It also discusses how the theoretical framework of the research evolved is relevant in the Ethiopian context. The second chapter, which is a review of extant literature, discusses the epistemological outlooks and theories on whose foundations of the present research are undertaken. The third chapter presents the methodological flows that go in line with the theoretical orientation of the research within the Ethiopian context. The fourth chapter briefly discusses the results of the study. This chapter also presents the subsequent discussions of the main findings. Whereas Chapter five briefly summarises the study and end with conclusions and practical implications.

# 2

# Literature Review

## Theoretical frames about values of environment

Schwartz's value theory (1992, 1994) laid down the foundation for the study of values in environmental research. Schwartz suggests a broad category of fifty-six values the importance of which may vary across persons and cultures. However, the structure of these values appears to be universal. Indeed, previous researches conducted across cultures and countries suggest that these values may be categorised into two dimensions (Schwartz 1994; Schwartz and Bardi 2001). The first, openness to change versus conservatism, distinguishes values that stress independence (e.g., self-direction, stimulation) from values that emphasise tradition and conformity. The second dimension distinguishes a social or self-transcendent value orientation from an egoistic or self-enhancement value orientation. Whereas the first value orientation includes altruistic and biospheric values such as universalism and benevolence, the latter includes values relating to the pursuit of personal interests, such as power and achievement.

To be more specific, four types of values, i.e., hedonic, egoistic, altruistic and biospheric, have been identified in the literature and they have proved to be very significant for understanding environmental actions (Steg, Perlaviciute, Van der Werff & Lurvink 2014). Hedonic values reflect an explanation of concern with improving one's feelings and reducing effort, while egoistic values focus on safeguarding or increasing one's resources. Conversely, altruistic values reflect a concern with the welfare of others, and biospheric values reflect a key concern with nature and the environment for its own sake (De Groot & Steg 2007, 2008; Steg, De Groot, Dreijerink, Abrahamse & Siero 2011; Steg, Dreijerink & Abrahamse 2005).

Inglehart (1977) proposed a value revolution theory which suggests that concern for the environment arises after basic materialistic values are fulfilled and when survival needs are met. The theory further argues that biospheric values will particularly emerge, be endorsed, and influence beliefs, norms and behaviour when

basic needs are fulfilled. The prevalence of biospheric values indicates that an endorsement of biospheric values is mainly a product of a post-materialist cultural shift. Conversely, biospheric values results from other sources, based on observation of environmental degradation or a strong reliance on environmental systems (Steg *et al.* 2014). This suggests that people across the world seem to differ on how they value nature and the environment. Therefore, individuals develop and act upon biospheric values accordingly. Consequently, environmental considerations are part of people's morality, with both human and nature rights being protected by values (Lindenberg & Steg 2013b).

Goal-framing theory suggests that three different types of goals govern environmental behaviour in a given situation. These are hedonic goals, gain goals, and normative goals (Lindenberg & Steg 2007). In reality, individuals can be motivated to engage in pro-environmental action for hedonic reasons (e.g., because it is evoking pleasure), for gain reasons (e.g., because it increases benefit), or for normative reasons (e.g., because they think protecting the environment is an exemplary behaviour). However, values are general and transcend situations while goals are situation specific as they are activated in a particular situation. Values influence the chronic accessibility of these goals, i.e., when someone strongly endorses a particular value, it is more likely that goals aligning to that value will be relatively strong in a given situation. Lindenberg and Steg (2007) proposed that hedonic goals may strongly influence environmental behaviour as these goals are a priori strongest. Therefore, based on the goal-framing theory, we may also expect hedonic values to influence environmentally relevant beliefs and behaviour, as they are likely to influence the strength of hedonic goals.

The other theoretical framework developed by Manfredo, Teel and Henry (2009) is the cognitive hierarchy framework. The theory suggests that values are the basis of all mental processes, behaviours and actions toward the environment. Based on this, they argue that value orientations are clusters of interrelated basic beliefs within a given domain of interest which strengthen and provide contextual meaning to the more general values and provide the foundation for an individual's attitudes and norms, which in turn guide behavioural intentions. Put another way, the cognitive hierarchy suggests that behaviour is ultimately connected to the values that people hold. There may be other factors related to a particular behaviour that directly affect that behaviour, but the underlying values will typically form the basis for a person's pro-environmental behaviours (Bright & Burtz 2006a).

The value-belief-norm theory provides a framework for examining the normative factors that promote long-lasting pro-environmental behaviour (Lind *et al.* 2015). It suggests a chain of variables, including values and environmental concern, to specific beliefs about the negative consequences of certain actions and the individuals' responsibility to avert these negative consequences (Lind *et al.* 2015).

This, in turn, activates sustainable personal norms for behaviour. The value-belief-norm (VBN) theory integrates the value theory (Schwartz 1992), the new environmental paradigm perspective (Dunlap *et al.* 2000), and norm-activation theory (Schwartz 1977). The value theory proposes that values are stable dispositions, which structure and guide specific beliefs, norms and attitudes that in turn affect behaviour. Motivated by Schwartz (1992) value theory, De Groot and Steg (2007, 2008) have proposed value types believed to be particularly important precursors of environmental beliefs and behaviours. This includes biospheric, egoistic and altruistic value orientations. Steg, Perlaviciute, Van der Werff & Lurvink (2014) further expanded the notion to include hedonistic values. The New Environmental Perspective (NEP) emphasises beliefs in the limits of benefits, the necessity of balancing economic growth with environmental protection, and the need to preserve the balance of nature (Dunlap 2008). This perspective consists of general beliefs about the environment, awareness of environmental problems and acknowledgement of strong pro-environmental actions.

According to the norm-activation theory (Schwartz 1977), pro-social behaviour (e.g., the choice of environmentally friendly energy used) should occur as a response to personal norms about such behaviour. The theory proposes that beliefs about the environment influence the individuals' awareness of the consequences related to specific behaviours and beliefs about the ability to avert the negative consequences of these behaviours (ascription of responsibility). Previous research works have given support to the idea that norm-activation may be important for a variety of behaviours (Stern, Dietz & Kalof 1993; Guagnano 1995). The predictive power of value-belief-norm models strengthen when awareness of consequences and ascription of responsibility predict specific behaviour (Steg, Dreijerink & Abrahamse 2005). These specific beliefs appear to activate personal norms which could influence various types of actions (Lind *et al.* 2015). Specific beliefs also determine whether the individual feels morally obliged to act in environmentally-friendly ways (Steg 2005).

## Understanding values of the environment

Throughout history human beings have shown a close attachment to nature because natural areas serve as symbols of individual value systems (Fisher *et al.* 2012). Indeed, the focus of this study is on values, and there are several reasons for that. One is that values influence our behaviour towards the natural environment. The second is the importance of values in making descriptions, predictions, explanations and control of the behavioural intentions at individual and societal level. The third reason is that the number of values people pay attention to is relatively small (De Groot & Steg (2007b). Practically, however, relative to other antecedents of behaviour, values provide an economic and efficient instrument for describing and explaining similarities and differences based on various demographic characteristics.

Psychological theories and researches on values are based on the previous work of Rokeach (1973, 1979) and, more recently, Schwartz (1992, 1994). Schwartz (1992:21) defines value as 'a desirable trans-situational goal varying in importance, which serves as a guiding principle in the life of a person or other social entity'. This definition includes most important features of values. First, values reflect a belief on the desirability of a certain end-state. According to Allport (1963:454), 'A value is a belief upon which a person acts by preference'. Second, values are rather abstract and, therefore, transcend specific situations. Third, values serve as a guiding principle for selecting or evaluating behaviour and events. And finally, they are ordered in a system of value priorities. This feature implies that when different competing values are activated in a specific situation, choices are based on values that are considered to be most relevant to act on.

Schwartz (1999) wondered whether people tend to believe that they can actively master and change the world and get ahead through active self-assertion and ambition. The question after which cultural values in the Ethiopian context needs to be studied, as values are determinant factors in dictating the behaviour of persons towards the environment. Values will determine the meaning of environment and so will the orientations. Therefore, values are going to affect human's beliefs, attitudes and actions together. According to Fishbein & Ajzen (1975) attitudes are also influenced by social norms. This, in turn, will affect the personal norms or feelings of respect for the environment. These norms together with attitudes determine behavioural intentions, which in turn predict behaviour or value orientations or dimensions.

## Relationship of environmental values and environmentally relevant behaviours

There are various approaches that focus on the relationship between values and behaviour and attempt to explain the differences between individuals in terms of behaviour and attitudes. One of these approaches is proposed by Schwartz's norm activation model of altruism. According to this approach, behaviour toward others is a result of the personal and social standards, awareness of consequences, and taking responsibilities at a personal level (Snelgaer 2006). This is so because the individual possesses personal moral standards or norms and acts accordingly whenever there is a negative result that might affect others. This way, a person can decide what action to take in order to prevent these consequences from occurring (i.e., personal responsibility) (Stern & Dietz 1994).

Though individuals will endorse all four spheres of values to some extent, there may be substantial differences in the extent to which different individuals endorse specific values. Yet, importantly, people seem to endorse biospheric values strongly, which are generally more strongly related to pro-environmental beliefs, attitudes,

norms, and actions than the other three values such as hedonistic, egoistic and altruistic (De Groot & Steg 2007, 2008; Helbig 2010; Hiratsuka 2010; Nilsson *et al.* 2004; Steg *et al.* 2005). Besides, individuals with strong biospheric values are more likely to be intrinsically motivated to engage in pro-environmental behaviour (i.e., they seek to benefit the environment), while the opposite is true for those with strong egoistic values, who are more likely to engage in pro-environmental behaviour because of extrinsic factors (De Groot & Steg 2010). Likewise, people with high environmental concern seem to focus on environmental consequences, whereas those with low concern especially seem to consider personal outcomes when making choices (Loukopoulos, Jakobsson, Gärling, Schneider & Fujii 2004). This outcome implies that people particularly consider aspects that have important implications for their most important values.

Outlined by the value-belief-norm theory of environmentalism (Stern 2000; Stern *et al.* 1999), it seems that values affect the extent to which people are aware of the negative consequences of environmentally harmful behaviour (i.e., problem awareness). Consequently, the stronger one's biospheric values, the higher one's problem awareness, while strong egoistic values are associated with lower problem awareness (De Groot *et al.* 2008; Schultz *et al.* 2005; Steg *et al.* 2005). These relationships again demonstrate that values affect how individuals evaluate the consequences of environmental behaviour. Previous correlational researches show that problem awareness, in turn, affects the extent to which people feel responsible for environmental problems and whether they think they can reduce environmental problems by engaging in pro-environmental actions: higher problem awareness is associated with stronger feelings of responsibility (De Groot & Steg 2009; Steg & De Groot 2010; Steg *et al.* 2005). These factors, in turn, activate personal norms, that is, feelings of moral obligation to act pro-environmentally, which eventually affect behaviour. In a similar vein, values affect the overall outlook of the environment, which in turn affect our beliefs about the consequences of environmental change. The beliefs we hold also affect our understanding of the extent of our ability to reduce threats to the environment, which in turn affects about the quality of action taken. The actions taken by the individual takes place in the private sphere, including consumer choices and behaviours in pro-environmentalism (Dietz, Fitzgerald & Shwom 2005).

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tend towards a willingness to reduce specific environmental problems. Moreover, personal norms mediated the effects of values on a willingness to reduce specific environmental consequences or risks.

People could be pro-social or pro-self in their engagement with the environment by developing an appropriate behaviour. In social dilemma research, a distinction is made between pro-socials and pro-selves (Gärling *et al*. 2003; Joireman *et al*. 2001; Van Vugt, Van Lange & Meertens 1996). People having a pro-social value orientation focus on optimising outcomes for others, while people with a pro-self value orientation focus on optimising outcomes for themselves. Various social dilemma studies have studied the role of value orientations in explaining behaviour (Kramer, McClintock & Messick 1986; Parks 1994; Van Lange & Liebrand 1989).

## Gender and values of the environment

Overall, environmental concern indicates the degree to which people are aware of problems regarding the environment and support efforts to solve them and/or indicate a willingness to contribute personally to their solution (Dunlap & Jones 2002:485). Although gender has been one of the most examined factors predicting environmental concern, its influence has been vague and inconsistent. Based on the data from different countries, for example, Blocker and Blocker (1989), Arcury and Johnson (1987), and Arcury (1990) indicate that men are more active, knowledgeable, and concerned about the environment than are women. On the other hand, Olofsson and Ohman (2006) said women are more concerned about the environment than are men. In particular, Uyeki and Holland (2000) reported that women are more concerned about the environment, nature, and animals than are men. In contrast, Hayes (2001:657) argued that gender does not influence environmental concern and that women are not more concerned about the environment than men. On the other hand, Blocker and Blocker (1989), Stern (1993), Mohai (1991), Davidson and Freudenberg (1996), and Bord and O'Conner (1997) indicate that gender differences, if any, in environmental concern between men and women are related to the divergences in the perceptions of the harmful consequences of environmental problems on humans generally rather than on gender per se. Finally, Arcury and Johnson (1987) played down the consideration of gender for environment, noting that the link between gender and environmental concern is weak and inconclusive; hence no definite conclusion could be drawn about it.

## Environmental risk and people's perceptions of risks

Burger, Greenberg, Gochfield, Shukla, Lowrie, & Keren (2008) summarised risk perception as the acquisition of information, interpretation and synthesis of different pieces of information, and the understanding of that information in light of previous

knowledge, perceptions and attitudes. It is expected that the interactive exchange of information between a source and the receiver will lead to better risk management and behaviour changes. Knowledge acquisition is essential to understanding hazards and risks (Burger, Greenberg, Gochfield, Shukla, Lowrie, & Keren 2008) and should be a central belief for the planning of effective risk communication and messages.

Environmental risks are usually understood as environmental hazards or processes with potentially negative consequences to human beings and what they value (Böhm & Pfister 2000). The risks from environmental change can be seen from two perspectives: human activities which cause environmental damage and pose risks to the natural environment, and environmental changes which result in negative effects on humans and constitute risks to the human environment. Thus, the risk analysis needs to address not only physical processes, but also the social, economic, cultural, and political views to provide more insights for environmental risk management (Cvetkovich & Earle 1992; Stahl *et al.* 2001). In previous research, environmental risks have been analysed from a social science perspective to explore public concerns, such as how the public responds to and evaluates various technological and environmental risks, how risks are presented and communicated, and how risks are framed in social processes (Krimsky & Golding 1992; Lai & Tao 2003; Lazo *et al.* 2002; McDaniels *et al.* 1996).

A person's level of risk perception to environmental hazards can be impacted by society and social media (Weber, Hair & Fowler 2000). The harm from environmental pollution exposure may not be seen first-hand; mass media exposure may greatly influence many people's perception of risk. The perception of risk, when related to food choices, is a barrier to nutrition interventions. The health effects from environmental hazards are not usually short-term effects. Usually, they are effects that may compound with other risk factors and influence a person's health for a long time. This may play a role in the level of risk perception to pollutants in a person's immediate area. When negative effects are not seen quickly or first-hand, it can be easily dismissed or viewed as not relevant to health behaviour choices.

Assessing a community's knowledge of risks and their level of concern that those risks cause illness may be viewed as a measure of 'environmental literacy' (Weber, Hair, & Fowler 2000). This may help educators understand why certain behaviours are taken or not taken by individuals living in that community. The need exists to measure the risk and environmental literacy from educators involved in disseminating health information because teaching may be influenced by the teacher's personal views and beliefs (Weber, Hair & Fowler 2000). It is quite possible that media exposure may have impacted many community members' perception of risk to pollution as well as their trust in industry and government health agencies to respond appropriately to the situation. These factors of personal experience are relevant when considering health lessons and risk message planning for this community.

When evaluating an individual's response to a risk or level of risk perception, it is important to understand the decision-making factors that may affect risk perception. These factors or characteristics include previous knowledge, values, social pressures, environmental barriers, financial constraints and psychological factors. The psychological factor to most likely impact health behaviours is called 'optimistic bias' and it addresses the commonly belief that one is less likely to experience harm from a behaviour than someone else behaving the same way. Other biases include 'anchoring', which is about the first initial impression of a risk by an individual, and 'availability', which addresses the fact that an individual may have already experienced the effects of a particular risk or been exposed to it through the media (McGloin, Delaney, Hudson & Wall 2009).

There are many factors to consider when thinking about environmental risk communication. Characteristics of the affected community, target audience and the information sender will impact how well a message is received. The characteristics of the target community are important to consider when planning environmental risk communication programmes. Literacy rate, cultural norms and socio-economic status must be taken into account when designing written materials and preparing presentations (McGloin, Delaney, Hudson & Wall 2009).

Understanding receiver characteristics is important according to the 'mental model' approach which seeks to identify accurate and inaccurate beliefs on a particular hazard held by a target audience (Breakwell 2000). The information gathered from environmental health engagement surveys can be useful for correcting misunderstandings on environmental health topics. This may lead to getting individuals and communities to a better position to make more informed decisions about health and food choices.

Consideration of audience characteristics, such as age, income, activity level and education level, is essential for effective interventions concerning nutrition and health risk. Research has found that gender plays a role in risk perception. For example, males usually view risks as less of a threat than females. A more predominant male audience may need more dramatic messages or images to increase risk perception and change behaviour. Women with children or stay-at-home mothers may believe risks to be higher. Older adults have been found to perceive risks to be higher and avoid risk more than others. Interestingly, higher education level has been equated with less aversion to risk and feeling less confident about the effectiveness of protective measures against a risk. Consideration of the audience is very important to successful message planning and audience segmentation may be ideal in specific communities (McGloin, Delaney, Hudson & Wall 2009).

## Factors that influence environmental risk behaviour

Risk perception factors depend not only on the general characteristics of a risk; perception is also affected by socio-demographic attributes, psychological disposition and the perceived context associated with risk events (communication, management and control). Thus, risk perception is rarely directly correlated to a strict assessment of potential gains and losses, but varies depending on the type of activity or the individual. This does not mean that people are irrational. A mixture of technical knowledge, common-sense reasoning, personal experience, social communication and cultural traditions shape perceptions (Douglas & Wildavsky 1982). Rather than being seen as a single data process, risk perception is more relevant to social representations. If the danger is real, we can claim that the risk is a socio-psychological construct. Definitions of risk depend on how the likelihood of a hazard is specified and measured; how undesirable the outcomes are and how individuals define their reality (Renn *et al.* 1992).

Social amplification or attenuation of risk (Kasperson *et al.* 1988; Kasperson 1992; Pidgeon, Kasperson & Slovic 2003) occurs when hazard–related messages interact with the social context ('social arena') in ways that can increase or reduce the perceptions of risk and shape risk behaviour. How risk is appraised depends on the individuals, groups and organisations that receive, interpret, pass or provide information about risks. It varies with media coverage, pressure group activity, protest movements, the volume of information, symbolism, and contesting claims or dramatisation. These social amplification or attenuation phenomena lead to a definition of the level of concern within the risk agenda. Proponents of this concept suggest that trust, which can be defined as 'confidence in the reliability of a person or a system' (Giddens 1990), plays a major role in shaping opinions and risk decisions. According to Schuler (2004) 'trust is the cornerstone of risk communication because it influences public attitudes and behaviours'. It seems, therefore, that risk acceptance depends more on the public's trust in the source of hazard-related messages rather than on the estimate of the level of risk itself. Yet, as Slovic (2000) claimed, trust is fragile and once lost, it is very difficult to restore. Known as the asymmetry principle, negative events can undermine trust and overshadow good news. Trust can also be eroded by 'denial of the public's concerns' and the 'manipulation of public opinion over the benefits and risks of technology' (Schuler 2004).

The implication is that risk perceptions are not uniform across technologies, countries and time. For communicators, being able to manage the risk decision-making process in a rapidly evolving environment will require understanding of a wide range of risk perceptions and trust levels.

## A need to protect the natural environment from risks

The social cognitive theory states that behaviour is dependent on a multitude of personal, environmental, and behavioural factors. The adoption of a behaviour or a change in behaviour can be facilitated by strengthening cognitive, behavioural, and efficacy skills and providing environmental supports that are specific to the behaviour (Derrick, Miller & Andrews 2008). Many common health behaviour theories, including the health belief model, the theory of reasoned action, and the protection motivation theory, include risk perception but they are not clear on the degree of influence on a person's health behaviours (Brewer, Chapman, Gibbons, Gerrard, McCaul & Weinstein 2007). This view supports using environmental nutrition risk communication to impact health behaviours through interactive dialogue on pollution and health effects even if the extent of the impact is unknown.

The health belief model predicts health behaviours based on (i) a perceived probability that an outcome will occur; (ii) the severity of the negative outcome; (iii) the perceived effectiveness of the precaution'; and (iv) cost to adopt the precautionary action. The theories all differ by the number and kind of variables used in the prediction of health behaviours. Some account for present behaviours, like the health belief model, while others look more at future behaviours and their impact to risk (Weinstein 1993). The environmental risk perception surveys look at present levels of knowledge, concern and actions. The accuracy hypothesis of behaviour assumes that one's perception of risk at a given time will predict the risk behaviours at the same point in time. The data gathered in this study was analysed for simple correlations and associations at a given point in time, which was the point at which the participant took the survey.

Most theories agree that a higher perceived risk of harm from a hazard should encourage action to reduce risk (Brewer, Weinstein, Cuite & Herrington 2004). The motivation for health protective behaviour is believed to rise from the anticipation of a negative health outcome and desire to avoid this harm (Weinstein 1993). The motivation to act is also dependent on the person's belief that the negative outcome will happen to them rather than to someone else, commonly referred to as the optimistic bias. Another important factor is the consideration that the intended behaviour change or action will reduce the likelihood of harm from a risk (Weinstein 1993).

Risk perception in most health behaviour models is described as a person's likelihood, susceptibility, or vulnerability to an adverse health effect from a hazard. Susceptibility and likelihood describe an individual's probability of harm from a hazard under certain situations (Brewer, Chapman, Gibbons, Gerrard, McCaul & Weinstein 2007). Everyone's susceptibility and likelihood to adverse health effects from pollution is different and based on many factors, such as genetics, current health status, the environment, and health behaviours. The environmental risk

perception survey instruments do not quantify an individual's susceptibility to harm from pollution; rather they attempt to examine a person's knowledge and thoughts on pollution issues, a concern that the hazard will cause harm and the resulting health behaviours. Environmental nutrition interventions research is important to ensure that the results will benefit the community or target population (Goldberg-Freeman, Kass & Tracey 2007). Researching a population's views and attitudes on pollution will benefit communities living near hazardous waste sites by helping to guide researchers in the planning of lessons intended to impact nutrition behaviours and attitudes towards pollution. Bridging the gap between what the communities are doing and what the researchers want the community to be doing is important for decreasing risks to chronic diseases.

Environmental nutrition interventions are also intended to serve the needs of the general public because environmental pollutants can travel far from the source. Current research from air sampling stations in Beijing, China and across the Pacific Ocean show that air pollution generated during the 2008 Olympics travelled to the U.S. west coast in under a week (Simonich 2009). Particulate matter from coal combustion in urban areas and large forest fires can have long range transport. China, India, and the U.S. are the largest emitters of particulate matter into the global environment, and these pollutants can cause adverse health effects in populations far from the source of emission. Pollutants have an atmospheric fate and a metabolic fate, and both will have health effects to the human population. Simonich and Harris (2010) suggest that everyone who is exposed to environmental pollution would benefit from educational programming designed to improve health. Commission for Environmental Cooperation (CEC) research supports the need for offering environmental nutrition information to affected community members.

## Personal norms and environmental concerns

The environment is the most imperative element for the survival of human beings. However, it is only recently that there are serious concerns about climate change as well as the deteriorating conditions and severe damages done to the environment. These conditions compel people to reconsider their behaviours and become more pro-environmental. Previous studies (Corraliza & Berenguer 2000; Harladn, Staats & Wilke 1999) have shown that attitudes influence the behavioural intentions and pro-environmental behaviours. According to Babcock (2009), a significantly large portion of environmental pollutions and problems is caused by individuals. Therefore, more individual efforts should be channeled at reducing the unabated pollution, destruction and damage done to the environment. One of the possible reasons why individuals fail to adopt environmentally protective behaviours is a sense of amotivation and helplessness. Amotivation – which is lack of the ability to foresee the consequences of one's actions in the future and feeling helpless about

what they can do about ongoing intractable environmental problems – can be used to help explain why individuals fail to adopt environmentally protective behaviour (Pelletier, Dion, Tuson & Green-Demers 1999). In particular, lack of efforts, strategies, and capacity leads amotivation. The study by Pelletier *et al.* (1999) shows that amotivation resulting from lack of strategy and capacity predicted weak beliefs about the environmental consequences. Conversely, amotivation resulting from lack of efforts predicted strong beliefs about environmental consequences.

Hence, we contend that the personal norms that people have and the values they have developed based on the environmental concerns they observe will affect their pro-environmental and environmentally relevant behaviours. Findings from such studies would be helpful in developing environmental protection and conservation policies and strategies (Thogersen 2006). Personal norms and environmental concerns are also pivotal in fostering conditions for effective interventions to rectifying the overarching problems that we face. Stern (2000) reviewed the effectiveness of four major types of intervention that would change the values, beliefs, views, attitudes and, thereby, the behaviours of individuals or groups. These are religious and moral approaches; education and providing information; the use of rewards or penalties; and community management, by shared rules and expectations. Each intervention can be very effective if well planned and implemented carefully. For instance, moral and educational methods have a bad record of bringing about realistic changes followed by incentive and community-based approaches. A combination of two or more methods would make effective intervention especially in cases where multiple problems are identified.

## Personal norms and environmentally responsible behaviours

Personal norms are self-expectations and internalised values that dictate the way people behave. They stem from and are honed by social norms and, thus, can be explained by the socialisation theory (John, 1999) which says the family is the most proximal and colossal part of the socialisation of adolescents in integrating norms and values of which pro-environmental behaviour is one example. For example, in a study of the pro-environmental behaviour of Danish adolescents, Gronhoj and Thogersen (2012) found that adolescents behaviours are, to a large extent, influenced by the social norms within the families of those adolescents in general and, specifically, how the parents display such behaviours.

According to Schwartz's activation theory, personal norms are activated in two steps. The first is the awareness the agents have on their intended behaviours followed by ascribing the responsibility for bringing or preventing the problems or consequences. In a study of the New Environmental Paradigm (NEP) that helps measure awareness of consequences and personal norms, which is indicated by guilt and embarrassment if someone causes damage to the environment. Wiidegren

(1998) found out that the personal norms indicator was strongly associated with pro-environmental behaviours and willingness to paying higher prices for environmentally-friendly foods. In the same token, in a sample of German participants, Bamberg, Hunecke and Blobaum (2007) showed that personal norms are important predictors of public transport use instead of cars in a pursuit of protecting the environment. These personal norms were derived from projected feelings of guilt and influences from perceived social norms.

The second is the societal attitude towards environmental protection and the environment could, however, be murky because the strength of attitudes in predicting behaviours could be affected by the situation (physical-environmental conditions). Situational factors could interact with personal variables in a way that would compromise the predictive power that attitudes could have on actions and behaviours towards the environment. Hence, Corraliza and Berenguer (2000) explained that the attitude-behaviour prediction depends on the congruence of personal intentions and predisposition as well as the demands and difficulty of situations, and environmental conditions. If personal predispositions and situational variables are in conflict with each other, the likelihood of an attitude predicting behaviour is lesser. This resonates with the theory of planned behaviour, also known as theory of reasoned action (Fishbein & Ajzen 1975). These situational variables influence pro-environmental behaviours more than demographic variables. This finding implies that individuals and groups should inculcate norms and attitudes that foster nurturing the environment.

The theory of planned behaviour explains the relationship between attitudes and behaviours, particularly on environmental issues. To take this relationship to the next level, Harland, Staats and Wilke (1999) tried to find out if personal norms would predict and explain pro-environmental behaviours and intentions beyond and above what subjective norms, attitudes and perceived behavioural control could predict. The study was carried out among Dutch citizens who were enlisted in behavioural intervention programmes on environmental activities. The result shows that personal norms increased pro-environmental intentions and behaviours. In other words, personal norms explain variance to what the three predictors did. Pro-environmental behaviours include saving energy by using power-saving bulbs, saving water, reducing consumption of meat, using alternative means of transport to car, and using unbleached papers. Here the following hypothesis will be formulated: demographic variables (sex, income level, level of education) will moderate the effect of personal norms on pro-environmental behaviours. Put another way, the effect that personal norms will have on pro-environmental behaviours depends in the sex, income level and/or level of education.

There are also moderating conditions in facilitating compliance with the demands of the environmental and pro-environmental behaviours. Saliency of

personal norms of pro-environment have become an important aspect of, and condition for, encouraging pro-environmental behaviours. In a series of studies on existential threats and compliances (Fritsche *et al.*, 2009) contended that the interaction of morality salience and the saliency of the pro-environmental norms predicted a pro-environmental attitude and information search regarding environmental protection. In a second study, the interaction of the two variables predicted a forest management game that shows sustainable behaviour and intentions of pro-environmental behaviours. More specifically, the effect of morality salience, together with higher norm salience, increases pro-environmental activities and behaviours. Also, the study showed that norm salience, together with saliency of personal morality threat, had a significant effect on pro-environmental attitudes and behaviours.

Personal norm influences people's motivation to abide by and comply conform to pro-environmental behaviours. Thogersen (2006) proposed that these personal norms can stem from superstitious and external influences that affect the sense of pride and guilt associated with a given behaviour based on the internalised values, principles, and meaning people give to the environment-related behaviours. The former is termed an *introjected norm* while the latter is called an *integrated norm*. Based on these premises, Thogersen (2006) tested four environmentally responsible behaviours (buying organic milk, buying energy saving bulbs, recycling kitchen wastes, and using public transport to commute to and from work and shopping) among Danish participants. The result showed that such moral norms are associated with environmentally responsible behaviours. In a longitudinal panel study of Danes on their buying behaviours, Thogersen and Olander (2006) found a supporting evidence for attitude-norm-behaviour relationship. Their study revealed that strong personal norms regarding buying organic foods and perception that organic food are not expensive leads to a higher likelihood that people will be in favour buying organic foods. Based on these findings, the following hypothesis is formulated, that personal norms will positively predict environmentally-relevant behaviours. In other words, people with personal norms of protecting the environment will be more likely to show pro-environmental behaviour expressed in taking actions to preserve the environment.

### Environmental concern and awareness of consequences

An awareness of environmental consequences is related to the value orientations, beliefs and concerns people have for themselves, other people and the biosphere (i.e., egoistic, socio-altruistic, and biospheric value orientations, respectively). A study sample of adolescent, adult and elderly participants from Sweden aged from 18-69 years, showed that the beliefs and concerns people have are related to three types of values: power, benevolence and universalism (Hansla, Gamble, Juliusson

& Garling 2008). Furthermore, the findings also revealed that people are pro-environmental because the consequences will affect their own lives and those of people and other co-inhabitants of the planet Earth. Pro-environmental behaviours derive from an awareness of the possible adverse consequences that a contrary behaviour could cause. Empirical findings do not confirm differences between social-altruistic and biospheric beliefs on awareness of environmental consequences. Egoistic value orientation, which comprises achievement and power, are negatively correlated to pro-environmentalism. Universalism (self-transcendence) is a pro-social behaviour driven to protecting the environment whereas benevolence is more of a pro-self behaviour in response to an awareness of environmental consequences.

Similarly, the three models that explain environmentalism-egoistic, social-altruistic, and biospheric models – are related to one another. Stern, Dietz and Kalof (1993) expanded Schwartz's model of pro-environmentalism where actions and behaviours about the environment are conditioned by an Awareness of the Consequences (AC) of such behaviours on the environment. Awareness of consequences amounts to presumed beliefs given that the consequences hinge on the future, which might not occur. Such awareness is assumed to induce pro-environmental behaviours when individuals are convinced that their actions or behaviours will lead to adverse consequences for themselves, other people, and the environment as a whole. According to Schwartz's' model, personal responsibility and personal norms mediate the relationship between awareness of consequences and pro-environmental behaviours.

Tourist destination areas are some of the places that are vulnerable to littering and environmentally hazardous behaviours. In a study of the influences that the awareness of disasters' consequences has as well as the values and attachment that Chinese residents demonstrate towards their environment or specific places. Zhang *et al.* (2014) concluded that these factors were positively associated with pro-environmental behaviours. The results show that, compared to egoistic values, altruistic values are powerful in influencing pro-environmental behaviours, and place attachment has a stronger predictive power on pro-environmental behaviours than awareness of consequences and values. This finding can be applied to other vulnerable areas where individuals and communities can be made to develop strong place attachments and a sense of responsibility.

Based on the value-belief-norm (VBN) theory, the measures of awareness of consequences and environmental concerns were assessed. Snelgar (2006) confirmed that the Environmental Concern (EC) scale showed more reliability and clearer dimensionality than Awareness of Consequences (AC). It was also confirmed that the three dimensionalities of the VBN theory fitted the data than two, though four dimensionalities also fitted the data with separate biospheric values for animals

and plants. In a sample of US students, Schultz (2001) showed that environmental concern has three-factor models, namely, egoistic, social-altruistic, and biospheric values. Social-altruistic and biospheric values or concerns are positively correlated with environmentally friendly behavioural indicators whereas egoistic value is negatively correlated (Stern & Dietz 1994). Self-serving and 'place serving' biases are the psychological mindsets applied to the pursuit of environmental protection. In a cross-cultural study across North and South America, Asia, Europe and Africa on spatial bias beliefs in the severity of environmental problems, Schultz *et al.* (2014) argued in support of the spatial bias belief, which implies that people perceive environmental problems as being more severe globally and in other places than in their own locality.

## Gender and pro-environmentalism

Though limited and inconsistent, the literature has shown a relationship between environmental attitudes and behaviours, and between gender and other demographic variables. More specifically, the association of gender differences with environmental concerns received attention in the new trends of environmental studies as already shortly discussed above. For example, in a meta-analysis of studies examining the environmental paradigm of men and women from 1988 to 1998, Zelezny, Chua and Aldrich (2000) found that in four out of six studies women showed significantly more environmental concern than men. Moreover, nine of the 13 studies that examined the environmental behaviours of men and women showed that women participated significantly more in pro-environmental activities and behaviours than men. In their study of the concern of high school girls and boys for environment and participation in pro-environmental behaviours in their schools, Zelezny, Chua and Aldrich (2000) further demonstrated that girls showed more concerned about their environmental, especially in activities such as cutting trees, trashing them, cleaning the litter, and recycling the cut branches or stems. In line with the meta-analytic results, girls also were more willing to participate in environmental activism and taking actions to help improve their school environment. In another study, the personal norms indicator was less strongly correlated with NEP. The study further showed that education and income hardly showed any relationship though age and gender showed a moderate one (Wiidegren 1998).

The biggest threat that our environment faces is the overuse and destruction of natural resources. Though not successful enough, there have been countless efforts and interventions aimed at changing and inculcating environmentally friendly behaviours by raising peoples' awareness of the effects and consequences of abusing the environment. In line with this, Fransson and Garling (1999) revealed that correlations between background and environmentally responsible behaviours are weak. However, factors affecting environmentally responsible behaviour and

correlated with such behaviours are knowledge, a positive locus of control, personal responsibility, and perceived threats to personal health. In Ethiopia, demographic variables appear to have stronger effects or relationships. For example, people who are less educated and whose livelihood depends on farming, selling charcoals, and woods are more likely to care less about the environment and its consequences. Apart from low education, proenvironmental behaviour depends also on the geographical-cultural background. For example, there is a study by Mulubrhan and Kelemwork (2013) that Afar pastoral people care much more about the bushes and trees than adjust highlands. Hence, the following hypothesis is formulated: women are more likely to show more pro-environmental behaviours and values than men do; and demographic variables such as age, socio-economic status and level of education will be positively related to environmental concerns and awareness of consequences.

## Environmental risk and indigenous knowledge

### *Environmental risk*

The US Presidential/Congressional Commission on Risk Assessment and Risk Management (USPCC RARM, 1997) defined risk as the probability that a substance or situation will produce harm under specified conditions. Risk, therefore, is a combination of two factors: the probability that an adverse event will occur, and the consequences of the adverse event (USPCC RARM, 1997). Environmental risks are those related to the environment. Environmental risks arise in, or are transmitted through, the air, water, soil or biological food chains, to man. Their causes and characteristics are, however, very diverse. Man creates some through the introduction of a new technology, product or chemical; while others, such as natural hazards, result from natural processes which happen to interact with human activities and settlements. Some can be reasonably well anticipated, such as flooding in a valley or pollution from an industrial smelter. Others are wholly unexpected effects, such as the possible effects on the earth's ozone layer of fluorocarbon sprays or nitrogen fertilisers (Smith & Pettey 2009).

### *Indigenous knowledge*

Indigenous knowledge refers to what indigenous people know and do, and what they have known and done for generations. These are practices that evolved through trial and error and have proved flexible enough to cope with change (Melchias 2001). Indigenous knowledge practices were also developed by experimentations even though these experiments were not documented. Nevertheless, the knowledge systems were legitimised and fortified under suitable institutional frameworks, culture, and practices. They have been passed on to other generations (though discriminatorily) and have enabled indigenous people to survive and manage their

natural resources and the ecosystem as well as their economic, cultural and political organisation. Knowledge of these elements forms a set of interacting units known as indigenous coping systems.

Hence, indigenous knowledge is a set of interactions between the economic, ecological, political, and social environments within a group or groups with a strong identity, drawing existence from local resources through patterned behaviours that are transmitted from generation to generation to cope with change. These patterns are sustained by micro-level institutional arrangements vested with differentiated responsibilities that ensure the group's continuous survival. These systems, however, are eroding due to the modern systems such as colonialism, commercialisation, globalisation and modernisation. Lack of efficient codification, breakdown of the traditional family structure and function, developmentally induced human displacements are also important challenges.

## The combined use of traditional and scientific knowledge

Cultural beliefs and ideologies are handed over from generation to generation through the process of socialisation (Akinsola 1983). Indigenous knowledge practices are multi-dimensional; so, they deal with socio-cultural and environmental undertakings. Indigenous knowledge practices are highly prominent in Africa where modern science is a recent history. This makes integration of the two knowledge practices difficult. There are also limits to the extent to which the two approaches can be combined. It is believed the two kinds of knowledge should not be blended or synthesised; both should retain their own identity. The reason is that the two have different epistemologies and are based on different worldviews (Davidson-Hunt & Berkes 2003; Parlee *et al.* 2005; Moller *et al.* 2009). In most cases, not taking knowledge out of its cultural context is one of the biggest challenges of indigenous knowledge research.

In the other dimension, action on environmental resources conservation can be based on traditional knowledge and values or a resurgence of these values (Johannes 2002). Areas conserved by the indigenous community are often aimed at multiple objectives, including sustainable use and livelihood needs, cultural value, self-governance, and economic development, as well as for biological conservation (Berkes 2009). Hence, we need more and deeper partnership of traditional knowledge and science to solve conservation problems, strengthen the network of community conserved areas, engage in ecosystem-based management, set up cross-cultural monitoring for environmental change, and carry out ecological restoration that responds to community needs.

What factors could make the integration of traditional and scientific knowledge difficult? Since indigenous knowledge is attuned to religious, cultural, social practices and individual views, it is difficult to integrate it with new scientific

knowledge. An individual's worldview largely determines their beliefs about disease and the appropriate treatment. For example, a belief in magic would lead to the assumption that disease is as a result of human behaviour (manipulation) and, therefore, that only magical means can achieve cure (Giger & Davidhizar 2008). Social factors also have a profound effect on both the experience and occurrence of illness and how to react to it (Giddens 1993). Individual views on indigenous knowledge practices are not influenced by the level of education and type of profession (Akinsola 1983). It is the synergy between the indigenous ecological knowledge and scientific knowledge (Becker & Ghimire 2003) that can sustain both the ecosystem and biodiversity through integrated forest conservation. In such sustainable environmental practices, communities make common property decision by balancing benefits to individuals with benefits to their communities. But meeting the interests of individuals optimally remains a challenge.

## Incorporating local knowledge into development and conservation activities

Since the 1970s, a growing body of literature has emphasised the importance of incorporating local knowledge and practices into development and conservation projects. Increasingly, the importance of local knowledge and practices has also been highlighted in relation to environmental hazards and disasters (Cronin *et al.* 2004; Dekens 2007b; Haynes *et al.* 2005; Howell 2003; Jigyasu 2002; Mitchell 2006). However, while the importance of such work has been recognised in theory within the international community, the practical application only occurs on a small scale within communities of developing countries (Dekens 2007a). This reality has heightened the interest of non-governmental organisations (NGOs) and other organisations working with populations threatened by environmental hazards; they are all keen on tapping the potentials of indigenous knowledge to contribute to disaster risk reduction (Mercer *et al.* 2007).

To engage indigenous knowledge productively in development, there is a need to move beyond the indigenous-scientific dichotomy and work towards building bridges across the indigenous and scientific divides (Agrawal 1995). Such bridge-building venture requires parity and integration between traditional and scientific knowledge systems, and demands a mutual understanding of the cultural, material and epistemological basis of each. To ensure sustainable development worldwide, for example, Usher (2000) asserted that it should now be a policy requirement that 'traditional ecological knowledge' be incorporated into environmental assessment and resource management. It is necessary, therefore, to develop a participatory process in which the value of indigenous knowledge is demonstrated and kept within the community. It is essential that indigenous communities themselves have

easy access to relevant research and information that may assist them in reducing their vulnerability to environmental hazards (Sillitoe 2000).

## Indigenous knowledge and environmental change

### *Climate change*

Climate change is an issue of this generation as it widely affects various aspects of the environment. Over the millennia, Africa has experienced serious environmental changes resulting from climate change. However, because of high poverty rates, changing socio-economic and political circumstances and demographic growth, traditional coping strategies are becoming inadequate for reducing people's vulnerability. In the recent past, some 320 million hectares (or 25 per cent) of the already fragile resource base in African dry lands have further been degraded by unsustainable land uses, such as over-grazing, over-cultivation, illegal and excessive fuel wood collection compounded by poorly conceived policies and ineffective governance (UNEP 2002).

Climate change has impacted the spatial and temporal distribution of water and nutrients. It has increased the natural disturbances, changed the natural processes, modified the structure and functioning of the ecosystem, and changed the distribution of plant and animal species (Adger & Brown 1994; Ojima *et al.* 1994; Barbier *et al.* 1995; Peterson *et al.* 1997; Vitousek *et al.* 1997; McCarthy *et al.* 2001). The impacts of climate change include the following: streams that are too dry to support animals and plants; alteration in rainfall patterns thus causing runoffs; soils and vegetation to becoming drier; increasing frequency and intensity of forest fires; changing forest composition; changing spatial and temporal occurrence of new assemblages of species; increasing spread of invasive species; and altering the quantity and quality of wildlife habitat, and predator/prey relationships. Other impacts include increasing the area covered by early succession of ecosystems in response to more outbreaks of flooding and fire (Harding & McCullum 1997; Hebda 1997; Walker & Steffen 1997; Kirschbaum 2000; Hansen *et al.* 2001; Stenseth *et al.* 2002).

The likely impacts of climate change in Africa will add to these existing stresses and exacerbate the effects of land degradation. Increased temperature levels are expected to cause additional loss of moisture from soil, reduced and more intense rainfall and higher frequency and severity of extreme climatic events, such as flooding and droughts. These factors are already leading to a loss of biological and economic productivity and putting the population in dryland Africa at risk of short- and long-term food insecurity. Drought-prone areas are particularly deemed to suffer complex, localised impacts of climate variability/change (ATPS 2013).

### *Indigenous knowledge for climate change adaptation*

Practical initiatives that address and improve societal adaptive capacity, thereby reducing risk vulnerability, are commonly expected to be evident at the community level. Individuals, communities and nations have to adapt to climate variability and change for centuries to sustain life (Tyson *et al.* 2002). People are already adapting to climate variability and change to enhance their resilience to livelihood stresses. However, livelihoods are dynamic, complex and variable. Local experiences offer important lessons for institutions or organisations wishing to support adaptation strategies (Hellmuth *et al.* 2007).

Not all responses may have a positive impact on livelihood resilience, as there are spatial spillovers and negative externalities. For example, a community as a whole may be resilient but there could still be winners and losers within the community at the household level because some individuals may be better able to capture the benefits of adaptation. Autonomous decisions can also be constrained by the wider economic and socio- political environment (e.g., poor access to markets, finance or information), and locking individuals into particular pathways (i. e., there may be limits to the resilience of local practices to future risk) (Leach *et al.* 1999; Chambers *et al.* 1989; Ribot & Peluso 2003; Blaikie *et al.* 1994).

Availability of potential adaptation measures cannot simply be translated into enhanced resilience of dryland communities to climate change. Empirical analysis points to the existence of a complex web of challenges and barriers, both real and perceived, which undermine the willingness and ability of dryland dwellers in Africa to adapt to climatic changes and upscale good practices. At the community level, for example, some of the constraints observed can include socio-cultural rigidity and non- availability or restricted access to credits, assets and other resources as well as alternative livelihood options in the locality. At the institutional level, limited understanding of climate risks and vulnerabilities and lack of policy direction and regulatory guidance tend to account for the difficulty of coordinating the various government departments and other stakeholders as well as their narrow sectoral focus. Attitudes associated with the uncertainty that regards climate change as inevitable or as an issue to be dealt with in the future are among the systemic impediments often encountered during adaptation decision-making.

The practice in northern Ethiopia which encourages partnership between the local community, the government, micro-credit institutions and extension agents (such as in a food security demonstration project) is an important factor in terms of ensuring climate change adaptation and food security. The experience of this indigenous knowledge practice in climate adaptation is important because it is a testimony that climate change adaptation policies should be considered a part of the development process and implemented at the local level. It is believed that when such holistic interventions are upscaled the problems associated with food

security might be resolved sustainably (ATPS 2013). Hence, there is a need to strengthen the dissemination of indigenous knowledge and to integrate modern approaches that strengthen indigenous knowledge in climate change adaptation and resilience (Egeru 2012).

# 3

# Research Methods

## Background of the study area

Located in the Horn of Africa, Ethiopia is characterised by heterogeneous agro-climatic conditions and socio-cultural practices. For this project, the Tigray region, which is located in the northern part of the country, was taken as a representative case study area. The study area is selected for reasons related to socio-cultural diversity and feasibility. Ethiopia is a large country with more than 94 million inhabitants and high socio-cultural diversity and agro-climatic conditions. As Ethiopia is highly diverse, any research has to focus on specific sub-region in order to get a relevant picture. In this case, Tigray has been chosen.

The region is divided into seven administrative zones and 52 *weredas* (local districts). The administrative zones are West Tigray, North West Tigray, East Tigray, Central Tigray, South Tigray, South East Tigray and Mekelle. The region has more than 4.5 million people, diversified socio-cultural practices, and agro-climatic settings. It has seven zones with Mekelle as its capital city. The climatic conditions include kolla (semi-arid), dega (humid), and woyna dega (sub-humid) agro-climatic zones. The region is now relatively degraded in its landforms. The socio-economic conditions of the study area remain comparatively weak despite the continuing decline of poverty in terms of the headcount ratio. It needs urgent environmental rehabilitation programmes and the development of environmental protective interventions to improve the livelihood and well-being of the inhabitants. Moreover, there is a natural resource competition among the communities living around it which may be attributed to the value orientations people have about environmental protection and the corresponding risk perceptions of the environment. All these features make it worthwhile to conduct this research which has significant implications for urgent remedial actions and interventions to take place.

### *Physical characteristics*

Tigray forms the northern most reaches of Ethiopia and is located at a longitude that falls between 36° and 40° E. Its north-south extent spans 12.5° to 15° N. Eritrea border in the north, Sudan in the west, Amhara in the south and Afar in the east. Tigray is located at the northern limit of the central highlands of Ethiopia. The landform is complex, composed of highlands (in the range of 2300-3200 meters above sea level), some lowland plains (with an altitude range of less than 500-1500 meters above sea level), mountain peaks (as high as 3935 meters above sea level) and a high-to-moderate relief hills (1600-2200 meters above sea level).

Tigray has diversified agro-ecological zones and niches each with its distinct soil, geology, vegetation cover and other natural resources. The climate is sub-tropical with an extended dry period of nine to ten months and a maximum effective rainy season of 50 to 60 days. The rainfall pattern is predominantly uni-modal (June to early September). Exceptions to the rainfall pattern can be found in areas in the southern zone and the highlands of the eastern zone where there is a little shower during the months of March to mid-May. The highlands receive most of their rainfall during the summer months, much of which goes into tributaries of the Nile, 85 per cent of whose water comes from Ethiopia. Many centuries of cultivation have depleted the soil; hence water is scarce. Considering the low level of rainfall, atmospheric temperature and evaporation, more than 90 per cent of the region is categorised as semi-arid. The remaining areas in the region can be categorised as dry sub-moist (near the central south highlands and the Welqayt highlands) and arid (the lower areas of Irob and Hint'alo Wajjerat woredas).

### *Socio-economic characteristics*

Out of the gross regional income (GDP) registered in the past strategic plan of the government, the share of agriculture reduced to 38.7 per cent in 2009/10 from what it had been (40.9 per cent in 2005/06), while the share of industry reduced from 20.4 per cent to 19.4 per cent in the same period. However, unlike the agricultural and industrial sectors, the share of services has shown a remarkable growth from 38.7 per cent to 41.9 per cent in the same years (Bureau of Planning and Finance, 2009/10). More specifically, farmers make up approximately 83 per cent of the population. The main crops they produce are teff, wheat, and barely. Other agricultural products include beans, lentils, onions, and potatoes. The farmers practice irrigation and terrace farming on the steep slopes. The region is also known for its export items of cotton, incense, sesame and minerals. Handicraft (goldsmith painting and wood sculptures) is another area of activity observed in the historic cities of the district.

According to the 2007 housing and population census report, some 4,314,456 people inhabit the region compared to 3.367 million in 1994. This means that the population of the region has grown almost by one million. Regarding the sex

composition of the population, 49.2 per cent are males and the remaining 50.2 per cent are females. Also, 19.5 per cent of the population lives in urban areas while 80.5 per cent live in the rural areas. Although the population growth of the region decreased from 2.67 per cent before the 2006 census to 2.5 per cent after the 2007 census, the overall population of the region has been growing from year to year.

The Ministry of Finance and Economic Development (2004/05) reports that the poverty rate in the region, defined as the number of citizens with a daily income of less than US$1 per day was 48.5 per cent. The figure has, however, reduced progressively from 2005/06-2009/10. The current poverty rate is believed to be lower than it was in 2005/06. The improved statistics derived from the integrated efforts made in the household-based package in the rural areas and the credits given to the micro and small-scale enterprises in the urban areas. Nevertheless, estimation has been made based on the elasticity of growth to poverty and the level of poverty in the region was estimated at 41 per cent in 2009/10.

### *Nature of environmental degradation, concerns or risks in the selected zones*

Although the ecosystem is designed to sustain life, the ecosystem and regenerating bio-capacity in the study area, by contrast, are severely degraded and pose a major threat to agricultural livelihoods and household well-being. Current estimates indicate that nearly half of all arable land is either moderately or severely eroded, thus, changing previous cultivable lands into barren wastelands. Soil erosion is said to be occurring at a rate of 30-70 tons per hectare each year, while vegetation cover is thought to be as low as 2-3 per cent and appears most likely to continue to deteriorate if management practices remain the same. As land degradation amplifies the negative impacts of drought, productivity decline is bound to worsen. Indeed, the trend has been for some time now. For instance, the World Bank, cited in 2012 Annual Report of Relief Society of Tigray (REST), has estimated that a 2.2 per cent fall in productivity has been occurring each year since 1985, and this is mostly due to soil erosion. In their study, Nyssen et al. (2014) concluded that the direct human impacts are prevailing the effect of climate change particularly the northern highlands of Ethiopia.

The causes and consequences of environmental destruction are many, and they are interconnected. Among these are the following: (a) unprecedented settlement expansion where even steep mountainsides are farmed; (b) cultivable land has become increasingly scarce with population growth, yet livelihoods have continued to depend on subsistence agriculture; (c) soil erosion is a continuing experience leading to desertification and loss of a production base; (d) the impacts of climate change continue to deepen; (e) agricultural practices are still unsustainable, including the use of dung for fuel rather than as organic fertiliser; and (f) continuing a vicious cycle of land over-use in order to meet basic food

security causing decreased fertility. Even the practice of fallow farming is slowly disappearing as the pressure for more land for agriculture, fuel, construction and grazing mounts.

The region certainly stands in need of government intervention to improve farming practices and influence policies concerning ecosystem management and preservation through intensive capacity building and evidence-based advocacy. This will make land and water resources more resistant to climate change and halt soil erosion so as to raise land and agricultural productivity.

## Methods

### *Sampling and participants*

As indicated previously, communities in the seven administrative zones of the Tigray Regional State Government make up the target population. The administrative zones are West Tigray, North west Tigray, East Tigray, Central Tigray, South Tigray, South East Tigray and Mekelle. The study is based on cross-sectional survey with samples that accurately represent the population about which generalisations are to be made. Thus, the random sampling technique was used based on the assumption that environmental problems are highly pronounced in all zones of Tigray region. To select respondent samples, the research population was first divided into six zones (one zone, i. e., Mekelle is deliberately excluded because its socio-economic context is quite different from the others). Three zones were randomly selected. Secondly, each selected site was divided according to type of residence (urban-rural background). Thirdly, the resident population was divided into stations (ketenas) in accordance with the division of kebele (local district). After that, a multi-stage random sampling technique was used to select stations from each local district. The 2007 housing and population census was taken into consideration and that made it easy for the individual householders to be reached and communicated with. Then, based on residence (urban or rural), proportionate samples were drawn from each local district. In all, some 450 samples (representing 150 from each district) were included in the study which made it possible to make comparative analyses. At the end, however, only 435 responses were used in the final analysis. All incomplete questionnaires and responses which failed to give complete data were discarded. The research team opted for a multi-stage random sampling procedure because they believed that the exclusion of local districts and stations would not affect the results of the study.

What is more, outside the sample frames, five key informants from each local district (making 30 informants in all) were purposively interviewed. In addition, 24 participants (12 each from rural and urban areas) were also used for Focus Group Discussions (FGDs). Ultimately, only a group of eight individuals in each study site was selected for use in the Focus Group Discussions.

**Table 3.1:** Characteristics of sample profiles (N= 435)

| Variables | Grouping | F | % |
|---|---|---|---|
| Sex | Male | 255 | 58.5 |
| | Female | 180 | 41.3 |
| Age | 20-39 Years | 226 | 51.8 |
| | 40-59 Years | 157 | 36.0 |
| | 60 years and above | 52 | 11.9 |
| Zone | Eastern Zone | 148 | 33.9 |
| | Southern Zone | 143 | 32.8 |
| | Western Zone | 144 | 33.0 |
| Residence | Urban | 220 | 50.5 |
| | Rural | 215 | 49.3 |
| Educational Background | Did not attend school | 158 | 36.2 |
| | Attended some primary school or completed primary school | 108 | 24.8 |
| | Attended some secondary school or completed secondary school | 84 | 19.3 |
| | Did a Certificate Programme | 36 | 8.3 |
| | Obtained a Diploma and above | 49 | 11.2 |
| Occupational Status | Employed | 140 | 32.1 |
| | Unemployed | 124 | 28.4 |
| | Farmer | 151 | 34.6 |
| | Others | 20 | 4.6 |
| Income Level | Low Income | 174 | 39.9 |
| | Lower Middle Income | 122 | 28.0 |
| | Upper Middle Income | 111 | 25.5 |
| | High Income | 28 | 6.4 |

The samples are of different profiles and coupled with a mix of backgrounds. A deliberate attempt was made to ensure that the distribution of respondents across the three sites is relatively even. Thus, 148 (33.9 per cent) came from Eastern Zone (Atsbi), compared to 144 (33.3 per cent) and 143 (32.8 per cent) who were from Western (Shire) and Southern (Moheni) zones, respectively. Regarding the gender

of the participants, 255 (58.5 per cent) were males while the remaining 180 (41.4 per cent) were females. Respondents between ages 20 and 39 years numbered 226 (51.8 per cent), while those between 40 and 59 years were 157 (36 per cent). The remaining 52 (11.9 per cent) respondents were aged 60 years and above. Concerning education level, 158 (32.6 per cent) had no school education at all, 108 (24.8 per cent) stopped at the primary school. About 84 (19.3 per cent) of them went to secondary school, while 36 (8.3 per cent) had post-secondary certificates and another 49 (11.3 per cent) had diploma certificates and above.

The income level of the respondents shows that 174 (39.9 per cent) were low income earners, 122 (28 per cent) were middle income earners while 111 (25.5 per cent) and 28 (6.4 per cent) belonged to the upper middle income and high-income levels, respectively. To control demographic differences, respondents were also matched according to their residences. The results showed that 220 (50.5 per cent) respondents were from the urban areas while the remaining 215 (49.5 per cent) were from the rural. Also, regarding occupational level, 140 (32.1 per cent) were employed, 124 (28.4 per cent) were unemployed, while 151 (34.6 per cent) were farmers. The remaining, 20 (4.6 per cent) were reported as 'others'. For further information, please see Table 3.1.

## Data collection instruments

### *Questionnaires/Surveys*

***Value Orientation (VO):*** Value orientations were assessed by means of a short version of Schwartz's value scale (1992) and De Groot and Steg (2007) and adopted by the present researchers. The value scale consists of values that belong to the self enhancement versus self-transcendent dimension. Respondents were asked to rate the extent of the importance of these values 'as a guiding principle in their lives' on a five-point scale ranging from (1 = not important to 5 = extremely important).

***Risk Perception (RP):*** This self-report perception inventory, adopted from the previously mentioned researchers (De Groot & Steg 2008), was grouped into two dimensions of risk perceptions: risk to the environment in general, and risk to human health. Items describing the magnitude of risks and judgments concerning environmental risks were included. Concerning risk to the environment, respondents were asked to judge the degree of risk of those environmental issues pose to the environment on a five-point scale ranging from 1 to 5 along with their correspondent values, namely, 1 (no risk at all), 2 (low risk), 3 (moderate risk), 4 (higher risk), and 5 (extremely high risk). The same algorithm was also used to measure risk to human health where respondents were asked to rate health risks posed by those environmental issues to the community in their locality.

***Personal Norms (PN):*** Personal norms items were included to measure behaviour-specific beliefs (feelings of moral obligations to behave pro-environmentally) using a five-point Likert scale with the following values: 1 (Totally Disagree), 2 (Disagree), 3 (Neutral), 4 (Agree) and 5 (Totally Agree). This scale had items to be re-coded so that positive scores would imply higher concern to behave pro-environmentally. The items included, for example, 'I feel bad for taking part in the deforestation of the neighborhood where I live'; 'I would be a better person if I used other fuels more often instead of fire wood' and 'I don't feel guilty when I use every free space for waste disposal'.

***Awareness of Environmental Consequences (AEC):*** Awareness of environmental consequences was measured with items reflecting the extent to which respondents think environmental use would be a problem for society. Eventually, respondents rated the extent to which they agree with these items on a four-point scale ranging from *strongly disagree* (1) to *strongly agree* (4). Items included were, for example, 'The effects of pollution on public health are worse that we realise' and 'Laws that protect the environment limit my choices and personal freedom'.

***Indigenous Knowledge (IK):*** As there was no previously validated instrument for assessing the adapted indigenous knowledge and know-how to the perceived risks, the researchers developed the components used to measure adaptation mechanisms in terms of indigenous knowledge with the guidance received from extant literature. As a result, the researchers first elicited a pool of items from the target population and then developed the items into a structured questionnaire for use in assessing the respondents' indigenous knowledge concepts.

## *Qualitative data collection methods*

***Open-ended questions****:* The researchers developed a concourse of diverse environmental concerns (values, risk perceptions, awareness of environmental problems) based on their literature review. We designed the items to simulate real situations in order to understand community's experiences, in the course of a life time, in their value orientations, risk perceptions and awareness of environmental problems.

***Interviews****:* The interview method constituted another instrument that was used for investigating the problem at hand. Various respondents were interviewed to collect data on concepts regarding an environmental problem, risk perceptions, and awareness of environmental problems. For this purpose, a semi-structured interview guide was developed.

***Focus Group Discussions (FGD)****:* FGDs were used to triangulate, supplement and enrich the results of the survey questionnaire. For this purpose, three focus groups (each containing eight participants) comprising diverse groups (such as sex, religion, and so on) of communities was formed.

## Data collection procedures

A content validity evaluation was done to find out whether the instruments properly represent what they intended to measure. The questionnaire was initially developed in English. Questions about values that show openness to change, tradition, and self-enhancement versus self-transcendent dimension were presented in a way that allowed respondents to depict their real life situations. All questionnaires or inventories were discussed with and verified by a panel of three senior lecturers of the Department of Psychology, Mekelle University, and one Assistant Professor from the Department of Geography and Environmental Studies of the same university. All this was done to determine the validity and the relevance of items in the Ethiopian context. The panel suggested revisions of some questions to make them more straightforward, and/or clearer to elicit the right answers from the respondents.

The first revised version of the questionnaire was given to 10 undergraduate students of the Department of Psychology, Mekelle University. The student evaluators were instructed to complete the questionnaire and write their comments and suggestions on possible areas for further revision. Accordingly, the students made changes on the wording and expressions to improve the questionnaire's clarity, accuracy and validity. After carrying out the necessary changes, the final version of the questionnaire was translated into the local language (Tigrinya version) by two experts in the area. The same instructions regarding the reviewing procedures in English were given to Tigrinya reviewers. The reviewers made further suggestions on changes to be made to certain Tigrinya expressions to achieve greater clarity and accuracy of the questionnaire. In addition to the professional ratings of the items and overall evaluations, confirmatory factor analyses were run to check if the scale(s) is one-dimensional.

To verify the instruments, the researchers had to go through several revisions and then a pilot-test was administered on a group of samples (10 per cent of the total sample size) outside the main sample frames to estimate the reliability of the variables. The reliability test was carried out to check the internal consistency of pooled items or to determine the accuracy of the instruments in terms of effective measurements of the variables. Finally, Coronbach's Alpha for the items of Likert type scales were calculated in order to see an appropriate internal consistency among the items of each scale. The Alpha values of all versions of the scale were found (Openness Values Scale = 0.56, Traditional Values Scale = 0.72, Egoistic Values Scale = 0.66, Altruistic Values Scale = 0.87, Biospheric Values Scale = 0.79, Risk Perceptions to Environment Scale = 0.89, Risk Perception to Human Health Scale = 0.91, Personal Norms of Environmentalism Scale = 0.69, Awareness of Environmental Consequences Scale = 0.50). All the tests show that the reliability of the scales is up to standard.

In the Focus Group Discussions and interviews, trustworthiness was assured by avoiding double barreled, as well as long and complex questions. Efforts were also made to avoid leading questions and false premises. As a final test of the instruments' validity and reliability, the researchers invited their colleagues with ample experiences to comment and debrief on the prepared questions.

After the instruments had been improved upon through this rigorous process, they were administered to respondents in the sample communities in the presence of the researchers and assistant researchers. The objectives of the research were also verified before administration. Local officers assisted the Focus Group Discussions. The collected data were tabulated, analysed and interpreted systematically in conformity with scientific research protocols. Frequencies with percentages, mean scores, standard deviations and t-tests, factor analysis, correlations, regressions and Multivariate Analysis of Variance (MANOVA) were applied to analyse the data through the SPSS software. A qualitative analysis combined with thematic analysis was used to work on qualitative data.

*Data analysis*

The mix of qualitative and quantitative methods of analysis was used to help in the process of arriving at findings with implications for a real understanding of environmental concerns and risk behaviours. The collected data were tabulated, analysed and interpreted through various scientific statistics. For instance, the simple descriptive statistics (mean scores, standard deviations) and an independent samples t-test was used to examine the urban-rural difference on the values the community places on the environment, as well as their risk perception of the environment in general and the risk perception on human health. Also, principal factor analysis (PFA) was used to examine the factor loadings of value clusters. Paired samples t-test was used to determine the relative importance of perceived values and risks of environmental concerns. A linear correlation was also used to show the relationship between value orientation and specific behaviour beliefs. A multiple linear regression (LR) was applied to observe the predictor variables of risk perceptions, personal norms and awareness of consequences of the environment. Eventually, a Multivariate Analysis of Variance (MANOVA) was applied to see the main and interaction effects of independent variables (sex, age, education, and occupation) on the possible extracted attributes of dimensions of value orientations and risk perceptions to environmental concerns. The quantitative data was processed through the SPSS software.

On the other hand, a qualitative analysis was also carried out through thematic analysis to supplement and strengthen the quantitative data. Relevant information obtained from interviews and FGD participants were analysed and interpreted thematically with a series of steps such as pre-coding (data transcription was

repeatedly done until the intended main points of the interview were achieved, significant quotes and statements of informants were highlighted), coding (the pre-coded statements or ideas were summarised and structured into meaningful experiences or organised units), categorising (bringing texts, which were coded in a similar pattern, into meaningful units), themes (concepts, that explain how ideas are connected, leading to analytical reflections) and write up (generating meaning out of the themes developed).

# 4

# Results and Discussions

In this section, the results of the study are reported in descriptive and inferential statistics. The results are presented based on the hypotheses formulated. First, the quantitative data are presented, followed by the qualitative data collected through interviews and FGD. The subsequent discussion will follow the findings.

## Values held by respondents / communities towards environmental concern

### *Environmental values across urban and rural community*

The first objective of this research was to assess the values people hold about environmental concerns. Hence, respondents were asked to rate how important each value is as a guiding principle in their lives on a five-point scale, ranging from 1 (not important at all) to 5 (extremely important). Simple descriptive statistics were used to score each of these values. In order to ease the discussion, we grouped the responses of the five point scale into two categories such as 'not important' and 'important', while the neutral category served as a midpoint for the level of importance of values. Prior to the discussion of the subsequent results, please see the definitions of some of the value–items for further clarification and understanding.

For the openness to change value dimension, 39.7 per cent of the urban and 34 per cent of assessment of the rural communities agreed that 'curiosity' is a guiding principle in their environment. Curiosity values are inquisitive thinking and learning about the environment evident by individual's careful observation about the environment, e.g., exploration of nature. In the same way, 36.5 per cent and 33.3 per cent of the urban and 24.2 per cent and 28.3 per cent of the rural believed that 'daring' and 'varied life' are more likely the principles guiding their environmental concerns, respectively.

| Value-Item | Description |
|---|---|
| Curiosity | Direct experience and exploration of nature |
| Varied Life | A life filled with challenge, novelty and change of nature |
| Accepting | Willing to submit the circumstances and situations of natural world |
| Self-discipline | Self-restraint and resistance to nature |
| Social order | Spiritual respect and ethical concern for nature |
| Reciprocation | Making a return on everything that one takes from nature |
| Social power | Mastery, physical control, dominance of nature |
| Influential | Havine an impact on and manipulation nature |
| Broad mindedness | Being tolerant towards nature and the natural world |
| Forgiveness | Willingness to prosocial change toward nature |
| Social justice | Correcting injustice and care for nature |

Both urban and rural populations believed that they hold traditional values regarding the environment (36.4 per cent of the urban and 35.1 per cent the rural dwellers as the important guiding principles of their lives) but attach moderate values to environmental concerns in the proportion of 26.9 per cent of the urban dwellers and 27.2 per cent of the rural dwellers. Nearly 40.7 per cent of the urban and 37.2 per cent of the rural people agreed that 'acceptance' of nature is a guiding principle in their environmental values. Almost the same percentage, i. e., 39 per cent of both groups also believed that 'obedience' is more likely the principles guiding their environmental concern. Surprisingly, nearly 39 per cent of the urban and 35 per cent of the rural community dwellers considered 'self-discipline' and 'reciprocation' as driving factors in their lives. Similarly, 38.7 per cent of the urban and 36.5 per cent of the rural dwellers felt that 'social order' is a guiding principle in their lives.

Regarding the egoistic value cluster, more urban residents (30 per cent) than rural groups (26.4 per cent) think that 'authority' is not an important factor in their lives. Similarly, both groups (23.3 of the urban and 24.9 per cent of the rural) say that 'influence' is not an important factor in guiding their environmental concern. Fewer urban (25.9 per cent) than rural community dwellers (34.8 per cent) considered 'social power' as a guiding principle in their lives. Respondents from both groups (32 per cent of the urban and 33 per cent of the rural) are ambitious, while 25 per cent of the urban and 24.8 per cent of the rural populations felt that 'wealth' is a guiding principle in their lives.

For the altruistic values category, more than 40 per cent from both groups responded that 'honesty' (42.7 per cent of the urban and 41.9 per cent of the rural), 'loyalty' (44.6 per cent of the urban and 41.3 per cent of the rural), 'equality' (42.6 of the urban and 42 per cent of the rural) and 'social justice' (41.6 per cent of the urban and nearly 40 per cent of the rural) were the values that served as the guiding principles of their lives. Conversely, 41.3 per cent and 40 per cent of the urban and 36.3 per cent and 38.2 per cent of the rural residents believed that 'broadmindedness' and 'forgiveness' are the principles guiding their environmental concerns, respectively. Nearly a proportionate cast of respondents from both groups (40 per cent of the urban and rural communities) thought that a 'world at peace' and 'being helpful' were the guiding factors in their lives of environment interaction.

As for the last dimension of biospheric values, both groups recognised that they are important guiding principles. More of the urban (40.3 per cent and 41.8 per cent) than rural people (35.8 per cent and 37.5 per cent) agreed that that 'respecting the earth' and 'preventing environment from damage' were important guidelines in their lives. Nearly 39 per cent of the urban and 37 per cent of the rural people responded that 'preventing pollution' was an important factor guiding their lives. Fewer of the rural group (31.1 per cent) than the urban (37 per cent) felt that 'unity with nature' is a driving factor in their lives.

To compare the 27 items of different value dimensions among rural-urban respondents, an independent samples t-test was employed. The mean scores, standard deviations, and t-tests are presented in Table 4.1. Among the 'openness to change' value category, the mean scores of the values of 'curiosity' and 'daring' were significantly higher in the urban areas than the rural (Urban Mean = 4.00, SD = 1.18; Rural Mean = 3.76, SD = 1.17). However, the mean scores of varied life were not statistically significant both among the urban and rural groups. The same pattern of analysis indicated that the mean scores of reciprocation were significantly higher for urban respondents than their rural counterparts (Urban Mean = 4.00, SD = 1.12; Rural Mean = 3.77, SD = 1.23). Other mean scores from the tradition value cluster (namely tradition, moderate, accepting, obedience, self-discipline and social order) had no statistically significant difference among the two groups (see Table 4.1). The mean scores for social powers were significantly higher for rural groups than the urban (Urban Mean = 3.25, SD = 1.45; Rural Mean = 3.74, SD = 1.11), while the remaining mean scores of the egoistic value cluster had no statistically significant difference for the two groups. The same analysis was also applied to 'altruistic' and 'biospheric' value clusters. Statistically significant differences were not registered in all values of the two categories among the rural-urban groups except that the mean scores for the world at peace were significantly higher among the urban group than the rural. Further research should be conducted to sort out the differences clearly.

**Table 4.1 :** Mean scores, SD and independent samples T-test of values of environment across residence

| Values to Environment | Urban (N =220) | | Rural (N = 215) | | Independent samples t-tests | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | t | df | Sig. | Mean Difference |
| Curiosity | 4.009 | 1.182 | 3.763 | 1.178 | 2.177 | 433 | .030 | .24630 |
| Daring | 3.818 | 1.206 | 3.112 | 1.345 | 5.770 | 433 | .000 | .70655 |
| Varied Life | 3.668 | 1.152 | 3.488 | 1.135 | 1.639 | 433 | .102 | .17981 |
| Tradition | 3.859 | 1.195 | 3.795 | 1.190 | .557 | 433 | .578 | .06374 |
| Moderate | 3.332 | 1.319 | 3.242 | 1.468 | .673 | 433 | .502 | .08996 |
| Accepting | 4.018 | 0.998 | 3.823 | 1.159 | 1.882 | 433 | .061 | .19493 |
| Obedience | 4.041 | 1.120 | 3.958 | 1.034 | .801 | 433 | .424 | .08277 |
| Self-discipline | 4.009 | 1.090 | 3.954 | 1.230 | .499 | 433 | .618 | .05560 |
| Social order | 3.968 | 1.070 | 3.888 | 1.147 | .751 | 433 | .453 | .07981 |
| Reciprocation | 4.000 | 1.127 | 3.772 | 1.230 | 2.016 | 433 | .044 | .22791 |
| Social power | 3.250 | 1.451 | 3.740 | 1.118 | -3.935 | 433 | .000 | -.48953 |
| Wealth | 3.468 | 1.386 | 3.600 | 1.314 | -1.017 | 433 | .310 | -.13182 |
| Authority | 2.427 | 1.529 | 2.437 | 1.412 | -.070 | 433 | .944 | -.00994 |
| Influential | 2.746 | 1.474 | 2.526 | 1.349 | 1.622 | 433 | .106 | .21987 |
| Ambitious | 3.218 | 1.410 | 3.186 | 1.305 | .247 | 433 | .805 | .03214 |
| Broad Mind | 4.164 | 1.119 | 3.972 | 1.160 | 1.753 | 433 | .080 | .19154 |
| Honesty | 4.282 | 1.052 | 4.302 | 1.022 | -.206 | 433 | .837 | -.02051 |
| Loyalty | 4.355 | 0.917 | 4.242 | 1.022 | 1.211 | 433 | .227 | .11268 |
| Forgiveness | 4.150 | 1.056 | 3.958 | 1.220 | 1.755 | 433 | .080 | .19186 |
| Equality | 4.250 | 0.905 | 4.233 | 1.024 | .188 | 433 | .851 | .01744 |
| A world at peace | 4.246 | 1.004 | 4.019 | 1.264 | 2.075 | 433 | .039 | .22685 |
| Social justice | 4.186 | 1.019 | 4.107 | 1.047 | .802 | 433 | .423 | .07939 |
| Helpful | 4.036 | 1.068 | 3.926 | 1.178 | 1.028 | 433 | .304 | .11078 |
| Preventing pollution | 3.964 | 1.174 | 3.926 | 1.112 | .347 | 433 | .729 | .03805 |
| Respecting the earth | 4.123 | 1.037 | 3.935 | 1.158 | 1.783 | 433 | .075 | .18784 |
| Unity with nature | 3.832 | 1.140 | 3.674 | 1.154 | 1.431 | 433 | .153 | .15740 |
| Protecting the environ | 4.132 | 1.027 | 4.056 | 1.138 | .731 | 433 | .465 | .07600 |

P*<0.05

The simple descriptive analysis shows that the urban groups scored higher percentages in all values of environmental values except moderation, social power and wealth than the rural population. Put differently, urban-dwellers ranked higher in more of 27 items. We can say, therefore, that they are more concerned about the environment having internalised the values of the environment to a higher degree. The result indicates that people living in the urban areas are more environmentally concerned than those living in the rural context. However, an item-by-item analysis of value clusters indicates that the differences between rural and urban samples are not extensive and generalised. Rather, they are concentrated on specific aspects relating to the seriousness of the environmental crisis and an understanding of the uses made of the environment.

As Berenguer *et al.* (2005) observed regarding his own study, there were no significant differences between the two groups where rural and urban people show themselves to be equally concerned about the environment, as well as for its defense. However, the present research highlights some evidence that values vary with residence (urban and rural contexts). As shown in Table 4.1, the key differences between the two groups can be seen in 'social powers', which scored higher in the rural context, and 'openness to change' (curiosity, daring), 'tradition values' (reciprocation), and 'altruistic' (the world at peace), which scored higher in the urban context. The cumulative demographic main and interaction effects on the five value clusters will also be discussed in the next section.

Qualitatively, respondents were asked how they value nature. In the ensuing discussion, some of them surprisingly said 'Nature is life and life is nature, they are inseparable', while few of them had loosened attention to nature. Accordingly, values are patterns by which individuals orient themselves and adapt to their nature. These patterns are basic conceptions about lives which underlie an individual's behaviour (for instance, pro-environmentalism). Values are also categorised into 'self-centered' and 'social-centered' in the sense that they form the point of intersection between the individual and society, and between society and the environment. This was clearly evident in the results of the FGDs. As such, values are patterned in the nature-life interactions of the local people. These life-long interactions guide people to construct the self-centered values reflecting their personal interests and enjoyment as well as the socio-centric values-reflecting care and concern for the succeeding generation. This discussion would help us to extrapolate the gender consideration in the environmental concern. One explanation that does gain more support, according to Davidson and Freudenburg (1996), is the 'safety concern hypothesis' that addresses the role of women as the care taker of their family unit may become extended to their local community and environment. Hence, this invokes greater concern for both. Though not conclusive, women seem

to be more environmentally concerned than men probably due to the experience and effects of parenthood. For men, parenthood leads to less environmental concern while, for women, it leads to greater concern. This survey results agree with previous researches reported by, for example, Slovic (2000) and Kalantari *et al.* (2007), while it contradicts with the results reported by Hayes (2001).

Another broadly categorised discussion was the motivational factors that push the local people to protect or destroy the natural environment. Motivation, shaped by intensity and direction, determines which behaviour people will adopt from all the possible options. The primary motives are the larger motives that let us engage in a whole set of behaviours, e.g., striving to live an environmental life style. Selective motives are those which influence one's specific action which comes to dominate the behavioural pattern in a locality. As far as our focus group discussion is concerned, primary motives – environmental values seem to be overridden by the selective motives which develop around one's own needs (e.g., personal comfort).

In one of the much-awaited discussions, the group members spoke about the concerned or carefree attitude of individuals towards the natural environment. These attitudes and the driving forces behind them were examined from the community's perspectives. The respondents argued quite differently: some showed support for the environment through a reactive response to the high levels of air pollution, water contamination, and other environmental risks in the society. In contrast, a smaller number of people showed their support for the environment in a way, which is deemed to be proactive and ecocentric in nature. In the discussion, we noted that gender variation is weak and inconclusive. However, there was some supporting evidence for the impression that women seemed to be more concerned about the environment than men did.

### *Factor loadings of the perceived values of environmental concern*

Furthermore, we used the principal axis factoring with Varimax rotation to see the factor loadings and the successive strengths of the underlying value dimensions of environmental concern. The factor analysis produced 22 value items measuring values as principles guiding their environmental concern, accounting for 42.13 per cent of the overall variance accounted in the data. We strictly follow the guidelines recommended by Bordens and Abbott (1988) to determine the level of significance of factor loadings. With this presumption, the statistical significance of item loadings was taken into account when defining factors. The given N = 200 (fair) factor loadings of greater than 0.4 met Bordens' and Abbott's significant criterion. It is largely recommended to maintain a factor loading of an item = 0.40 since our data are relatively large (N = 435). We believe the result will enhance the interpretability of the factors and provide the basis for further scale development in our context.

The first value factor accounted for 12.73 per cent of the variance; the second 9.46 per cent, the third 8.15 per cent, the fourth 6.32 per cent, and the last factor 5.44 per cent. As shown in Table 4.2, there are five factor loadings derived from the factor analysis: Factors 1, 2, 3, 4 & 5. In factor 1, 'forgiveness' (with highest loading factor), 'a world at peace', 'equality', 'honesty', 'loyalty', 'social justice', 'broadmindedness' and 'helpfulness' (lower loading factor) are loaded in that fashion of order. Similarly, in factor 2, the highest loading was 'respecting the earth' followed by 'unity with nature', 'protecting the environment' and 'preventing pollution'. Factor 3 constituted of items with the highest loading factor, such as 'moderation', 'accepting', 'self-discipline', 'obedience', 'social order', and 'tradition', respectively. In factor 4, 'authority', 'influential', and 'ambitious' were loaded. In the last factor, only 'curiosity' was found to be significant in its factor loadings. A list of the items and factor loadings for each factor along with variance explained are presented in Table 4.2.

The present result confirms the five component factors of value orientations. The first factor, called 'altruistic value orientation', reflects concern for the welfare of others. The second component is 'biospheric value orientations' which consist of a host of values emphasising the environment and the biosphere. The third resultant factor is composed of 'egoistic values' focusing on maximising individual outcomes. The fourth value cluster is 'tradition' which primarily reflects a motivation to preserve the status quo. The last value cluster is called 'openness to change' indicating the degree to which an individual is motivated to follow his or her own emotional and intellectual interests. This finding confirms the overall nature of environmental concern in a way that (1) orientation toward care of the environment as the reflection of altruistic behaviour; and (2) orientation driven by egoistic motives given the enjoyment and pursuit of personal interest obtained from the exploitation of natural resources.

As can be seen, the component factor analysis reproduced a five-factor component consistent with those previously reported by researchers for example (Schwartz & Bardi 2001, Schwartz *et al.* 2001; De Groot & Steg 2007c) namely, 'openness to change', 'tradition', 'egoistic', 'altruistic' and 'biospheric' values. The first three values are called self-enhancement; while the last two values are called self-transcendent. However, the findings in this study shows that the value of openness to change almost does not exist as one of the items rather loaded onto the traditional values, the other failing to load and only the third item loading on to the openness values cluster. The four major values that are characteristics of the community under scrutiny are traditional values, egoistic value, altruistic values and biospheric values.

**Table 4.2 :** Factor Loadings of the Five Value Components

| Values | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 |
|---|---|---|---|---|---|
| Curiosity | .240 | .230 | .325 | .004 | **.472*** |
| Daring | .070 | .087 | .261 | .216 | .084 |
| Varied Life | .135 | .140 | .402 | .096 | .217 |
| Tradition | .151 | .084 | **.419*** | .027 | .062 |
| Moderate | -.002 | .067 | **.488*** | .237 | -.143 |
| Accepting | .229 | .036 | **.483*** | -.093 | .185 |
| Obedience | .300 | .031 | **.428*** | -.025 | .238 |
| Self- discipline | .346 | .230 | **.443*** | -.048 | .140 |
| Social order | .203 | .233 | **.423*** | -.052 | .229 |
| Reciprocation | .257 | .301 | .398 | .122 | .129 |
| Social power | .089 | .116 | .152 | .266 | .349 |
| Wealth | .162 | .116 | .120 | .232 | .400 |
| Authority | -.127 | -.137 | .042 | **.759*** | -.055 |
| Influential | -.053 | -.072 | -.010 | **.738*** | .016 |
| Ambitious | .091 | -.003 | .075 | **.495*** | .248 |
| Broadmindedness | **.554*** | .130 | .156 | -.049 | .478 |
| Honesty | **.599*** | .162 | .215 | -.026 | .369 |
| Loyalty | **.569*** | .196 | .218 | -.070 | .269 |
| Forgiveness | **.620*** | .254 | .272 | .100 | 6.150E-5 |
| Equality | **.608*** | .242 | .179 | -.083 | .132 |
| A world at peace | **.609*** | .390 | .193 | .039 | .053 |
| Social justice | **.563*** | .327 | .217 | .023 | .152 |
| Helpfulness | **.483*** | .404 | .234 | .146 | .069 |
| Preventing pollution | .267 | **.594*** | .079 | -.092 | .293 |
| Respecting the earth | .208 | **.722*** | .182 | -.113 | .212 |
| Unity with nature | .246 | **.609*** | .214 | .023 | -.006 |
| Protecting the environment | .251 | **.590*** | .085 | -.067 | .063 |
| Eigen Value (Successive Strength of Factors) | 7.86 | 2.39 | 1.44 | 1.44 | 1.13 |
| Variance Explained | 12.73% | 9.49% | 8.15% | 6.32% | 5.44% |
| **Total Variance Explained** | **42.13%** | | | | |

*Factor Loadings > 0.4, Principal Axis Factoring, Rotation Method: Varimax with Kaiser Normalisation

A general pattern of the structure of factors showed that the value orientations heavily rely on self-transcendent with the tendency of altruistic and biospheric values in opposition to self- enhancement values that are related to the pursuit of personal interests, such as power, achievement and ambition. The tradition and openness to change clusters have low factor loading and variance accounted. Including nature in one's self-construal would lead to concern for biospheric targets. The inclusion of nature in self is a concept very similar to 'The New Environmental Paradigm/NEP/' (Dunlap & Van Liere 1978), with the main difference being that the NEP targets a worldview on the interconnectedness between humanity and nature. Put another way, environmental concern is the relationship between the individual and the environment, and the society and environment (Berenguer *et al.* 2005; Hansla 2011). The variations of the pattern of this result, however, seem to be attributed to the outcome of differences in the contextual relevance of items, and other attributes of society.

Even though a large number of items loaded on self-transcendent (i.e., altruistic or biospheric) as opposed to self-enhancement (i.e., egoistic), the value dimension is related to different types of environmental beliefs and behaviours, and this is because environmental behaviour often involves a conflict between immediate individual gains and long-term collective interests (Nordlund & Garvill 2003). Most previous findings found that people with a dominating self-transcendent value orientation have stronger pro-environmental beliefs and are more likely to engage in pro-environmental behaviour than people who strongly prefer self-enhancement values.

Derived from the data set, the tradition value cluster that primarily reflects a motivation to preserve the status quo, and the openness to change indicating the degree to which an individual is motivated to follow his or her own emotional and intellectual interests are also taken in account. Given the predictive value of social influence on behaviour, promoting an environment in which a wise use of resources is the norm appears to be a powerful means to reduce environmental risks.

When rated specifically about the value orientations, respondents were not as hard-nosed as their egoistic value orientation might imply. Still, as noted earlier, respondents believe that their value orientation is due wholly or at least partially to social justice, helpfulness, unity with nature and respecting the earth. More specifically, the notion that value orientation is blameworthy for egoistic value is weaker among the respondents of this study. One possible explanation for the account of this finding is the socialisation process and the resultant effect of social interaction in the Ethiopian context. Through socialisation, the conceptions of values are developed mainly towards conformity, peace, helpfulness and respect rather than ambition, power, influence and the pursuit of personal interests. However, values that are based on value systems of the society conflict with the immediate

individual satisfaction of the members of community in the dynamic interaction of their environment. Thus, the respondents would, in part, have egoistic values towards the recurrent change of environment.

Furthermore, we carried out paired samples t-test to systematically examine the relative weight of values of the community about their environmental concern. To examine the relative importance of each conceived value clusters, the researchers computed scale scores for each component (by summing up the item scores for each scale and dividing by the total number of items in the scale) and compared the mean scores for each component using paired samples t-test (see Table 4.3).

Mean scores, standard deviations and paired samples t-test for the five value clusters were computed. The higher the mean score the higher the agreement that the community predominantly holds the value orientation. Hence, the highest agreement was with the altruistic value cluster (M = 4.152, SD = 0.786) followed by biospheric (M = 3.955, SD = 0.883), traditional (M = 3.833, SD = 0.713), openness to change (M = 3.645, SD = 0.886), and egoistic value orientation (M = 3.059, SD = 0.894). Egoism or self-interest orientation that is best described by the 'not in my backyard' attitudes seems to be lowest ranked but still its mean scores are higher. Surprisingly, statistically significant differences were observed among the five value clusters ($P < 0.01$). These results provide further support for the five distinctions of value orientations in the way it seems consistent to the results reported by Duan (2005) although there is a variation in terms of relative importance of mean scores in value components. Nonetheless, egoism, biospheric, and altruistic values are not incompatible; rather, they are correlated. In other words, many people's environmental attitudes reflect some combination of the three orientations (Stern *et al.* 1993). Although the present results tend to incline towards altruistic and biospheric value orientations, the communities are less likely to engage in pro-environmentally behaviour and that is why the environment is getting worse. These will lead us to revisit the egoistic values more than the other values of the environment. Therefore, the present study will induce interventions designed to change their attitude through communication behaviour change strategies.

**Table 4.3:** Mean scores and standard deviations of the five value clusters

| Value Clusters | Mean | Std. Deviation | Std. error |
|---|---|---|---|
| Openness to change Values | 3.6452 | .88630 | .04249 |
| Traditional Values | 3.8335 | .71317 | .03419 |
| Egoistic Values | 3.0593 | .89642 | .04298 |
| Altruistic Values | 4.1523 | .78669 | .03772 |
| Biospheric Values | 3.9557 | .88375 | .04237 |

## Communities risk perception of specific environmental consequence and their degree of sensitivity to the risks inherent in the environment

### *Rural-urban community's perception of risks*

Perceptions of risks were measured with two composite measures, namely, risk perceptions to the environment and risk perceptions to human health. In both measures, respondents were asked to judge the riskiness of those environmental issues to the environment in general and risks to human health, a total of 25 items with a five-point scale, ranging from 1 **(**no risk at all) to 5 (extremely high risks) to environment/human health. The results are presented briefly as follows.

### *Risk perceptions of environment*

Table 4.4 indicates the mean scores, SD and an independent samples t-test of the 25 risk items across the urban and rural groups. The higher the agreement is, the higher the environmental issues would be harmful to the environment and vice versa. Urban groups were found to be more risk perceiver (Mean greater or equal to 3.00) than their counterparts on 19 items. While rural groups were found to be rather high-risk perceiver in comparison to urban groups on three items such as drought (Mean = 3.87, SD = 1.208), cutting of trees and bushes (Mean = 3.61, SD = 1.27) and loss of farming lands (Mean = 3.64, SD = 1.16). The urban group was more likely to perceive biodiversity loss (M = 3.65, SD = 2.20) as highest risk to the environment, followed by safe drinking water shortage (Mean =3.63, SD = 1.42), global warming (Mean = 3.59, SD = 1.39), cutting of trees and bushes and wild fires (Mean =3.57, SD = 1.35), fresh water shortage (Mean = 3.55, SD = 1.34), soil erosion and flooding (Mean = 3.52, SD = 1.42), energy shortage (Mean = 3.50, SD = 1.24), drought and species extension (Mean = 3.49, SD = 1.30). Neither of the groups perceived that the use of fertiliser had low risks to the environment. The result also indicates that the two groups were quite different regarding the types of environmental risks when perceiving the riskiness of the issues. For example, the rural communities were more concerned about drought and its related risks, while the urban group thought of lifestyle-related risks, such as safe drinking water shortage and energy shortage, etc. (see Table 4.4).

An independent samples t-test was performed to compare the mean differences of each risk item between the two groups for risk perception to the environment. The higher the mean score is, the higher the agreement that the environmental issue is assumed to constitute a risk to the environment. The analysis shows that the mean difference between the two groups on 7 items was statistically significant ($P < 0.5$), at a confidence level of 95 per cent. Urban groups more than the rural groups judged an automatic/car emission, livestock wastes, use of pesticides, urbanisation, safe drinking water and desertification as the highest risks to the

environment. On the other hand, the rural groups perceived drought as a higher risk to the environment in comparison to their urban counterparts. However, the mean differences between the two groups on the remaining 18 items were not statistically significant at the confidence level of 95 per cent.

**Table 4.4 :** Mean scores, SD and independent samples T-test of risk perception to environment across residence

| Risks to Environment | Urban (N = 220) | | Rural (N = 215) | | Independent t-tests | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | t | df | Sig. | Mean Difference |
| Burning fossil fuel | 3.450 | 1.481 | 3.186 | 1.489 | 1.853 | 433 | .065 | .26395 |
| Automobile/car emission | 3.100 | 1.404 | 2.749 | 1.344 | 2.664 | 433 | .008 | .35116 |
| Solid waste | 3.086 | 1.320 | 2.898 | 1.253 | 1.529 | 433 | .127 | .18869 |
| Soil erosion | 3.527 | 1.425 | 3.502 | 1.282 | .192 | 433 | .848 | .02495 |
| Livestock waste | 2.836 | 1.375 | 2.521 | 1.307 | 2.451 | 433 | .015 | .31543 |
| Use of pesticides | 2.477 | 1.603 | 2.181 | 1.223 | 2.161 | 433 | .031 | .29588 |
| Use of fertiliser | 1.964 | 1.317 | 1.958 | 1.341 | .043 | 433 | .966 | .00550 |
| Flooding | 3.523 | 1.557 | 3.386 | 1.240 | 1.011 | 433 | .312 | .13668 |
| Drought | 3.496 | 1.609 | 3.870 | 1.208 | -2.739 | 433 | .006 | -.37431 |
| Wildfires | 3.573 | 1.483 | 3.377 | 1.435 | 1.400 | 433 | .162 | .19598 |
| Firewood/charcoal | 3.050 | 1.362 | 3.037 | 1.286 | .101 | 433 | .920 | .01279 |
| Over-grazing | 3.223 | 1.289 | 2.898 | 1.293 | 2.625 | 433 | .009 | .32505 |
| Cutting of trees and bushes | 3.573 | 1.351 | 3.619 | 1.277 | -.364 | 433 | .716 | -.04588 |
| Urbanisation | 2.559 | 1.424 | 2.205 | 1.310 | 2.700 | 433 | .007 | .35444 |
| Species extinction | 3.496 | 1.329 | 3.274 | 1.348 | 1.722 | 433 | .086 | .22104 |
| Invasive species | 3.464 | 1.346 | 3.391 | 1.349 | .565 | 433 | .573 | .07294 |
| Freshwater shortage | 3.559 | 1.348 | 3.377 | 1.287 | 1.442 | 433 | .150 | .18235 |
| Safe drinking water shortage | 3.623 | 1.420 | 3.372 | 1.357 | 1.881 | 433 | .051 | .25063 |
| Energy shortage | 3.500 | 1.248 | 3.442 | 1.182 | .499 | 433 | .618 | .05814 |
| Loss of farming lands | 3.477 | 1.214 | 3.642 | 1.167 | -1.441 | 433 | .150 | -.16459 |
| Global warming | 3.596 | 1.390 | 3.395 | 2.464 | 1.046 | 433 | .296 | .20011 |
| Desertification | 3.073 | 1.390 | 2.777 | 1.338 | 2.262 | 433 | .024 | .29598 |
| Ozone depletion | 3.486 | 1.485 | 3.256 | 1.369 | 1.683 | 433 | .093 | .23055 |
| Biodiversity loss | 3.659 | 1.200 | 3.461 | 1.218 | 1.713 | 433 | .087 | .19863 |
| Population growth | 3.341 | 1.274 | 3.284 | 1.400 | .446 | 433 | .656 | .05719 |

P*<0.05

### *Risk perceptions to human health*

A similar pattern, as risk perception to the environment, was also used where respondents were asked to judge the 25 risk items to human health with a five-point scale ranging from 1 (no risk at all) to 5 (extremely high risks to human health). Table 4.5 shows the means scores, SD and an independent samples t-test of the 25 risk items across the urban and rural groups. For more of the risk items they were given to rate, the urban groups were perceivers of risks to human health to a larger extent than the rural groups. Urban groups more than rural groups ranked safe drinking water shortage (Mean = 3.86, SD = 1.29) as a higher risk environmental issue to human health, followed by global warming (Mean = 3.66, SD = 1.25), freshwater shortage (Mean = 3.62, SD = 1.33), ozone depletion (Mean 3.59, SD = 1.42), flooding (Mean = 3.58, SD = 1.38) and biodiversity loss (Mean = 3.52, SD = 1.29). Quite interestingly, the rural community more than the urban perceived drought as the highest risk to human health (Mean = 3.86, SD = 1.21) followed by loss of farming lands (Mean = 3.595, SD = 1.16), deforestation (Mean = 3.591, SD = 1.23) and soil erosion (Mean = 3.34, SD =1.28) in that order. Both groups ranked the use of fertiliser, as compared to other risk items, as a lower risk factor to human health followed by livestock waste, wildfires and solid waste. The analysis provided some insight that the two groups differ regarding the nature of environmental risks. For example, the urban group thought of lifestyle-related risks, such as safe drinking water shortage and global warming, while the rural communities were more concerned about drought and its related risks to human health.

Our analysis further demonstrates the extent of variations of risk perceptions to human health among residents. Thus, an independent samples t-test was performed to compare the mean differences of risk that each item poses to human health as perceived by the two groups. The higher the mean score, the higher the risk the environmental factor is assumed to pose to human health. The results show that the mean difference between the two groups based on only some of the risk items, is statistically significant ($P < 0.05$), at the confidence level of 95 per cent. Urban groups perceived environmental issues such as automobile emission, livestock waste, urbanisation; safe drinking water shortage, energy shortage and global warming as being more harmful to human health than the rural groups. Conversely, the rural groups perceived drought and desertification as being more harmful environmental risks to human health than their urban counterparts did. However, the analysis did not show the mean differences on the remaining risk items to human health between the two groups (see Table 4.5).

**Table 4.5:** Mean scores, SD and independent samples T-test of risk perception to human health across residence

| Risks to Health | Urban (N =220) | | Rural (N = 215) | | Independent Samples t-test | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | t | df | Sig. | Mean Difference |
| Burning fossil fuel | 3.300 | 1.484 | 3.242 | 1.366 | .425 | 433 | .671 | .05814 |
| Automobile/car emission | 3.173 | 1.400 | 2.754 | 1.322 | 3.209 | 433 | .001 | .41924 |
| Solid waste | 2.968 | 1.339 | 2.954 | 1.230 | .119 | 433 | .905 | .01469 |
| Soil erosion | 3.314 | 1.400 | 3.349 | 1.284 | -.273 | 433 | .785 | -.03520 |
| Livestock waste | 2.723 | 1.368 | 2.284 | 1.093 | 3.692 | 433 | .000 | .43901 |
| Use of pesticides | 2.346 | 1.348 | 2.135 | 1.186 | 1.728 | 433 | .085 | .21057 |
| Use of fertiliser | 2.136 | 1.496 | 1.888 | 1.255 | 1.871 | 433 | .062 | .24799 |
| Flooding | 3.586 | 1.384 | 3.451 | 1.202 | 1.087 | 433 | .278 | .13520 |
| Drought | 3.605 | 1.539 | 3.861 | 1.219 | -1.920 | 433 | .050 | -.25592 |
| Wildfires | 2.946 | 1.473 | 2.777 | 1.270 | 1.278 | 433 | .202 | .16871 |
| Firewood/charcoal | 3.018 | 1.303 | 3.107 | 1.247 | -.726 | 433 | .468 | -.08879 |
| Over-grazing | 3.164 | 1.304 | 2.954 | 1.321 | 1.670 | 433 | .096 | .21015 |
| Cutting of trees and bushes | 3.486 | 1.360 | 3.591 | 1.234 | -.837 | 433 | .403 | -.10433 |
| Urbanisation | 2.636 | 1.527 | 2.158 | 1.287 | 3.527 | 433 | .000 | .47822 |
| Species extinction | 3.350 | 1.303 | 3.191 | 1.292 | 1.280 | 433 | .201 | .15930 |
| Invasive species | 3.400 | 1.276 | 3.209 | 1.332 | 1.525 | 433 | .128 | .19070 |
| Freshwater shortage | 3.627 | 1.330 | 3.409 | 1.318 | 1.716 | 433 | .087 | .21797 |
| Safe drinking water shortage | 3.868 | 1.295 | 3.437 | 1.369 | 3.374 | 433 | .001 | .43097 |
| Energy shortage | 3.514 | 1.270 | 3.237 | 1.243 | 2.294 | 433 | .022 | .27643 |
| Loss of farm lands | 3.459 | 1.214 | 3.595 | 1.160 | -1.197 | 433 | .232 | -.13626 |
| Global warming | 3.668 | 1.251 | 3.270 | 1.402 | 3.129 | 433 | .002 | .39841 |
| Desertification | 3.127 | 1.311 | 2.823 | 1.352 | 2.381 | 433 | .018 | .30402 |
| Ozone depletion | 3.591 | 1.426 | 3.409 | 1.322 | 1.377 | 433 | .169 | .18161 |
| Biodiversity loss | 3.523 | 1.298 | 3.488 | 1.164 | .290 | 433 | .772 | .03436 |
| Population growth | 3.300 | 1.338 | 3.237 | 1.432 | .473 | 433 | .637 | .06279 |

*P*<0.05*

This study has attempted with a descriptive approach, to establish a relationship between risk perceptions and place of residence. The differentiating rural-urban factor represents a good example of how the perception of environmental aspects (risk to the environment in general and risk to human health) can be influenced by the different interaction processes emerging between the group and the environment. Our data also confirms that the perception of the seriousness of specific environmental problems is closely linked to the place of residence. The higher the agreement is, the higher the likelihood that the environmental issues would be harmful to the environment, and the vice versa. Urban groups were found to be better risk perceivers (mean greater or equal to 3.00) than their rural counterparts on 19 items, while rural groups were found to be high risk perceivers in comparison with the urban groups regarding the three items such as drought, cutting of trees and bushes and loss of farming lands.

Derived from the data set, the two groups differ on the nature of risk perceptions both in the case of risk perceptions in relation to the environment in general and risk perceptions in relation to human health in that the rural people were more concerned about drought and its related risks while the urban people thought more of lifestyle-related risks. These perception differences among the two groups are determined by the social and physical characteristics of life space, that is, of the subject's environmental reality, of his or her experiences with the environment, of the links with his or her immediate environment and of the cultural relationship with it. This appears to indicate that, at least at the level of a trend, those living in the rural settings are more concerned about cultivation and farming issues than city-dwellers, while those from urban neighborhoods are more concerned with pollution issues than those in the villages. It should be borne in mind that the number of options for conservation and pollution are not the same, and this aspect will certainly have influenced the result.

Once we had considered the possibility of differences regarding specific risk items as a function of these concerned measures, we moved on to check what would occur when the group variable was the place of residence. The aim of these analyses was also to determine whether the perception of certain aspects of the environment as problematic depends mainly on the place of residence. We can also see that in rural and urban settings, people show that they are not equally concerned about the environment, nor do they defend it with the same intensity. Thus, people differ in their perception of the relative seriousness of environmental problems. In other words, what is emphasised in the urban communities is not what is emphasised in the rural. This result is consistent with the work of Berenguer, Corraliza, and Martín (2005) whose study confirmed that the perception of the seriousness of specific environmental problems is more closely linked to the place of residence.

Our quantitative analysis of the perception of risk to environment in general and risk to human health in particular was gauged primarily by the gender considerations in the sphere of risk perception. Women appeared to be risk perceivers to a higher degree than men. This would help us to infer that the sphere of risk knowledge is the tendency for groups exerting powerful influences within society to place epistemic authority in technical-rational approaches to understanding and managing risk problems. Such knowledge of risks tend to attach lesser value to worldviews stressing broader social and ecological considerations (for example, the responsibility/care principle). As noted in our samples, the relationship between gender and risk discourses is much more implicit, reflecting their engagement with the ongoing play of meanings and constructions of environmental issues that arise in socio-cultural settings.

The focus group participants were also in a position to make a detailed analysis of the environmental changes observed over the years even as environmental risks become more pronounced. One of the participants said, 'Risks to the environment are a matter of life and death'. The rural discussants focus on the nature of risks that are closer to their subsistence economy such as drought, desertification, and related risk behaviours (for example, famine). They think of these risks as being harmful to their health. On the contrary, the urban dwellers focus on the risks that are related to their daily lifestyles, such as shortage of fresh water, energy shortage, and loss of biodiversity (related loss of recreation areas). They think these risks are impacting each and every one of us on a very personal level that many of us do not even realize, that it is our health. The attribution differences among risk perceptions seem to be the contextual factors of the living settings.

### *Risk sensitivity, personal norms of environmentalism and awareness of consequences*

The degree of sensitivity the participants have toward their vicinity and environment was measured using the self-report scale of change in the environment. It was hypothesised that such sensitivity to observed changes in the environment would lead to perceived risks both on the environment and human health that they would, in turn, lead to developing pro-environmental personal norms. As shown in Figure 4.1, participants' sensitivity to the dynamic environmental changes makes people to perceive the risks would pose to the environment and human health, making them to develop pro-environmental personal norms. Put another way, perceived risks to the environment and human health mediated the relationship of sensitive threshold to the changes in the environment and the development and enhancement of personal norms of pro-environmentalism. However, the relationship is partial mediation: meaning there are other variables that might account for the mediation between changes in the environment and personal norms of pro-environmentalism.

Moreover, we also hypothesised that the direct effect of sensitivity to changes in the environment to perceived risks to health and environment would help raise the awareness of the participants (communities) to the consequences of their actions to other people and the biosphere (the latter scale was rejected because of very poor reliability, and this analysis is squarely focused on the awareness of consequences to others). The result showed that noticing changes in the environment makes them to perceive an environmental risk which, in turn, leads to awareness of the consequences for others. The relationship is a partial mediation. On the contrary, perceived risk to health failed to significantly mediate the relationship of changes in the environment and awareness of consequences for others.

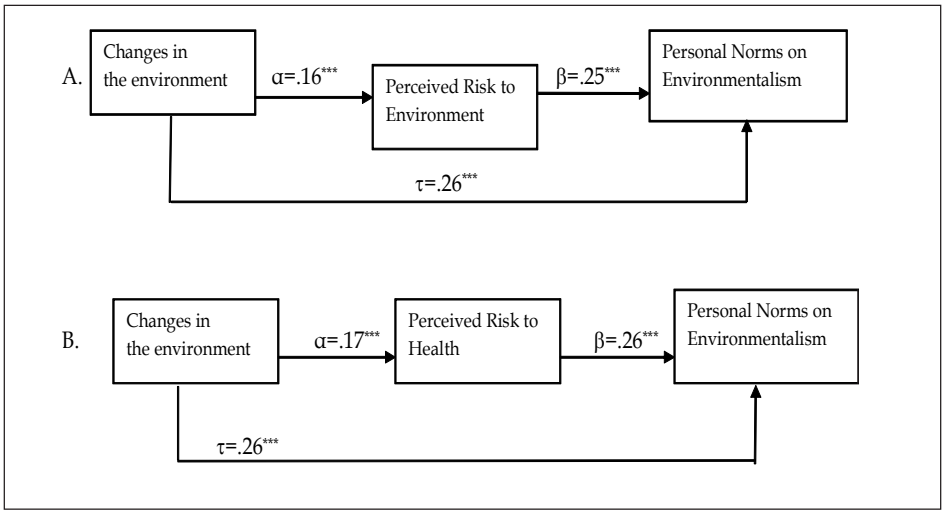


**Figure 4.1:** Mediation analyses of changes in the environment, perceived risks and perceived norms

***P<.001

In the focus group discussion, some of the respondents said that community involvement had a stronger association with the mitigation of environmental risks. If many individuals in the area believe that personal agency and individual hygiene practices can protect against risks, the effects of an area-level health risk such as deforestation may not fit into their perceptions regarding personal health. The non-prioritisation of air pollution in the discussions may indirectly speak to the need for interventions that address these types of area level health risks.

Additionally, there was clear variation among focus groups regarding the extent of residents' belief in the personal agency as a protective factor against environmental risks. An intervention targeting environmental factors would likely fail in a community that held strong faith in personal behaviours but might do better in a district that acknowledged the effects of environmental factors on health.

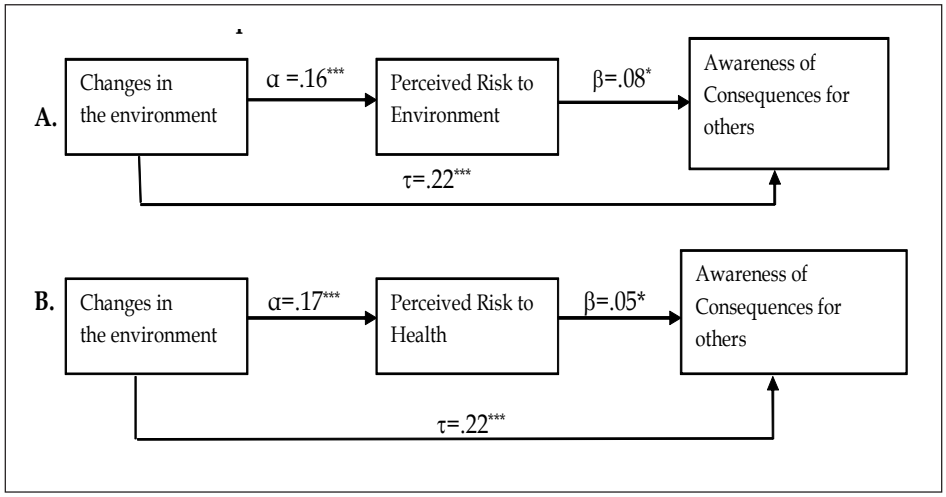


**Figure 4.2** Mediation analyses of changes in the environment, perceived risks and awareness of consequences

***P<.001, *P<.05

In general, according to the value-belief-norm framework, individuals engage in a given pro-environmental behaviour because they feel the moral obligation to behave properly when they feel responsible for the consequences of their actions on the environment (awareness of consequences). The present study leads us to focus both on the negative consequences of environmental change and enhances awareness of their responsibility (thus triggering their sense of moral obligation) in the shift towards promoting environmental risk-free community.

### The relationships between values, risk perceptions, personal norms and awareness of the consequences of environment

Our third objective was to determine the relationships between different hosts of variables. Simply put, we further examined the correlations between value clusters, risk perceptions to the environment, risk perceptions to human health, personal norms and awareness of consequences of the environment. Hence, the distinction between five value categories was further confirmed by inter-correlating the value clusters to

risk perception (risk perceptions to environment and risk perception to human health), personal norms and awareness of environmental consequences. The relationship of egoistic values between risk perceptions to environment/human health and personal norms of environmentalism remained statistically insignificant. However, we found statistically significant positive relationships among the rest of other variables at the confidence level of less than 95 per cent ($P < 0.01$). This means that the other cluster values (biospheric, altruistic, openness to change, tradition) were positively related to both environment and health risk perceptions. Simultaneously, the analysis shows that the same variables were positively correlated to personal norms and awareness of environmental consequences.

We were expecting significant negative correlations between egoistic value and behaviour specific beliefs (risk perception, personal norms and awareness of environmental consequences). But our assumptions were not met. Despite taking into account the statistical significance of item correlations when defining correlations, it is recommended to maintain the interpretability of negative correlations for further discussion in our context. The more people are egoistic in their value orientations, the less they will perceive risks or demonstrate a responsible behaviour pro-environmentally. This indicates the need of further research in order to sort out clear correlations among these hosts of variables. The result shows that value orientations made a significant contribution in the explanation of the psychological determinants of the environment in personal norms and awareness of environmental consequences. The correlations matrix among these hosts of variables are reported in Table 4.6.

**Table 4.6:** Linear correlations among value clusters, risk perceptions, personal norms and awareness of environmental consequences

| **Variables** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|
| Openness to change Values(1) | 1 | .476** | .255** | .452** | .345** | .342** | .328** | .312** | .312** |
| Traditional Values (2) | | 1 | .199** | .601** | .444** | .206** | .230** | .404** | .354** |
| Egoistic Values (3) | | | 1 | .154** | -.024 | -.047 | -.076 | -.090 | -.336** |
| Altruistic Values (4) | | | . | 1 | .623** | .292** | .308** | .453** | .217** |
| Biospheric Values (5) | | | | | 1 | .350** | .343** | .454** | .192** |
| Risks to the Environment (6) | | | | | | 1 | .805** | .259** | .110* |
| Risks to Human Health (7) | | | | | | | 1 | .275** | .120* |
| Personal Norms (8) | | | | | | | | 1 | .388** |
| Awareness of Environmental Consequences (9) | | | | | | | | | 1 |

P**<0.01, P* < 0.05

We further tried to capture the correlations of the value clusters to 27 items of specific risk perceptions to the environment and health separately. The analysis shows important significant positive and negative relationships. More negative significant relationships of egoistic values and specific risk perceptions to the environment and health have been observed. This serves as a reminder that the more egoistic people are, the lower their risk perception of the environment and health will be. In particular, significant negative correlations of egoistic values and risk perceptions to the environment (such as global warming and desertification) are reported in the analysis (see Appendix 1). The patterns of such relationships are very crucial to the adoption of early preventive measures by government institutions accordingly. In general, while most FGD participants recognise that they individually make some contribution to environmental risk, denial of personal responsibility is widespread. Many feel that their own actions have no real effect on the health problem. The more effective people think they can be, the more likely they are to act in environmentally helpful ways. Feelings of moral obligation also help to force actions intended to counter risk. Feelings of personal responsibility and related actions are more likely when people perceive that their efforts are part of a broader effort in society.

## Predictor variables of risk perceptions, personal norms and awareness of environmental consequences

Using multiple linear regressions, the five value clusters (openness to change, tradition, egoistic, altruistic, biospheric values) were examined to predict risk perception to environment. They explained 17.1 per cent, ($F (5, 434) = 18.93$, $P < 0.01$, $R^2 = 0.171$) of variance in the risk perception of the environment. Of this, the openness to change value is the strongest predictor of risk perception (ß = 0.264, $P < 0.01$) followed by biospheric values (ß = 0.251, $P < 0.01$). The same predictor variables (value clusters) accounted for 16.1 per cent, ($F (5, 434) = 17.68$, $P < 0.01$, $R^2 = 0.161$) of variance changes in risk perceptions to human health. Biospheric value (ß = 0.227, $P < 0.01$) and openness to change value cluster (ß = 0 .225, $P < 0.01$) found to be the strongest predictors of risks to human health.

A similar pattern analysis was carried out to predict personal norms of environmentalism by the five value clusters. The dimensions of value orientations explained 26.9 per cent, ($F (5, 434) = 32.96$, $P < 0.01$, $R^2 = 0.269$) of variance in personal norms of environmentalism. Biospheric values (ß = 0.257, $P < 0.01$) followed by altruistic value orientation (ß = 0.167, $P < 0.01$) and conservation/ tradition values (ß = 0.153, $P < 0.01$) had the highest contributions in explanations of personal norms of environmentalism. The same predictor variables accounted 20.8 per cent, ($F (5, 434) = 23.9$, $P < 0.01$, $R^2 = 0.208$) of variance changes in awareness of environmental consequences. Egoistic values (ß = 0.263, $P < 0.01$), tradition

values cluster (ß = 0.253, P < 0.01) and openness value cluster (ß = 0.136, P < 0.01) observed to be factors affecting awareness of environmental consequences. This means that the more people are egoistic in their nature of value orientation, the less they will be aware of their environmental consequences. However, altruistic and biospheric value clusters made little or no contribution towards the awareness of environment consequences. This would imply that future research should be conducted to see its contribution in the explanation of belief and behavioural intention to the environment.

The extent to which the five value clusters made their specific contributions to the explanation of risk perceptions, personal norms and awareness of environmental consequences differed in a way that one might seem to be the prevailing factor than others in environmental concern. The openness to change value cluster was the most significant predictor of personal norms in that the more people emphasised the importance of emotional and intellectual interests, the stronger their personal risk perception to their environment would be to reduce risk specific environmental use. Biospheric value orientation was also observed to be the most important factor affecting the risk perceptions to human health, meaning that the more biospheric people are, the higher they perceive the risk items to be harmful to human health. Egoistic value orientation followed by conservation value clusters were also observed to be factors affecting awareness of environmental consequences. That is, the more people focused on egoistic value orientations, the lesser they will be by examining the magnitude of risks and judgments concerning the environment.

Concluding from the data set, the biospheric and altruistic value orientations are also the most significant predictors of personal norms of environmentalism. With them more people think of biospheric and altruistic values as important guiding principles in their lives, and this helps reinforce considerably their feelings of moral obligations to increase their environmental protection. The more people are altruistically oriented, the more they intend to donate to humanitarian organisations. Similarly, the more people valued the biosphere and the environment, the more they prefer to donate to environmental movements. Therefore, in the present research, there would be a slightly unique contribution of both value orientations to the explanation of behaviour-specific beliefs, while in other research projects altruistic and biospheric value orientations may be simultaneously related to such beliefs. Future research should further examine the relationship among a host of variables.

Reductions in firewood use, for example, may more significantly threaten egoistic values when fuel dependence is high or when less feasible alternatives are available. Biospheric values may be activated more when people are confronted with environmental problems. Therefore, the present researchers would expect that the value orientation that contributes most to the explanation of behaviour-specific

beliefs will depend on the values held individually by the people and values collectively held by the society. Further research should examine how the differences in contributions of value orientations on behaviour-specific beliefs and risk perceptions may be explained, because pro-environmental behaviour, such as reductions in risk specific environmental use (fuel wood, waste disposal), may imply different things for people from different socio-cultural and economic conditions.

## The effect of contextual attributes (age, educational status, occupation, residence, income level) and gender difference on values and risk perceptions of environmental concern

### *MANOVA results of demographic variables on value orientations/clusters*

The researchers further carried out a multivariate analysis of variance to examine the extent to which hosts of demographic variables had effects on values of communities about environmental concern. Although the main effects of the independent variables are of considerable interest, interaction effects can also be extracted from multivariate analysis, with which coexisting factors will be taken into account in the momentum of environmental protection and pro-environmental behaviour.

The multivariate analysis of the independent demographic variables (sex, residence, education, age, income) on the dependent variables of value orientations (openness, tradition, egoistic, altruistic, biospheric) produced some important results. The education level, among other variables, was a statistically significant main effect on the openness to change value cluster ($F(4, 434) = 2.63$, $P < 0.05$); conservation value ($F(4, 434) = 2.38$, $P < 0.05$); altruistic value ($F(4, 434) = 2.35$, $P < 0.05$); and biospheric value cluster ($F(4, 434) = 2.98$, $P < 0.05$) were reported. Turkey's post-hoc tests were also carried out, mean scores and standard deviations between respective groups were calculated, and holders of diploma certificates and above ($M = 4.359$, $SD = 0.715$) were more altruistic than their counterparts in their value orientation towards environmental concern. Respondents of the same education group were also more inclined to biospheric value orientation than their other counterparts. In comparison, those who only attended or completed primary school were found to be more conservative (traditional) in their orientation than other education groups.

Education and residence had significant interaction effects on biospheric value clusters. Thus, in the urban context, the biospheric and altruistic values are more salient, while egoistic values are more relevant in the rural one. The study thus confirms that the relevance of one's experience of the natural world for defining environmental beliefs appear to be a function of education. As the classic authors of ecological psychology wrote, if you want to explain an action, go to the place where it occurs (Barker 1968 cited in Berenguer, Corraliza & Martin 2005). In the

present study, the different experience of nature in rural people and urban context shape different ways of thinking and feeling about the environment.

In addition, statistically significant main effects of income level on egoistic value orientation ($F(3, 434) = 3.06$, $P < 0.05$), and tradition value cluster ($F(3, 434) = 2.74$, $P < 0.05$) were also reported in multivariate analysis of variance. In a similar pattern, Tukey's post-hoc tests were carried out, the mean and standard deviation between the groups were computed, and the lower income groups were found to be more egoistic and conservative in their value orientation than the other income groups. This would further imply that the more people had low income, the more they were likely to destroy the environment in order to meet their immediate basic needs.

The multivariate analysis of variance showed that demographic variables (sex, resident, age) had no significant main effect on either of the five value clusters. Our assumption was, therefore, not met. However, statistically significant interaction effects were found between sex and education level on conservation values ($F(4, 434) = 3.19$, $P < 0.05$). The same variables also had interaction effects on other altruistic value dimensions. The study also reported that there were interaction effects of age and residence on openness to change value clusters. Other interaction effects are also observed in the multivariate analysis of variance (see Appendix 2). Given the present main and interaction effects of demographic variables on value orientations, how individuals value their environmental settings and meanings attached to their settings across the ecological levels of analyses are taken into account in the environmental protection.

Another important aspect of the analysis is that sex had no main effect on all clusters. This result is inconsistent with the previous work reported by Gilligan (1982) where females were more altruistic than males in their value orientation towards environmental concern. He argued that women often voice their moral concerns regarding an 'ethic of care-concern for responsibility towards others, and regard for the consequences of actions on relationships with others and their environment', while men claimed an 'ethic of justice'. This was clearly borne out in our qualitative analysis when focus group participants underlined the values that provide support for a 'parental role' when women express higher levels of concern than do men, not because they know less but because they care more. This further shows social differentiation which suggests that gender matters in valuing the environment.

### *MANOVA Results of Demographic Variables on Risk Perception, Personal Norms and Awareness of Environmental Consequences*

We further investigated the relationships of the demographic variables (sex, residence, education, age, income) and the four dependent variables (risk perception to the environment, risk perception to human health, personal norms, and awareness of environmental consequences). We expected a statistically significant effect of

sex, age and residence on the above stated sort of variables, but our assumptions were not met. Indeed, we particularly expected the older respondents to be more environmentally conscious, risk perceiving and behave more pro-environmentally than their youngest counterparts. However, age did not show any correlation. A further research may be needed to validate this relationship.

We also observed that education level had a statistically significant main effect on risk perceptions to the environment ($F(4, 434) = 3.31$, $P < 0.05$), and risk perceptions to human health ($F(4, 434) = 3.98$, $P < 0.01$). The mean and standard deviations were computed, and holders of diploma certificates and above were found to have a higher risk perception regarding the environment in general and risk perception to human health than other groups with lower education. The educated groups show more consciousness than the other groups that environmental risks are affecting human health. In fact, the study suggests that those who are more educated (Diploma and above in our case) had better developed sense of moral obligation to care for the environment and behave more responsibly. These results are especially important if we take into account the fact that a higher educational level translates to greater access to information. Thus, our research confirms that, consistent with the existing literature, the perception of the seriousness of specific environmental problems, moral obligation (personal norms) and awareness of environmental consequences are relatively higher among people with higher education than those with lower levels of education.

Statistically significant main effects of income level were registered on personal norms of environmentalism ($F(3, 434) = 3.19$, $P < 0.05$). The results show that income level had no main effects on the awareness of environmental consequences. In a further analysis of means and standard deviations between groups, the more educated groups showed more environmental concern and demonstrated more moral obligations to behave pro-environmentally than the less educated groups. There were no clear relationships registered among these variables as we had expected. Therefore, there should be further rigorous research to examine and clear these relationships.

Our final analysis, however, showed that sex and residence of respondents had no main effects on all variables at all. However, we observed a number of interaction effects, for example, sex and residence on awareness of environmental consequences; sex and income on perceptions of risk to the environment; and age and residence on awareness of environmental consequences; residence and education on personal norms of environmentalism (see Appendix 3). The result seems to be inconsistent with previous researches as reported by Satterfield *et al.* (2004). Of course, the extent and the nature of variation will have broadened implication for policy makers.

We were unable to determine whether sex overrides environmental risk perceptions in that how men and women construct understandings of risk issues would be limited by reliance upon evidence drawn from a quantitative survey of the present study. However, data sets derived from the qualitative analysis showed gender variations in risk perceptions. Thus, the focus group discussion led us to extrapolate that the sphere of risk knowledge partly depends on groups who have powerful influences within society. Thus, men tend to attribute lesser value to worldviews stressing broader social considerations (for example, the responsibility and care principle) than women do in understanding and managing risk problems. As our samples showed, the relationship between gender and risk discourses was much more implicit, reflecting their engagement with the construction of environmental issues within a sociocultural setting.

From our data there is, on the one hand, evidence of a marked masculine dialogue articulating risk controlling the power of pollution. This is obvious in that men showed a greater affiliation to modernisation itself, or a greater familiarity with the processes/technical workings of technologies and their risks. An alternative feminine marked dialogue concerned the importance of individual and collective responsibility as a protection against possible harm, accompanied by the value of small-scale technologies and efforts at remediating the effects of technological risk (the 'moral' discourse of care for others). Most of the women arrived at a position where they were prepared to reject large-scale technologies, due to their perceived negative moral implications (because of damage to future generations), but would invest in discourses valuing technology where it would have positive moral implications. Following this discussion, our conclusion is that women and men are responding to strong regulatory norms around gender authenticity in a way that individuals may differ in their levels of concern about environmental and technological hazards.

It is important, therefore, to understand the social environment and the structure of environmentalism of different social groups, as the perceptions and values of the community are conditioned by unique socio-cultural, historical, and contextual factors in society. With this presumption, policy and decision makers can better understand the environmental concerns and risk perception among each group and respond to these with appropriate policies and programmes. Understanding the structure of values, risk perception, personal norms, and awareness of environmental consequences are profoundly important to risk communication among different groups in the community.

## Community's indigenous knowledge on changes in environment and social adaptation mechanisms to environmental risks

Respondents were asked to state their understanding of the severity of environmental changes in their locality on a five-point Likert scale, ranging from 1 (no change at all) to 5 (very high changes). About 50 per cent of the respondents perceived changes in environmental sanitation, the climate, water, soil, vegetation cover, biodiversity, air, and farming systems (see Table 4.7). This result is supported by a previous research (Maddison 2007) which states that globally there are environmental changes from time to time, and year after year. Surprisingly, few of the group participants stressed "We have learnt from our lived experiences that there have been environmental changes over time, from low change to moderate, and from moderate to high changes". At the same time, we learnt from our qualitative analysis, that it is important to emphasise that though local peoples make detailed observations of changes in the environment, they do not always register the alarming occurrences they encountered in their course of life. If the local community understands gradually about the change in the environment as Maddison (2007) argued, communities will also learn gradually about the best techniques and adaptation options available. The study for north highlands of Ethiopia by Nyssen *et al.* (2014) also confirms that people have no option but to be inventive in its relationship to the natural world when the environment is exhaustive. According to Maddison (2007), people learn about the best adaptation options through three ways: (1) learning by doing, (2) learning by copying, and (3) learning from instruction. Our discussions with interviews clearly confirm the same learning processes. As such, the indigenous people have elaborated coping strategies to deal with unstable environments and, in some cases, are already actively adapting to early climate change impacts. To increase trees and bushes cover, environmental rehabilitation or recovery programs has been encouraged by local government, resulting in, for example, the creation of exclosure plot. This proves to decrease erosion rates in north highland escarpments of Ethiopia (Meire *et al.* 2013). The study by Nyssen *et al.* (2014) observed the cover by the indigenous trees is also evident in the current land management practices.

Our qualitative data analysis also shows that noticing environmental changes increases the probability of uptake of adaptation measures. Communities who are aware of changes in environmental conditions have higher chances of taking adaptive measures in response to the observed changes. This presumption was reflected during our focus group discussions which showed that highly experienced communities (particularly farmers) are likely to have social adaptation knowledge on changes in climatic condition. Crop and livestock management practices communities use helps to forecast changes in the environment, such as varying planting date, using irrigation (ground water) and growing crop varieties that are

more suitable to predict the changes. This is unlikely to happen to those who are less experienced in the community. We also noticed that moving from farming to non-farming land is an adaptation strategy that the community often uses given the high perceptions that the timing of rain has changed.

**Table 4.7:** Percentages, mean scores, SD of changes in environment (N = 435)

| Variables | NC | VLC | LC | HC | VHC | Mean | SD |
|---|---|---|---|---|---|---|---|
| Environmental sanitation | 23 (5.3%) | 41(9.4%) | 78 (17.9%) | 178 (40.9%) | 115 (26.4%) | 3.737 | 1.1093 |
| Climate | 22 (5.1%) | 38 (8.7%) | 107 (24.6) | 159 (36.6%) | 109 (25.1%) | 3.678 | 1.0956 |
| Water | 18 (4.1%) | 35 (8%) | 82 (18.9%) | 149 (34.3%) | 151(34.7%) | 3.873 | 1.1030 |
| Soil | 19 (4.4%) | 40 (9.2%) | 98 (22.5%) | 135 (31%) | 143 (32.9%) | 3.788 | 1.1283 |
| Vegetation cover | 18 (4.1%) | 47(10.8%) | 78 (17.9%) | 142 (32.6%) | 150 (34.5) | 3.825 | 1.1407 |
| Bio-diversity (fauna and flora) | 19 (4.4%) | 48 (11%) | 88 (20.2%) | 151(34.7%) | 129 (29.7%) | 3.742 | 1.1269 |
| Air | 29 (6.7%) | 52 (12%) | 95 (21.8%) | 163 (37.5%) | 96 (22.1%) | 3.563 | 1.1530 |
| Farming systems (animal & crop) | 21 (4.8%) | 27 (6.2%) | 59 (13.6%) | 167(38.4%) | 161 (37%) | 3.965 | 1.0909 |

Notes: NC = No Change, VLC = Very Low Change, LC = Low Change, HC = High Change, VHC = Very High Change
Source: Our own Source, 2015

The urban and rural communities of today are in quandary because they depend on resources and the environment for their sustenance, while the environment, as we have said repeatedly in this study, is changing very unpredictably. The experiences of the community members led us to the conclusion that the local people make detailed observations in environmental changes and ecological responses. However, they do not always register the alarming situation for years; instead, they keep trying to adapt to the changes they perceive. The adaptive strategy they use is to switch on to their activation memory (memory that can be accessed quickly and rapidly). The capacity of the local community to adapt to environmental change is based primarily on their in-depth knowledge of nature and its derivatives. They use the land and resources and develop a sensitivity to be able to 'read critical signs' from the environment that something unusual is happening or about to happen. The community would not be able to respond effectively to what they are observing if they are not connecting with the land or nature in a practical way. This is the argument that Berkes (2012) made when he said the inherent dynamism of traditional knowledge systems lies at the heart of this ability to adapt. He noted

that the local people are constantly renewing their status through learning-by-doing, experimenting and building knowledge processes that allow knowledge holders to adjust and modify their actions in response to environmental change. In light of the foregoing insights, it must be noted that the local community should learn to record environmental change alarms in order to take action to protect humanity.

While modern agriculture and modern varieties of crop may increase productivity, the study shows that under conditions of environmental stress and climatic changes, survival depends on more readily available traditional varieties of crop. For instance, farmers identified planting diverse traditional varieties to reduced risk and emphasised the importance of sharing and exchanging seeds to gain access to diverse varieties. The present study highlights the role in adaptation to environmental change. This suggests the need to support initiatives such as local land conservation and community-based conservation and adaptation.

The study brought out the local people's understanding of environmental changes (for example; climate, water, soil, vegetation cover, biodiversity, air and farming systems) which they learned through their observation, experience and practice in the field. Understanding the local people's perception of dynamic environmental change is necessary to communicating risks. By the same token, farmers learn and recognise changes within a cultural context and the knowledge base follows specific language, belief, and process. Such knowledge base facilitates social interaction and acceptance among the farmers. Without valuing the traditional knowledge, it is very difficult to communicate the social adaption options necessary for coping with the observed environmental risks.

There is also insufficient recognition of gender considerations although men and women hold distinct knowledge sets relating to differing and complementary roles in society and production. Interestingly, men and women have different knowledge levels (understanding) and use it for different purposes. Women also have little voice in decision making. Similarly, elderly people are more knowledgeable and able to deliver more experiences to the succeeding generation. The social stratification largely influences the evolution and management of knowledge. Socialisation and social heredity (the process of learning) take place within a particular socio-cultural setting, which is determined by class (high and low social status). In general, social adaptation mechanism (indigenous knowledge) is passed on through older generations in casual conversations and observations mostly during practice in the field.

## Factors affecting social adaptation mechanism

Factors that affect the quantity and quality of indigenous knowledge individuals possess about environmental risks and the corresponding adaptation mechanisms were exhaustively listed out and respondents were asked to rank them on a 13-point scale with 1 for the most and 13 for the least important factors. From this

perspective, the least ranks were assigned lowest scores, while the first ranks (ordered in terms of relative importance) were assigned highest scores. Therefore, the higher the mean score, the more important factor it would be in affecting indigenous knowledge that the individual possesses, and vice versa.

The respondents felt that learning by copying/observation from others (Mean = 8.232, SD = 3.831) ranked the most important factor in acquiring indigenous knowledge, followed by social and economic status (Mean = 8.048, SD = 4.561), learning by instruction – informal education (Mean = 7.901, SD = 3.781), learning by doing or actions of elderly people (Mean = 7.873, SD = 4.135), normative beliefs of men and women (gender) (Mean = 7.466, SD = 3.646), aptitude and intellectual capability (Mean = 7.443, SD = 3.796), and daily experiences of social interaction (Mean = 7.404, SD = 3.455). We observed that these factors are critical as they are for the survival of the communities, and are largely vulnerable to climate and climate change as their economy is predominantly based on agricultural farming. The remaining factors, namely, roles and responsibilities in the home and community, the level of curiosity and observation skill, ability to travel and degree of autonomy, moral and religious teachings, and rewards and penalties in the local community, are also ranked with moderate factors in guiding the indigenous knowledge that individuals possess in their locality (see Table 4.8).

**Table 4.8:** Factors affecting social adaptation mechanism

| SN | Factors | Mean | SD |
|---|---|---|---|
| 1 | Learning by doing or actions of senior citizens (age) | 7.8736 | 4.13595 |
| 2 | Learning by instruction (informal education) | 7.9011 | 3.78109 |
| 3 | Learning by copying/observation from others (para-profession) | 8.2322 | 3.83158 |
| 4 | Normative beliefs of men and women (gender) | 7.4667 | 3.64694 |
| 5 | Social and economic status (low or high) | 8.0483 | 4.56141 |
| 6 | Daily experiences of the social interaction | 7.4046 | 3.45504 |
| 7 | Roles and responsibilities in the home and community | 6.5701 | 3.69849 |
| 8 | Aptitude and intellectual capability | 7.4437 | 3.79648 |
| 9 | Level of curiosity and observation skills | 6.4552 | 3.51031 |
| 10 | Ability to travel and degree of autonomy | 6.9632 | 3.64224 |
| 11 | Control over natural resources | 6.5241 | 3.84567 |
| 12 | Moral and religious teachings | 6.7080 | 4.14982 |
| 13 | Rewards and penalties in the local community | 6.1034 | 4.21221 |

Interestingly, the group focus discussion indicates that men and women have different knowledge levels and use them for different purposes. Similarly, elderly persons are more knowledgeable and able to transfer more mature experiences to

the succeeding generations. Variations in the indigenous knowledge in a community are based on age, gender, kinship affiliation, ideology, and literacy. The social stratification process influences the evolution and management of knowledge. Socialisation and social heredity (the process of learning) take place within a particular socio-cultural setting, which is determined by class (high and low social status). Gender is another important dimension in the social stratification.

Gender is becoming an increasingly important issue that demands special attention in the context of environmental change adaptation. The present emphasis given to gender in risk reduction and climate change adaptation focuses on the need to address the gender divide and fulfill the special needs of women in emergency situations. Hiwasaki *et al.* (2014) have observed that indigenous knowledge and practices should focus on an equitable consideration of the two sexes. According to them, there are two points that need to be considered. The first is the specialised knowledge held by women and men. Women often hold unique knowledge unknown to others in the community and, therefore, their knowledge needs to be included in the decision-making of environmental risk adaptation. The second is ensuring that risk reduction and environmental change adaptation strategies based on the integration of indigenous knowledge and practices do not lead to the reinforcement of gender inequality. Government institutions need to be aware that some traditional knowledge systems reinforce social inequality based on gender, which in turn contribute to the increased vulnerability of the group.

Economically vulnerable countries are more subject to various natural risks, such as recurrent droughts. These risks affect food production, and adversely affect livelihoods. The threats geared towards household security have significant gender implications because of the different roles, needs, capacities and positions of men and women in society (Nampinga 2008). As a consequence, the degree of vulnerability is not the same though both women and men are exposed to similar natural risks. The nature of the adaptive strategies taken is not gender neutral. Hence, the current climate change impacts and adaptation strategy should take gender as important components (IPCC 2012), as it contributes to the level of vulnerability a household faces and the possible choices of responses taken to climate change distress events (Denton 2002). However, women are far the most part not well represented in environmental policy formation. For instance, in times of drought and water stress, women walk long distances in search of water and firewood for their families (Mulubrhan & Kelemework 2013). This is aggravated by the unequal power relations between men and women. Therefore, a gender perspective in adaptation to environmental change can moderate impacts and secure benefits (Nampinga 2008; Orindi & Erikessen 2008), if women and men complement their efforts and build a sustainable environment. But the invisibility of the roles of women in indigenous adaptation practices is challenging the gender

asymmetry in developing countries (Denton 2002). Related to this, we observed that gender and adaptation mechanisms in the study areas, for example, include men and women hold specialised knowledge. Furthermore, taking into account gender-specific skills and techniques of indigenous knowledge adaptation mechanisms would provide valuable information to the local community and serve as a useful model for environmental policies.

### Indigenous knowledge and its relation to the current pace of change

The data gathered through interviews and focus group discussions were transcribed and grouped into themes in a way that will meaningfully produce such knowledge experiences. The community's traditional knowledge is structured into three basic groups. The first set follows certain universal principles and logics. The second is based on some correlation in terms of time (the severity of risk they experienced within specific time frame). The third is based on local experiences obtained from elderly people. The knowledge set gives a framework to explain relationships between particular events in the environmental change and farming. Environmental, biological and traditional belief indicators are common among a community's effort to take critical environmental decisions and adaptive options in response to the observed recurrent pace of changes.

Put another way, indigenous observers base their judgments on multiple environmental and social factors that they consider in an integrated manner (e.g., wind speed, direction, and variability, combined with temperature and precipitation, as well as the need for shelter and safety when travelling with or without family). This knowledge evolved by locally defined conditions and needs. It is dynamic and nurtured through observation and the experiences of men and women in communities, and it incorporates their perspectives by slightly modifying and using their experiences to meet current needs and situations. Despite this fact, many of the discussants significantly underlined the following 'A great losses or widespread abandonment of oral record keeping is going on; songs that codify complex pieces of information and pass this across multiple generation are about to be forgotten'. This awareness shows that loss of indigenous knowledge systems that incorporate traditional values (folklore and proverbs of nature) is one that will, unfortunately, produce a generation that is ignorant of their roots and identity.

Local people are usually uncertain about the environmental changes, and the fears of risk (for example, drought and famine) are ever present over large areas of the region. Climate changes and variability over time have resulted in water scarcity that retards progress in rural communities, causing land degradation, loss of livestock, food insecurity, famine, loss of livelihoods and epidemics of infectious diseases. Observation of these phenomenal developments provides an important element in empowering rural communities to deal with the ever-changing

environmental risks today. Such development can better prepare communities to tackle the current pace of changes observed.

Indigenous observers of environmental trends base their judgment on multiple environmental and social factors that they consider in integrating physical aspects. They may not isolate a single environmental variable (e.g., temperature, or wind speeds) and reach broader conclusions based on an extrapolation from this narrow data set. Furthermore, the local people do not focus their attention primarily on mean values (e.g., mean temperature); rather the primary preoccupations of indigenous observers of weather may be the intensity and frequency of peaks and lows. This argument is important and demonstrates how knowledge of the local community is related to the current pace of changes observed over large areas of the region. Faced with the challenge of environmental changes and the corresponding risk behaviours, efforts to create a constructive dialogue between indigenous adaptation alternatives and scientific knowledge constitute an important step towards decision-making based on the best available knowledge in response to the repeated adverse environmental changes.

The above view was further supported by quantitative data where respondents were asked to indicate the traditional practice that helped them integrate their knowledge with the observed pace of environmental changes. More than 60 per cent of them replied that traditional practices, such as environmental management 328 (75.4 per cent), common-property management practices 297 (67.4 per cent), traditional laws/rights for environmental resources 294 (67.6 per cent), community control of cultivation and harvesting 286 (67.5 per cent), conflict-resolution practices for environmental resources 277 (63.7 per cent) and traditional decision-making processes 273 (62.8 per cent) enabled the local community to further capture the changes observed. This simple descriptive analysis was made to capture the detailed observations of participants about the existing traditional institutions that support how such knowledge is applied to the changes observed. For instance, as long as the practice of common-property management works, the local people will continue to jointly discuss the resources available for deployment among them. Joint activities, for example, on run-off diversion channels and grazing lands, can further help them to use the resources wisely with little or no conflict. In further discussion, traditional laws that make people share resources together are most likely important in refining their observations of environmental changes. It follows, therefore, that climate change adaptation needs to include local solutions. Previous studies on local adaptation provide an insight into how individuals within communities experience environmental change, and emphasise local solutions and decision-making processes (Keskitalo 2004). Governments are more likely to find workable local solutions and increased support for policy by informing and including households in preparing for climate change.

**Table 4.9:** Traditional practices with the environmental changes observed

| Whether such traditional practices matches the changes observed | Yes | No |
|---|---|---|
| Environmental management | 328 (75.4%) | 107 (24.6%) |
| Common-property management practices | 297 (67.4%) | 142 (32.6%) |
| Traditional decision-making processes | 273 (62.8%) | 162 (37.2%) |
| Conflict-resolution practices for environmental resources | 277 (63.7%) | 158 (36.3%) |
| Traditional laws/rights for environmental resources | 294 (67.6%) | 141 (32.4%) |
| Taboos and rituals related to environment | 254 (58.4%) | 181 (41.6%) |
| Community controls on cultivation and harvesting | 286 (67.5%) | 149 (34.3%) |

### *Variations and effectiveness of social adaptation mechanisms across residents and zones*

Adaptation is nothing new in human experience. Throughout history, human beings have always adapted to a changing environment. What is new, however, is the rapid pace of environmental degradation that brings on the new challenge of adapting at a much faster rate than before. Conversely, not everyone has an equal capacity to adapt to environmental risks. Delaying action will result ultimately in a greater risk for vulnerable people. The data generated on knowledge of changes in the environment were further refined based on discussions with communities, particularly on how they can adapt to environmental risks. Many more ideas were generated and coupled into a mix of meaningful interpretations. The interviews and focus group discussions tried to capture the following questions: what are social adaptation mechanisms in general? What are the social adaptation mechanisms in each of the selected zones? How do they vary between urban and rural communities and from one zone to another? How effective have they been over the years? What adaptation mechanisms apply to specific environmental risks?

Communities are vulnerable to the impacts of environmental risks for the reason that they significantly depend on resources and the environment. This said, they are neither passive nor without ways and means to cope with the ongoing risks of the environment. They engage actively with their natural environment in their day-to-day lives, are experienced and attentive observers, and have accumulated meaningful bodies of knowledge and practices about their environment, its variability, and change. This knowledge provides the basis for community's livelihoods, which are in turn at the centre of communal efforts to adapt to variability and change. Indigenous knowledge can, therefore, provide important insights into processes of adaptation. This is critical for the survival of their communities as

they are largely vulnerable to climate change as their economies are predominantly agriculture based. The following discussion presents examples of adaptation options rooted in traditional knowledge and practice: nurturing plant and animal diversity; adaptation through diversified land use; and adaptation measures rooted in social networks and customary institutions.

Mixed crop and livestock are associated with significant adaptation to the observed changes compared to mono-cropping (specialised crop or livestock farming). An important reason for this observation is that mixed farming systems are already diversified, and they have a number of alternative crops and livestock options that can ensure that if one option fails the other will do well even if there are changes in climatic condition. Subsistence farmers are also more likely to opt for variations in planting dates, small vegetations, crop diversification and water conservation techniques as their adaptation options. The reason for this observation is that subsistence farming usually produces one staple food in most cases and it is easier for them to incorporate other crops in their present options than completely changing to different crops or using extensive irrigation technologies.

Adaptation may be complemented through diversification at the level of the landscape. Traditional land use and management, for example, ensure multiple uses of single land resources. The territory is composed of multiple land use types, namely shifting mosaic land-use patterns that are pockets of natural forest, managed forests, rotating fallow, and permanent fields molded to the ecological conditions of the mountains and river valleys of a particular community's territory. In many local communities, a typical land area will also include spaces for cash crops. These multiple land-use systems are both a livelihood strategy and a source of adaptation measures in response to coping with environmental risks.

Adaptation is a dynamic social process (Adger & Brown 2009). The ability of a community to adapt is determined partly by its ability to act collectively. In managing land resources, the local people use social mechanisms and customary governance systems to build the social fabric of adaption in the face of environmental changes or risks. Customary laws and rituals, among other things, are mechanisms and structures. The local community reported that they use a mix of institutions and rules, some formal (for example, rituals, conflict-resolution governance) and some informal (for example, social prestige) to reduce resource competition and ensure that soil conservation terraces receive a fair share of the limited water resource. Common property management practices are also adopted as a critical factor in ensuring that these rules remain in force.

Rural households make temporary changes to farming practices to cope with the occurrence of dry spells and serious droughts such as reducing the area of dry land cropping or changing varieties of crops. As the practices were repeated, they were adapted to managing the change with seasonal variability. These included

selling livestock and breeding more resilient indigenous species, planting winter crops and late-maturing fruit trees, using more irrigated land and adopting resilient crop varieties. The Moheni community, for example, small-scale garden fruits farming have emerged to supplement the stable crops of teff and maize. Another is, in the Atsbi community, specific species of tomatoes were chosen deliberately for their drought-resistant proprieties and shorter growing times. Unlike in other communities where gaining access to land was a problem, for the local people in Shire, gaining access to land has been made possible by investing in existing friendship-networks to form small groups and by drawing on the extended family in nearby areas to gain access to new land. Furthermore, the results of FGDs clearly shows that common adaptation practices involve modifying some existing resource management strategy (e.g., water conservation or catering in Moheni), livelihood enhancement initiatives (e.g., income diversification in Atsbi), and disaster preparedness plan (e.g., planning in highland or land management alternatives in Shire). All these approaches play an important role in empowering rural communities to deal with the ever variable and changeable environmental and climatic conditions. They also help communities to be better prepared to develop proper environmental risk behaviours by undertaking various changes in management practices.

Urban households make use of collective action as a major way to set up new opportunities to reduce the risks associated with vulnerability. For example, households actively practice exchange of goods and services as a safety net. However, women and small households found such norm of reciprocity difficult even though the traditional informal networks continue to protect these social norms and thus provide effective coping mechanisms at community level. In the long run, they can open room for exploitation and further create room for inequalities and vulnerabilities in the community. In the discussion, we noticed that more access to information and safety net services could significantly increase the local adaptation measures.

On the adaptation mechanisms applied to specific environmental risk, replanting grass was the case study identified across the study areas. The removal of vegetation along the escarpments of the highlands in both study areas for use as firewood, charcoal and to clear spaces for small-scale agriculture, has led to significant highland erosion. The erosion has exposed communities to further productivity decline. Crop supplies are affected, thus impacting people's lives negatively. Although this environmental degradation has long been recognised, it was only when community-based participatory tools were used that the nature and scale of the threat were clearly defined. Groups of community members have effectively replanted grasses to protect the highland from further erosion and to support terracing lines (run-off diversion channels). Even in areas where there is population

density, there has been significant increase in vegetation cover and water conservation structures in the northern highlands of Ethiopia (Nyssen *et al.* 2014).

The effectiveness of these adaptation practices is contingent upon the contexts. Many of the networks had been built on existing groups of people who had built up trust over time so that experimentation and innovation were shared and viewed as risk-adverse rather than risk-prone strategies. Their effectiveness was also largely dependent on positive reinforcement of traditional networks.

In summary, in response to increasing environmental risks, the local communities tend to change their crop and livestock management practices to suit the observed changes. For example, they diversify crop and use other non-farming income options. They also use soil and water conservation techniques to conserve the little rain that is received as well as build small irrigation projects to supplement rainwater and increase crop growing period. What is more, instead of specialising in single resources and mono-cultures with high capital investment, the community relies on multiple resources and on a diversity of crops and crop varieties.

# 5

# Summary and Conclusion

## Summary of findings

Human behaviour is changing the environment at a rapid pace. Therefore, this study is conducted to examine values, risk perceptions and indigenous social adaptive mechanisms among selected communities in the Tigray region. The study also focused on the implications of these approaches for the continued support for the improvement of environmental protection policy. The study samples were drawn from people of different profiles with mixed backgrounds. The distribution of respondent samples across the three selected sites seems to be even. Some 148 (33.9 per cent) were from East Zone (Atsbi), 144 (33.3 per cent) from the West Zone (Shire), and 143 (32.8 per cent) South Zone (Moheni). The study applied both exploratory and explanatory research approaches with triangulation of data collection methods within the theoretical and conceptual framework of the research.

A total of 435 samples (Urban = 220, Rural = 215) completed a composite of measures, namely, Openness Values Scale (OVS), Traditional Values Scale (TVS), Egoistic Values Scale (EVS), Altruistic Values Scale (AVS), Biospheric Values Scale (BVS), Risk Perceptions to Environment Scale (RPES), Risk Perception to Human Health Scale (RPHHS), Personal Norms of Environmentalism Scale (PNES) and Awareness of Environmental Consequences Scale (AECS). To verify whether they are valid and reliable, the researchers had to go through several revisions and, finally, pilot-testing. Interviews and Focus Group Discussions (FGD) were used simultaneously to triangulate, supplement and enrich the results of survey questionnaire. Perhaps key informants were being taken up purposively for the qualitative data collection.

The mix of qualitative and quantitative method of data analysis helped to simplify the findings and point out the implications for a real understanding of environmental concerns and risk behaviours. Mean scores, standard deviations,

and an independent samples t-test were used to examine the urban-rural difference in community's values of the environmental concern, risk perception to the environment in general and risk perceptions to human health. Moreover, Principal Factor Analysis (FA) was used to see the factor loadings of the five value clusters. Linear Correlation (LC) was also used to show the existence of a relationship between value clusters, risk perceptions, and specific behaviour beliefs. The Multiple Linear Regression (LR) was applied to observe the predictor variables of risk perceptions, personal norms and awareness of consequences of the environment. On the other hand, relevant information obtained from interviews and Focus Group Discussion (FGD) participants were analysed and interpreted thematically with a series of steps such as pre-coding, coding, categorising, themes and write up.

The factor analysis revealed that the respondents' value orientations could be identified along five value clusters with 'altruistic' as the highest loading factor, followed by 'biospheric', 'tradition', 'egoistic', and 'openness to change' values. The simple descriptive analysis shows that more of the urban than rural groups scored higher percentages in all values of environmental concern except moderation, social power and wealth for that matter. The present research highlights some evidence that values and risk perceptions vary depending on residence (urban and rural groups). It was found that the urban more than rural groups had higher scores in value clusters of environmental concern such as openness to change (curiosity, daring), traditional values (reciprocation), altruistic values (the world at peace), while the mean scores for social powers was significantly higher for rural than urban groups. The result was supported by qualitative results where values of the community are structured into self-centered and social-centered ones in the sense that they form the point of intersection between the individual and society, and between society and the environment.

It was also found that urban groups were higher risk perceivers (mean greater or equal to 3.00) than their rural counterparts on more items (nearly about 19 items), whereas the rural groups were found to be higher risk perceivers than the urban groups on three items such as drought, cutting of trees and bushes and loss of farming lands. In similar fashion, the urban groups, more than the rural, ranked safe drinking water shortage as the most pressing risk environmental issue to human health, followed by global warming, freshwater shortage, ozone depletion, flooding, and biodiversity loss. Interestingly, rural communities, more than the urban ones, perceived drought as the most pressing risk issue to human health, followed by loss of farming lands, cutting of trees and bushes, and soil erosion. The analysis shows that the two groups have different perceptions on the nature of environmental risks they face. For example, the rural communities were more concerned about drought and its related risks, while the urban group thought more of lifestyle-related risks such as safe drinking water shortage, and so on.

We further found positive correlations among the five cluster values, risk perceptions, personal norms and awareness of consequences except among correlations of egoistic value cluster and risk perception, personal norms, and awareness of environmental consequences. In effect, the results of the present study show that the five distinctive value clusters and demographic variables interact with one another to influence risk perception, personal norms and awareness of environment consequences.

The qualitative analysis shows that even when local people make detailed observations in environmental changes and ecological responses, they do not always register the alarms they feel for years. The capacity of the local community to adapt to environmental change is based primarily on their in-depth indigenous knowledge of nature and its derivatives (plants, animals, air, etc). The study to some degree made brought out community's understanding of environmental changes clear (for example; climate, water, soil, vegetation cover, biodiversity, air and farming systems) and the corresponding adaptation measures to the observed changes learnt through observation, experience, and practice. The observation of these phenomenal developments, over time, can provide an important element in empowering rural communities to deal with the ever-changing environmental risks today. The findings of the present research identify three examples of adaptation options rooted in traditional knowledge and practice: nurturing plant and animal diversity; adaptation through diversified land use; and adaptation measures rooted in social networks and customary institutions.

## Conclusion

This research was conducted to examine values, risk perceptions and the corresponding adaptation options among the communities of the three selected administrative zones in Tigray Regional State. The study provides an insight that the urban group was more concerned about environmental issues than the rural groups. We identified five distinctive values with the highest loading factor being the altruistic value cluster. The result is inconsistent with previous researches (for example; Schwartz & Bardi 2001; Schwartz *et al*. 2001; De Groot & Steg 2007c). The variations of the pattern of this result, however, seem to be attributed to the outcome of differences in the contextual relevance of items, and other attributes of society. The analysis shows that the two groups have different perceptions of the nature of environmental risks they faced. For example, the rural villagers were more concerned about drought and its related risks to human health, while the urban group thought of lifestyle-related risks such as safe drinking water shortage and global warming. This result is confirmed by the work of Duan (2005). We were unable to find significant negative correlations between egoistic values and risk perception, as well as between personal norms and awareness of environmental consequences, different from what we had expected. The results also show that the five distinctive

value orientations and demographic variables interact with one another to influence risk perception, personal norms and awareness of environment consequences. We also reported that the local communities make detailed observations of environmental changes, suggesting a wide spectrum of adaptation mechanisms such as nurturing plant and animal diversity; adaptation through diversified land use; and adaptation measures rooted in social networks and customary institutions among other things. Taken together, the indigenous/social adaptation process of the local community is partly a function of gender. Observational experiences and social status are some other factors of note.

### *Implications for research and practice*

On the theoretical level, the results show that the five distinctive value orientations and demographic variables interact with one another to influence risk perception, personal norms and awareness of environmental changes and their consequences. From an applied perspective, these results suggest the need to stress that environmental concerns are linked to the five distinctive value orientations and that values (not all values) predict specific beliefs and risk perceptions. Behaviour depends to a great extent on specific attitudes or direct experience with the natural world. Therefore, social practitioners and policy makers should design cognitive and behavioural intervention models such as environmental education and community dialogue, and awareness training, which take into account the values and norms of users of the environment. Understanding the structure of value orientation, risk perception and behaviour-specific beliefs should also be of particular importance for the social practitioner as part of evidence-based risk communication strategies (social marketing, advocacy) among different groups or segments of the society.

The study also shows that the local people make detailed observations of environmental changes and ecological responses though they do not always register alarming signs until much later. Local peoples have a long-standing history of interaction with their environment that include coping with environmental change. The study identified three examples of adaptation options rooted in traditional knowledge and practice. These include nurturing plant and animal diversity; adaptation through diversified land use; and adaptation measures rooted in social networks and customary institutions. Consequently, the observations of these phenomenal developments over time are very helpful for NGOs and government decision makers in that they provide an important element or toolkit for empowering rural communities in dealing with the ever-changing environmental risks. Another consideration is that traditional knowledge is often gendered. Hence, gender equality in environmental change policies and responses to enhance adaptive capacity should be taken up as a priority concern by the local governments.

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# Appendices

**Appendix 1:** Correlations of values and specific risk perceptions to environment

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Openes Values | 1 | .476** | .452** | .345** | .255** | .220** | .184** | .140** | .255** | .050 | .039 | .023 | .209** | .134** | .210** | .145** | .202** | .229** | -.006 | .181** | .149** | .256** | .350** | .308** | .252** | .203** | .223** | .227** | .274** | .056 |
| Traditional Values | | 1 | .601** | .444** | .199** | .109* | .144** | .097* | .118* | .036 | -.018 | .048 | .109* | .096* | .120* | .054 | .161** | .196** | -.045 | .111* | .019 | .143** | .202** | .191** | .187** | .140** | .143** | .153** | .199** | .020 |
| Altruistic Values | | | 1 | .623** | .154** | .165** | .188** | .168** | .241** | .046 | -.129** | -.066 | .167** | .295** | .286** | .058 | .165** | .205** | -.108* | .141** | .142** | .231** | .329** | .286** | .243** | .171** | .144** | .180** | .255** | .050 |
| Biospheric Values | | | | 1 | .024 | .181** | .170** | .238** | .302** | .130** | -.009 | .010 | .226** | .306** | .272** | .163** | .214** | .245** | -.084 | .179** | .183** | .206** | .271** | .294** | .246** | .170** | .152** | .189** | .271** | .115* |
| Egoistic Values | | | | | 1 | .068 | .129** | .057 | .032 | .109* | .068 | .183** | .019 | -.074 | .004 | -.051 | .012 | .001 | .072 | -.034 | -.097* | -.081 | -.038 | .072 | .079 | .019 | .009 | .015 | .008 | .049 |
| Burning fossil fuel | | | | | | 1 | .594** | .467** | .494** | .248** | .153** | -.002 | .364** | .427** | .464** | .327** | .246** | .327** | .077 | .309** | .379** | .382** | .447** | .203** | .227** | .198** | .226** | .314** | .349** | .050 |
| automobile/car emission | | | | | | | 1 | .687** | .508** | .428** | .256** | .215** | .261** | .341** | .385** | .304** | .383** | .254** | .301** | .350** | .322** | .335** | .333** | .166** | .194** | .168** | .316** | .308** | .398** | .177** |
| Solid waste | | | | | | | | 1 | .635** | .404** | .238** | .191** | .294** | .320** | .275** | .324** | .350** | .257** | .273** | .307** | .323** | .270** | .323** | .179** | .217** | .147** | .249** | .291** | .280** | .150** |
| Soil erosion | | | | | | | | | 1 | .359** | .231** | .009 | .435** | .431** | .361** | .345** | .281** | .394** | .030 | .292** | .378** | .328** | .443** | .262** | .202** | .162** | .235** | .325** | .395** | .131** |
| Livestock waste | | | | | | | | | | 1 | .435** | .352** | .132** | .192** | .172** | .295** | .309** | .092 | .383** | .174** | .164** | .161** | .134** | .160** | .140** | .035 | .270** | .146** | .154** | .119* |
| Use of pesticides | | | | | | | | | | | 1 | .434** | .073 | .054 | .000 | .148** | .162** | -.036 | .431** | .086 | .033 | .057 | .032 | .113* | .088 | -.020 | .212** | .076 | .039 | .121* |
| Use of fertilizer | | | | | | | | | | | | 1 | .045 | -.045 | -.036 | .183** | .104* | -.103* | .421** | .025 | -.064 | .009 | -.080 | .029 | .103* | -.007 | .248** | .106* | .067 | .238** |
| Flooding | | | | | | | | | | | | | 1 | .401** | .421** | .210** | .208** | .384** | -.050 | .264** | .322** | .312** | .410** | .270** | .293** | .145** | .132** | .210** | .332** | .050 |
| Drought | | | | | | | | | | | | | | 1 | .452** | .451** | .269** | .338** | .010 | .286** | .324** | .302** | .379** | .295** | .305** | .109* | .180** | .269** | .326** | .103* |
| Wildfires | | | | | | | | | | | | | | | 1 | .325** | .342** | .487** | -.007 | .423** | .442** | .471** | .461** | .272** | .191** | .185** | .173** | .271** | .353** | .026 |
| Firewood/charcoal | | | | | | | | | | | | | | | | 1 | .487** | .355** | .262** | .246** | .251** | .234** | .246** | .165** | .193** | .193** | .298** | .305** | .225** | .248** |
| Over-grazing | | | | | | | | | | | | | | | | | 1 | .374** | .288** | .309** | .259** | .288** | .345** | .278** | .227** | .128** | .234** | .150** | .234** | .200** |
| Cutting trees &bushes | | | | | | | | | | | | | | | | | | 1 | -.018 | .332** | .326** | .328** | .375** | .248** | .148** | .163** | .097* | .193** | .337** | -.007 |
| Urbanization | | | | | | | | | | | | | | | | | | | 1 | .239** | .101* | .044 | -.026 | .018 | -.012 | .021 | .332** | .208** | .007 | .272** |
| Species extinction | | | | | | | | | | | | | | | | | | | | 1 | .544** | .513** | .398** | .312** | .199** | .140** | .207** | .272** | .398** | .101* |
| Invasive species | | | | | | | | | | | | | | | | | | | | | 1 | .601** | .541** | .315** | .264** | .233** | .201** | .281** | .350** | .079 |
| Freshwater shortage | | | | | | | | | | | | | | | | | | | | | | 1 | .703** | .399** | .283** | .243** | .285** | .256** | .381** | .143** |
| Drinking water shortage | | | | | | | | | | | | | | | | | | | | | | | 1 | .483** | .328** | .294** | .275** | .363** | .419** | .107* |
| Energy shortage | | | | | | | | | | | | | | | | | | | | | | | | 1 | .376** | .202** | .223** | .196** | .333** | .044 |
| Loss of farming lands | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .228** | .252** | .159** | .342** | .198** |
| Global warming | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .276** | .272** | .258** | .169** |
| Desertification | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .432** | .322** | .372** |
| Ozone depletion | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .399** | .333** |
| Biodiversity loss | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .314** |
| Population growth | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |

*P** < 0.01, P* < 0.05*

**Appendix 2:** Correlations of values and specific risk perceptions to health

| Openes Values | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Traditional Values | 1 | .476** | .452** | .345** | .255** | .267** | .252** | .162** | .238** | .041 | -.019 | .018 | .294** | .186** | .114* | .075 | .191** | .120* | .044 | .157** | .204** | .274** | .329** | .271** | .260** | .267** | .167** | .253** | .241** | .177** |
| Altruistic Values | | 1 | .601** | .444** | .199** | .144** | .152** | .120* | .154** | .042 | -.003 | .019 | .099* | .119* | .109* | .111* | .158** | .081 | .040 | .162** | .134** | .166** | .220** | .187** | .256** | .145** | .143** | .171** | .191** | .102* |
| Biospheric Values | | | 1 | .623** | .154** | .278** | .261** | .214** | .246** | .028 | -.091 | -.071 | .262** | .271** | .039 | .097* | .183** | .166** | -.037 | .175** | .224** | .267** | .324** | .271** | .320** | .218** | .083 | .166** | .281** | .150** |
| Egoistic Values | | | | 1 | .024 | .279** | .220** | .199** | .332** | .058 | .007 | -.037 | .286** | .246** | .030 | .167** | .253** | .172** | -.036 | .196** | .193** | .222** | .292** | .249** | .310** | .293** | .172** | .184** | .291** | .234** |
| Burning fossil fuel | | | | | 1 | -.010 | .113* | .099* | -.001 | .057 | -.048 | .132** | .056 | -.028 | .067 | -.055 | .080 | -.001 | .076 | -.039 | .004 | -.033 | .003 | .124** | .130** | .000 | .048 | .080 | .071 | .130** |
| Car emission | | | | | | 1 | .560** | .464** | .551** | .293** | .169** | .009 | .459** | .447** | .222** | .215** | .297** | .286** | .049 | .377** | .439** | .492** | .495** | .246** | .279** | .301** | .207** | .336** | .382** | .221** |
| Solid waste | | | | | | | 1 | .621** | .485** | .357** | .190** | .173** | .375** | .360** | .329** | .249** | .401** | .309** | .313** | .379** | .395** | .383** | .390** | .300** | .286** | .333** | .345** | .326** | .421** | .264** |
| Soil erosion | | | | | | | | 1 | .581** | .413** | .254** | .184** | .330** | .358** | .259** | .291** | .421** | .304** | .249** | .255** | .300** | .315** | .333** | .211** | .264** | .193** | .186** | .273** | .353** | .183** |
| Livestock waste | | | | | | | | | 1 | .363** | .219** | .118* | .462** | .451** | .230** | .333** | .302** | .346** | .106* | .343** | .347** | .406** | .445** | .275** | .341** | .240** | .241** | .377** | .425** | .305** |
| Use of pesticides | | | | | | | | | | 1 | .490** | .391** | .216** | .205** | .294** | .243** | .391** | .155** | .316** | .143** | .234** | .245** | .201** | .234** | .082 | .127** | .211** | .137** | .214** | .152** |
| Use of fertilizer | | | | | | | | | | | 1 | .570** | .168** | .057 | .238** | .182** | .207** | .009 | .336** | .051 | .102* | .062 | .033 | .071 | .047 | .020 | .205** | .181** | .122* | .141** |
| Flooding | | | | | | | | | | | | 1 | .138** | .003 | .264** | .220** | .246** | -.026 | .341** | .004 | .088 | -.020 | -.063 | .069 | .025 | .018 | .213** | .128** | .046 | .145** |
| Drought | | | | | | | | | | | | | 1 | .556** | .261** | .281** | .300** | .392** | .031 | .363** | .337** | .428** | .468** | .329** | .414** | .311** | .248** | .350** | .405** | .222** |
| Wildfires | | | | | | | | | | | | | | 1 | .324** | .415** | .282** | .355** | -.005 | .278** | .286** | .373** | .448** | .271** | .326** | .277** | .151** | .277** | .384** | .250** |
| Firewood/charcoal | | | | | | | | | | | | | | | 1 | .442** | .400** | .184** | .302** | .166** | .153** | .206** | .164** | .182** | .151** | .148** | .359** | .214** | .189** | .243** |
| Over-grazing | | | | | | | | | | | | | | | | 1 | .508** | .251** | .248** | .264** | .214** | .207** | .210** | .157** | .245** | .228** | .309** | .251** | .207** | .312** |
| Cutting trees &bushes | | | | | | | | | | | | | | | | | 1 | .318** | .349** | .345** | .339** | .294** | .273** | .287** | .239** | .206** | .269** | .197** | .321** | .252** |
| Urbanization | | | | | | | | | | | | | | | | | | 1 | .159** | .376** | .285** | .336** | .362** | .161** | .194** | .229** | .140** | .212** | .335** | .090 |
| Species extinction | | | | | | | | | | | | | | | | | | | 1 | .234** | .212** | .013 | .026 | .054 | .066 | .125** | .222** | .166** | .128** | .137** |
| Invasive species | | | | | | | | | | | | | | | | | | | | 1 | .558** | .486** | .449** | .320** | .400** | .330** | .245** | .233** | .471** | .185** |
| Freshwater shortage | | | | | | | | | | | | | | | | | | | | | 1 | .619** | .531** | .399** | .303** | .369** | .265** | .295** | .442** | .273** |
| Drinking H2O shortage | | | | | | | | | | | | | | | | | | | | | | 1 | .714** | .444** | .368** | .380** | .221** | .272** | .417** | .256** |
| Energy shortage | | | | | | | | | | | | | | | | | | | | | | | 1 | .431** | .452** | .448** | .218** | .375** | .479** | .264** |
| Loss of farming lands | | | | | | | | | | | | | | | | | | | | | | | | 1 | .571** | .325** | .304** | .261** | .473** | .348** |
| Global warming | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .420** | .331** | .329** | .452** | .386** |
| Desertification | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .385** | .416** | .451** | .303** |
| Ozone depletion | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .445** | .351** | .475** |
| Biodiversity loss | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .490** | .380** |
| Population growth | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .359** |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |

*P** < 0.01, P* < 0.05*