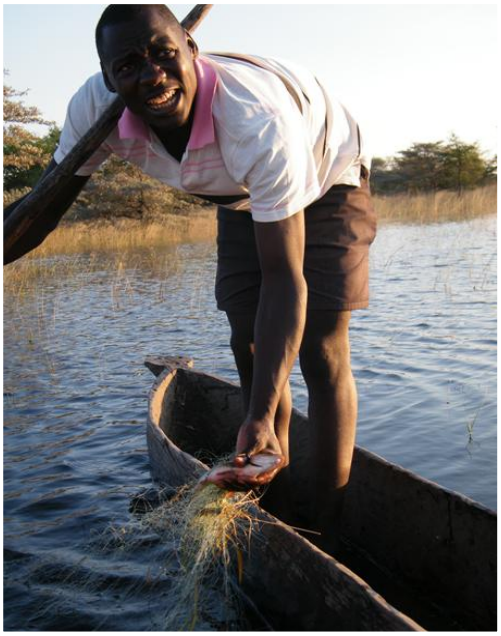
MSC THESIS CHAIR GROUP: FOREST AND NATURE CONSERVATION POLICY, WAGENINGEN UNIVERSITY

# FISH NEVER FINISHES
# versus
# SHIFTING BASELINE SYNDROM

## Local knowledge contestation in Caprivi's fishery management, Namibia




**Study programme:** MSc. Forest and Nature Conservation (MFN)

**Author:** Lisa Heider

**Supervisors:** Dr. Paul Hebinck (Rural Development Sociology)

Dr. Ir. Freerk Wiersum (Forest and Nature Conservation Policy)



**Thesis code:** FNP-80436

# *FISH NEVER FINISHES*

# *versus*

# *SHIFTING BASELINE SYNDROM*

---

## *Local knowledge contestation in Caprivi's fishery management, Namibia*


Wageningen, December 2012

Lisa Heider

lisaheider@gmx.de


WAGENINGEN UR
For quality of life

# *Abstract*

This study describes how local knowledge of fisher folk in Caprivi is contested by scientific actors from universities, non-governmental organizations (NGOs), the ministry and donor agents. In the attempt to increase democracy and stimulate emancipation of the rural poor, the Namibian government principally supports the concept of CBNRM in the form of communal conservancies and fishery co-management schemes. In drawing up the rules of the game for the management of natural resources by local people, their knowledge, including interests, skills, beliefs and practices, is largely marginalized by the scientific community. Local knowledge becomes selectively studied, transformed and adapted to meet globally accepted, scientific standards for conservation. Mismatches between scientific and local knowledge are inevitably culture-based and found explained in the social, cultural and political history of actors within a knowledge network. This study aims to contribute to a greater understanding of the nature of local knowledge networks in NRM, hoping to assist in the acknowledgement of unrestricted, unmodified and unconditional local knowledge in autonomous NRM. An analysis of knowledge spaces is used to investigate the diversity of knowledge axioms and culture-based interests that shape the way scientific and local networks construct knowledge, give meaning and priority to it and how it is applied in fishery management. It identifies the manifestations of cognitive conflicts and knowledge struggles and it delineates how the scientific network contests local knowledge in theory and practice. For this, a qualitative case study was conducted with participatory observations and interviews with informants from the scientific network and fisher folk from a fish market and six fishing villages and conservancies in the eastern Caprivi floodplain, Namibia. The empirical findings revealed knowledge axioms typical for the respective knowledge spaces, resulting in deviating ways of *knowing nature*. Numerous incompatibilities between the two scientific and local knowledge spaces result in conflicts related to interest and priority struggles, legal and perceptual ties to powerful actors, unsustainability of methods, resistance to rules and regulations and conflicts on a community level. Contestation of local knowledge through the scientific network could be identified in the phases in fishery management: knowledge construction, prioritization and the development of methodologies. According to this study, the contestation could be accounted to the nature of the scientific knowledge space. This contestation reflects in fishery management concepts that are built on scientific self-referencing and disciplining, aiming at creating forms of local participation that are compatible with the scientific knowledge space. But the fundamental differences between both knowledge spaces prove impossible to align through force and top-down control. The consequences of such strategies for the local knowledge network showed in the destabilization of the local knowledge network and in the reshaping of project rules and state regulations targeting the sustainable management of fisheries.

Human agency of local actors in the context of their knowledge space should be accepted, or rather welcomed as diverse and inimitable ways of knowing nature, which can teach lessons to Western societies and scientific communities. Local knowledge of fisher folk in Caprivi must gain respect and recognition in the development of CBNRM projects in order to make them locally sustainable, relevant and local empowerment-supporting. To stimulate emancipation of local people and to fully benefit from the diverse aspects of local knowledge, the local knowledge space should directly feed fishery management, instead of passing through the scientific space where it becomes transformed by the scientific network.

***Keywords:*** *scientific spaces, local spaces, knowledge axioms, local knowledge contestation, fishery co-management, conservancies, FPAs, local empowerment, Caprivi, Namibia*

# *Acknowledgement*

I specifically would like to thank my thesis supervisors, Dr. Paul Hebinck and Dr. Ir. Freerk Wiersum, who have made this learning experience a memorable and valuable one. Thank you for your kind support, respected suggestions and meaningful guidance during the course of the thesis development. I am also very grateful to Rodgers Lubilo, a Zambian Phd student from Wageningen University, who was my trusted person in Caprivi. Thank you for assisting me with all logistical, practical and emotional difficulties that I encountered during the field work. This study would have not been possible without the assistance from staff of the Integrated Rural Development and Nature Conservation (IRDNC), who allowed me to use their office facilities and helped me in establishing contacts in the local network. I would also like to thank Lancoh Moya for being my interpreter and friend during my time in Caprivi. A special word of thank goes to my friend Mekhala van der Schyff who accompanied me to Caprivi and assisted me in all possible ways. Thank you for your help, motivation and inspiration. Last but certainly not least, I thank all interview respondents for their trust and their time to share wonderful stories and meaningful information. Thank you for letting me be part of a different way of life. This experience has broadened my horizon and influenced the way I *know nature*.

# *Table of content*

# *List of figures*



# *List of tables*

# Chapter 1-

# Introduction

## 1.1. Problem statement

In striving towards sustainable development of the rural poor, the Namibian government invests into strengthening national democracy and community emancipation. In the context of natural resource management (NRM), this has led to a current re-structuring of traditional state-controlled forms of management towards decentralized communal structures, such as communal conservancies (NACSO, 2011). However, in the attempt to empower local communities in NRM local knowledge still receives inadequate attention and recognition. Values, meanings, practices and goals of local people are continuously contested by external experts, scientifically-developed conservation interventions and state-enforced regulations. Due to the many contradictions with local knowledge, most of the implemented conservation concepts prove unsustainable and locally irrelevant (Stuart-Hill, 2005; Shakeroff & Campbell, 2007; Danielsen et al., 2008). This becomes particularly apparent in the co-management of inland fisheries in Caprivi. Often alienated goals, values and interests of external expertise and powerful actors are shining through subtly or bluntly in implemented fishery regulations, conservation projects and initiatives. Insisting on keeping a share in disciplining local fishing communities with scientifically validated rules and interventions contradicts with the decentralization process of fishery management. Not surprisingly, such knowledge struggles have negative implications for the local communities and the sustainable management of Caprivi's fish resources.

## 1.2. Conceptual approach

### *1.2.1. Knowledge spaces*

Knowledge broadly involves the awareness and exposure to facts, information, and skills through education or experience (Ossai, 2010). Since Plato defined knowledge as the 'justified true belief', it is still commonly understood as such. A modern interpretation of Plato's theory elaborates that belief is only counted as knowledge when it is perceived as fact supported by sufficient evidence or justification (Website: Stanford). In a long history of epistemological studies, numerous theories around the concept of knowledge have evolved. The lack of consensus and the contradictions within the discussion indicate that no blue-printed definition is readily available. Considering one other popular understanding of knowledge as 'the belief which is in agreement with the facts', the knowledge-concept is a vague one, subject to many different interpretations. This point was raised by Bertrand Russell in his 'theory of knowledge', in which he questions who determines 'fact', who

determines ‘belief’ and what is the nature of this ‘agreement’. Just like the notion of ‘rationality which cannot be rationally defined’, knowledge can only receive its title and the greater meaning through the perception of a knowledge holder in his social reality. It is thus relative, and contextually and situational very specific (Long, 2001).

What many theorists are in agreement of is that knowledge can become apparent in produced or constructed forms. Produced knowledge is information that is externally generated upon purposefully extracted data targeting a specific issue (McGee, 2004). This process results in neutral, objective and theoretical knowledge equivalent to what epistemologists may call ‘explicit’. Produced knowledge can be quantified, formalised and structured, and it is thus easily accessible (Sanchez, 2001; Ossai, 2010). Constructed knowledge on the other hand is less visible or evident and difficult to formalize. It may become apparent as experiential knowledge, practical skill and expertise for example. It is implicit, unstructured, and vaguely expressed (Sanchez, 2001; Ossai, 2010). Constructed knowledge is generated within and between actors (McGee, 2004), in two broad processes (Illeris, 1993): The one is an inner mental acquisition, which occurs from within actors through unique experience, observation and inference (Sanchez, 2001; Ossai, 2010). The second one occurs during complex and unpredictable interactions of actors with different social, political and cultural realities (Illeris, 1993; Long, 2001). These internal and external processes cannot be seen in separation as they influence how individually and context-specific knowledge is constructed (Illeris, 1993). They may be well understood and analyzed using the metaphor of [knowledge] spaces; spaces containing social, political and cultural history (McGee, 2004). Each knowledge holder occupies a knowledge space of unique sets of conditions that are inimitable, unpredictable and locally specific. Produced and constructed knowledge can therefore be found ‘situated’ in spaces of local actors (Haraway, 1998; Sanchez, 2001; Campbell & Vainio-Mattila, 2003; McGee, 2004).

In line with this thought it follows that knowledge cannot be transferred as a static accumulation of undisputable facts to other actors within and across social entities. All message receivers respond cognitively, emotionally and organizationally different to a situation than another and construct knowledge in accordance with social agency, unique worldviews and interests (McGee, 2004). Knowledge and messages thus change while passing through the stages of transmission and the transmitters have considerable influence in how the message is perceived on a lower level of knowledge transfer (Long, 2001). Moreover, knowledge spaces of actors are generally regulated by unique formal or informal access rules and conducts, and knowledge transmission between different spaces might be considerably restricted (McGee, 2004). As spaces are subject to ever-changing external and internal influences and behaviour of actors, culture-based methodologies are dynamically changing too (McGee, 2004). These are the products of knowledge construction in knowledge spaces, and become apparent as operational mechanics, skills and practices for example.

In light of the above, it is doubtful whether ‘situated’ knowledge could ever be learned by actors occupying a different knowledge space (Long, 2001). While it was widely understood that produced knowledge in a formal arrangement can be easily transferred to other knowledge spaces by adding the dimension of ‘situatedness’ of the receivers spaces, experiences in the last twenty years have made clearer that knowledge does not separate action, thought and feelings and it cannot be generated outside its historical context or a ‘person-acting-in settings’ scenario (Aikenhead & Ogawa, 2007).

Even produced knowledge is generated in accordance with the social agency and on the unique foundations of knowledge spaces (McGee, 2004). In other words, a local knowledge space cannot be re-constructed and actors' responses anticipated. An actor would only be able to fully understand the message when being part of the cognitive, emotional and social changes in the internal and external processes of knowledge construction and transfer (Illeris, 1993). It follows that complex cosmologies and entire knowledge systems are virtually impossible to communicate (COFAD GmbH, 2002; Shakeroff & Campbell, 2007).

### *1.2.2. Knowledge networks in NRM*

Due to its amenability to internal and external conditions and to its flexibility in the face of interacting social actors, the term 'knowledge system' should rather be replaced by 'knowledge network'. A social [or knowledge] network constitutes interpersonal ties in which actors form the nodes (Granovetter, 1973). While 'system' implies a closed structure of single entities which use self-proclaimed plausible grounds to demarcate itself from its complex surroundings (Kohorst, 1996), a network describes more adequately how dynamic and receptive knowledge is. Through negotiations and competitions between many different actors over paradigms, controversies and concepts, knowledge is constantly shaped (Barnes & Shapin, 1979), and it never remains free of social influences and human agency (Pickering, 1995). Actors situated within one knowledge space can be seen as a knowledge network (McGee, 2004), and the description 'network' represents the flexible construct and transfer of knowledge within, but also between social groups.

Collaborative learning in knowledge networks is considered an essential tool in co-management strategies for natural resources. However, mutual misperception and unequal power relations in the co-management arena bias the content of interventions and they stifle the exploitation of the full learning potential (Shakeroff & Campbell, 2007; Olsson et al., 2007). In order to identify such biases in NRM strategies, it is essential to understand the nature of power and cognitive conflicts in knowledge transfer. An analysis of knowledge spaces can provide valuable insight into the mental and physical possibilities and restrictions of a network to engage in collaborative learning (McGee, 2004). Knowledge networks involve a range of chosen actors, with each one forming a node of expertise (Olsson et al., 2007). The restriction in knowledge exchange through networks is then who actually defines 'expertise' and appoints the nodes, and based on which premises? The answer to this seems to be found (1) deeply engrained in the network's respective way of knowing, valuing and perceiving the natural environment (Aikenhead & Ogawa, 2007) and (2) in the position of the actor in the decision-making process in NRM strategies (Keeley & Scoones, 1999; McGee, 2004). An analysis of knowledge spaces equally accommodates for actor-level interpretations and the consideration of external social and political forces and temporal events (McGee, 2004).

Operating in NRM in developing countries are commonly the two broad knowledge networks, scientific and local: The scientific knowledge network occupies a scientific knowledge space that has its origin and displays history of Western societies. It characteristically generates produced and constructed knowledge that is situated in the global context (Sambo & Woytek, 2001; Agrawal, 2002; Ossai, 2010). In contrast, the local knowledge network constitutes actors engaging in the local space, generating mainly

constructed knowledge very particular to the locally lived realities (Sambo & Woytek, 2001; Agrawal, 2002; Ossai, 2010). A synonym for local knowledge is 'indigenous knowledge' which is described by Warren (1991) as including 'traditional and local knowledge developed within and around conditions of people indigenous to a particular geographical area'. The term 'indigenous' describes that the knowledge has been generated by the people from the area, and it entails a reference to the ethnicity of the local community (COFAD GmbH, 2002). However, indigenous groups not necessarily remain indigenous, as migrations between different communities and across ethnic groups diversify the knowledge networks. Local knowledge is also often referred to as 'traditional knowledge'. Under 'traditional' it is understood that it involves continuity (COFAD GmbH, 2002). Because existing NRM structures since post-colonial eras are continuously influenced by modernization and globalization, knowledge changes adaptively and should no longer be exclusively described as 'traditional' (Berkes et al., 2000; COFAD GmbH, 2002; Ossai, 2010). Defining knowledge as 'local' finally summarizes traditional and indigenous as locally 'situated' knowledge that has been generated in the local knowledge space, developed under and for local conditions by local people (COFAD GmbH, 2002).

Considering that scientific and local knowledge spaces differ substantially in contextual, epistemological and methodological grounds (Agrawal, 1995), it is clear that knowledge transfer and learning become a complicating factor in NRM co-management. Power relations, self-interests but also discourses about values, standards and meaning regarding the natural environment strongly influence local and scientific spaces. But a space also constitutes dimensions of learning and dynamic change and is thus by no means restricted and static (McGee, 2004). Networks co-evolve and interact within the confines of their spaces (McGee, 2004) and may even develop forms of 'hybrid knowledge' (Reid et al., 2011).
To exploit these learning potentials, new spaces in NRM co-management should ideally form and present opportunities for community participation and local capacity.
In reality however, knowledge spaces in environmental management have a 'generative past', a previous occupation of mainly powerful and privileged actors who have left traces of ideologies (McGee, 2004). Reasoning and problem-solving in NRM traditionally occurred in 'closed spaces' which excluded opinions from other networks. Grounded on positivism and realism of the powerful actors, local knowledge networks are suppressed by scientific spaces still today (McGee, 2004). Discrepancies regarding the goals and tools often cause local resistance to intervention strategies (Hockley et al., 2005; Stuart-Hill, 2005; Danielsen et al., 2008). Cognitive conflicts in the form of mutual misperception and marginalization of local knowledge are great inhibitors in common pool resource management (Adams et al., 2003). The deviating positions, interests and goals of scientific and local knowledge networks are found rooted in the respective knowledge spaces and their nature and relevance for NRM can only be understood on the basis of culture-based axioms and interests (Sambo & Woytek, 2001; Aikenhead & Ogawa, 2007).

### *1.2.3. Local spaces in NRM*

Local knowledge is considered the basis for local-level decision-making in NRM in rural communities (Warren, 1991). Local knowledge spaces are shaped through a complex interplay of local practices of resource use, observational ecosystem knowledge and underlying beliefs about people's place and function in the natural environment (Berkes et

al., 2000; Sambo & Woytek, 2001; Ossai, 2010). Due to a physical, emotional and spiritual proximity to the natural environment, knowledge and practices of local people are believed to hold secrets for sustainable resource management and biodiversity protection (Berkes et al., 2000; Murray Li, 2007). Through daily interactions with the natural environment, local resource users observe, learn lessons and create knowledge from plants and animals directly. In addition, they construct knowledge through dreams, visions and intuitions (Brody, 1982; Castellano, 2000; Dyck, 1998; Michell, 2005). As a result of a direct dependency on the natural resources, local resource users may offer alternative solutions to live in a sustainable and sensible manner in the natural environment (Berkes et al., 2000; Aikenhead & Ogawa, 2007).

In many remote parts of the world, local people have carried out NRM for centuries (Berkes et al., 2000; Danielsen et al., 2008). Their practices include the restriction of resource access, limitations of take offs, distributions of harvest and monitoring of resource abundance and distribution (Western & Wright, 1994; Danielsen et al., 2008).

Many of the local management practices are shaped by traditions, tribal structures and social rules. For example, in many African tribes the use of certain animals and places is restricted by the underlying worldview on certain species or locations being sacred (Berkes et al., 2000). Such locally specified practices are embedded in social institutions of the communities and they are an inseparable part of the broad cosmology and value system of the culture. But management practices might also be adaptive responses of local resource users to certain external forces and environmental, social or political constraints. Through feedback learning from highly unpredictable external and internal processes, local communities develop strategies which closely resemble adaptive management approaches (Berkes et al., 2000).

This cumulative body of knowing how to live with the natural environment inherently adapts most readily to changes and pressures through experiential learning, and in this flexible form, it is passed onto next generations (Berkes et al., 2000) by oral transmission or active practice (Ohmagari & Berkes, 1997). Local management approaches often hold firmly as they are based on deeply rooted beliefs and values regarding the natural environment. The adaptive nature is entrenched in axioms that underlie local knowledge. The major axioms have been summarized by Aikenhead & Ogawa (2007), who call them ‘indigenous ways of knowing nature’:

- Monist

  Local knowledge makes no distinction between matter and mind, and everything in the universe is considered alive and connected (Battiste & Henderson, 2000; Cajete, 2000; Chinn, 2006).

- Holistic

  Local knowledge does not categorize ways of living and knowing. Local people do not separate biological phenomena, spiritual processes or socio-political circumstances.

- Relational

  In indigenous thought, a focus must be on relationships between knowledge, people, and all aspects of the spiritual and the natural world. Everything has spirit and knowledge. ‘Thus everything is like me, and everything is my relation’.

- Mystery

Local communities do not wary the unknown, but celebrate the unpredictable flux of the environment. Coexisting with the mysteries of nature is one important way to feel harmony for the purpose of survival.

- Place-based

Local people in rural environments often directly depend on the natural resources of their native lands. They interact closely with the elements, with plants and with animals. This interaction and dependency triggers a deep connection to the place that sustains them (Cajete, 2000).

- Dynamic

Local knowledge is not only dynamic on a vertical plain, which reflects continuity through transfer from generation to generation. It is also dynamic on a vertical dimension, which indicates change through new observations, new messages, and new insights (Warren, 1991; Kawagley, 1995). Local knowledge is thus continuously internally challenged and traditional knowledge and skills are debated and improved (Warren, 1991).

- Innovative

Local knowledge is open to innovations (Warren, 1991; Cofad GmbH, 2002; Ossai, 2010). In the process of dynamic change, local practices may be abandoned or exchanged for modern technologies and externally developed solutions and suggestions.

- Systemically empirical

Local communities do not use force to collect empirical ecological data but do so as part of natural forms of land management and daily interactions with nature. Data accumulation is not time-restricted and it can occur over many generations. This implies that local communities allow the natural flux in the environment to occur and to be captured in a bigger picture of ecosystem change.

- Circular time

Local knowledge is based on a circular time pattern which harmonizes with cyclic developments in the natural environment (Peat, 1994). It recognizes the re-occurrence of cyclic patterns in nature, such as seasons, animal migrations or flower blossoms. In line with the holistic and dynamic assumption, local knowledge believes a constant circular flux to represent the interconnectedness of all elements of the natural world.

- Content validity

Local knowledge has a strong content and intrinsic validity, which it draws from (1) its long history of application and (2) its utility in ensuring survival. Local knowledge investigates what the universe is and not how it works and does not need verification through external thresholds and quantified measuring.

- Rational

Like in other kinds of knowledge construction, local people use their ideas and perceptions to engage in logical reasoning, supported by empirical data. Although the information is truly culture-based and locally specific, the way of reasoning is locally accepted as rational.

- Survival-strategic

Local knowledge is constructed for and through practical day-to-day activities that primarily revolve around the focus on surviving (Michell, 2005).

### *1.2.4. Scientific spaces in NRM*

Through the process of industrialization and modernization the mind-set of western societies regarding the management of the natural environment was shaped to deviate more and more from the paradigms of third world countries. People in the early 20th century expected that social change would follow a clearly distinct evolutionary path, on which traditions, religion, tribal hierarchies, and shared commons would gradually become replaced with notions on territories, equalities, rationalities and science (Agrawal & Gibson, 1999). The desired and expected evolutionary process would form society from an 'undeveloped', to a 'developing' into a 'developed' one (Parson, 1966. In: Aikenhead & Ogawa, 2007). From this kind of knowledge, values and moral standards towards the natural environment have evolved (Campbell, 2000). Most of these scientific standards are commonly associated with terms such as 'accuracy', 'precision', 'rationality', 'adequacy' (Berkes et al., 2000; Haggan & Neis, 2007; Aikenhead & Ogawa, 2007) and 'curiosity' (Abbott, pers. comm., 2012). It is widely accepted that the scientific knowledge network is scientifically inquiring, analytical and formal, and scientific knowledge based on quantitatively and physically proven facts, which become standardized in an attempt to create something universally applicable (Ossai, 2010). Scientists thus often debate over paradigms, which they either want to prove or challenge (Hazen, 2005; Aikenhead & Ogawa, 2007). For this, scientific networks often rely on produced knowledge, rather than constructed knowledge which is considered as being biased by human agency (Nader, 1996). This information then spreads through networks of Western knowledge institutions and is employed worldwide by businesses, industries, private foundations, scientific research, conservationists and governmental institutions. Scientific actors historically represent a knowledge network of power and privilege associated with research and development, economic growth and globalization. The individuals within each institute are paid to generate, transform, or use knowledge to benefit those institutions (Aikenhead & Ogawa, 2007).

In the eyes of Alcorn (1995) scientific knowledge is closely related to 'big conservation'; the studies of scientific experts supporting the conservation programmes of international NGOs and governmental institutions. The actors of 'big conservation' are conceived of as the 'saviors of global heritage and endangered species and habitats' with values shaped in their urban environments, far away from the place of project implementation (Alcorn, 1995). Their efforts to manage resources are shaped by scientific conservation standards (Alcorn, 1997; Danielsen et al., 2008) and supported by donor agent at the macro-policy level, who base their assistance on international conventions and agreements on biodiversity

conservation and human resource development. In order to evaluate management interventions and justify the donations, the success of the conservation programmes is measured against scientifically developed standards (Murray Li, 2007; Danielsen et al., 2008). Such resource monitoring is of importance for scientific experts and conservationists as a mean to further refine conservation efforts and adapt practices to changing ecological conditions. The urgent need for 'adequate' knowledge of trends in species and habitats to make management decisions based on scientific data is being stressed by various international agreements, such as the Millennium Development Goals and the national legislative frameworks of many countries (Danielsen et al., 2008). 'Adequate' knowledge entails, that ecological data must be delivered in a quantitative form to scientific experts for analysis (Abbott, pers. comm., 2012). The donors are most commonly interested in filling mandates for sustainable development, environmental protection, poverty alleviation and most recently, empowerment of local communities (Murray Li, 2007; Danielsen et al., 2008). The NGOs generally have made commitments to deliver data and report on the successes of the projects to their donors (Danielsen et al., 2008). Their interest is often twofold: the conservation of biodiversity and natural resources (Campbell & Vainio-Mattila, 2003) and the justification of the donor funds (Murray Li, 2007; Danielsen et al., 2008). In both cases, they respond to and agree on scientific standards found deeply engrained in scientific spaces. Produced and constructed knowledge of the natural environment is shaped by well-recognized fundamental beliefs held by the scientific network. From a wealth of literature, Aikenhead & Ogawa (2007) have summarized the scientific axioms that shape scientific knowledge spaces in NRM:

- Nature is knowable.

Scientists strive to solve mysteries in nature. For this, scientific actors draw upon mechanistic explanations such as prediction models, and series of cause-effect events to achieve predictability.

- Knowledge as a destination.

Acquiring knowledge is a social goal of a scientist for reasons such as satisfying their curiosity, acquiring or maintaining credibility among their peers, or receiving research grants.

- Predictive validity.

Science constantly strives to prove or disapprove the validity of hypothesises, in order to strengthen or weaken paradigms and explain 'how the universe works'. The power of a paradigm to predict is the most important criteria in defining validity.

- Uniformitarianism.

Science has a pronounced wish for consistent application of scientific constructs through time and space.

- Rectilinear time.

Culture-specific technologies define different concepts of time. Mechanical clocks and computers indicate that the culture of science is based on rectilinear time. Rather than being a subjective personal concept as it is in most rural communities in developing countries, rectilinear time is an essential component of an absolute reality for scientists.

- Cartesian dualism.

This axiom refers to the clear distinction of matter and mind. Science draws upon the belief that these two elements are non-interacting and that the knowledge of matter is devoid of human intuition or spiritual forces.

- Reductionism.

Science strives to understand the function and structure of the whole, by investigating the separate parts.

- Anthropocentrism.

An anthropocentrism belief views nature as an instrument for human benefit. It entails regarding humans as superior to other life forms.

- Quantification.

In a scientifically constructed worldview, reality can only be reflected in objective mathematical equations. This results in the drive to quantify natural phenomena.

- Realism.

Science draws its construction of a reality from quantified, measurable information which is perceived with human senses. Drawn from reification, realism is the assumption that nature can be known as it 'really is' (Milne & Taylor 1998). It claims fidelity of a reality.

- Positivism.

Positivism embodies a universal worldview, which contains the one ideal, norm and standard. Scientists are positivists who consider the scientific ideal, norm and standard to be the ultimate measure of rationality (Holton, 1978). Ogawa (1995. In: Aikenhead & Ogawa, 2007) defines science as 'a rational perceiving of reality', while the rationality has its roots within the cultural context of its use (Elkana, 1971).

- Order

Western societies often express the wish to bring structure, order and simplicity into complex conditions.

### *1.2.5. Local knowledge contestation in fishery management*

As outlined above, scientific and local spaces are influenced by distinct worldviews which create different interests. However, the two networks also share certain intellectual process such as tendencies of observing, predicting, verifying, seeking patterns and inferring (Corsiglia & Snively, 1995). Both networks base a judgment of the truth in their respective way of knowing nature on rational argumentations, using culturally-based empirical data (Aikenhead & Ogawa, 2007). Each network intuitively develops tools with which knowledge can be constructed, conveyed and applied. Tools commonly found in local spaces include symbols, art, songs, metaphors, structures and geometrical shapes (Cajete, 1999). Science refrains to mathematical models, linear predictions, hypothesis verification, global verification, disciplining and quantification (Aikenhead & Ogawa, 2007). Both networks are

very dynamic and adapt according to personal experiences and understandings and new observations and ideas. The outcomes are prioritized and communicated within the knowledge spaces with the use of culturally-specific language. Local and scientific knowledge networks thus share that they are based on rational thinking, empirical approaches, intellectual processes and dynamic adaptations of their ways of knowing nature. However, the fundamental difference in the two knowledge networks is that the content of the spaces in which they operate are culture-based and unique (McGee, 2004; Aikenhead & Ogawa, 2007) and thus inimitable in the context of co-management strategies in NRM (Agrawal, unpublished data).

According to Aikenhead & Ogawa (2007) there are several processes, in which the fundamental differences of local and scientific spaces show. In NRM, knowledge spaces differ in the way (1) knowledge about the environment is constructed (*knowledge construction*), (2) how this way of knowing gains validity, momentum and importance and thus priority for management interventions (*prioritization*) and (3) how it is put into action (*methodologies*). Pinpointing the characteristic beneficial features of scientific and local knowledge in these phases of NRM is well displayed in the global discourse over best fishery management strategies (COFAD GmbH, 2002; Haggan & Neis, 2007). Always a point for debate is which distinguishable viewpoints and perceptions make either of the two knowledge spaces better 'sanctuaries' for fish resources.

According to Warren (1991), from the perspective of a professional network local knowledge may gain relevance through three different kinds of values: encyclopaedic, efficiency and emancipation value (In: Wiersum, 2000). The encyclopaedic value of local knowledge originates from locally specific information, skill and experience which may aid in understanding and potentially using alternative forms of resource use or management (Warren, 1991). For example in fisheries, scientific experts appreciate new insights into the biology of the freshwater ecosystem and the sustainable management of resources that local fishery knowledge reveals (Johannes et al., 2000; Haggan & Neis, 2007). Fisher's knowledge has many advantages in studying resource trends, as it is thought to encompass a finer spatial scale and be more updated than produced scientific knowledge (Rochet et al., 2008). In this way, it can be used very well to detect subtle changes in daily fishing activities which cannot be seen by outsiders. Locally developed fishing technologies and strategies which may result in increased fishing effort are important elements in predictive modeling (Hilborn & Walters, 1992; Jennings et al., 2001). Moreover, through long-term monitoring and experiences, local knowledge often provides a longer historical perspective than other data sources (Dulvy & Polunin, 2004; Lavides et al., 2009). The scientific knowledge network also recognizes the encyclopedic value of local management in its dynamic and adaptive approach to respond to changes and pressures on fish resources (Alcorn, 1997; Leach et al., 1999; Berkes et al., 2000; Purvis, 2002; Stuart-Hill, 2005; Aikenhead & Ogawa, 2007; Danielsen et al., 2008).

Efficiency value of local knowledge is derived when it complements scientific knowledge by adding information that improves the transfer of knowledge, concepts and technologies within and between knowledge spaces (Warren, 1991). In practice, efficiency value of local knowledge is exploited in the process of fishery co-management for example. Co-management relies on the facilitation of knowledge exchange between local actors, scientists and state institutions to develop greater understanding and more efficient resource governance (Hoefnagel et al., 2006). It is intended to build dynamic partnerships in

which the capacities and interests of the local fishers and communities are complemented by scientific expertise and the power of the state to establish enabling legislation and enforcement (Jentoft, 1989; Pinkerton, 1989; Berkes, 1994).

In the eyes of proffessional networks, emancipation value has any knowledge of local people that helps in developing projects which stimulate participation and self-determination of local communities (Warren, 1991). This kind of value currently receives increasing recognition in a phase in which the global NRM discourse promotes decentralization. It can also be seen in the plans of the Namibian government for the fishery management in Caprivi (Tweddle, 2009). Until recently, most fishery management has been the sole responsibility of scientific-lead state institutions (COFAD GmbH, 2002; Purvis, 2002). Since the development of international conventions and agreements supporting the sustainable development and empowerment of rural communities in developing countries, however, the role of scientific expertise has been adapted from top-down control to a rather guiding function for local communities in fishery management (COFAD GmbH, 2002; Tweddle, 2009). The International Convention on Biodiversity and chapter 26 of Agenda 21 ('Strengthening the Role of Indigenous People'), developed during the United Nations Conference on Environment and Development (1992), provide international frameworks which encourage the recognition of local knowledge in the context of community empowerment and decentralized resource management (Sambo & Woytek, 2001). This is currently reflected in the establishment of many co-managed fishery projects (Haggan & Neis, 2007), such as in Lake Malawi (Baldarin, 2001), St. Lucia (Brown & Pomeroy, 1999), Bangladesh (Middendorp et al., 1996), the Philippines (Pomeroy et al., 1999), Uruguay, and great potential for all freshwater ecosystems worldwide (Gutiérrez, 2011).

Replacing the often ineffective centralized fisheries management with a co-management platform can create a new space in which collaborative learning occurs (McGee, 2004). In reality however, these three kinds of value are strongly outweighed by negative processes, which lead to the contestation of local knowledge in fishery management (Haggan & Neis, 2007). The encyclopaedic value of local knowledge is challenged by many academics, who perceive it as inadequate in meeting the scientific needs and expectations for the conservation of biodiversity and natural resources. Traditional practices of local resource users are seen as too backward and superstitious to aid in sustainability management (Ossai, 2010), and lack in the efficiency and precision required in ecological studies (Sambo & Woytek, 2001). Considering that each knowledge network brings along a substantially different way of perceiving, valuing and managing the natural environment, the efficiency value of local knowledge is also often overlooked. Instead, local and scientific opinions often clash on the fishery co-management platform and complicate knowledge exchange and learning (Sambo & Woytek, 2001; Tweddle, 2009). The most challenging obstacle for local knowledge integration in co-management however, appears to be the recognition of emancipation value. Many scientific experts argue that the course of globalization and commercialization gradually destroys an indigenous inherent sense of living in balance with the natural flux of resources (Sambo & Woytek, 2001; Ossai, 2010). Instead of managing fish resources sustainably, local people are thus thought to be biased by vested interest in economic growth (Harmon-Jones & Harmon-Jones, 2007; Hay, pers. comm., 2012; Abbott, pers. comm. 2012). This lack of trust in local resource users by scientific advisors and decision-makers leads to the marginalization of local knowledge in the planning and implementation of fishery management schemes. Scientific experts often attempt to transfer produced and constructed knowledge to local resource users as a blue-printed

version of 'the right way' to NRM. Through this scientific positivism, local spaces remain largely suppressed by globally institutionalized scientific knowledge (Matowanyika et al., 1995; Kolawole, 2001; Butz & Besio, 2004) Even in fishery projects with a high degree of local participation, the full spectrum of local knowledge is still poorly considered (Shakeroff & Campbell, 2007; Danielsen et al. 2008). The actors of 'big conservationist' may try to incorporate the needs of local communities (Brosius, 1998; Lundy, 1999), but seldom succeed in understanding these needs on the basis of a differently 'situated' knowledge space (Alcorn, 1997; Aikenhead & Ogawa, 2007). Superficially conducted research of local knowledge often leads to a failure to capture its complexity (Shakeroff & Campbell, 2007) and it becomes even further altered and enriched through scientific disciplining to make it valid in management application (Agrawal, 1995).

Another relevant aspect which leads to the formalization of misperceived local knowledge in fishery management lies in the politically and economically vested interest of powerful actors in scientific spaces (Keeley & Scoones, 1999; McGee, 2004). Studying local knowledge in the first place benefits the researchers who obtain data that fills in knowledge gaps, academics who can publish results and conservationists who may achieve the establishment of protected areas (Shakeroff & Campbell, 2007). This 'local participation' then satisfies governmental institutions and donor and creditor agencies who promote democratic development and local empowerment on the basis of imperative mandates (McGee, 2004). State institutions are furthermore interested in implementing NRM schemes that are economically feasible and sustainable (van Rijsoort & Jinfeng, 2004; Stuart-Hill, 2005; Danielsen et al., 2008). The inclusion of local knowledge and the involvement of local communities has thus become a strategy to make local conservation projects more cost-efficient and sustainable (McGee, 2004; Rochet et al., 2008; Danielsen et al., 2008; Tweddle, 2009). For most scientifically-driven conservation projects, local fishing communities merely fulfil an assisting function, and fish experts and marine scientists have used the knowledge of local fishers in developing species assessments, research programs and conservation schemes (e.g. Sadovy & Cheung, 2003; Aswani & Hamilton, 2004; Dulvy & Polunin, 2004; Saénz-Arroyo et al., 2005; Silvano et al., 2006; Aswani et al., 2007). In this way, scientific networks selectively extract, interpret, oversimplify, and translate local knowledge within scientific spaces, before it is applied in fishery co-management. NRM projects based on one-sided knowledge axioms and interests are unsustainable (Stuart-Hill, 2005; Danielsen et al., 2008) and can severely harm the knowledge network in the endeavor to emancipation (Tuhiwai-Smith, 1999; McGee, 2004). Investigating the nature and the dynamics of knowledge spaces matters as they influence, stimulate or inhibit knowledge exchange and collaborative learning in NRM co-management (McGee, 2004). Hence, an analysis of knowledge spaces can aid in increasing the recognition of local networks in Caprivi's fishery co-management.

## 1.3. Research objective and questions

### *1.3.1. Research objective*

This study aims to contribute to a greater understanding of the nature of scientific and local knowledge spaces in NRM and of the contestation of the local network by scientific actors. By delineating the axioms and interests that shape distinct differences between the two knowledge spaces, I seek to raise awareness of the difficulties that the local network faces in the process of incorporating local knowledge in fishery co-management. With this study, I hope to assist in the acknowledgement of unrestricted, unmodified and unconditional local knowledge in autonomous NRM.

### *1.3.2. Research questions*

On the basis of the conceptual framework, this research objective has been operational zed in the following research questions:

(1) Which different interests and positions can be identified within knowledge spaces of actors on the three levels (knowledge construction, prioritization and methodologies) in fishery co- management in Caprivi?

(2) How do different knowledge spaces conflict in the fishery co-management in Caprivi?

(3) How is local knowledge contestation apparent on the level of discourse in the phases of knowledge construction, prioritization and methodologies? What are the consequences of local knowledge contestation for local communities in sustainable fishery management?

### *1.3.3. Operational delineation*

This leads to the operational delineation of this study as depicted in the conceptual model in figure 1. I will first determine the positions of the local and scientific network in the fishery management in Caprivi. I then explore the nature of the local and the scientific space by identifying axioms and interests in the three phases of fishery management (1) knowledge construction, (2) prioritization and (3) methodologies. I will firstly evaluate the problems and conflicts that arise through cognitive mismatches in the fishery management. I then outline the practical and theoretical forms of local knowledge contestation on a level of discourse over best standards and procedures in these phases. I will shine a light on how scientific actors use disciplining of local actors to derive local participation in forms that are compatible with scientific spaces. At the same time, I will investigate how local knowledge is transformed or restricted by the scientific network before it is applied in fishery management. I will conclude the study by establishing the consequences of local knowledge contestation for the local network and sustainable fishery management in Caprivi.

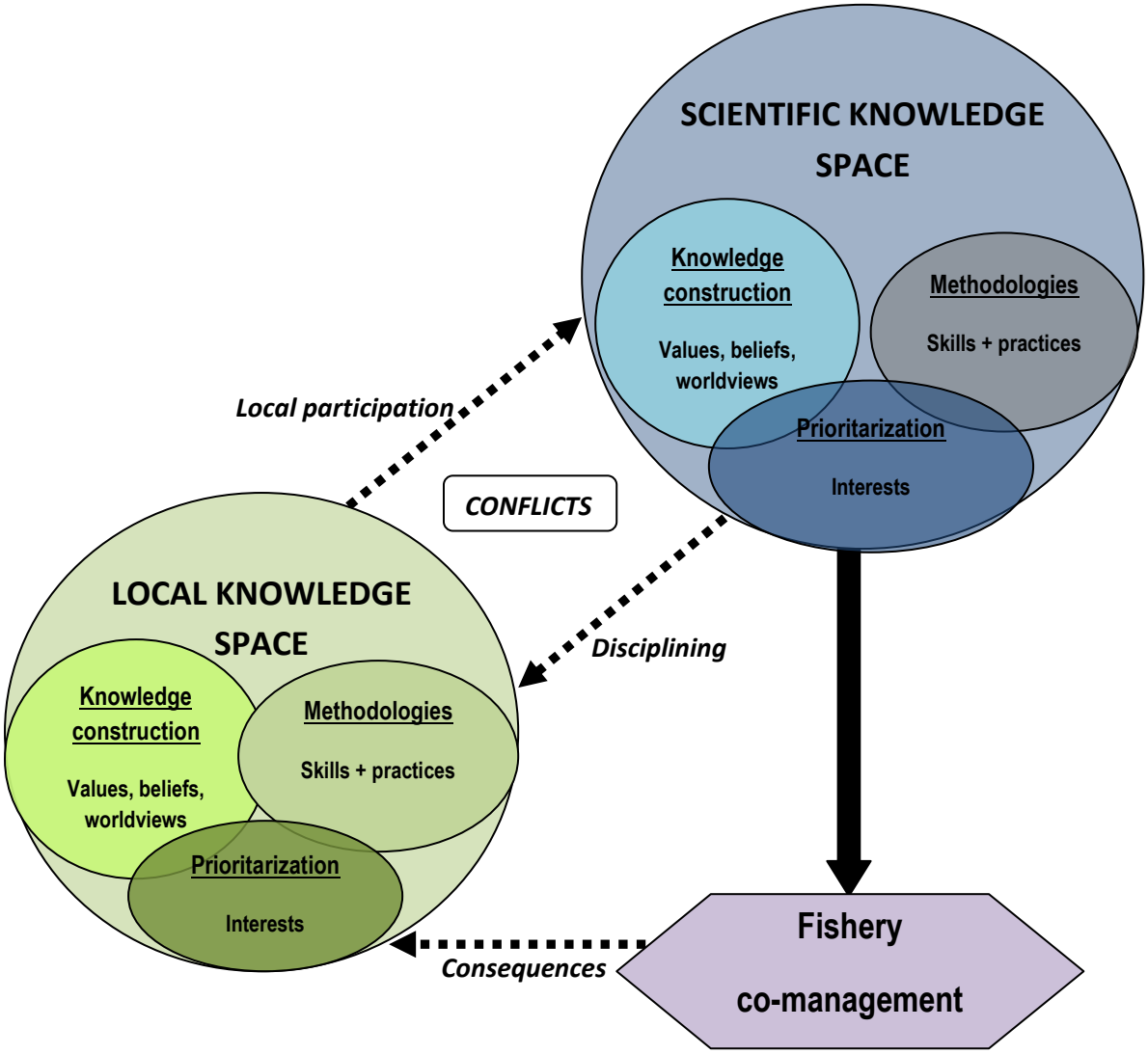



**Figure 1:** Conceptual model

## 1.4. Methodology

### *1.4.1. Research design*

This study followed a purely qualitative assessment of multiple realities in their locally specified contexts (Hammersley & Atkinson 2007; Green & Thorogood, 2009). I used the emic perspective in order to address the interpretive social sciences paradigms (Fetterman, 1989). The interpretive social sciences paradigms consider that there are numerous realities and explanations for phenomena, depending on the angle of observation. They draw on building theories based on the social reality, rather than testing existing theories as it is done in deductive approaches (Jennings, 2001). This implied that I entered the social setting of each study group to regard the phenomena under study through the lens of the actors in an inductive research approach (Fetterman, 1989). This provided me with empathic

understanding of the emotional context in which action takes place by means of sympathetic participation (Weber, 1978). The research was approached with a mixture of ethnographic study, opinion study and literature study. Ethnographic research questions are descriptive and include all questions that describe the values and meanings underlying the issue (Morse, 1994). In an opinion study, the opinions of the scientific experts are extracted in interviews. The research also entailed a document study of local laws and regulations and the rules of the game of formal monitoring schemes in place in Caprivi. The theoretical positions taken in this study and their implications for the research approach are listed in table 2.

### *1.4.2. Study area*

This case study research was conducted in the Caprivi Strip, which is the most northern part of Namibia bordering Angola and Zambia to the north, Zimbabwe to the east and Botswana to the south (fig. 2).

More specifically, the study took place in the eastern Caprivi floodplain (fig. 3). The floodplain is made up of permanent lakes, rivers and channels, but also temporary water bodies which form during the flooding season in autumn. Three main river channels run through the study area: the Chobe River and the Kwando/Linyanti River System and the Zambezi River. The Zambezi forms the border between Namibia and Zambia and stretches through Caprivi for 120 km from Katima Mulilo to the most eastern point of Namibia. The Zambezi River is the seasonally dominant force which determines the direction and velocity of the water flow in the Chobe and Linyanti. The Kwando River flows from the north to the south of Caprivi before it joins a complex wetland system in the eastern part. It eventually dries up at Lake Liambezi. The Chobe River emerges from Lake Liambezi, and runs in an eastward direction to join the Zambezi at Impalila Island, the most eastern tip of Namibia (Purvis, 2002).


**Figure 2:** Study area (Website: Globalsecurity, 2012)

During flooding season, the overflowing main channels form a complex wetland system partly on Zambian, but mainly on Namibian side, with lakes, backwaters, small channels and swamps then covering approximately 30% of the land surface of Caprivi (Purvis, 2002). Lake Liambezi, once a critically important source of fish for subsistence fishery in the 1970s and early 1980s, dried up in 1985 (Tweddle, 2009). Local communities on the banks of the lake had to switch their livelihood activities to mainly crop farming (Purvis, 2002). Only through major floods in 2000, 2003 and 2009, the lake has recently filled up again. Fishing activity has resumed since then and developed into a semi-commercial fishing business in some of the surrounding villages (Tweddle, 2009; MFMR research technician, pers. comm., 2012).

The annual inundation of grasslands makes the floodplain a fertile environment, with plenty of food and a diversity of habitats for a variety of species. Fish tend to time their spawning and feeding season with the flood season. During this time of the year, they can disperse and hide well in protected and calm water bodies. The floodplains then sustain masses of fish

and fishing activities of fishers are most lucrative until water recedes into the main channels again in June/July (Purvis, 2002).

Most of the floodplain consists of communal land on which several separate fishing communities are based. Many of them have established communal conservancies. A conservancy is a communal area for which the government has granted certain rights over NRM to local communities. The communities are to benefit from wildlife and natural resources through nature-based tourism for example, while at the same time making an obligation to manage for resource sustainability and species protection (Purvis, 2002).

For this study, I selected six fishing communities in which I conducted interviews with local people. I used purposive sampling, a form of non-probability sampling, to make a selection of local knowledge groups most suitable to match the study focus (Jennings, 2001). With assistance from IRDNC and the Ministry of Fisheries and Marine Resources (MFRM), I selected those communities in which fishing plays a major role as a livelihood activity. I visited four communities which are part of established conservancies, namely Impalila, Kasika, Mayuni and Sikunga. I also selected two fishing villages which ward off the conservancy model for various reasons. The settlement Lusu, a fishing community at Lake Liambezi, chooses to remain as independent from the government as possible, in order to practice semi-commercial fishing activity with least amount of legal restrictions and surveillance. This was explained to me by several fishers, vendors and the village chief (*the induna*) (5.04.2012). Lusese is a community which practices mainly subsistence and small-scale commercial fishing. During the flooding period, local fishers benefit from the overflow of the Chobe and the Zambezi which nearly reaches the settlement. For the rest of the year, the fishers need to walk far and even camp out on the bank of the Chobe River to engage in fishing. The conservancy model is also rejected in this community. Three local fishers and a farmer explained that the community fears resource use restrictions through the state, loss of ownership of the communal land and loss of powers over controlling wildlife populations (25.04.2012). As a seventh and last local respondent group, I interviewed vendors and buyers at the Ngweze fish market in Katima Mulilo.

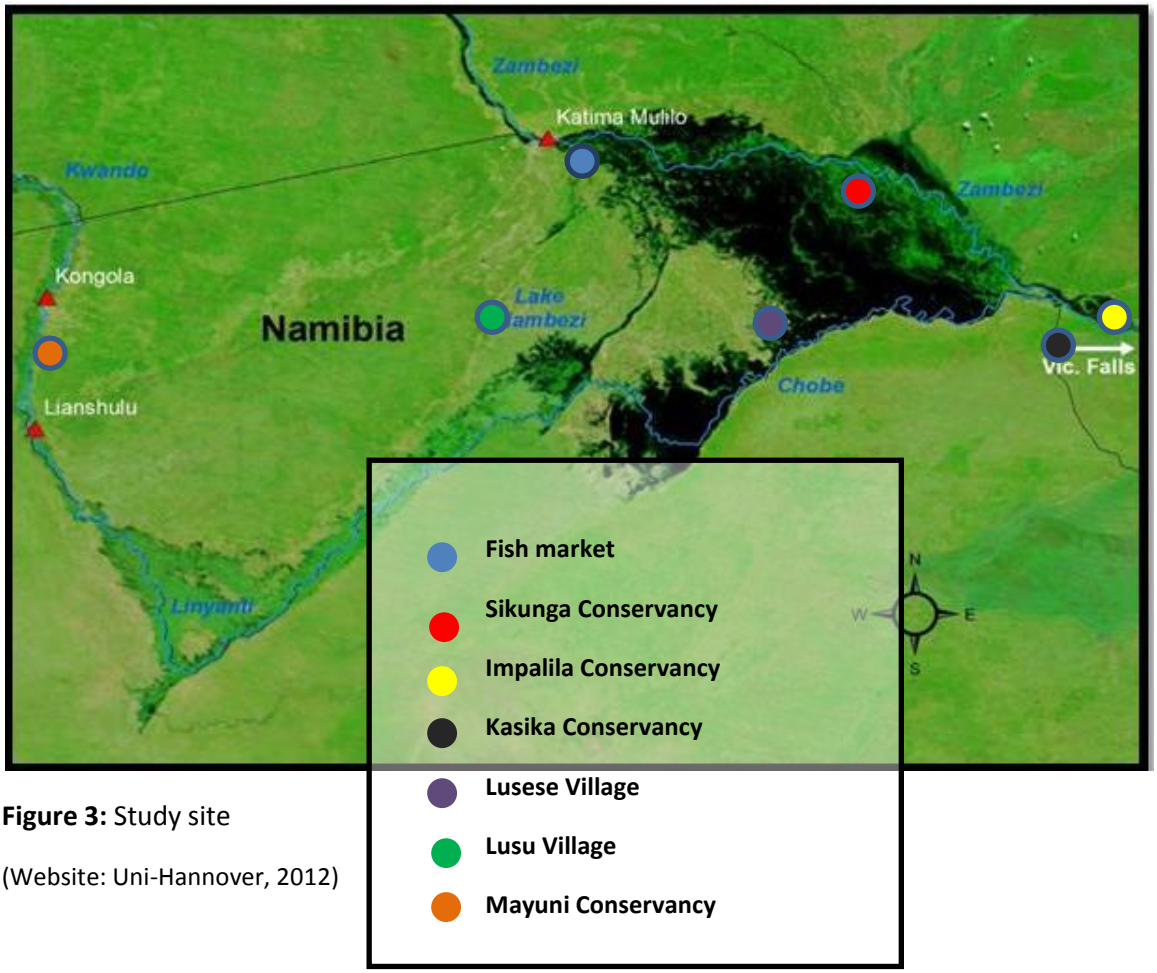



**Figure 3:** Study site

(Website: Uni-Hannover, 2012)

The selected study sites form a representative mixture of land tenure and fishery livelihoods in eastern Caprivi. By including conservancies, other communal land, communities on main channels and on floodplains, communities bordering Botswana and bordering Zambia, a variety of social, political and environmental issues became part of the investigation. This provides a more representative image of Caprivi's fishery management.

### *1.4.3. Selection of informants*

The sampling techniques of informants in this study were study-group specific (Jennings, 2001). I firstly placed the study respondents into the two categories local knowledge and scientific knowledge networks (Table 1). The findings of each study group and subgroup were then made applicable for the respective knowledge network. In order to identify the most relevant participants within a subgroup, the snowball sampling technique was applied (Jennings, 2001).

**Table 1:** Study group division

| **Knowledge network** | **Scientific** | | | **Local** | | | |
|---|---|---|---|---|---|---|---|
| **Study group** | **Scientific experts, conservationists** | | | **Fishermen/women, local resource manager** | | | |
| **Subgroup** | NGOs | Ministry officials | Researchers | Subsistence | Vendors | Conservancy members | Conservancy management |

### *1.4.4. Methods for data collection*

This research followed a case study approach, in which an empirical inquiry was made of the phenomena of different knowledge spaces in their real-life contexts (Jennings, 2001). The types of case studies chosen for this purpose were 'explanatory' in nature. This means that multiple cases were assessed on 'how and why' they operate as they do (Yin, 1994). Due to the diverse nature of the study groups and because each single method only targets one aspect of empirical realities, a variety of observation methods occurred in the process of triangulation (Denzin, 1978, Molnar, 1989). Drawing on several theories and applying different methods to receive data in so-called theory and methodological triangulation helped me to increase the reliability and validity of the collected data (Molnar, 1989).

**Table 2:** Theoretical positions and research implications

| **Strategy** | **Research questions** | **Research question focus** | **Informants** | **Sample size** | **Methods** | **Other data sources and toolkits** | **Results** |
|---|---|---|---|---|---|---|---|
| **Ethno-graphic study** | 1 and 2 | Describing values, beliefs, interests and practices of local resource users | Fishers, vendors, conservancy staff | 56 interviews | RRA: Semi-structured interviews, participatory observations, situational analysis | Documents, records, literature, canoe trips, area walks | Description of ecosystem values and day-to day activities |
| **Opinion study** | 1 and 2 | Experience with and opinions on local knowledge systems, identifying contrasts between the two knowledge spaces | Scientific experts, ministry officials, NGO staff | 8 interviews | In-depth semi-structured interviews | Participant observations, memoing, diary | Description of social psychological processes in experiences with local knowledge systems, contradictions between two spaces |
| **Document study** | 1, 2, 3 | Scientific interests, formalisation of opinions | | | Cross-referencing | Ministry documents, conservancy management plans, NGO project plans, regulations, expert presentations | evidence for local knowledge contestation reflected in formal document-tation |

(Morse, 1994)

❖ **Rapid Rural Appraisal (RRA)**

In order to answer the research question aimed at exploring the local knowledge network, I used Rapid Rural Appraisal (RRA) methods. RRA is used to assess a situation or a topic through a combination of creative investigation tools for social sciences. The characteristic of RRA is that parts of the data assessment and analysis already occur during data collection. RRA methods are open-ended and allow for flexible re-adjustment of research focuses and questions, which may arise during the course of the study (Molnar, 1989). Furthermore, they are holistic, multidisciplinary and interactive, enabling the situation to be viewed from a shared perspective by researchers and interviewees (Molnar, 1989). The RRA methods in this study included semi-structured interviews in combination with participatory observations and situational analysis. I used a list with broad themes and topics, but open-ended questions about the interviewees' views and values of the ecosystem, and descriptions of their daily activities regarding fishing practices. I allowed sufficient space and time for interviewees to speak about their concerns and problems. I also picked up these issues raised in future interviews to explore the dimensions of the locally perceived problems. An open and flexible interview approach is advisable in situations where qualitative data is required to explore an ontology consisting of multiple realities (Jennings, 2001). In order to maintain an emic perspective, I used the researcher participation observation in which I maintained a role as a researcher, while becoming an active member of the activities (Junker, 1960; Lewins, 1992). I participated in the activities of each community that I visited, for one, two or three days-depending on the logistical conditions on site. Tools that assisted me in semi-structured interviews to generate discussions on the use of freshwater resources were canoe trips and area walks. I participated in fishing with nets, line and mosquito nets. I helped the fish monitors to weigh and record fish catches. I also helped preparing the fish for consumption with the women of the households. I made sure to get into contact with people who sell or buy fish on the streets, or to find out from 'town-dwellers' in Katima Mulilo how they are or have been connected to fishing in Caprivi. Many of the interviews thus took place in an informal and often unplanned manner alongside daily interactions with the local communities (De Walt & De Walt 2002). An interactive interview approach stimulated a deeper elaboration of the daily or seasonal fishing practices in a holistic and site-specific context. A local interpreter accompanied me to conduct the research in fishing communities. Only the interviews with English-literate conservancy staff could occur without the interpreter.

❖ **Semi-structured interviews**

To learn about opinions of the scientific knowledge group, I used semi-structured interviews in the form of in-depth conversations with the chosen key respondents. A number of key informant interviews took place with individuals with special knowledge and experience, relevant decision-making power or influence on the policy makers. These included members of the World Wide Fund for Nature (WWF) and the Namibian Nature Foundation (NNF), representatives of MFMR, and freshwater biologists from scientific knowledge institutions. Once again, I followed a list of topics to be covered in the interviews. In order to investigate what is a real concern to the interview participant, the questions remained open-ended and were flexibly adapted to the responses of the interviewees.

❖ **Literature study and secondary data sources**

In order to answer research question 3, but also to complete the overall picture of the local situation gained during field work, a literature study was done. Ministry documents, conservancy management plans, NGO project plans, environmental laws and experts' power point presentations were studied and sometimes complemented with internet-sourced information.

### *1.4.5. Methods for data analysis*

I prepared memos with the use of a voice recorder in the field in order to record observations, reflections and comments. I also documented occurrences photographically, given the respondents allowed me to do so. All interviews with scientific and local knowledge networks were captured with a voice recorder and transcribed on the same day.

In order to make a contextually specific analysis, I used an objective hermeneutic approach. This means that subjective and objective methods were used for analyzing interactions and their associated interpretations and consequences (Jennings, 2001). I combined a thematic content analysis (Hammersley & Atkinson, 2007; Green & Thorogood, 2009) and a situational analysis (van Velsen, 1964). For a thematic content analysis, I searched the field data to identify any recurrent patterns and information, which I grouped in themes. The knowledge axioms guided the organization of themes, and patterns became apparent in the form of conflicts and problems described by informants. The situational analysis approach then facilitated the connection of empirical data and theoretical interpretations. By entering various situations of the actor, the researcher can better understand actor's responses to certain social constraints and influences. I could thus interpret the responses of local fishing communities in the context of knowledge paradigm conflicts (van Velsen, 1964).

Finally, a simple content analysis of secondary data was used in the literature study.

### *1.4.6. Limitations*

I experienced several limitations in the course of data collection in both knowledge networks.

❖ **Local knowledge**

As in all social researches in which language barriers are bridged by an interpreter, the data is always subject to biases. The interpreter might have misunderstood my questions to the interviewees, the interviewees might have misunderstood the interpreter, and the same might have happened with the answers from the interviewees. The information has to pass several stages in which personal opinions and interpretation might enrich or impoverish the data. Nuances, symbols, body language, emotions- all of this might get lost through the passage of a third party. However, I cannot confirm that this limitation has biased the data from the respondents. I had no difficulties in bringing my points across through the interpreter and he appeared professional and confident.

A far greater limitation was to find fishers as respondents in areas where a lack of strict law enforcement favored illegal fishing activity. The selection of interview participants had to occur with the indunas/or conservancy managers of each community. I then often struggled to find fishers who volunteered to speak with me and show me how they fish. Most fishers were suspicious and thought that I am a spy for the government or that I belong to the ministry. This rumor spread quickly through the villages and most fishers left and hid, before the village chief/or conservancy manager could even convince them of my harmless intentions. Once a fisher's mind could be changed and I started the first interview, the fisher gained trust and helped me to reach further respondents.

- **Scientific knowledge**

I experienced similar hide-and seek scenarios in the scientific knowledge group. I had great difficulties in reaching ministry officials. MFRM staff made several appointments with me, but I generally found empty offices at the scheduled meeting times. I continued visiting the offices or calling the officials at least every second day, but I seldom reached anyone who had time to talk to me. Only on my very last day in Caprivi, when once again I was turned down by the chosen respondents, the fishery research technician volunteered to give me an interview.

Some of the scientific experts from NNF also hesitated to speak with me. It was explained to me that there is a surfeit of researchers and actors with interests in the fishery in Caprivi, and that the local communities would currently be subject to many different projects, researches and initiatives. Many stakeholders pulling on many different ends would confuse the fishers and thus threaten NNFs' plans for the fishery co-management. Fortunately, I found two scientific experts who did not share this opinion and agreed to be interviewed.

# Chapter 2-

# Historical background

## 2.1. Conservancies in Namibia

Until about two decades ago, NRM in Namibia was a representative example of conventional centralized management controlled through strict top-down law enforcement within clearly demarcated protected areas (Boudreaux, 2010). Convinced that the preservationist way is the best way to secure natural resources, it was long supported by international policies, conservation standards, environmental NGOs and scientific experts (De Vette, unpublished data). Over time however, this strategy proved more and more unsustainable in most rural settings in developing countries. Too many conflicting interests of various actors hampered the attempts to protect large areas from exploitation by rural settlements (COFAD, 2002).

In recognition of the shortcomings of this ideology, the notion of community involvement in local conservation was raised in the 1990s (Boudreaux, 2010). The idea was that decisions about NRM should be made by the people who are most dependent on them. It was not long until various international agreements supported the establishment of so-called Community-Based Natural Resource Management (CBNRM) projects all over the world. The Brundtland Commission (WCED, 1987) and the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro were the first international initiatives which encouraged community-based wildlife management in Namibia (UNCED, 1992). As formulated in the Agenda 21, development interventions in rural environments must address complex economic, social and cultural relationships. Furthermore, unique indigenous and traditional management systems must be recognized as important determinants for the use of resources (COFAD GmbH, 2002). Another influential legislation which led to the establishment of CBNRM projects was The Convention on International Trade of Endangered species (CITES). Under the heading 'sustainable development', the goals of environmental policies following the Earth Summit stimulate government decentralization, devolution of responsibility for natural resources to local communities and community participation. The motivations for investing into decentralized decision making were among others cost-savings, improved access to local knowledge and practices, donor influences and civil and societal calls for more political participation opportunities for marginalized communities (Boudreaux, 2010).

In 1992, the post-independence Namibian government drafted the 'Policy on the Establishment of Conservancies'. The conservancy model is based on the idea that local communities receive certain rights over natural resources and wildlife in their communal area. By protecting wildlife, forests, and freshwater ecosystems for now and for future, local communities within conservancies engage in NRM by and for the benefit of the local people (Boudreaux, 2010). The core area of conservancies is set aside for wildlife and tourism, and settlements and farming activities are only found along the periphery of communal areas

(Purvis, 2002). The conservancy model was introduced to Namibia to address two policy concerns: rural development and environmental protection. On the one hand, civil war, drought and socio-political instability have led to the negligence and severe losses of wildlife in the 1970s and 1980s. Secondly, rural communities in Namibia were poor and not benefitting from entrepreneurial opportunities associated with wildlife and eco-tourism (Boudreaux, 2010).

In 1993, the project run by WWF 'Living in a Finite Environment (LIFE)', was initiated with funding from the United States Agency for International Development (USAID) (Hoole, 2010). In 1995, a 'Policy on Wildlife Management, Utilization, and Tourism in Communal Areas' supported the creation of community-level conservancies. These policies were put into effect by the Natural Conservation Amendment Act in 1996 (GON, 1996). This act clearly defined that financial and economic benefits only reaches these communities that legally register as a communal conservancy (Boudreaux, 2010). In order to support the establishment of conservancies, the national CBNRM coordinating body IRDNC was launched in 1998 (NACSO, 2011).

The conservancy program in Namibia is globally recognized as one of the leading case examples of legal empowerment of the poor. It has uplifted human capital and increased wildlife numbers at the same time (Boudreaux, 2010). Up to date over 59 conservancies and 29 joint–venture tourism agreements have been established in Namibia; some benefitting more, others less from wildlife and natural resources (Jones, 2003; NACSO, 2011). While the income to conservancies through consumptive and non-consumptive use of wildlife has increased from N$ 600,000 in 1998 to N$ 35.02 million in 2009, these financial benefits are not always equally distributed (NACSO, 2011). It is recognized that further efforts need to be invested into delivering benefits to the poorest households and the ones which suffer most from human-wildlife conflicts.

The conservancy model is based on the principles of Common Property Regime, co-management, collective action, community management, joint management and participatory management. In practice, it entails the collaborative effort of government, NGOs and local communities to manage biodiversity on communal areas in a sustainable manner (Stuart-Hill et al., 2005). In reality, several flaws in the conservancy model inhibit the potential of this CBNRM strategy to stimulate local empowerment. Criticism has been raised that the devolution of decision and management power for conservancies is incomplete (Boudreaux, 2010). Major obstacles for the conservancy model to deliver the expected successes are twofold: Firstly, the land tenure system in Namibia is insecure and property rights and land ownership are not always well defined (Boudreaux, 2010). The state owns communal areas in Namibia and the function of local communities is limited to one of custodians over land and resources (Jones, 2003; De Vette, unpublished data). Secondly, the legal rights over wildlife and natural resources by local resource managers are still very limited (Boudreaux, 2010). The management rights for conservancies are only conditional and the government maintains a level of steering control. A community has to meet certain requirements in order to register as a conservancy. One precondition is the establishment of an institution, which is drawn up with guidance from exogenous agents. Furthermore, MET holds the legal power to withdraw conservancy rights again under circumstances which are only vaguely described in the conservancy act (Jones, 2003).

In order to increase transparency and accountability in the governance of natural resources, there is still a significant need to build local capacity in the context of conservancy management (Boudreaux, 2010).

## 2.2. Fishery in Caprivi

### *2.2.1. Environmental conditions*

The floodplain in Caprivi is a complex ecosystem which comprises main channels and seasonal backwaters of the Chobe, Kwando, Linyanti and Zambezi rivers. With more than 80 species, these rivers are high in fish diversity. Lake Liambezi, situated between the Linyanti and the Chobe River in eastern Caprivi, supports important fish stocks since it has refilled in 2009 after a dry spell longer than twenty years (Tweddle, 2009). The productivity of the floodplain fisheries, including species composition, abundance and distribution are dependent on seasonal flooding patterns (Næsje et al., 2002; Jul-Larsen et al., 2003; Tweddle, 2009). The lifecycle of many indigenous fish coincide with the flooding period in winter. When the water spills over the main river channels, primary production flourishes on the shallow banks. Adult fish feed and lay eggs in the floodplains. Together with the emerged young, they either re-join the main channel with the retreating floodwater or they remain trapped in seasonal water bodies (Abbott & Campbell, 2009). These distinct seasonal conditions strongly influence the temporal and spatial management of the fishery, which is one of the most relevant livelihood activities in Caprivi (Purvis, 2002; Abbott et al., 2007; Tweddle, 2009).

### *2.2.2. Resource use patterns*

The local fishery management constitutes two broad groups: vendors and fishers (Tweddle, 2009). However, subsistence and commercial activities are often difficult to separate and to most local communities fish has consumption and commodity value at the same time (Purvis, 2002; Abbott et al., 2007). Fishing also seldom constitutes the only livelihood activity for a household in Caprivi. It is a season-dependent income source and varies in its intensity and technical application. The fishers use a range of unsophisticated gears to target a multi-species resource in this complex environment (Purvis, 2002). In the main river channels, drag nets and gill nets are the most commonly used fishing gears, operated by men in traditional canoes (*mokoros*). During flooding season, fishers can also use a variety of traditional gears, such as baskets, funnels and fences. These forms of fishing are more simple and passive and they can also be operated by women and children in Caprivi (Purvis, 2002). In response to a growing demand for fish, small-scale commerce and fish vending has commenced in the town of Katima Mulilo in the 1950s (Abbott et al., 2007). Fish supply and market demand are highly variable in time, due to environmental and socioeconomic constraints and influences. In order to prepare themselves for this uncertainty, fishers can choose between selling fresh fish and drying it (Abbott et al., 2007). Many of the fishing

enterprises are kin-based and marginal and most market vendors are married females (Abbott et al., 2007). Fishermen who supply their wives to sell at the market switch their livelihood activity when fishing is not optimal or when farming practices prove more efficient (Purvis, 2002).

### *2.2.3. Current management structure*

Land tenure on the floodplains in Caprivi is mainly communal; a large percentage of it in the form of conservancy area (Purvis, 2002). The local management of fisheries is only one aspect of a broad NRM system in Caprivi. It is partly based on state-enforced regulations, and partly on informal traditional structures. Distributing access to the fishery by traditional systems still occurs, but is severely weakened since the introduction of fishery regulations. Laws may be enforced in theory by the Traditional Authority (TA) and community fishing committees of the respective fishing village, but in practice this occurs only sporadically (Tweddle, 2009). The technical and ecological elements which shape the existing system are for example seasonality, gear and skills, availability of material, site accessibility, and the opportunities for alternative livelihood activities (Purvis, 2002). However, there are still social and cultural institutions which are firmly grounded in this informal fishery management (Purvis, 2002; Tweddle, 2009). Although these have shown to restrict resource exploitation and evidently supported the conservation of freshwater resources in various ways, scientific experts express concerns about the strength of such informal management practices. External forces such as commercialization, population increase, and a growing need for cash income increase the pressure on fish resources and weaken local and social institutions or change situational inadvertent management practices (Purvis, 2002).

The fishery in the Zambezi/ Chobe floodplain is currently poorly formalized, but a variety of site, season and gear restrictions are being developed and introduced by MFRM (Abbott et al., 2007). In accordance with scientific expert advice, the focus is on controlling catch input and effort. The Namibia Inland Fisheries Resources Act (2003) prohibits destructive active fishing methods, drag nets and gill nets below a certain mesh size and exceeding a certain length (Tweddle, 2009). The amount of nets that any one fisher can operate may not exceed the number of four. This is controlled through licensing and the distribution of permits to local fisher folk by MFMR (MFMR research technician, pers. comm., 2012). The compliance with these regulations by local resource users is limited and the enforcement inconsistent and erratic, as the resources and infrastructure to patrol the floodplains is missing (Abbott, pers. comm., 2012; Hay, pers. comm., 2012, MFRM research technician, pers. comm., 2012). The shared nature of the transboundary freshwater resources complicates the matter further. The economic and environmental importance of freshwater resources attracts a variety of different stakeholders. Conflicts arise between households, vendors, conservancies, TAs, the tourism industry in Zambia, Namibia and Botswana, MFMR, Zambia Department of Fisheries, WWF in Namibia, NNF; all of which maintain different goals, interests and rules of the game (Tweddle, 2009).

### *2.2.4. Integrated Management of Zambezi/Chobe River System Project*

In order to incorporate the needs and wishes of all stakeholders, while at the same time stimulating a decentralization process, the Namibian inland fishery management strives towards co-operation with neighboring states, regional and international NGOs, the Namibian government and local communities in a co-management system of shared fisheries (Tweddle, 2009). Co-management has been defined more generally by many authors as a 'partnership arrangement using the capacities and interests of the local fishers and the community, complemented by the ability of government to provide enabling legislation, enforcement and conflict resolution, and other assistance' (In Hoggarth et al., 1999). In the case of Caprivi, the term co-management describes the collaborative management of freshwater resources between the countries of all three river systems, which are namely Angola, Namibia, Botswana and Zambia (Purvis, 2002). At the same time, NNF and MFRM are seeking for more affordable and sustainable management strategies for which community involvement is considered the key (Abbott, pers. comm., 2012; Hay, pers. comm., 2012, MFRM research technician, pers. comm., 2012).

With this in mind, the Integrated Management of Zambezi/Chobe River System Project was initiated by WWF, NNF and MFRM. With guidance from NNF and MFMR through the project, local communities will be assisted in drawing up their own localized regulations for ratification under the Namibia Inland Fisheries Resources Act (2003). Like in the case of wildlife and forest management, freshwater resources should eventually fall under the conservancies act, empowering the local communities to manage it independently (NNF, unpublished data).

The activities of MFRM and NNF in Caprivi through the fishery project focus on biological surveys of fish stocks. The importance of including local communities in fish monitoring is being recognized and NNF and the ministry have a variety of monitoring projects in place to collect so-called 'fishery dependent' data: Selected community members are appointed as fish monitors by the ministry, in conservancies and areas in which Fish Protected Areas (FPAs) are being established (NACSO, 2011). FPAs are sanctuaries for fish to breed and nurse young in, without being disturbed by fishing activities. Fish monitors are responsible for monitoring and controlling access to the FPAs. Furthermore they are tasked to record fishing effort and catch trends of the fishers in other areas of the conservancies. They fill in data sheets with information about fish catches and gear used, which are regularly collected by MFRM. Fish monitors are employed by NNF, but not MFRM, and they are thus not allowed to enforce fishery regulations. In areas outside conservancies and FPAs, ministry staff patrols fish landing sites to record the same type of data, and to hand out fines or confiscate illegal fishing gear (Abbott, pers. comm., 2012). Moreover, a market survey exists in which MFRM records fish diversity, market prices and length and weight of fish from the vendors and fishers (Abbott, pers. comm., 2012).

## 2.3. Community committees

Each conservancy and each fishing village has to form a community-representative committee. A conservancy committee consists of a number of elected community members- typically a chairman, a manager, a few representatives of the TA of the village, a secretary, a treasurer, an enterprise development officer, a field officer, community rangers and natural resource monitors. These form the decision-making body of the community, acting on behalf of all registered members. Their functions and goals are determined in conservancy institutions which were drawn up in collaboration with the Ministry of Environment and Tourism (MET). The conservancy committees report to MET on all internal processes (MET, 2008). Fishery village committees are established in villages outside conservancies. They fulfill a similar function in managing the sustainability of specifically fish resources. They report to MFRM, but have a more lose structure, and no constitutions (MFRM research technician, pers. comm., 2012). Conservancy committees or fishing committee members are local people with local knowledge and skills, who work in close cooperation with several scientific institutions, researchers, NGOs, state bodies and donor agents. Their influence on community representatives and consequently on the entire local knowledge network is considerably strong (De Vette et al., 2012), as will be displayed in the context of this study.

# Chapter 3-

# Interests and positions of actors

The purpose of this chapter is to identify culture-based axioms and interests in the local and the scientific knowledge spaces in the three phases of fishery management: knowledge construction, prioritizing and methodologies.

## 3.1. Local knowledge network

The local knowledge network in this study is represented by subsistence and commercial fishers, by vendors and by local community representatives in conservancy and fishing village committees.

The inland fishery in Caprivi is characterised by several hundred fishing communities with mainly male fishers. The most pronounced trait of fisher's knowledge in Caprivi's floodplain is the highly flexible and dynamic nature, which is reflected in the diverse management systems that have developed in response to different socio-economic, political and environmental forces. Most fishers are subsistence and they use simple gear to supply the needs for household consumption. However, small quantities of fish are also sold by most fishers to the market in Katima Mulilo (Purvis, 2002). The income generated from fishing generally serves to meet the basic needs such as food, clothing and school fees. This small-scale commercial focus of fish exploitation varies in intensity between the different communities, depending on factors such as migrations, alternative livelihood opportunities, or market structures, for example. However, no commercial fishing with significant financial surplus takes place along the Chobe and the Zambezi River or inside communal conservancies (Tweddle, 2009). Fishers in conservancies have to meet stricter mandates for fish conservation than fishers in other communal areas. As formulated in conservancy management plans, conservancy committees pursue goals for the sustainable management of the diversity of fish resources (NACSO, 2011). In Kasika, Impalila and Sikunga conservancies, in which FPAs are currently established, the ministry appointed additional fish monitors who control the exploitation of fish. Two fish monitors in each case are paid and supervised by NNF to monitor the local fishers, weigh and count catches, record species and the type of fishing gear that was used (Hay, pers. comm., 2012).

In contrast to the subsistence form of resource use, a few fully commercial operations have developed in highly productive areas, such as Lake Liambezi (fig. 4). Although independent fishing villages have village fishery committees in place to manage for sustainability and to control access to the resources, the committees' interests are often economically driven (Tweddle, 2009). Lake Liambezi has only filled up after major floods ten years ago, and currently supports plenty of fish species with a high market value, such as *Tilapia rendalli, Oreochromis andersonii* and *Serranochromis robustus*. Communities like Lusu and Muyako

have readily adopted management strategies to exploit the economic value of mainly cichlids (Tweddle, 2009; Hay, pers. comm., 2012).

**Figure 4:** Commercial fishery in Lusu village

The trade of fresh and dry fish is an important income source for many households in Caprivi; particularly those who have few other natural resources at their disposal (Purvis, 2002). Most trade activity occurs through the largest and most central Ngweze market in Katima Mulilo. However, due to physical proximity, vendors from Impalila and Kasika conservancies sell fish at the market in Kasane, Botswana. Of all Namibian vendors 96% are female (Abbott et al., 2007b). Women are only marginally involved in actual fishing and, at the most, they may aid in providing protein to the family by fishing small fish with mosquito nets (Abbott et al., 2007b).

Despite the various differences in the lives of fishers, vendors and community representatives, they are all local people operating within the local knowledge space; constructing, prioritizing and applying knowledge based on culture-based axioms that address local realities. Within the local network, a distinction between fisher folk and conservancy and fishing village representatives can be made, as the latter group directly reports and communicates with the scientific network on behalf of the rest of the community. A difference in the way community committees construct, prioritize and put knowledge into action is seemingly due to the groups' constant need to adapt, grow and develop according to scientific knowledge networks' wishes and standards. Accordingly, the most pronounced local knowledge axioms that could be identified among conservancy staff were the dynamic and the innovative ones. These local skills are to the advantage of the scientific network and used in cooperation with MFRM, IRDNC, WWF and NNF, in the pursuit of a dynamic and innovative transboundary co-management of Caprivi's fishery (Tweddle, 2009).

### *3.1.1. Knowledge construction*

In constructing knowledge, local resource users draw from mainly qualitative observations of the natural environment. An observer assumes a relation between himself or herself and the subject of observation. Upon this assumption, culture-based values, norms and standards regarding the natural environment develop (Aikenhead & Ogawa, 2007). In Caprivi, several local knowledge axioms shape the way freshwater resources are valued by local resource users.

Similarly to many local knowledge networks worldwide (Michell, 2005), Caprivi's local fisher folk believes that certain animals and plants have powers for the health and survival of the family and community. Indigenous thought assumes a relationship between all elements in the natural environment, which influence each other on one level (Aikenhead & Ogawa, 2007). The interviewees for example described that catfish (*Clarias spp*) and some breams (*Tilapia spp*) are considered as *"healthy food for body and mind"* (Sikunga, 30.03.2012; Impalila, 12.04.2012). Especially women and elderly people showed sensitivity to the connection between fish consumption and the physical well-being, such as described by a vendor, wife and mother in Impalila:

*"Mbufu and bubblefish are light on our bodies and for our spirits. It's very good for us. We can always eat it and we will never get tired of it" (Impalila, 13.04.2012).*

While the demand for fish in Caprivi has increased, the popular fish species have never changed during the regions' fishing history (Sikunga, 30.03.2012; Impalila, 12.04.2012; Mayuni, 5.06.2012). All interviewees of the local knowledge network named the tilapia species and the catfish as the most valued fish. Remarkable was that the locally most valued species are coincidentally the ones that are perceived as the most abundant ones in all villages. This is somehow different in western societies in which *rare* is equivalent to *special* and more *precious*. It indicates that not quantity, but reliability in sustaining local communities is the important criterion for a better life in direct dependency on the natural resources. It let's assume that Michell's assumption (2005) that indigenous knowledge revolves around ensuring the communities' survival is also priority in local fishery management. Like most local informants, a subsistence fisher in Mayuni expresses optimism about this goal:

*"There is plenty of fish; there will always be enough to feed us, and for some income to pay our children's school fees" (Mayuni, 5.06.2012).*

Being mainly concerned with meeting the major requirements for family survival, this overall perception of the freshwater resources is satisfying, and most subsistence fishers claimed to have "*everything we need" (Impalila, 11.04.2012)*.

In addition to criteria related to reliability, economic value and taste, I could clearly identify the monist belief influencing the valuation and use patterns of fish by local fisher folk. Vendors in conservancies described eating fish as bringing a feeling of *"…complete satisfaction and relaxation. There is no better feeling in the world then satisfying my body with a tasty mbufu and then lying down under a tree to digest. This is a feeling that beef could never bring to us" (Sikunga, 29.03.2012).*

Ultimate contentment of local people thus seems to depend on the satisfaction of basic needs in the form of mental and physical requirements (Aikenhead & Ogawa, 2007). This way of valuing fish is based on the assumption that a connection of the physical, mental and spiritual level exists in the local reality. Viewing all separate elements that make up the fishery in Caprivi in an interrelated and interacting way also indicates the presence of the holistic axiom. Several fishers describe how the particulars of the natural environment are seen in relation to the whole:

*"The diverse vegetation in the floodplains provides endless refuge opportunities for the fish. The occurrence of birds or certain plant cover can give us an indication of where the fish*

*could be" (Impalila, 13.04.2012). "Water lilies for example are eaten by mbufu and they provide shelter for all kinds of fish. We then depend on the king fishers and the fish eagles to show us where we find fish" (Lusu, 8.05.2012).*

Although interviewed fishers are unfamiliar with the scientific concept of 'biodiversity', culture-based paradigms highlighting the relation between all abiotic and biotic components in the ecosystem lead to an astonishingly similar way of holistic appreciation (Warren, 1991). Knowing the natural environment holistically is reflected in symbols such as birds and plants (fig.6), which are highly respected in the local knowledge network (Sikunga, 30.03.2012; Impalila, 12.04.2012; Kasika, 15.04.2012; Mayuni, 5.06.2012).

The local ways of knowing and valuing natural resources develops through direct experiences in the local environment (Barnhardt & Kawagley, 2005). The importance of natural diversity for the functioning of the world around local resource users is recognized and constantly put to the test through experimental learning (Barnhardt & Kawagley, 2005). In their daily engagement in fishing, fisher folk observe fish movement and learn about feeding and breeding habits of a variety of species. This results in place-based knowledge that is grounded on empirical data. I was amazed when a group of fishers led me through the floodplains in Mayuni, and confidently showed me where feeding fish schools can be found when the floodwater is high. They pointed to white areas of exposed rocks, which attract the fish through its high mineral content. The grass in these areas was indeed more heavily grazed by fish, when compared to the surrounding sites (fig. 5).

**Figure 5:** Local knowledge of fish feeding grounds

An elderly fisher in Impalila with four decades of experience in fishing is certain:

*"Everything here is connected in some or the other way. The knowledge of the rivers and the floodplains makes us experts on our own grounds" (Impalila, 13.04.2012).*

The dynamic nature of local knowledge is shown in the adaptive form of the fishery livelihood. Fishers in Caprivi are used to drastic circular changes in seasonal floodwater patterns and fish abundances; conditions to which they respond readily by switching fishing methods and strategies (Purvis, 2002). Fishers refrain to trial-and-error to test and adapt different fishing activities in order to improve local efficiency and feasibility (Sikunga, 30.03.2012; Impalila, 12.04.2012; Mayuni, 5.06.2012).

In summer periods, the floodplains are dry and subsistence fishers in conservancies need to either fish in the main channel or switch to an alternative livelihood activity. Fishers thus consider themselves '*fishers'* only for a certain period of the year, but '*farmers'* during others. Conversely, in daily interactions with town-dwellers in Katima Mulilo, I ascertained that male teachers, policemen, accountants or local ministry staffs all refer to themselves as '*traditional fishers'*. Almost every man in the rural setting in Caprivi grows up learning how to fish, and still engages in fishing when visiting the home villages. The holistic nature of local knowledge thus shows in the way the network refrains from categorizing ways of living. This was expressed in the following statements by local people:

*"We are all fishermen" (Teacher at Bukalo Secondary School, pers. comm., 2012).*

*"We are not just vendors. We are mothers, wives, community members and farmers" (Sikunga, 29.03.2012).*

In this holistic way of interacting with the environment, local people obtain information that is systemically empirical. It captures the wide variety of natural and socio-economic fluxes, without being biased by experimental manipulation; such as the data on changes in traded fish diversity, abundances and quality obtained by vendors through daily activities on Caprivi's fish market. Based on such kind of data, interviewed vendors can for example make the meaningful assessment that there has been no apparent change in the diversity, amounts or the sizes and qualities of fish, supplied from local fishers to the market over the last twenty years (Ngweze market, 3.04.2012).

Systemically empirical data serves to build up meaning and momentum of local knowledge within the network. The local perception of rationality in local knowledge spaces then influences how local resource users build argumentations in order to make them culturally-based valid. In this way, fishers, vendors and community representatives initially question and challenge any development or strategies on its feasibility to meet local priorities. Whether new technologies or ideas are considered valid or invalid is decided on the basis of locally specific conditions. Using a motor boat for example may protect the fishers from animal attacks, but it reduces the likelihood of catching fish due to noise pollution. Furthermore, in the eyes of interviewed fishers, it is not sensible to adapt expensive fishing methods, which prove locally unsustainable (Sikunga, 30.03.2012; Impalila, 12.04.2012). A subsistence fisher in Impalila urges to maintain traditions for the sake of local sustainability:

*"We must continue to pass on the traditional fishing practices, even though we are not allowed to use them anymore. We cannot adopt all the methods from the 'Makuas'* (white people). *We must keep some of our own methods; cheap methods appropriate for a life in dependency and good use of local material, such as reeds" (Impalila, 12.04.2012).*

Upon data which is rationally determined as culture-based valid, fisher folk may predict fish stocks. According to all local respondents, the species composition in the floodplains and the main river channels varies slightly with the seasons. Viewed from a long-term perspective, however, fish composition and species diversity has not changed. The systemically empirical data is collected over a long time period in recognition of circular patterns in nature. According to the predictions of vendors, depressions of fish supply are solely accounted to strong winds or full moon in the previous nights or to bad seasons, but not to overfishing (Sikunga, 29.03.2012; Ngweze market, 3.04.2012). Trusting in the circular time that underlies natural processes leads to a trust in the overall stability of the fish

resource, which is reflected in the most frequent phrase from local people: *"Fish never finishes".* Natural fluctuations are thus never recognized as an abnormal process, or accounted to global warming and climate change. In fact, these terms are unheard of by fisher folk (Sikunga, 30.03.2012; Impalila, 12.04.2012; Lusese, 25.04.2012; Mayuni, 5.06.2012.

Despite the uncertainty that natural flux brings to the livelihood security, local fishers describe feeling *"wealthy and content" (Kasika, 14.04.2012)*. This highlights the ability of local communities to cope with mystery and the unknown in their daily lives. The mystery axiom acts on the manner Caprivi's fishers give significance to unavoidable local realities. Day by day, they have to live with the dangers of crocodiles and hippopotamus in the floodplains. Often, canoes are being flipped over by hippos and fishers injured through bites and kicks from wild animals. Deaths are reported especially often in the main river channels, where animal densities are particularly high. Despite this constant threat fishers are facing, they do not let it carry their days. Interviewed fishers simply smiled placidly when asked how they cope with the danger, and explained something in line with the statement: *"You just have to pray and trust" (Kasika, 18.04.2012).*

This attitude also once more suggests the monist belief in local knowledge construction. Often found in indigenous cultures is the belief that everything in the universe is alive, interacting and influenced by spiritual forces (Aikenhead & Ogawa, 2007). This becomes especially apparent in the belief in witchcraft and black magic in Caprivis' local knowledge network, which was further explained to me by a group of fishers in Kasika:

*"Many fishers in Caprivi make use of black magic (muti) and medicine in fishing. The difference between the two is that magic is used to impress and medicine is used to kill. Many people who have access to muti use it in order to make better catches" (Kasika, 15.04.2012).*

Alongside the pronounced belief in interactions between the spiritual and physical world, the ultimate power in NRM is commonly perceived to be on a higher level than the individual. The trust that the ecosystem itself or that god protects the fish resources is stronger than the impact of individual fishers could ever become. A fisher in Impalila expressed his deep faith in relation to his fishing activity:

*"God distributes the fish. One day He gives us only two, sometimes even none; but the next day He might give us ten. He knows what He is doing" (Impalila, 12.04.2012).*

The cultural significance of the monist belief may once again become manifested in symbols (fig.6), such as the ones named by community members in Lusese:

*"Crocodiles and hippos are our policemen" (Lusese, 25.05.2012).*

This statement further implies that the relational axiom influences local knowledge, as fishers regard people, animals and spirits as capable of communicating in the common goal to live and interact harmoniously.


**Figure 6:** Symbols of the local fishery management in Caprivi (water lily, king fisher, sausage tree, hippopotamus) (Heider, 2012)

While all the above traits of the local knowledge network indicate stable social and cultural institutions based on traditions, I could clearly establish that the dynamic nature of local knowledge can lead to changes in NRM approaches. Several kinds of adaptations to external political and economic influences were especially pronounced in interviews with commercial fishers, community representatives and vendors. These groups of interviewees displayed changing values and norms that consequently shape interests and methodologies in local fishery management. A general growth of market demand has been confirmed by all vendors in Caprivi. The external pressure on fish resources and the increase in economic value (Abbott et al., 2007b) leads to dynamic changes in the way local people perceive fish. In conservancies in which recreational angling forms an important source of income for example, tigerfish (*Hydrocynus vittatus*), as a common game species in the Zambezi region, was more recently added to the list of the most popular fish species (Sikunga, 30.03.2012; Impalila, 13.04.2012; Kasika 15.04.2012). A general wish for economic growth by committee staff in these conservancies was visible in the following statements:

*"More fish means more income for us" (Sikunga, 29.03.2012).*

*"We want more fish, in order to improve the recreational angling industry" (Impalila, 11.04.2012).*

Moreover, for many young vendors who only recently started in the trade business, fish has primarily economic value. In contrast to vendors aged 30 or older, several young informants on the Ngweze market could not tell the different fish species' names and tastes apart. Smiling slightly sheepishly, one said: *"Well, we just have to sell it" (Ngweze market, 3.04.2012).*

The economic focus leads to an instrumental valuation of the freshwater environment, and fish is primarily seen as a servant to human interests. This perception of nature is commonly found as part of the anthropocentrism in scientific knowledge networks (Aikenhead & Ogawa, 2007). In Lusu, sustainability management of fish merely becomes a tool to keep the market alive (Lusu, 9.05.2012). These economic aspirations are somehow contrasting to the opinions of most subsistence fishers in conservancies, who described an overall feeling of contentment regarding their simple lives as fishers (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 15.04.2012; Lusese, 25.04.2012). Stronger commercialisation of the fishery sector thus seems to change how values and perceptions of fish are constructed and transmitted within local groups.

### *3.1.2. Prioritization*

The interests of local resource users are locally-specific and culture-based, shaped by knowledge axioms in the local space. Local fisher folk predict natural, social and political developments in the light of a pursuit of harmonious and balanced interactions of the elements that interrelate in local realities (Aikenhead & Ogawa, 2007). This means in practice that priorities of the local network revolve around meeting the diverse needs which form the requirement for an integrated live in a fishing community.

As a reflection of the holistic perception of the world around them, local actors consider it important to protect not only fish, but also water birds, water lilies and reeds (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 14.04.2012; Mayuni, 5.06.2012). To do this, almost all interview respondents prioritize the control of illegal fishing activity by Zambians who use trawlers and drag nets that threaten the biodiversity of Caprivi's floodplains. Drag net fishing is known to have considerably destructive effects on fish stocks and water plants in freshwater systems worldwide (Tweddle, 2009; Abbott, pers. comm., 2012) and almost all interviewees fear that it may lead to a depletion of fish stocks in Caprivi one day. This prevailing concern was well summarized in the statement by Kasika's conservancy manager:

*"Zambians use drag nets, motor boats and black magic to extract large amounts of fish from the rivers. This is the real threat to river resources and needs to be monitored by the ministry; not us as the small-scale subsistence fishers" (Kasika, 16.04.2012).*

The statement above further implies the monist belief in the local knowledge space, which leads to a perceived threat of black magic to fish stocks in all villages. This was highlighted even more by a group of fishers in Sikunga:

*"People who have muti take out tons of fish at a time, while you sit with four or five fish in the net right next to theirs. They are likely to overfish and should be monitored" (Sikunga, 23.04.2012).*

Fish monitors and fish guards wish for a greater recognition of the destructive impacts of magic in fishing by MFRM (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 15.04.2012), and fish monitors in Impalila complained:

*"Magic is so difficult to keep in check; especially with the tools that MFRM gives to us" (Impalila, 11.04.2012).*

The holistic nature of local knowledge is once again mirrored in a pronounced wish of local community representatives to adopt integrated management approaches in fishery management. Conservancy and fishing village committees highlight the need to address local ways of living, ways of knowing and ways of managing fish. Only through the integration of the various environmental, political and social elements, fishery management can be made locally sustainable. Moreover, conservancy staff expressed the hope for a closed loop in NRM, accentuated by several complaints regarding the exploitation of fish resources by outside parties. Points of protests are for example that many recreational fishers, especially in Impalila and Kasika, enter the conservancies illegally, without paying angling fees to the communities. Moreover, it is considered insensible by local resource managers that conservancies have no legal rights to distribute fishing permits, and even more so, that fees for fishing permits flow to MFRM and not the conservancies (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 15.04.2012). The treasurer of Kasika conservancy criticizes:

*"It is not right that the ministry keeps the money that they get from our community members for fishing licenses for our fish. The money was generated on our land, from our resources and it should not leave the confines of the conservancy" (Kasika, 15.04.2012).*

A holistic way of observing the local conditions leads to a wish of community representatives for integrated knowledge sharing and transparency of all stakeholders on the fishery co-management platform, which was reflected in the interview with Kasika's conservancy manager:

*"The data that the fish monitors hand over to the ministry does not come back to us. This is not right. We should always know what is going on in the conservancy, and it should help us to manage" (Kasika, 14.04.2012).*

It was also frequently mentioned that tourist enterprises in Caprivi should be monitored more carefully by the government. Fishers find that recreational angling operators ill-treat the wetland ecosystem by uprooting water lilies and polluting the water in conservancies (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 15.04.2012). In Kasika, where particularly many touristic operators travel in the Chobe River, one fisher exclaimed:

*"We often find oil spills in the floodplains. We do not use motor boats, so it must be from the lodges. The oil kills our fish and it pollutes our drinking water. We despise this pollution. We are dependent on the resources of our land" (Kasika, 16.04.2012).*

These concerns show a distinct place-based analysis of local situations through place-based experiences. A situation gains meaning and local priority through emotions that evolve in response to a deep connection of fisher folk to the communities' place.

The overall perception of the state of the river resources in Caprivi was frequently summarized with the statement: *"Fish never finishes!"*. As a result of this positive assessment, the local knowledge network does not convey a need for drastic fishing restrictions or species conservation initiatives. Instead, interviewees in conservancies urge to develop and maintain a sustainable management system for fish resources in order to derive long-term benefits (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 15.04.2012; Lusese, 25.04.2012; Mayuni, 5.06.2012). This priority leads to a general acceptance of the planned FPAs in conservancy areas, for example in Impalila:

*"We really want the fish reserve here. When we set up the fish reserve, only recreational angling will be allowed in order to conserve the fish for future economic benefit" (Impalila, 11.04.2012).*

As seen in the statement above, the goal of sustainability management in fisheries is frequently driven by economic interests, which was especially obvious in interviews with vendors, commercial fishers and community representatives. Fishers in Lusu stated a wish for technical and economic improvement, and more efficient gear, such as drag nets and motor boats (Lusu, 8.05.2012). Currently, Lusu supplies fresh fish to Namibians and Zambians and dried fish to the Democratic Republic of Congo. All interviewed vendors in the village stated that the income does not satisfy them. Their greatest wish is posed to the government and concerns the assistance in developing a larger international market for the community:

*"We have seen how Zambia does it. They sell so much fish on the international market. We know that the demand is there, so why can't we participate in the international trade" (Lusu, 9.05.2012)?*

Alongside the economic growth in Caprivi, most informants in Lusu increasingly value fish for its market function. Species protection and nature conservation were well-known concepts in conservancies, but unfamiliar topics to Lusus' vendors and village committee, who showed no concern that too much pressure on fish could threaten the resources (Lusu, 8.05.2012). This was elaborated by the fishing village committee:

*"We would like an international market to set up a business opportunity; for this sustainable management of fish is necessary. But in principal, we are not concerned about the depletion of fish. There is plenty of it" (Lusu, 8.05.2012).*

This example shows that, under certain socio-political conditions, the prioritization of meeting basic livelihood needs can form into an aspiration for financial surplus. This somehow reflects an anthropocentric axiom in the interests of the local knowledge network. Valuing the natural environment for its instrumental function is commonly found in scientific networks (Aikenhead & Ogawa, 2007), and it was conveyed as an incentive for local communities to accept the conservancy model and FPAs in educational programmes and project descriptions (eg. UNDP, 2005; MET, 2008; MFMR, 2009; NACSO, 2011; MET policy on CBT, unpublished data; Website: IRDNC). A statement of Impalila's treasurer further supports the assumption that communication with the scientific network shapes local ideas:

*"Our main goal is to secure the economic value of the river. This is what NNF also wants for us by introducing the FPA to our conservancy" (Impalila, 11.04.2012).*

From a different perspective however, observing and valuing fish resources instrumentally may also reflect the mere wish of local fishers to live in balance and harmony with the natural resources for the purpose of survival, which is indicated in the statement below:

*"We wished everyone could just work together, to protect our natural resources. These constant fights and conflicts are very tiring. We just want to protect what we have; and we can show it to the tourists and get income through angling to make a living" (Impalila, 11.04.2012).*

Regarding the livelihood of fish trade, the priority of vendors in Impalila (12.04.2012) and Kasika conservancies (15.04.2012) is the wish for an own market on Namibian side. The respondents from other areas in Caprivi hope for lesser costs for market stalls and contributions that they need to pay for fishing licenses and conservancy management of the wetland (Sikunga, 29.03.2012; Ngweze market, 3.04.2012; Mayuni, 5.06.2012). All conservancy committees stated that they would like to receive the legal rights to distribute fishing licenses and permits for nets. Interests of subsistence fishers on the other hand are more modest and simple, and they revolve around the wish to meet household needs (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 15.04.2012; Lusese, 25.04.2012). An elderly fisher from the community in Kasika summarizes this well:

*"We just want to fish the way we used to, to feed our families. We don't understand all these restrictions" (Kasika, 15.04.2012).*

On top of this diversity of local priorities and wishes elaborated above, all of them additionally reflect the general desire for emancipation and independence of the local network in some way.

### *3.1.3. Methodologies*

Local methods in NRM are adapted to culture-based knowledge and skills and they aim at meeting local priorities. They often assume qualitative forms and are based on the holistic axiom or a belief in spiritual powers (Aikenhead & Ogawa, 2007), such as the widespread use of magic in African cultures (Kohnert, 1996). While western societies often judge magic as a superstition, the long term application of it in Caprivi's NRM management make it a culturally-based valid phenomena with culturally-perceived hand-tight consequences. Beliefs in spirits or magic can shape methodologies in local management of fish, such as in the examples described by a group of fishers in Sikunga:

*"Muti can serve to curse nets of other fishers and put a good spell on your own. It is widely believed that sleeping with your own daughter brings you better catches. Some other fishermen do not even hesitate to use medicine to eliminate competitors. Medicine is used by fishers to assign snakes, crocodiles and hippos to guard their fishing nets and to kill every person who comes near it. They may also send you snakes or rain and thunder to your home, to pay you revenge. All these strategies make fishers who have access to magic and medicine superior fishers. When you have access to muti, you are immune to others who try to defend themselves" (Sikunga, 23.04.2012).*

The monist belief is generally very prevalent in traditional strategies aimed at controlling human-wildlife conflicts in Caprivi. Local resource managers may use magic to call upon ancestral spirits and to assign them to protect crops and villages from wildlife (De Vette, unpublished data). Spiritual forces have also influenced problem animal management by fisher folk for centuries and the long history of perceived successful application in protecting the fishers make such practices culturally-based valid. Fishers in Lusu elaborated on one well-established traditional strategy in Caprivi's fishery:

*"In the river, you can refrain to magic to protect yourself. But if you don't have access to magic, you can also tie the seed pod from the sausage tree to the mokoro. This keeps the hippos away. It really works" (Lusu, 8.05.2012)!*

The local conviction that spirit, mind and the physical environment have interrelated functions is found manifested in the local knowledge network as symbols, such as in the example of the sausage tree (*Kigelia africana*) (fig.6). In line with this belief, the local network bases local methodologies on the trust that humans and all elements of the natural environment relate, communicate and interact. An experienced fisher in Impalila explains how these relations can influence fishing in practice:

*"Most importantly, a fisherman needs to be experienced in the mokoro and sensitive and composed enough to pick up the signals from the animals. They will give you clues, where you can and where you should not go" (Impalila, 13.04.2012).*

The statement above further demonstrates that it is of critical importance for the fishery livelihood to remain calm and collected. Being in harmony with the unknown is a level-headed attitude to deal with local conditions of volatility and it proves of major importance for the fisher folks' survival. In this acceptance and respect of nature's unpredictability, the mystery axiom becomes visible in the local knowledge space.

The influence of the holistic perception of the environment is especially apparent in local strategies to meet livelihood needs. The incompliance of fisher folk with state-regulated fishery laws shows that local realities of fisher folk cannot be seen in separation of political and environmental conditions. This latter point was criticized by a group of fishers in Sikunga:

**Figure 7:** Women fishing with mosquito nets (Heider, 2012)

*"We also have to make a living. In some cases the regulations are simply not compatible with our lives and we cannot comply with them" (Sikunga, 29.03.2012).*

The same becomes apparent in the reactions of vendors to incompliance with fishery regulations (Sikunga, 29.03.2012; Ngweze market, 3.04.2012; Kasika, 15.04.2012):

*"Not all fishermen care about the regulations. Some overfish by using illegal gear. We are being taught by the ministry that we shouldn't buy from them, but we often do it anyway. We also need to make a living" (Ngweze market, 3.04.2012).*

The ignorance of state-enforced restrictions of active fishing gears, such as in the case of formally prohibited mosquito net-fishing (fig.7), seems to lie firstly in the relevance and importance of these methodologies to fulfill local priorities; secondly, their long-term application successes in meeting these local priorities and thirdly in the disbelief of rectilinear prediction models which forecast a gradual resource decline, once again reflected in the local conviction: *"fish never finishes"!*

Based on such locally valid arguments, the local knowledge network builds up reasoning for or against methodologies in fishery management. This reflects the rationality in local decision-making, in which externally developed and suggested methodologies are critically assessed before being accepted or rejected. Although all interviewed fishers for example perceive ministry regulations that aim at a sustainable exploitation of fish as being important, field observations showed that fishers only comply with such regulations when they are logistically and financially able to do so. This was confirmed by the conservancy manager of Kasika:

*"Regulations are necessary, but they need to be sensible. We cannot pay 50 NS for a new net once a week, and then again 60 NS for transport to Katima Mulilo to get a license from the ministry" (Kasika, 14.04.2012).*

In a similar way, customary and traditional methodologies that have developed internally are critically evaluated on its relevance, purpose and sense by the local knowledge network. As suggested by Sambo & Woytek (2001), the decision of local communities to adopt or reject, or to adopt but change the conditions of methodologies in NRM is strongly influenced by the groups' skills, beliefs and interests as found rooted in their culture-based knowledge. In this way culture-based traditional beliefs and methods may show irrelevant one day. A single woman in her forties explained her struggle to care for herself and her parents in Impalila:

*"The reasons that women seldom actively engage in fishing is because men consider the duties of fishermen too dangerous and the steering of the mokoros too difficult for us. Here on this island of Impalila, there are not enough men and many of us are single ladies. We can only laugh about the dangers involved in fishing. We don't have men, so we don't have a choice, but to catch the fish ourselves" (Impalila, 11.04.2012).*

A dynamic change of local practices is also shown in the way fishers adapt fishing methods experimentally to environmental political and social conditions. Many of the traditional active and passive fishing methods are seen as inefficient, complicated and also dangerous in water bodies full of wild animals. An example of this is the fish fence (*siyandi*), a barrier gear made from reeds used in running water, which was still frequently used one generation ago (Purvis, 2002). The setup of the fish fence requires time-consuming group effort, and it also implies that the fishers are exposed to hippopotamus and crocodiles for a long and dangerous period of time. Another disadvantage is that the siyandi is stationary and cannot be moved flexibly in accordance to the movement of fish (Sikunga, 30.03.2012; Impalila, 12.04.2012). Today, all these disadvantages overrule community traditions and budget-friendliness, and the siyandi is only used when local fishers cannot pay for fishing nets or canoes (Sikunga, 29.03.2012; Impalila, 12.04.2012; Lusese, 25.04.2012). The most commonly used fishing gears in Caprivi are various types of gill-nets, which are operated from canoes (Purvis, 2002). The traditional canoes are locally known as *mokoros* (fig.8). They are hardwood logs ranging in size from two to six meters and are imported from Zambia (Purvis, 2002). Mokoros may be very durable, but the initial investment costs are quite considerable for a subsistence fishing household (Mayuni, 5.06.2012).

The findings of this study show that local fishing methods are constantly challenged by various influences, and that fishers consider all forms of internally and externally developed adjustment strategies, modern technologies and modified traditional methods in order to improve safety, costs and efficiency in fishing. An example of this is to retain the traditional

mokoros, but to replace the net material to a stable and easily accessible nylon twine (Purvis, 2002; Abbott, pers. comm., 2012). In the past, local fishers extracted string from vehicle tires, from which they tediously mended gill nets. The by now widely available Chinese, Japanese and Kafue-made net types in Caprivi have only advantages for the fishers. Young fishers hand the raw twine to former fishers who are too old to actively participate in fishing, to have a net mended (Impalila, 11.04.2012; Abbott, pers. comm., 2012). The development of hybrid fishing methods shows the ability of local communities to change the subsistence fishing sector innovatively and dynamically. The trial-and error strategy has accompanied fishing since its beginning, and its success in perfecting fishing methods has made it the most valid strategy in the local fishery management.

The acceptance of Western methods for NRM shows the nature and the magnitude of influence from the scientific knowledge network in local fishery management. Overly striving towards independency and emancipation, support and advice from scientific and state institutions remain appreciated and accepted in all conservancies. Especially conservancy committees value scientific guidance as esteemed and needed, such as shown in the statement by Kasika's and Sikunga's managers:

**Figure 8:** Traditional mokoros (Heider, 2012)

*"Most people here are still backward and behind. They don't understand why the conservancy is good for us. This is why we need experts to tell them. After being informed and educated by them, the community receives all the management power and will be the one who makes decisions in the end" (Kasika, 15.04.2012).*

*"We are happy with the tools of the ministry. They bring development to our community and they are appropriate for sustainable management of our resources. We need assistance and advice from the government and NNF" (Sikunga, 29.03.2012).*

MFRM is currently investing much time, effort and financial resources into an Aquaculture Development Project, for which fish farms shall be established at the main fishing villages in Caprivi (MFRM, 2009). In Lusu, all vendors and fishers like the idea of a fish farm, and are waiting impatiently for the project to arrive in the area:

*"We simply don't have the know-how for a fish farm. We don't know how to create natural patterns artificially that are important for the fishes' breeding and feeding in a pond. We need experts to instruct us" (Lusu, 9.05.2012).*

The striving for innovation leads to changes in local methodologies in fishery management. The dynamic form of the fish trade livelihood is apparent in the adaptations of vendors to externally-driven changes, market forces, and logistical difficulties. Women who do not catch

fish themselves order fish from fishers in advance. Until approximately five years ago, women had to travel cumbersomely from landing site to landing site to get hold of different fishers and their catches. These days, vendors and fishers simply communicate with cellphones (Sikunga, 30.03.2012). Wives of fishers are supplied with fish by their husbands; the others have to be flexible and responsive to availability from a variety of contacts. Vendors indicated that they have no preferences for certain suppliers, but that they buy fish from anyone who can provide it. A middle-aged vendor at the fish market in Katima explains why:

*"The demand for fish is high, and more and more women start in the trade business. We cannot afford to be picky" (Ngweze market, 3.04.2012).*

Changes are also apparent in practices related to sustainability management of fish, from small-scale compared to large-scale commercial operations. In subsistence terms, good daily catches vary between 20-100 fish, depending on the region that people fish in. Some of the fish is sold, and some is kept for own consumption. Whatever is left is dried for later consumption or for sale. Despite increasing economic forces on Caprivi's fish markets, small-scale vendors and subsistence fishers believe that they maintain a sensible and efficient resource use. Especially women of the households make sure that no fish is wasted, a finding that was emphasized by two female interview respondents in Lusese and Sikunga:

*"No fish ever goes to waste. When you do not have much, you also do not go around squandering it" (Lusese, 25.04.2012).'*

*"In the middle of the month, we often return with a lot of fish. But nothing goes to waste. We feed our family or we dry the fish" (Sikunga, 29.03.2012).*

In Lusu, fishers' daily catches may count up to 400 fish per fisher. Large amounts of fish need to be transported to the market in Katima Mulilo. Vendors and fishers explained that they have no cooled storage containers and that they have to take into account that fish may spoil on the way to the market. Currently, no local practices exist to manage this waste of natural resources (Lusu, 7.05.2012). This suggests that methodologies aiming at a sustainable fish management may change or even degrade in the face of economic influences.

In the view of almost all local respondents, financial aspirations and greed that shows at Lake Liambezi, could possibly take over any fishing community and lead to higher pressure on the resources. This threat is analyzed with rational argumentations, which leads to culturally-based valid intervention measures, shown for example in this explanation of an elderly fisherman:

*"Any fishing method, traditional or modern, can be destructive. It depends on the attitude of the operator. Some fishers understand that we need to fish sustainably, and others don't care. This is no different from all the other places in the world! We know from our fathers what sustainability means, but the choice is with the individual. For this, environmental education is important" (Kasika, 15.04.2012).*

Local management systems also have traditional institutions and methodologies in place to keep excess fishing in check. According to all interviewed fishers, Zambians are not welcome in the fishing territory in Caprivi. Zambians would not even be accepted on Namibian fishing

grounds if they would pay the conservancies or the indunas for it. Namibian fishers showed a deep sense of ownership within their communal areas, which in turn seem to result in strong social bonds within communities. This reflects the place-based paradigm in which a long history of local communities with the communal land leads to a deep connection to their home ranges. Although there are always exceptions, Namibian fishers described that there is a general mutual respect of each other's fishing gear and fishing locations (Sikunga, 29.03.2012; Kasika, 16.04.2012).

Interviewed vendors explained that there are cultural and social rules in place which restrict and shape resource use for women and men:

*"Muti makes the fish tasteless. We all know that and do not buy fish from the ominous fishers. We also try to live sincerely with the wishes of god. If you really believe in god and you go to church, you should not use or support magic. This does not go together" (Kasika, 15.04.2012).*

This devout lifestyle leads to a relational way of valuing life forms and an assumption that the interactions of mind, matter and spirits influence biological processes and human agency in the local reality. Harming one element will thus bring harm to all interrelated aspects of the community's lived reality. As seen in the example below, fish can form a cultural symbol for monist, holistic and relational methodologies in fishery management. A group of women described:

*"Here in Africa, we believe in witchcraft. Women are not allowed to eat mbufu when they have their period. They are also not allowed to eat nembwe or bubblefish when they are pregnant. You may not give ngenga to your mother in-law because it is considered an insult. When you are an epileptic, you may not eat tigerfish. You always see tigerfish leaping out of the water to catch small fish. They are so active; they would make your epileptic fits worse. During sabbath, we women are not allowed to eat or sell bubblefish, as a fish without scales" (Sikunga, 29.03.2012).*

These descriptions by interviewees are coherent with Warren's suggestion that stable cultural and social institutions can help in restricting resource use in common property regimes (Warren, 1991).

## 3.2. Scientific knowledge network

The scientific knowledge network in this study is represented by staff members from MFRM, the regional NGOs NNF, WWF and IRDNC, and individual fishery scientists from a range of knowledge institutions, such as universities in Namibia, Canada and South Africa.

MFMR is responsible for the freshwater resources in Caprivi and, as a body of the state, it bases management interventions on the Namibian Constitution (Article 95): 'The state shall actively promote and maintain the welfare of the people by adopting policies aimed at maintenance of ecosystems, essential ecological processes and biological diversity of Namibia, and utilization of living natural resources on a sustainable basis for all Namibians,

both present and future' (MFRM, 2009). MFMR is comprised of scientific expertise from disciplines such as resource management, policies, planning and economics (MFMR, 2009). They deliver 'professional service' to meet the following objectives: regulating sustainable management of inland fisheries, promoting aquaculture and the international expansion of the domestic fishing industry, the investment into human resource management to enhance Namibia's independency in managing fisheries, while playing an effective role in regional and international fisheries affairs (MFRM, 2009). These visions are tackled in cooperation with a variety of regionally active NGOs. Particularly well represented in NRM in Caprivi are the organisations NNF, WWF and IRDNC. NNF's mission is to protect biodiversity and ecosystems and to support the sustainable development and welfare of the local communities in Namibia. The roles of NNF in Caprivi's fishery are diverse and include the assistance of CBNRM and livelihood development, and river health and biodiversity protection initiatives. In various partnerships with other NGOs, private stakeholders, MFRM and project funders, NNF is the executant of the Integrated Management of the Zambezi/Chobe River System Project. This project also relies on a partnership with IRDNC, which supports local communities in the establishment and management of conservancies (Tweddle, 2009). The role of WWF Namibia is to assist in the development of CBNRM and monitoring systems in the context of local capacity building (Tweddle, 2009). As part of a broader NRM approach, WWF works with MFRM and NNF to develop a sustainable transboundary fishery management system in the setting of the fishery project (Tweddle, 2009). In order to fill in knowledge gaps for the fishery project, scientific advisors from universities are employed by NNF, MFRM or WWF. Through the intense engagement of a variety of stakeholders, the fishery project is majorly shaping a current re-structuring of Caprivi's fishery sector towards integrated and sustainable co-management, with a focus on community participation (Tweddle, 2009).

### *3.2.1. Knowledge construction*

In scientific knowledge spaces, the natural environment is typically viewed from an objective perspective, assuming that no relation between the observer and the phenomena under observation exists. Knowledge is then produced upon a more or less neutral and mathematical analysis, often resulting in quantified forms of knowledge (Aikenhead & Ogawa, 2007).

This presumption was supported in an interview with Richard Diggle from WWF (2012), who is one of the developers of resource monitoring tools for conservancies. He criticized that scientists generally try to transform local knowledge into more bureaucratic and formal language by quantifying and structuring it:

*"Scientists are disappointed in the data that WWF derives from local knowledge networks and delivers to scientific knowledge institutions. Most criticize it as insufficiently scientific and rigorous, and thus as inadequate in drawing up reliable prediction models or in planning intervention measures. We frequently get requests from scientists to adjust the data that local people collect, and to add criteria which may be useful to scientific studies, but totally irrelevant to local communities" (Diggle, pers. comm., 2012).*

The information that experts require in order to develop CBNRM methods, primarily exists in the local peoples' heads (Abbott, pers. comm., 2012). As scientist James Abbott believes *"…it needs to be captured in a different form to be useful in science" (Abbott, pers. comm., 2012).*

This attitude towards qualitative data of local resource users hints that supporting NGOs and scientists base their objectives in NRM on the scientific perception of nature as being *knowable*. In order to construct knowledge for fishery management in Caprivi, the scientific network draws upon local assistance to capture a diversity of information. Scientific opinion then holds that *"local knowledge and scientific language need to be aligned, in order to make the data accessible and understandable" (Abbott, pers. comm., 2012).* When asked for a definition of 'understandable' forms of data, fishery scientists and NGO staff named illustrated trends such as graphs and tables. This wish for quantification is closely connected to the scientific realism axiom, which becomes apparent when scientists construct a reality based on measurable units which can be perceived with human senses (Aikenhead & Ogawa, 2007). An example of this is the following assessment of the fishery sector by staff of MFRM:

*"According to demographic statistics, we have more and more fishermen here in Caprivi, which means that the fish populations will go down at one stage. Considering that we have an open access fishing system, we are pretty sure that the data we are collecting will show that fish populations have decreased and that they will continue to do so" (MFMR research technician, pers. comm., 2012).*

This shows how local situations are assessed on physically measurable criteria, upon which assumptions about a perceived problem are made and constructed as the undeniable reality. Dr. Clinton Hay, fishery scientist from NNF, is thus certain:

*"The threats to Caprivi's resources are twofold: fishing gear is available in abundance and more and more people come to Caprivi to use it. Money and overpopulation- these two factors are our problem" (Hay, pers. comm., 2012)!*

The belief that only quantified and measured risks are valid risks may justify or invalidate fishery regulations, and the realism in the scientific knowledge network may occasionally, though scarcely, work in favour of local interests. This was shown in an interview with Beaven Munali from the IRDNC resource management group:

*"Restrictions are a good tool to manage fish exploitation, but you need sufficient data to justify them. If the data shows that the resources are not depleting, it shall also be accepted that strict laws and restrictions are not essential" (Munali, pers. comm., 2012).*

In line with a wish for quantification and structure, the scientific way of planning intervention methods in NRM is based on measurable rectilinear time, with a determined start and end. Thinking and arguing along linear patterns seems to hold more predictive value for scientists and thus more validity and security in analysing resource use. Mr Abbott displays how such an argumentation can develop:

*"Actually, we have no idea whether the situation in the Zambezi and Chobe is alarming. There are scientists that advocate that you don't really have to manage fish and that declining populations will bounce back in circular fluxes. But most scientists predict that fish will be depleted in 10 years' time. Most of us see it is a shifting baseline syndrome-we expect*

*a slow gradual change which might only be discovered when it is too late" (Abbott, pers. comm., 2012).*

This statement indicates that a linear, rather than circular development of natural phenomena serves as the more valid parameter to construct knowledge about resource development and prioritize management interventions. Relying only on information that has predictive validity and which is visible to human senses shows the Cartesian dualism axiom in the scientific knowledge space. Science holds the conviction that knowledge of matter is clearly separate from elements that work on the mind, such as intuition and spirits. This leads to the disbelief of interviewees that the holistic and monist nature of local knowledge might hold a solution to NRM problems, which was displayed in the statement below:

*"We don't think that local resource users have a built-in sense for sustainability... Greed is probably taking over all human agencies at one stage" (Abbott, pers. comm., 2012).*

In a similar way, all scientific respondents raised doubts about the workings of black magic in fishing:

*"We have also heard of spells that fishers put on the nets, but we don't believe that these things work. It is probably just a lie" (MFRM research technician, pers. comm., 2012).*

Instead, the positivism axiom in the scientific knowledge network leads to the faith that scientific ideals, norms and standards hold the ultimate truth and solution to NRM. Under the strong influence of positivism, the ministry is committed to regulations that restrict resource use and seeks to maintain the ultimate control over local operations:

*"Without our restrictions, they would simply mess up the fish resources" (MFRM research technician, pers. comm., 2012).*

### *3.2.2. Prioritization*

Interests and priorities in science are often driven by the aspiration of actors for power and dominion over nature. In the attempt to explain how the universe functions, important is what carries a high predictive validity in proving or disproving paradigms (Aikenhead & Ogawa, 2007). This becomes clear in the interests that the scientific knowledge network upholds for the fishery management in Caprivi. The priorities of fishery scientists active in biological research in Caprivi are twofold:

*"We would like to fill in knowledge gaps of the biology and ecology of key fish species, such as the cichlids. Secondly, we want to establish predictive monitoring measures for the freshwater resources. The fishery here is booming and we need to keep exploitation levels in check" (Abbott, pers. comm., 2012).*

These goals reflect the scientific assumption that nature is knowable and that information can be collected as a mean to an end: Knowledge as a destination, forming the solution to struggles in NRM. At the same time it shows the predictive validity for patterns of resource use that science pursues.

Based on scientific norms and values, rules for the local management of fish are drawn up, which reveal even more scientific knowledge axioms. The goals of MFRM regarding the fishery management in Caprivi for example, can be analyzed in relation to the wish for order and structure. This was illustrated by the research technician from MFRM:

*"The entire fishery management needs re-structuring. All fish species are of significant importance and need a new form of managing and monitoring. Another aspect that we need to start managing is the hygiene in the fish trade. It is chaotic and unmanaged as yet" (MFMR research technician, pers. comm., 2012).*

All interview respondents implied that intervention measures for the fishery sector must primarily target the resource use patterns by the local network. The scientific knowledge network holds the opinion that the fishers themselves are the greatest threat to the rivers in Caprivi, shown in the statements below:

*"Locals think that fish never finishes. When we try to explain to them the importance of sustainability, they don't grasp it" (MFRM research technician, pers. comm., 2012).*

*"Through increasing numbers of fishermen in Caprivi, the numbers of fish on the market may easily explode to unmanageable dimensions. Most importantly, we must make sure that we keep track of the extent of resource exploitation" (Abbott, pers. comm., 2012).*

This priority shows the realism axiom in the way the scientific knowledge network expects the reality of Caprivi's fishery to be solely visible on a quantified dimension. The positivism in the accuracy of such scientific examinations of local realities then assigns momentum and meaning to priorities.

Prioritization of financial and technical assistance to local communities in the example of Caprivi's fishery often occurs upon criteria that are determined by external funding agencies. Causally arguing that the fundamental financial requirements for community support need to be met first, the priorities of NGOs are formalized. The Canadian scientist and Dominic Mwema from IRDNC explain:

*"Much of the locally-based resource monitoring is funded by tourist lodges that support recreational angling in conservancies. The data on fish resources needs to feed our local institutions to secure funding for the regional NGOs" (Abbott, pers. comm., 2012).*

*"We need to meet the obligations of donors and depend on locally-collected data from conservancies to show progresses in local management" (Mwema, pers. comm., 2012).*

In principal however, IRDNC staff considers the long-term monitoring of the fish stocks as the most important management measure, in order to capture the complex interactions of species with the environment:

*"The in depth- knowledge of the ecosystem must guide the management of the freshwater resources" (Mwema, pers. comm., 2012).*

Especially when scientists lack the financial or technical capacity to investigate matters on the ground, the systemically empirical data of local people becomes critically important (Munali, pers. comm., 2012). This was straightforwardly formulated by Mr. Abbott:

*"We are interested in records of daily catches of fishers. The data of local fishers gives us very cheap estimates for catch per unit effort" (Abbott, pers. comm., 2012).*

In this way, local knowledge has instrumental value and it becomes a tool to meet the interests of NGOs and scientists in the most cost-efficient manner. Furthermore, in an interview with MFRM it was made clear that local knowledge may serve to satisfy personal goals, while entirely lacking the consideration of local benefits and interests, such as in the following case:

*"The data that we collect from local fisher folk can be used for publishing scientific papers…" (MFRM research technician, pers. comm., 2012).*

Knowledge is thus seen as a destination. Even more, the 'possession' of it as an end product can serve to exhibit control and power over local communities, frequently to the disadvantage of community interests. This becomes particularly clear in the statement below:

*"…scientific papers, with which we can recommend closed seasons for fishing and restrict mesh size regulations a bit further" (MFRM research technician, pers. comm., 2012).*

Due to the NGO's striving to increase community emancipation in NRM, IRDNC's position to the existing fishery regulations is rather reserved. According to Mwema (pers. comm., 2012), the fishery management is regulated by the ministry and this often contradicts with the local empowerment process of the conservancy model (Mwema & Munali, pers. comm., 2012).
In the same context IRDNC highlights: *"We should not miss out on using the local knowledge as much as possible. An external expert with a Phd degree might be able to formalise concepts, but the ideas must come from the local people" (Mwema, pers. comm., 2012).*

In agreement with the local knowledge network, the scientific network critically observes the growth of the market exceeding local boundaries:

*"We don't really have a problem with the small-scale commerce on the local market. The problem is when outsiders catch, buy and sell fish in Namibian territory. This leads to overexploitation that is difficult to manage" (Hay, pers. comm., 2012).*

Such concerns regarding the development of resource use patterns in Caprivi leads to another priority of MFRM: to keep the commercialization of fish in check (MFRM research technician, pers. comm., 2012).

### *3.2.3. Methodologies*

Most distinguishably from local methodologies which enable local resource users to cope with the mystery and unpredictability in nature, scientific methods attempt to eliminate mystery by increasing predictive validity (Aikenhead & Ogawa, 2007). In order to establish knowledge about how the fishery sector functions, scientists are currently developing valid measures to predict the future of fish resources.

A prerequisite for predictive scientific methodologies seems to be a structured form. Scientists often refrain to reductionism, to bring order into complex knowledge databases. In Caprivi, several fish monitoring strategies are in place which reflects this structural approach.

Monthly surveys are conducted by MFRM on fish landing sites and in the FPAs. The surveys clearly distinguish between two kinds of data: independent data (collected by scientists) and dependent data (collected by fishers). The former kind is standardized and it shows the trends of catches based on the same fishing effort over many decades. The latter kind of data can by no means become standardized, as fishers flexibly adapt their fishing strategies to environmental and socio-political conditions (Abbott, pers. comm., 2012). By distinguishing dependent and independent data, the scientific network shows their awareness and also the incorporation of certain incompatibilities of local and scientific spaces:

*"There will always be different interests in the kind of data that scientists want and those locals want or need" (Hay, pers. comm., 2012).*

Another characteristic of scientifically-developed methodologies are that they are "*uniformly applicable (Abbott, pers. comm., 2012)"* in time and space. An example of this is the use of indicator species on regular fish market surveys in Katima Mulilo undertaken by MFRM. This kind of resource monitoring functions in the following manner:

*"Indicator species can help us to predict the future of fish stocks in Caprivi. When only small and least favoured fish species are being sold, then we know we have a problem" (Abbott, pers. comm., 2012).*

The nature of the scientifically-collected data already indicates the quantified, unified and predictive form that distinguishes it from data collected by fishers. By calling scientific data 'independent', scientists seem to make a statement about its 'neutral universal mean of accessing truth' and the power it gains as a result (Nader, 1996).

The order axiom becomes clear in the extensive debate over new or modified fishery regulations and amendment acts among the scientific knowledge network (Hay, pers. comm., 2012). Most interview respondents believe that *"without laws, the fisheries here would collapse" (MFRM research technician, pers. comm., 2012).* MFRM implies that the livelihood activities of local communities in Caprivi should follow ordered and predictive models which give better control over resource use patterns. Of importance to MFRM is thus the introduction of closed seasons into Caprivi's fishery:

*"With a closed season people will be forced to shift their livelihoods to farming. It will be good for the community. They must learn to plan ahead and to save up money and resources for bad times too" (MFRM research technician, pers. comm., 2012).*

To maintain order in the fishery management, state- empowered law enforcement is employed. This is essentially to the satisfaction of most scientific actors, displayed in the statement below:

*"Enforcement has an effect. People are intimidated and in response they refrain from using the destructive fishing gears" (MFRM research technician, pers. comm., 2012).*

Introducing formalized rules further implies that the scientific space is influenced by the quantification axiom when developing methodologies. This is shown in the example of regulations regarding the use of traditional fishing gears. The Namibian Inland Fisheries Resource Act of 2003 allows any traditional fishing method which does not involve dragging or drifting of nets (Tweddle, 2009). However, in order to use them, local fishers need to ask

MFRM for permission in a letter (MFRM research technician, pers. comm., 2012). This legal condition shows the wish for formal structure and bureaucratization of local knowledge. It appears that only in a structured form, scientific methodologies can accommodate local knowledge. Moreover, it indicates that the scientific network merely trusts in knowledge based on the Cartesian dualism- knowledge which adequately explains how the universe functions, instead of local knowledge about 'what the universe is' (Aikenhead & Ogawa, 2007). The statements by Mr. Diggle and Mr. Abbott below indicate that the accommodation of local knowledge in Caprivi's fishery management is restricted to the participation of local resource users in data collection.

*"We can use local knowledge of fishers in the triangulation of data. Whatever is important to conservancy management might also be relevant for NGOs, for researchers or for donors"* (*Diggle, pers. comm., 2012).*

*"We don't know much about floodplain dynamics and fish movement. We are trying to investigate this trough experience over time. Certainly, data of local fisher folk is very valuable for this" (Abbott, pers. comm., 2012).*

In this way, fishery scientists display an appreciation of the sheer instrumental value of local knowledge. These findings indicate that institutionalized local participation is not more than a scientific method in fishery co-management. Seemingly aware of the anthropocentrism in scientific methodologies, Mr. Abbott explains:

*"I suppose we are asking local fisher folk to measure certain things that might not be directly important to them, such as water temperature. I guess we could do it ourselves; but it is a lot easier and cheaper and it will benefit them in the long run. We do include local interests in scientific research: We buy nets in all mesh sizes for the fishers; they fish with it, keep the catches, and supply us with the data in turn" (Abbott, pers. comm., 2012).*

As a result of the overall scepticism about the ability of local resource users to manage the fishery sector independently, a selective screening of local knowledge occurs to extract the aspects that seem usable in scientific processes and practices:

*"Elderly people better understand the importance of sustainable fishing, as they have experienced declines of natural resources. This local knowledge could be used: Older generations should educate the younger ones and they should convince the indunas to enforce the fishery laws in their village" (MFRM research technician, pers. comm., 2012).*

In order to provide a formal platform for local participation in NRM, WWF has developed the event book system, which is a locally-based monitoring method for conservancies (Stuart-Hill, 2005; Danielsen et al., 2007). In the event book, local communities can freely decide which resources should be monitored within their conservancies. If a conservancy decides that fish requires more efficient management, the scientific knowledge network gives operational guidance by asking 'Why?', 'How?', 'When?' and 'Where?' monitoring should occur (Diggle, pers. comm., 2012). Mr. Diggle elaborates further:

*"This helps locals to keep a focus and it brings a rigour into their thinking. The way it should work is that fish guards record illegal fishing incidences over a month. At the end of the month all incidents are tallied up. This data then gets fed into a blue chart, which displays the*

*records over a year. At the end of the year, conservancy committees get together and sum up the blue charts" (Diggle, pers. comm., 2012).*

It is expected that formalised data in the event book system can lead to more concerted management strategies. Furthermore, the event book system is thought to make a positive contribution to local empowerment in conservancies (Mwema & Munali, pers. comm., 2012). IRDNC is very positive about the event book system in the use of local NRM:

*"The event book system makes truly adaptive management possible, as the locals can decide what is being monitored" (Mwema, pers. comm., 2012).*

In an attempt to maintain the adaptive nature of local management strategies, the event book system is constantly assessed and modified by the scientific knowledge network (Mwema, pers. comm., 2012).

At closer observation, the event book monitoring tool clearly reflects several of the scientific axioms. First of all, the mere wish for a formalised monitoring system for local fishery management mirrors the scientific tendency to quantify phenomena, which somehow increases the predictive validity of ecological data. Furthermore, a formal introduction of the event book system as a standard resource monitoring tool in conservancies indicates the aspiration for uniformitarianism. Reductionism is then apparent in the way natural resources, incidents and monitoring subjects are separated into categories. A wish for order and structure in NRM was once more highlighted by Mr. Diggle, who urges to keep biological data collection for scientific studies, and data collected for the purpose of local management clearly separate. He strongly advices *"not to interfere with a closed system in a conservancy" (Diggle, pers. comm., 2012).*

## 3.3. Conclusion

The local knowledge network, including fishers, vendors, conservancy representatives and members of fishing village committees, reflect all knowledge axioms which Aikenhead and Ogawa (2007) expect to find in a group of local resource users. In the phase of constructing knowledge about nature and resource management, local actors showed the monist, the holistic and relational belief, which leads to a somehow integrative perspective of the natural environment guided by ecological and spiritual forces, by intuition and a trust in god, spirits and the ecosystem itself. A reliable supply of fish resources to meet the basic survival needs of local communities in Caprivi, has led local actors to the belief that their knowledge has content validity in local forms of land management. Moreover, thinking in a circular time pattern has resulted in an utter trust in the stability of fish resources. The faith in circular fluxes in the natural environment and the conviction that fish never finishes also explains the acceptance of the mystery in the daily lives of local people. The perpetual danger of wild animals and the unpredictability of natural resource provision bring the local community to adopt an attitude of acceptance that allows them to settle in harmony in a mysterious environment. Due to the direct interaction with nature and the direct dependency on natural processes, local resource users have place-based knowledge, which they ground on

systemically empirical, and very often, qualitative forms of data. For the local network, such data forms the basis for rational reasoning in drawing conclusions about the natural environment.

The dynamic nature of the local network drives the adaptive way knowledge is constructed in response to continuously changing conditions within the local network, but also to external forces. The interaction with the scientific knowledge network and the exposure to the commercial fish industry for example, has shown to change the way fish is valued among conservancy staff and commercial fishers and vendors. Rather than appreciating its function for satisfying body and mind, fish is seen from an anthropocentric perspective. However, culture-based rationality always guides the evaluation process of any new development, idea or situation on its relevance for the local conditions and interests of the people.

Knowledge and management interventions are prioritized regarding the relevance to meet the diversity of interests related to a diverse and multifaceted lifestyle. The holistic perception of the natural environment leads to the wish for an integrative management approach with consideration of social, political and environmental elements. It also results in the wish for transparency and a say in all processes that make up NRM, including the planning and implementations of laws and rules, the legal rights to enforce them and a transparent distribution of benefits within the conservancies. With regards to the sustainable management of fish, most local actors consider it priority to control excessive illegal fishing by mainly Zambian fishers and the use of black magic. While subsistence fisher folks' priorities revolve around meeting basic and simple needs, commercial fishers, vendors and conservancy staff strive for financial benefit through natural resources. Sustainability is important to everyone, but since none of the local actors believes that fish resources are declining, legal fishing restrictions are perceived as exaggerated and unnecessary. Most fishers wish to be able to practice fishing as before. Commercial fisher folk wishes for better market opportunities and financial surplus. Conservancy staff prioritizes interventions to manage fish resources sustainably for long term benefits.

The prevalent trial-and-error strategy in developing methodologies in NRM shows that knowledge is seen as a journey towards wisdom-in-action. Local people show sensitivity to the interconnectedness of all elements, and they communicate with animals and spiritual guardians in the daily interaction with the natural environment. Methodologies in local fishery management are strongly shaped by the monist belief, for example apparent in the form of black magic. Magic may form the cause of excessive resource use, but it also serves to restrict and punish individuals who take out too much fish. The monist belief also introduces several cultural restrictions with regards to the consumption of very popular species. The physical and spiritual connection of local actors to an area and the sense of belonging to certain home-ranges lead to strong emotions regarding the pollution and exploitation of nature by external actors. These place-based emotions are important drivers in the defence of natural assets by the local network.

The local network has a variety of practices with a long history of successful application in satisfying the basic requirements for survival. Some of them are traditional, some change very dynamically in response to various influences. This becomes particularly apparent in the adaptation of fishing methods for more efficiency and safety in this livelihood practice. Local actors evaluate, adapt, reject or combine scientific and local methodologies, often resulting in hybrid forms of knowledge in fishery management. The trust in a circular time pattern in

fish supply and the wish to meet the survival needs often shows to be one of the primary reasons why certain fishery regulations and restrictions are being rejected and ignored in local management. As a result of a dynamic change in valuing and perceiving natural elements in the context of commercialisation for example, certain traditional methodologies that are relevant for sustainable NRM, however, seem to be threatened. In the end, the most important criterion for any methodology to be applied in local management is its culture-based validity in meeting local interests.

The scientific knowledge network in Caprivi comprises NGO and fishery ministry staff, as well as individual scientists from universities. Driving the construction of knowledge about local NRM in the scientific network is the assumption that nature is knowable. This knowledge of nature can be expressed best in formal, quantified and bureaucratic forms. Moreover, a wish for order leads to the structuring and categorisation of information. The Cartesian dualism in scientific rationality prevents that local knowledge, including intuitions and spiritual influences, receive trust and a chance in guiding NRM planning phases. The local perception that fish never finishes is directly responded to with assigning the shifting baseline syndrome to local resource managers. Thinking according to a rectilinear time concept leads to the assumption that human population growth and the commercialisation of the fish industry will lead to a gradual decline of fish stocks, ultimately ending in the extinction of favoured cichlid species.

Being certain that only conditions which can be perceived with human senses really exist, locally perceived threats of overfishing with magic are ignored. Most prominently prevalent in the way the scientific knowledge network constructs knowledge about the local situation, is the positivism of Western standards, beliefs and values. Priority receives any kind of knowledge which aids in receiving a level of control over ecosystem functioning, fish biology and resource fluctuations, and over resource use patterns by local actors. The scientific network constantly seeks to derive knowledge as a product of scientific research to bring order and predictive validity into the complex and uncertain local condition. Especially MFRM displays the interest in exerting control and power over fish use by local communities. Which aspects receive importance and relevance in fishery management is moreover influenced by the interests of individual scientists or donor agencies, such as tourist operators in the Caprivi region.

Scientific methodologies are based on reductionism, often separating and categorising resource users' functions in the local environment. This is especially apparent when looking at how roles and positions are assigned to local actors in scientific constructs like conservancies and FPAs. Moreover, scientific methodologies such as the event book system aim at quantifying observations of local people to bring order and uniformity into interrelated and complex processes, which built the lives of local actors. Similarly, ecological studies aim at creating predictive models for fish movement patterns and population dynamics in response to resource use. For this, local knowledge is selectively screened and translated into scientific language to serve an instrumental function in scientific methodologies. Another strategy of the scientific network is to engage in disciplining and stimulate local participation in resource management according to predetermined standards.

# Chapter 4-

# Knowledge conflicts

In this chapter I demonstrate conflicts and problems that have arisen as a result of knowledge interfaces in the practical management of Caprivi's fishery. The previous chapter has shown that differences in local and scientific approaches in constructing, prioritizing and applying methodologies are rooted in the respective knowledge spaces and culture-based axioms and interests. Some mismatches between the knowledge spaces present themselves in several theoretical and practical manifestations, which are elaborated in this chapter under the categories: interest struggles and contradicting priorities, legal and perceptual ties to the scientific knowledge network, unsustainability of methods, resistance to rules and regulations and community conflicts.

## 4.1. Interest struggles and contradicting priorities

It is generally believed that local knowledge holders seek to maintain a balance within a complex interplay of related elements. They predict natural phenomena to achieve a harmonious interaction with nature for the mere purpose of survival. This is contrasted by the scientific approach to treat nature with power and dominion to increase predictive validity (Aikenhead & Ogawa, 2007). Both presumptions of the knowledge groups have shown persistence in this study.

Within the broad common goal towards sustainable management of fisheries, the interests and priorities of the local and the scientific knowledge network may be accentuated differently. The scientific knowledge network displays tendencies to exert power and top-down control over the use of freshwater resources by refraining to legal restrictions of fishing efforts. As formulated in the Inland Fisheries Resources Act (2003), resource users require licenses from MFRM to operate any kind of fishing gear in Caprivi's freshwaters. The act further specifies that fishing licenses become invalid in protected areas, nature reserves and FPAs. During this current establishment phase of the FPAs, area restrictions for the fishery livelihood will be introduced to the fishing communities in Sikunga, Kasika and Impalila very soon. Thus far, the FPAs are supported by almost all interview respondents in the local knowledge network. However, none of the fishers was fully aware of the consequence that they will be no longer allowed to fish in the area. A subsistence fisher in Impalila for example did not know that the FPA will restrict him from fishing at his door step:

*"No, they would not prohibit us from fishing here in this part of the Kasai channel. Of course not; where else would we go" (Impalila, 12.04.2012).*

The ultimate goal for the future of Caprivi's fishery is to introduce closed seasons (MFRM research technician, pers. comm., 2012). As indicated in the previous chapter, the scientific

knowledge network obtains locally-collected ecological data on fish stocks, in order to prepare records which will justify this mission. It shows that the scientific network sees knowledge as a mean to an end; the end forming the fulfillment of personal pursues and interests such as [a closed fishing season], academic credibility, financial uplifts, economic growth, and sponsorships (Keeley & Scoones, 1999). In contrast, the local knowledge network pursues to gain knowledge in the form of wisdom-in action for survival strategies (Aikenhead & Ogawa, 2007). In Caprivi, these deviating interests create a conflict in the formulation of objectives in sustainability management of fish. While NNF and MFRM highlight the importance of generating economic benefit to conservancies and fishing villages (NNF, unpublished data), local fisher folk is rather concerned with meeting basic needs today. This was mirrored well in the statement of one fishing household in Kasika:

*"We just want to fish the way we used to… We don't understand all these restrictions" (Kasika, 14.04.2012).*

The conservancy committees seem to be positioned somewhere in between and explain the struggle in their function of disciplining agents and lobbyists for scientific concepts:

*"Not everyone in our conservancy understands the economic importance of the river. Fishers just want to fish the way they used to, in order to meet their own needs. They do not believe that they will benefit from the income one day" (Impalila, 11.04.2012).*

This conflict may also be partly explained by the lack of benefits that actually reach fisher folk. By stating that *"the economic benefit of fish which was promised to derive from the conservancy model is missing" (Impalila, 12.04.2012),* the conservancy committee admits that the local priority to make a living is clearly not met.

## 4.2. Legal and perceptual ties to the scientific knowledge network

By introducing scientific tools to the fishery management which are foreign to local people, the scientific knowledge network keeps local resource managers on a short leash. This is shown in the example of the FPA management, for which the ministry developed and assigned the role of fish monitors to selected conservancy members. The fish monitors are predominantly young members of the respective communities. All of them stated in the interviews that they have practiced the fishery livelihood with other community and family members since childhood (Sikunga, 30.03.2012; Impalila, 13.04.2012; Kasika 15.04.2012). Now, they are employees of NNF and the fishery project, and are suddenly restricted in their functions as fishers and vendors. They are paid and supervised by NNF to monitor fishers, who may often be relatives and friends, by weighing and counting their catches, recording species and the type of fishing gear used (Impalila, 12.04.2012). Being unfamiliar with the operational procedures and the exact purpose of these tasks, the fish monitors describe a strong negative dependency on NNF and MFRM:

*"Our training was poor, the supervision is very superficial, we hardly have resources to do our job and we have not even received our salaries in three months. At the same time the project*

*gives us so many restrictions. We are not allowed to continue our far-distance studies. If they would know that we do it anyway, they would fire us" (anonymous).*

The government maintains control over CBNRM operations and local knowledge in many subtle or obvious ways. An example is found in the context of local practices for human-wildlife conflicts. In the past, before wildlife was watched over attentively in conservancies, local people defended themselves and killed the animals that posed a threat to peoples' lives. The animal products were then shared and efficiently used by the community (Sikunga, 30.03.2012; Impalila, 13.04.2012; Kasika 15.04.2012; Mayuni, 5.06.2012). Today, local communities have to keep problem animals alive (MET, 2008) and fishers solely depend on a few traditional strategies for personal protection from crocodiles and hippos. While these restricting regulations are attempts to meet international standards and donor agencies' interests for wildlife conservation, they are promoted to the local network for the revenue value of sustainable wildlife management (eg MET, 2008; NACSO, 2011).

Through the Inland Fisheries Resources Act (2003), the local knowledge network is also formally dependent on the ministry to protect itself from illegal fishing activity. Legal rights to enforce resource restrictions are solely held by inspectors trained and assigned by MFRM (MFRM, research technician, pers. comm., 2012). Since illegal fishing by Zambians is locally-perceived the biggest threat to the fish resources and community well-being, the consequences of the dependency on the state are feelings of helplessness and vulnerability. This was elaborated well by a fish guard in Sikunga conservancy:

*"We should be monitoring illegal fishing by Zambians who use dragnets at night. This is what is most destructive; not the single subsistence fisherman. But we have no power or resources to enforce the law. The ministry patrols only very occasionally. This does not help. We would suggest that the ministry establishes a camp out here; or that they give us more powers to patrol and enforce laws" (Sikunga, 30.03.2012).*

Particularly conservancy committees expressed their frustration about the constraint for the conservancy management, such as in Kasika and Sikunga:

*"This conservancy would make sure that fishing takes place in a sustainable manner, because we depend on the fish. That's why they wanted to give us the power to manage our resources independently in the first place. But now we don't have the power to set up fishing laws, or to enforce them. The government looks at the situation only from far away and does not listen to our complaints" (Kasika, 15.04.2012).*

*"….being able to hand out fishing permits and net licenses ourselves. We see this as a major step towards independency. We request this at the ministry all the time, but nothing comes yet" (Sikunga, 30.03.2012).*

With the upcoming FPAs in conservancies it seems that the use of power and such ties to the scientific knowledge network will tighten even more. NNF and MFRM promised the conservancies more thorough protection from illegal fishing and better assistance in law enforcement through the FPAs (Sikunga, 30.03.2012; Impalila, 13.04.2012; Kasika 15.04.2012). The fish monitors however raise doubts that this will be the case. They comprehend such promises as empty and as strategies to get the permission from local fishing communities for the establishment of the fish reserves (anonymous).

According to section 22 in the Inland Fisheries Resources Act (2003), the minister can only legally gazette a fish reserve in Caprivi upon applications of communal area managers, namely the conservancy committees. An FPA must be justified by reasoning for the protection of individual fish species, entire fish stocks or the aquatic ecosystem as a whole. As the initiator and developer of FPA programmes in Caprivi, NNF [fulfils the role of project-lobbyist] and regularly visits, educates and negotiates with local communities, promoting the advantages of FPAs (fig. 9) (Hay, pers. comm., 2012).

**Figure 9:** NNF promoting the FPA concept to Sikunga conservancy and a Namibian TV station (Heider, 2012)

Eventually, conservancy committees apply (arguably) independently to the minister in an official letter (see Appendix 1). Wordings, argumentations, and formal structure of those letters bear the hallmarks of the scientific knowledge network, such as in the following citation of a letter from Sikunga conservancy committee: 'After extensive discussion over the last three years and with assistance of the MFRM/NNF Zambezi/Chobe Transboundary Fisheries Project we have identified suitable areas to be made into FPAs. We hope to protect further areas in future.'

In case that the FPAs will not lead to the desired outcomes in the conservancies, MFRM, WWF and NNF have laid out an appropriate response to prepare against uproar. It was summarized bluntly in the following statement by Dr. Hay from NNF:

*"We cannot force the communities to do things, if they are not ready for it; we can only guide them towards it and believe that in time, they will get there. If people are not happy about certain things, it will not be our fault. It was the decision of the conservancy" (Hay, pers. comm., 2012).*

While in this way control over fishery management remains with state agencies, the responsibility can be easily shifted to communal management structures which operate independently at least at the legal level.

The formal dependency of fishing communities on the state creates an additional mental reliance on external advice, assistance and guidance. In the attitude of the scientific knowledge network I could clearly recognize the positivism, leading to a feeling of

superiority over the local knowledge network. This was for example apparent in the interviews with respondents from NNF and IRDNC, who expressed a strong confidence in their role as technical advisers and educators for rural communities and in the content of their teachings. This was reflected in the statements below:

*"We as conservationists work closely with the communities and guide them in the management of wildlife and natural resources" (Munali, pers. comm., 2012).*

*"The fish monitors are educated and supported by scientific advisers from NNF. NNF checks up on them regularly, to make sure everything works smoothly" (Hay, pers. comm., 2012).*

Through the promotion of scientific norms, values and standards as the ultimate solution in fishery management, local fisher folk seem to gradually adopt an inferior attitude in response. This was shown in a pronounced perceived dependency of conservancy staff on external assistance to apply scientific methodologies, shining through in interviews with conservancy committees and fish monitors:

*"In the event book, a tool of the ministry to monitor our natural resources, the fish guards capture which species were caught, how many and which sizes. The information is then sent to the ministry, who analyses it and sends it back to us. It is important for management, as it shows us population trends. NNF then advices us on what we can do with the trends" (Sikunga, 30.03.2012).*

*"Sustainable management is very important, but we still need a lot of training from external parties. We were taught a lot about it at school, but we don't know much about it in practice" (Mayuni, 5.06.2012).*

*"We fish monitors only follow the regulations and do what the ministry asks us to do. We check net numbers, net mesh sizes and fishing permits to restrict fishing. We are trying to convince the fishers to use the gear recommended by the ministry, but they do not listen to us. Only ministry officials and scientists are heard by the fishers. Our knowledge is not respected"* (*Kasika, 14.04.2012).*

This insecurity of local communities firstly reflects the strong influence of the scientific knowledge network on degrading culture-based knowledge, priorities and methodologies. Secondly, it highlights how unlike the extraneous nature of scientific methodologies is, in the context of local knowledge spaces. The weakened confidence of local resource managers might be used to the advantage of the scientific knowledge networks' interest to maintain power and dominion over fishery management. In many cases, the local network expressed its resistance to the control of the state such as this fisher from Kasika:

*"Many of us do not understand or support the fishing regulations, but we accept it. The law is the law and we need to obey" (Kasika, 15.04.2012).*

The scientific knowledge network seems to have several strategies in place to disguise the legal and mental ties in the context of CBNRM and participatory management. This is mirrored in the regional rules for the use of traditional fishing gear. Contrary to the knowledge of local fisher folk, the fishery act allows any traditional method, except active gears such as drag nets, drifting gill nets and the use of poison for example. The research technician from MFRM describes how this misunderstanding has evolved:

*"But in order to use any of the traditional methods, they need to write a letter to us and ask for permission. The problem is that the people don't seem to understand the regulations and think it is prohibited" (MFRM research technician, pers. comm., 2012).*

While it is legally formulated that local resource users have the right to use traditional fishing methods, MFRM sustains ultimate power to decide upon requests conditionally. This situation represents one of many half-hearted strategies for community empowerment in Caprivi's fishery.

## 4.3. Unsustainability of methods

Local knowledge traditionally displays the holistic and monist beliefs, and assumes powers of spiritual forces in NRM methodologies. Scientific knowledge networks in contrast build upon Cartesian dualism and reductionism (Aikenhead & Ogawa, 2007). Through the marginalization of local beliefs in developing methodologies for Caprivi's fishery management, many of them show locally irrelevant and unsustainable eventually. As demonstrated in the previous chapter, some scientific knowledge institutions ask local communities to collect data without taking into account the technical, environmental, social or cultural conditions of the local network. In developing resource monitoring tools for communal conservancies, Mr. Diggle faces this problem continuously and criticizes:

"*If universities need data on wind speed for example, they should go and collect it themselves" (Diggle, pers. comm., 2012).*

Instead, most scientifically developed methodologies are directed towards the scientific networks' interests and priorities. This leads to false or half-hearted applications by the local knowledge network of tools that may be alienated and irrelevant for the local condition. This can be demonstrated in the consequences of mesh size restrictions for fishing nets in Kasika and Impalila conservancy. During the period of the year when the floodwater retreats to the Kasai channel, one of the only fish species that can be caught for consumption is the bulldog (*Marcusenius macrolepidotus*). The bulldog only reaches a maximum length of 32 cm (Website: Fishbase, 2012), and it cannot be caught well with the nets in the legal mesh size categories 3, 5 inches and larger (fig. 10) (MFRM research technician, pers, comm., 2012; Impalila, 11.04.2012; Kasika, 15.04.2012).

In Caprivi, the environmental conditions and the livelihood potential generally vary widely between the different conservancies, depending on the floodplain pattern or the nature of the main channel. In Mayuni conservancy for example, there is a lack of water access points to the Kwando River. This is firstly due to a dense cover of reeds and secondly to bordering National Parks which strictly prohibit entry (Mayuni, 5.06.2012). Mayuni's field officer explains the difficulties that arise for the fishers in the area:

*"The Kwando River is much less fruitful than the Zambezi and the Chobe. We cannot catch as much as in other areas in Caprivi; especially now that more and more lodges and protected areas want to keep us away. We have to feed so many people, how shall we do this when the regulations are so strict" (Mayuni, 5.06.2012)?*

**Figure 10:** The bulldog in relation to a 2-inch fishing net (Heider, 2012)

The statement above indicates that the wetland ecosystem and the socio-political conditions in Caprivi are too diverse to introduce fixed sets of rules to all communities. Insisting on their dependency on the bulldog during the autumn and winter season, local resource users in Impalila and Kasika conservancy therefore assertively reject the regulations for mesh sizes at this critical time of the year. The conservancy committees in Impalila and Kasika complain about the surrealism of state-enforced restrictions:

*"The regulations are not loose enough. In the Kasai channel, the people depend on the bulldog fish at this time of the year. But we cannot catch them with the legal mesh sizes. When we use illegal mesh sizes, they fine us. But nobody here has the money to pay the fines, so they take you to jail" (Impalila, 11.04.2012).*

Some of the difficulties related to blue-printed fishery regulations are recognized by the scientific knowledge network. Mr. Abbott responds to this point of criticism:

*"The new fishery regulations are not flashed out yet, but they must be more flexible and aligned with the complex conditions in the respective villages. Regulations need to allow different net numbers, different mesh sizes in different areas at different times of the year…"(Abbott, pers. comm., 2012).*

However, the main reason for conflict remains: scientific approaches to classify and categorize local realities show the misinterpretation, misperception and misconception of the adaptive local knowledge network. The wish to capture local flexibility in formal regulations is a contradiction in itself.

In a converse way, externally developed management tools may be often misunderstood by local knowledge holders. For example, instead of seeing the event book system as a tool for sustainable management of wildlife and fish exploitation (Stuart-Hill, 2005; Danielsen et al., 2008; MET, 2008; NACSO, 2009) conservancy staff in Sikunga conservancy said the following:

*"The event book system is very important for marketing purpose. We can only advertise recreational fishing if we know what we have in our conservancies. That is the main purpose of the event book" (Sikunga, 29.03.2012).*

Moreover, conservancy staff in FPAs seems to misunderstand the purpose of data collected by fish monitors. Instead of seeing the value of the data for compliance purposes and ecological studies, as its actual function is intended by MFRM, Kasika's community committee believes that it serves the direct economic benefit to the conservancy:

*"The fish monitors weigh our fish catches, because they need to know how much fish and thus how much economic value leave the conservancies. This is important in order to know which financial compensations have to come back to us" (Kasika, 14.04.2012).*

Mutual misunderstanding and superficial analyses of local realities empirically have shown to result in methods that are locally unsustainable in Caprivi's fishery and in CBNRM initiatives worldwide (Campbell & Vainio-Mattila, 2003; Stuart-Hill, 2005; Danielsen et al., 2008).

## 4.4. Resistance to rules and regulations

The unsustainable nature of scientific methodologies in fishery management is confirmed by the incompliance with extraneous rules and regulations through the local knowledge network. One reason for this is the lack of benefit or incentive that local people gain from the abidance by the rules. This was demonstrated by fish guards and fish monitors who felt discouraged to collect ecological data from fish landing sites (Sikunga, 29.03.2012; Impalila, 11.04.2012; Kasika, 15.04.2012):

*"We are supposed to capture everything we see in these record sheets. We must then deliver the data to the ministry, but we do this less and less. The results never come back to us. It is also not used in the conservancy management" (anonymous).*

Another example concerns the problem of diseased fish, currently found more frequently by fishers in the Kasai channel. The fishers blame oil leaks of house boats and tourist boats for this situation (Impalila, 13.04.2012; Kasika, 14.04.2012). Although they are requested by MFRM to report the incidents to officials, fishers seldom do so. A group of fishers in Kasika explains:

*"We throw sick fish back into the water. MFRM officials never do anything about it anyway. And our hands are tied" (Kasika, 14.04.2012).*

Fishery regulations have changed and rigorously restricted the way fishing traditionally took place in Caprivi (Hay, pers. comm., 2012). Many interview respondent from the commercial fishing village and the conservancy committees experience the regulations as too strict (Impalila, 11.04.2012; Kasika, 15.04.2012; Lusese, 25.04.2012; Lusu, 8.05.2012; Mayuni, 5.06.2012). The chairman of Kasika conservancy describes how his legal tasks as a committee member may conflict with the lived reality as a community member and fisherman:

*"Instead of using 500 yard fishing nets, fishers are now only allowed 200 yards. They don't understand these restrictions, because they struggle to make a living with this. In a certain sense, we are all fishermen here and we also find the regulations too strict. As members of the committee, of course we are restricted in using traditional fishing methods, and what they call, destructive gear that are not allowed anymore. But sometimes we don't have a choice and use illegal gear. This means we cannot expect the rest of the community to comply" (Kasika, 15.04.2012).*

The phenomena of incompliance with fishery regulations can partly be analyzed on the basis of the deviating ways nature and the environment are assessed and intervention measures prioritized. While the local knowledge network recognizes the local reality in its holistic form, fishery regulations reflect the reductionism axiom, in which livelihood, cultural, social and biological elements are not captured in its interlinked arrangements. The unsustainability of scientific rules of the game which lack a holistic perception of local realities shows in numerous cases of local resistance and incompliance. Fish monitors for example seldom trouble to confiscate nets or report illegal activity to the conservancy committee:

*"When we find people with small-meshed or unlicensed nets, all we can do is warning the fishers or confiscate their nets. Sometimes we do that, sometimes we don't, because we know that it means that they have to travel to Katima to buy a new net and an expensive license" (anonymous).*

I even observed fish monitors and fish guards fishing with 1 and 2-inch nets themselves before selling the fish illegally to Zambians. Conservancy managers admitted fishing with small-meshed nets too (anonymous).

Whether rules and regulations are considered valid or invalid by the local knowledge network is primarily dependent on their relevance to meet the culture-based objectives. Recalling that the local priority revolves around living a life in balance and harmony with the natural environment for the purpose of survival, a method or rule seems to gain cultural invalidity when it restricts the local livelihood practices too severely. In the debate whether and how fish stocks should be protected or not, the local knowledge network upholds its own, culture-based perceptions. Some of it is shown in the rational argumentation of fisher folk for locally applied mosquito-net fishing which is prohibited as 'destructive gear'. Fishing with mosquito nets forms a considerably important protein source for rural communities. It also plays a significant role for women and children to engage in livelihood activities as an otherwise marginalized group (Abbott et al., 2007). Long term personal experiences have shown no evidence for the women's responsibility for any declines in river resources. After I discovered a group of women from Sikunga fishing with mosquito nets in the floodplains, they defended this practice with the following argumentation:

*"There is plenty of fish! We have fished this way for many centuries and we have not experienced a decline in fish populations. What harm can we do as single women and children? We do not take much" (Sikunga, 29.03.2012).*

Not even scientific research conducted on the effects of mosquito net-fishing could show negative implications on fish stocks (Abbott et al., 2007b). Based on culture-based knowledge and observation of the fish resources, local women thus trust in the methods' content validity (Impalila, 12.04.2012). The same manner of argumentation upholds for

illegal use of several other traditional fishing methods. Maintaining their application is not only important in meeting basic needs, it is also considered an important element of the local culture (Sikunga, 29.03.2012; Lusese, 25.04.2012).

## 4.5. Community conflicts

The influence of the scientific knowledge network on the current re-structuring of Caprivi's fishery management markedly showed in negative implications for community structure, functioning and well-being. First of all, the mere separation of traditional community structures into conservancy committees and conservancy members results in the formation of elites; privileged community members who benefit financially and personally from the conservancies (De Vette et al., 2012). A new institutional hierarchy forms within the community, leading to a divide in interests, visions and motivations. This is shown in the previously cited statement of Impalila conservancy's manager:

*"Not everyone in our conservancy understands the economic importance of the river. Fishers just want to fish the way they used to, in order to meet their own needs. They do not believe that they will benefit from the income one day" (Impalila, 11.04.2012).*

Conservancy staff is promised opportunities for livelihood re-orientations, academic studies and apprenticeships in fields other than fishing, by the scientific knowledge network (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 14.04.2012). With confidence in the conservancy model, the chairman of Impalila explains to me:

*"Young people in the conservancy can learn about managing the resources at school and through external educational programs. They can understand and comply with fishery regulations. They also receive secondary and tertiary education and have chances for income sources other than fish" (Impalila, 11.04.2012).*

Due to this trust in their future perspectives, it appears that only conservancy staff can afford to have a deviating perspective on fishing restrictions, conservancies and FPAs, when compared to fishers and vendors who will remain dependent on small-scale fishing. This is reflected in various statements of committee members, such as:

*"The FPA will be good for us. It will bring in money" (Sikunga, 29.03.2012).*

*"Old fishing methods were very destructive, such as bashing the vegetation or using drag nets. But now with the new regulations, the fish is increasing. The fishers here don't seem to see this connection and still complain about the regulations" (Impalila, 11.04.2012).*

In Caprivi's fishing villages I could recognize a clear process of community destabilization in the form of jealousy, anger, allocations of blame, dishonesty and secretiveness. From the viewpoint of the conservancy members, frequent complaints revolved around the unequal distribution or even complete lack of financial benefit (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 14.04.2012; Mayuni, 5.06.2012). A semi-commercial fisher from Kasika with long term experience in fishing and vending assumes:

*"We don't think that the conservancy committee acts in our interests. At the annual meetings, each conservancy member receives a tiny amount of cash that comes from hunting. But if they would allow us to fish the way we wanted to, we would earn a lot more" (Kasika, 15.04.2012).*

Moreover, community members blame the conservancy committees for the state-enforced regulations, the increasing numbers of wildlife and the lack of compensation for wildlife damage (Sikunga, 30.03.2012; Impalila, 11.04.2012; Kasika, 14.04.2012; Mayuni, 5.06.2012). The fish monitors who are seen as the custodians of freshwater resources, including the hippos and crocodiles, describe their struggles:

*"We are not popular among the conservancy members. Everyone hates the conservancy and all the dangerous animals and all the problems are our fault" (Kasika, 15.04.2012).*

Due to a general disapproval of fishery regulations by fishers and vendors, fish monitors, fish guards and conservancy committees trying to enforce state-implemented regulations are put into unpleasant positions, such as the one described below:

*"We need to monitor whether the fishermen use illegal gear and whether they have unlicensed nets. The fishers do not trust us. They refuse to let us collect the data. They believe we are spies and get them into trouble. But the information is not for compliance purposes. It is for research mainly. We have no good position in the conservancy anymore, and life here is a constant struggle" (Kasika, 15.04.2012).*

The result of these conflicts is a lack of trust in conservancy staff and a marginalization of the previously well-integrated community members (Impalila, 12.04.2012). A family in Kasika believes:

*"The committee has become an organization of its own-they pursue their own goals and make many empty promises. They obey the wishes of the government; not ours" (Kasika, 14.04.2012).*

Contradictory to the intended goal of community empowerment, the influence of the scientific knowledge network on the conservancy model seems to have led to community oppression. The father of the same family elaborates further:

*"If we have concerns that we want to raise to the government or to the supporting NGOs, we need to do this through the conservancy committee. But they seldom take our points seriously. They either stay quiet or they shift responsibility to the government, and the matter then gets stuck on the way upwards. We as a community have no power anymore" (Kasika, 14.04.2012).*

Conservancy staff on the other hand, seems slightly ignorant of the community divide and many remain trusting in the conservancy concept. This is reflected in the statement of a game guard in Impalila:

*"In any case, people here are never happy. They complain with or without the conservancy. Instead of complaining all the time, the people here should not give up. They should continue to report human-wildlife conflicts and they should continue to demand compensations. We in turn will continue to educate. With more and more knowledge coming in, we can see our*

*conservancies moving towards greater independency. That is the most important thing" (Impalila, 11.04.2012)!*

The ignorance of the problems on a community level from the site of the conservancy committees becomes even clearer in a response from Kasika's chairman:

*"We believe that the people are content with the way we manage the conservancy. Communication between us and the fishermen is good" (Kasika, 15.04.2012).*

Reflected in an attitude of superiority, committee staff shows similar traces of the positivism axiom that could be identified in the scientific knowledge network, such as the one below by a fish guard:

*"The fishers here never used to care about fishing sustainably. We must be strict with them. Education is required." (Sikunga, 30.03.2012).*

This statement let's assume that further dynamic change and innovation towards scientific knowledge axioms will shape the management of fisheries in conservancies in the long run.

## 4.6. Conclusion

The differences between the two knowledge spaces of the local and the scientific network result in various conflicts in Caprivi's fishery management. While the scientific network displays an interest in controlling and restricting resource use for future benefit through regulations and fishery laws, the local network strives towards settling in harmony in the unpredictable and complex environment that determines local realities. In practice, this shows in the wish for making the fishery livelihood efficient in meeting community needs immediately. In order to control assumed irresponsible and unsustainable fishing by local resource users, the scientific network creates conditions of upward accountability. Scientific NRM strategies and initiatives inherently entail legal ties to the scientific network. Through disciplining and the conveyance of scientific axioms as the ultimate solution to local struggles, scientific actors create an additional mental dependency of conservancy committees and village representatives to the scientific network. Especially the reductionism axiom in scientific methodologies makes many of them incompatible with local axioms and local realities. The wish for universal strategies that bring order and predictive validity to complex situations, leads to unsustainable methods which address simplified and misjudged local conditions. The most natural response to this condition by the local knowledge network is the disobeying of fishery regulations and resource use restrictions, or half-hearted implementation of alienated tasks and rules entailed in scientific projects. The separation and reduction of local functions in conservancy committees and as part of the transboundary fishery project disrupts the daily engagement of these local actors with the natural and social environment. A communication and relationship gap evolves between appointed community representatives who function as lobbyists of the scientific network and the rest of the community. This situation reflects in mutual feelings of disappointment, distrust, frustration and separation.

# Chapter 5-

# Discussion and Conclusion

By delineating the differences between the local and the scientific knowledge spaces in chapter 3, and by relating them to the relevant conflicts and problems in the current fishery management in Caprivi outlined in chapter 4, it becomes clear that the socially and politically empowered scientific knowledge space has a strong influence in directing NRM in Caprivi. The purpose of this chapter is to establish how local knowledge is contested by the scientific network on the level of discourse over the theoretical and practical approaches in the three phases (knowledge construction, prioritization and methodologies) of fishery co-management. This study will be concluded by elaborating the consequences of knowledge contestation for the local network in sustainable fishery management in Caprivi.

## 5.1. Manifestations of local knowledge contestation

### *5.1.1. Knowledge construction*

Mr. Diggle recognizes that CBNRM-supporting initiatives overlook many aspects of local knowledge and its potential for sustainable NRM. He further explained that typical scientific knowledge axioms often restrict the assistance that NGOs can give to local communities. In the overall strive to support local communities in independent NRM, WWF is directly exposed to several inhibiting factors found in the scientific way of constructing knowledge. Scientific argumentations are always held in such a way that a direct comparison of different elements is made, eventually leading to the approval or disapproval of one or the other theory (Diggle, pers. comm., 2012). In the face of financial and legal dependencies on state bodies, scientific knowledge institutes and donor agencies, WWF constantly finds itself balancing arguments for and against local or scientific approaches to NRM with the aim to reject one of them eventually (Diggle, pers. comm., 2012).

In principal, WWF holds the opinion:

*"We would actually like to say that neither scientific nor local approaches are better; they simply serve completely different purposes" (Diggle, pers. comm., 2012).*

In reality however, the predictive validity and the uncontested norms, standards and ideals of scientific management tools and approaches are often considered the ultimate and indisputable solution for NRM related struggles (Warren, 1991), and they most frequently win the contest in the discourse over institutionalized fishery management strategies (Diggle, pers. comm., 2012).

**Fish never finishes versus shifting baseline syndrome**

Considering the cultural diversity of humankind and the complex socio-cultural processes it is exposed to, there is not one single definition for nature. Nature may for example be conceptualized as a resource, as a sacred refuge, as pure, as fluctuating, as stable, or as endangered. Each perception regulates a different response to potential threats against the environment and the nature-definition itself (Macnagthen & Urry, 1998). In a modern, westernized society the definition of nature implies a divide between nature, a controllable subject, and the human as its keeper (Aikenhead & Ogawa, 2007; Uggla, 2010). This nature-culture dualism logic shapes scientific norms, ideals and standards in a local discourse of sustainable development. Although the scientific network recognizes environmental problems, they are scarcely accounted to industrial and economic growth in scientifically-shaped societies. On the contrary, scientific networks expect the solutions to these problems to be developed within modern institutions through further modernization including research, market forces and technological innovations (Uggla, 2010). These approaches of constructing knowledge about fishery management in Caprivi, has led to the contestation of traditional and informal knowledge of local communities.

The scientific network in Caprivi accounts resource use patterns of local fisher folk as the biggest threat to declining fish stocks. Such scientific knowledge about local situations and the natural environment is constructed in reliance on theoretical concepts such as Cartesian dualism, reductionism and anthropocentrism in the pursuit of universality goals (Aikenhead & Ogawa, 2007). Fishery scientists hold the conviction that fish resources are declining in line with increased pressure and demand (Hay, pers. comm., 2012). Mr. Abbott stated with confidence:

*"You will never find a fisherman here who does not say: In the past, we caught much more fish than today" (Abbott, pers. comm., 2012).*

However, a rectilinear way of predicting resource patterns might insufficiently cover the natural flux that is assessed with locally-collected systemically empirical data. All interviews in the local knowledge network revealed the exact opposite perception of the state of fish resources. These deviating culture-based assessments of fish stocks lead to a lack of understanding of stringent resource use restrictions in local communities, mirrored in this complaint of Mayuni's field officer:

*"Nobody could ever prove to us that fish resources are threatened. The fishers here believe that fish is increasing, and they are the ones who should know" (Mayuni, 5.06.2012).*

When I informed scientific informants about this finding, all actors readily counter-acted with mistrust in the loyalty of local fisher folk reflected in statements very similar to the following example:

*"Of course they have to say that there is plenty of fish. They are afraid that they will be restricted further" (Abbott, pers. comm., 2012).*

In Caprivi, simplified and quantified assessments of complex local realities have generated the belief in the shifting baseline syndrome. Due to the physical, spiritual and emotional

proximity of local people to the natural resources, local knowledge is commonly believed to lack neutrality and objectivity to detect environmental deterioration (Saenz-Arroyo et al., 2005; Bunce et al., 2007). The notion of the shifting baseline syndrome directly contests the knowledge of the local network that *"Fish never finishes"*. This culture-based valid assessment of the fish resources is judged as a superstitious and naïve perception (Abbott, pers, comm., 2012), biased through human intuition and spirits. Scientific knowledge on the other hand gains its power precisely through a neutral universal mean of accessing truth. As the term 'neutral' implies, scientific communities expect their expertise to be free of a cultural context (Nader, 1996) thus representing 'a rational perceiving of reality' (Elkana, 1971). In accordance with this view, merely experts of the scientific network are trusted to construct knowledge for sustainable management of fisheries. People who qualify as experts are 'highly experienced in a given area with detailed knowledge of a range of relevant cases, they are trained in the specialized collection of data, and the systematic analysis of information, and, as professionals, they tackle issues with neutrality and aim at dispassionate objectivity' (Keeley & Scoones, 1999). However, this perceived neutrality was challenged in several knowledge theories which recognize the magnitude of social, cultural and political 'situatedness' of produced and constructed knowledge. McGee and Brock (2001) for example establish that expert knowledge in environmental sciences carries 'considerable ideological baggage' shaped by scientific paradigms, standards and interests. Supporting this presumption, scientific expertise in Caprivi's fishery management proved far from being neutral and objective:

*"Yes I agree. Institutions such as IRDNC, NNF and WWF have a big influence on shaping the rural development here. They facilitate research and bring in people like me. I am looking at things through a subjective filter; I know that. I streamline complex situations and make cause-and effects- linkages that might not be correct" (Abbott, pers. comm., 2012).*

**Formal structure versus informal knowledge**

Scientists strive to translate any information and data into a bureaucratic language. This most often entails the formalization of qualitative data from local descriptions of local realities into quantitative restricting units (Shackeroff & Campbell, 2007). In this way, local knowledge studied through interviews, observations and record sheets is coded and categorized (Agrawal, 2002) and spreads through the scientific network as produced knowledge. The risk of decontextualizing complex situated knowledge and alienating its true meaning is especially high when it is used for collecting purely biological data (Miller & Glassner, 2004). As an example, the collection of dependent data from fishers in Caprivi's fishery sector serves to fill in knowledge gaps of fish stocks and resource use patterns for fishery experts. However, fishers in Caprivi have no understanding for the purpose of these procedures, as the social agency within the local knowledge space restricts their ability to comprehend categorized, reduced and quantified ways of constructing knowledge in relation to holistically assessed realities. In direct contrast to the simplified knowledge about local situations in scientific spaces is the assumption of local communities that nature is intimately, subjectively, morally and ethically connected to human actions (Aikenhead & Ogawa, 2007). In the conventional definition of indigenous knowledge systems, all of life is not classified. People, knowledge, spiritual and natural forces are seen as relational and mutually dependent. Ways of living can thus also not be split into separate units or functions

(Aikenhead & Ogawa, 2007), such as ecologists, fishers, fish monitors, fish guards or vendors. Uggla (2010) sees the explanation of this phenomenon in the direct dependency of rural people in developing countries on the services of the natural environment in survival. In Caprivi's local reality, a fisher is subsistence and commercial at the same time. He or she is an ecologist and has knowledge of fish feeding, breeding and growth patterns. Daily interaction with the environment entails monitoring of fish behavior, but also behavior of other people. Lastly, fishers are custodians of the fish resources as they restrict their own consumption and catches, but also those of other resource users. All of these activities are essential in the survival of the local knowledge network. Local knowledge holders cannot make a distinction between them and the natural environment, as their practices are always closely linked to the environmental states. They consider themselves as an integrated part of nature and consequently interpret changes, whether human-induced or not, as natural (Uggla, 2010).

**Knowledge?- Journey versus destination**

Local knowledge construction draws from lived experiences with monist, relational and place-based axioms, and it holds wisdom on how to *live* in nature in a sensible manner (Aikenhead & Ogawa, 2007; Uggla, 2010). The holistic integration of these various elements into the day-to day practices of local people explains why the notion of knowledge in local networks can rather be termed *peoples' ways of living* which is symbolised by a journey (Aikenhead & Ogawa, 2007). Scientific negotiations on the other hand show difficulties in finding a point of reference where natural development stops and unnatural processes begin (Uggla, 2012). Due to a physical, spiritual, and emotional distance to the local situation, the scientific network relies on constructing theoretical knowledge of how locals *should* live sensibly with the natural environment. The faith in so-called school knowledge shows that the scientific network perceives knowledge as a destination, forming the mean to an end (Aikenhead & Ogawa, 2007). In Caprivi, the scientific network studies the separate elements of the local space to generate produced knowledge in separate categories such as ecology, economy, culture, politics and sociology. This reflects the reductionism axiom in the knowledge construction phase, which is often directly conflicting with the holistic axiom in local knowledge. In the wish to understand and improve the function and structure of the whole, the scientific network breaks down complex subjects into simple parts and bits of knowledge, which often result in an oversimplification and misunderstanding of the local way of knowing the local environment (Aikenhead & Ogawa, 2007).

**Rationality?**

In constructing knowledge, it is generally believed that local knowledge draws from qualitative observations of the natural environment. People observe the natural environment and learn lessons from plants and animals. The sources of information may also include dreams, visions and intuitions (Brody, 1982; Castellano, 2000; Dyck, 1998; Michell, 2005). This data accumulation is holistic, as it regards each component of information in its full contextual position, it is long-term, as it occurs naturally over all generations, and it is relational, as the observers assumes that he or she is related to the subject of observation. (Aikenhead & Ogawa, 2007). The local conviction about spiritual and physical relationships in

the natural environment are reflected in Caprivi in symbolic rituals, such as the seed pod that protects canoes from hippos, and in stories about magic and the communication with animals and spirits. Due to consequences that are perceived as substantial, local communities generally have faith in their own group's rationality. The scientific network in Caprivi on the other hand holds the attitude that such relational experiences are based on superstition and irrationality. Scientists observe natural phenomena from an objective perspective using a more or less mathematical or quantified analysis, and any other form of knowledge and data acquisition is expected to introduce mystery and superstition which consequently biases conservation schemes (Aikenhead & Ogawa, 2007). Lakota Elder Deloria (1992) challenges this opinion and asks*:* 'What could be more superstitious than to believe that the world in which we live and where we have our most intimate personal experiences is not really trustworthy, and that another mathematical world exists that represents a true reality?' (In: Aikenhead & Ogawa, 2007). By questioning the 'true reality' of the local network, scientific judgement and disciplining strategies leads to a feeling of inferiority of local communities and it impedes the local knowledge construction in fishery management.

**Mystery versus predictability**

The knowledge construction phase in Caprivi's fishery also pronouncedly shows the deviating perspective of nature as being knowable or as being a persistent enigma. While the scientific network supports the belief that nature can be known and predicted, the local network recognizes that the ecosystem is in a constant, mostly unpredictable flux. This mystery in nature is rather celebrated than battled, as it is in science. For coexisting in harmony with the unknown it is essential to accept ones position within a complex web of erratic interrelationships. To embrace the unknown is considered a requirement for the mere purpose of survival in a dynamic ecosystem (Aikenhead & Ogawa, 2007). In Caprivi, this becomes visible in the complete acceptance of the unpredictability of fish stocks. A deep trust in god, in spiritual forces and in the natural environment to sustain the local people has led to local composure and tranquillity. As a result, fisher folk have adopted flexibility and responsiveness to efficiently adapt to resource fluctuations. Through experiential trial-and-error experiences with various gears, methods and locations for fishing, the local network explores the potentials of this livelihood every day anew. Moreover, local communities may also flexibly switch between livelihoods in responses to external conditions (Purvis, 2002). A mixture of quantitative and qualitative assessments of the local situations thus leads to responsive and flexible knowledge construction within the local network. Local NRM approaches are thus as adaptive as an adaptive management strategy can be (Berkes et al., 2000).

Directly undermining the adaptive nature of local knowledge in Caprivi is the scientific tendency to bring order and predictive validity into fishery management. Rather than allowing natural developments of changes in fishing efforts, locations and livelihood practices, the scientific network wishes to exert force and power over the fishery resources and local resource users. Dominion over nature is mirrored in the ideas of closed seasons, FPAs and fishery regulations. These strategies symbolise predictive validity and the scientific assumption that nature is knowable. By disciplining the local network towards complying with these rules, the adaptive nature of local knowledge construction is severely inhibited.

### *5.1.2. Prioritization*

Striking differences in the way local and scientific knowledge networks prioritize knowledge and interventions in NRM are due to deviating values, expectations and interests. As predicted by Aikenhead & Ogawa (2007), at this stage in NRM the mystery axiom in local knowledge directly conflicts with the scientific opinion that nature is knowable. Calling back to mind that the local knowledge network seeks to maintain a balance within a complex interplay of related elements, local knowledge and management activities are prioritized to achieve a harmonious interaction with nature for the mere purpose of survival. Local fisher folk in Caprivi construct knowledge about survival strategies in daily interactions with the natural environment. They interact within local spaces but also with the scientific network without opposing external conditions that are seemingly incontestable. Also in the face of erratic social, political and environmental change, the local network in Caprivi primarily seeks to secure the basic needs for living. The priorities of knowledge construction and management interventions revolve around being able to supply fish and some extra cash for household needs. It seems that external conditions of natural fluxes and constantly changing fishery rules and restrictions are superficially accepted in order to maintain the harmonious relations of all elements that make up the local space.

This is contrasted by the scientific priority to eradicate mysteries and to generate knowledge which aids in exerting control and power over the natural environment (Aikenhead & Ogawa, 2007). Science seeks to prove or disapprove the validity of hypothesises, in order to strengthen or weaken paradigms and explain 'how the universe works'. Global fishery research for example is driven by the motivations of scientists to fill in knowledge gaps that can deliver a greater understanding and predictability of the ecosystem (Pauly, 1995; Pitcher & Pauly 1998). For fishery experts in Caprivi, one of the most relevant fields for research is the distribution of fish species in the floodplains in time and space. For this they draw upon mechanistic explanations such as prediction models, and series of cause-effect (Aikenhead & Ogawa, 2007). For MFRM, priority is to gain understanding of resource use patterns and fish stock fluctuations. NGOs in Caprivi highlighted the wish for sustainability management of resources-similarly, showing once again that fishery management is based on predictive validity.

MFRM displayed great inhibitions in allowing local communities to develop their own visions for sustainability management. Professionals are suspicious of deviating perceptions on fish and do not trust the reliability of locally developed conservation measures (Gray et al. 2008). Scientists and fishers monitor different variables, at different scales and with different priorities. While scientists generally urge to monitor accelerating resource declines for example, fishers very often deny that this is necessary (Daw, 2008).
Fishers in Caprivi respond to the uncertainty of resource supply through constant trial-and-error experiments with catching locations and strategies. Instead of being alarmed by threatening predictions of resource depletions, many indigenous knowledge holders trust that higher forces will take care of the distribution of resources; such as in the example of an indigenous group from the Bolivian Chaco: The Isoseno-Guaranı´ believe that the wildlife is cared for by spirit guardians. Extinctions are unheard of and the disappearance of a species from a given area is due to the guardians withholding the animals from the hunters (Riester, 1984; Combes et al., 1998). Over-exploitation is thus impossible for the local hunters as several self-imposed laws are directed at keeping the guardians satisfied. These laws restrict the hunters in killing immature animals or hunting numbers beyond the

personal needs for example (Noss, et al., 2005). Similarly, fishers in Caprivi never accounted decreasing fish resources to an over-use by local communities. As stated by the local respondents, shortages of fish were due to seasons or climatic conditions, bad luck or the will of god.

In the scientific network, acquiring knowledge may additionally be important to fulfil social goals and priorities. Knowledge may be seen as a tool serving to satisfy curiosity, maintaining credibility among peers, or receiving research grants for example (Keeley & Scoones, 1999). The scientific knowledge network in Caprivi described financial and legal dependencies on sponsors and decision-makers, who make demands on the operation of local fishery management. MFRM constituted the urgency for collecting ecological data of fish stocks to its relevance for closed seasons and fish reserves. All these scientific priorities show one thing in common: they generate produced knowledge, knowledge that is understood as a destination and mean to an end. This perception of management and knowledge priorities contests local values and meanings of constructed knowledge and it restricts the local journey towards 'knowledge as wisdom-in-action' (Aikenhead & Ogawa, 2007).

### *5.1.3. Methodologies*

As a result of the different ways knowledge is constructed and prioritized, the local and the scientific space generate methodologies that are mostly incompatible in practice. Scientific methodologies draw culture-based validity from their quantified and formalized arrangements and the potential to eliminate mystery in nature (Aikenhead & Ogawa, 2007). Focused on predicting social and environmental changes, scientific methodologies are also characteristically uniform in their application through time and space (Margenau 1950; Aikenhead & Ogawa, 2007). This is in direct contrast to local management tools, which are rather dynamic, flexible and informal (Berkes, 1999; Aikenhead & Ogawa, 2007). Too many conservation biologists remain concerned about the ability of local people to formulate their own methods for detecting changes in population dynamics, habitat use, or resource use patterns (Penrose & Call, 1995; Brandon et al., 2003; Rodriguez, 2003). Their greatest concern derives from comparative studies of professional and locally-based resource monitoring which show that locally adapted methods show higher variances (Barrett et al., 2002; Genet & Sargent, 2003), regarding the size or abundance estimates of plants and animals (McLaren & Cadman, 1999; Bray & Schramm, 2001), or false identification of some taxa (Brandon et al., 2003; Genet & Sargent, 2003). External experts thus perceive the lack of accuracy and precision as the downside of independent resource management by local resource users (Danielsen et al., 2008). However, accuracy and adequacy can only be measured against expert- developed quantitative goals, but they may become irrelevant criteria in light of local knowledge systems with a rather qualitative approach (Agrawal, unpublished data; Berkes, 1999).

Fisher folk in Caprivi monitor the ecology of different species, ecosystem changes, resource fluctuations, and fish market dynamics. Due to the holistic lifestyle in which one individual may make experiences and observations as a fisher, a vendor, a family member, a community member and a resource manager at the same time, these assessments are interpreted as interdependent and related phenomena. They can thus not be reduced to separate and static additions to materialistic, mechanical and generalized descriptions of

nature (Warren, 1991). Data collected by local resource users in their day-to day activities is evaluated in relation to culture-based priorities. Seeking to satisfy basic needs while maintaining a harmonious and balanced interaction with the environment, local fisher folk rely on qualitative assessments of their lived realities. Rather than gaining validity through their ability to predict the future of fish stocks and fishery livelihood changes, they have content validity, based on long-term experiences to meet culture-based interests (Aikenhead & Ogawa, 2007). Through such placed-based experiences and with systemically empirical data, methodologies in local knowledge networks derive as products of constructed knowledge from local knowledge spaces (McGee, 2004; Aikenhead & Ogawa, 2007).

Local methodologies are formed in recognition of human intuitions and spirits and with the belief that a relation exists between all earthly and spiritual elements (Aikenhead & Ogawa, 2007). For the scientific network, these perceptions of nature are not only impossible to be formally captured, they also seem far from being understood, respected and accepted. Ideas based on monist and relational beliefs are contested by the influence of the Cartesian dualism and realism in the scientific space. The ignorance of any forms of data other than mathematically and physically proven facts that can be perceived with human senses brings conflicts to the debates over methodologies in Caprivi's fishery management. According to the fishing communities, truly important processes that require monitoring and management are spiritual and relational interactions in the environment, such as magic, curses, spiritual rituals and tools. Western cultures see the belief in holistic connections, witchcraft and spirits as impeding rural development. A local conviction of magic is seen as a 'social constraint' (Douglas. In: Marwick, 1972) and it is contested in the development of scientific methodologies. Confirming this opinion, all interview respondents from the NGOs doubt that spiritual forces in the form of black magic have a negative influence on fish stocks. The Cartesian dualism axiom was especially apparent in the interviews with NNF staff who insist that spiritual processes have no relevance in fishery projects.

Some local resource users try to reduce the use of magic and medicine in fishing, by boycotting fish catches from potential suspects. The local network expressed the wish for greater support from the scientific network by recognizing this form of over-utilization in monitoring methods as a welcome start. Most conservancy staff confirmed the destructive impact of such "*fishing aids"*, but expressed a feeling of helpless in controlling them with the tools from MFRM and NNF (Impalila, 12.04.2012). Because these processes are basically non-existing for the scientific knowledge network, scientific tools do not target such forms of fishery management. De Vette (unpublished data) confirmed that conservancy committees are thus found sandwiched between tradition and the fear of and respect for witchcraft, and the striving for modernity in Western concepts of environmental management. A practitioner of traditional medicine from Sobbe conservancy, who was additionally employed by the conservancy as a game guard, explained that the two fields of knowledge cannot be integrated in conservancy management, as they 'work in different ways'. When directly comparing the two approaches of NRM, conservancy staff agreed that the modern, Western methodologies are superior (De Vette, unpublished data).

Local knowledge contestation in the phase of developing management methodologies is markedly the result of reductionism in scientific spaces. Reductionism becomes visible in the scientific tendencies to split up the fishery sector into categories, namely resource monitoring, law enforcement, and fishery management, and the resource users into

separate entities, such as fishers, vendors, fish monitors, fish guards, fish inspectors and resource managers. This categorization is found in formalized forms in management schemes and it disables local communities to manage the mechanisms of interlinked processes and mutually dependent factors. The contestation of holistic and adaptive local methodologies is institutionalized and controlled through upward accountability to MFRM, shown in the example of the fish monitors and fish guards who are expected to record activities of overfishing without being legally enabled to interfere. Considering that these individuals are local resource users themselves, watching the fish being exploited by large-scale fishing with drag-nets makes them feel *"restricted and frustrated" (Kasika, 15.04.2012)*.

Through a legal separation of dimensions of the fishery sector, collaborative learning within and between knowledge spaces is significantly inhibited. All separate entities of the fishery sector report to MFRM or NNF in a first instance, and horizontal communication of the local network within the local space appears undermined. As an example of this serves the struggle described by fish monitors in the collection of data on fish landing sites. Apart from biological data for NNF, fish monitors are expected to record the use of illegal fishing gear and unlicensed nets from fishers within their conservancy. However, local fisher folk do not make a distinction between the two units and their different functions, and their separation leads to local confusion and misunderstanding.

Descriptions by fish monitors have shown how upward accountability restricts the communication within the local network. The fact that *"the people do not listen to us anymore" (Kasika, 15.04.2012)* poses a problem in all visited conservancies, and it was perceived as an adamant obstacle which cannot be resolved through communication and learning within only the local space.

Above all, employing conservancy staff to capture such sensitive data from conservancy members brings in conflicts to the community as a whole. By attempting to formulize local knowledge, certain local codes of conducts are being contested and disregarded. The consequences of this adhere to conservancy staff and fish monitors.

*"Sometimes we feel like traitors, and we can understand that the people are suspicious of us" (Impalila, 12.04.2012).*

A concern of local people is also that they will be punished for handing over information to the ministry. Black medicine and magic is a common tool to pay revenge among community members and between different communities. According to some of the Namibian fishers, Zambians do not shy away from punishing and killing anyone who is in their way of fishing. According to a community-level analysis of conservancies by De Vetter (unpublished data), the magnitude of black magic in social interactions is substantial. Most people in Caprivi showed enormous respect and fear to become the victims of curses. Jealousy is considered the primary motive to kill those community members who achieve socially, financially or academically. While western perceptions and legal regulations do not recognize the existence of magic, the scale of influence on community structures and individual behavior is inevitable. Fear and inhibitions are a local reality which should neither be contested, nor ignored by the scientific network.

In light of the fundamental differences of scientific and local knowledge spaces, it is clear that collaborative learning becomes a complicating factor in fishery co-management. In order to compensate for mismatches on the cognitive level, most scientific methodologies in

Caprivi have internalized scientific disciplining strategies. In educational programs, workshops and constant communication with conservancy and fishing village committees through IRDNC, NNF and MFRM (Munali, pers. comm., 2012), the scientific network attempts to make the local activities compatible with scientific standards and goals. Following scientific disciplining, local participation is conditionally and selectively integrated as an additional management tool in scientific methodologies (Keeley & Scoones, 1999; Long, 2001).

#### *5.1.3.1. Disciplining the local network*

Seemingly deriving from a feeling of superiority, scientific networks use power to discipline and make the behavior of local people compatible with their standards. Rather than addressing the cognitive level of interest and knowledge conflicts, governments and powerful actors often resort to coercion and forceful adaptation of local behavior, in order to create local commitment to enact scientific interest (McGee, 2004; Schusser, 2012). The most common response to reduce the pressure on fish stocks is to introduce catch and effort restrictions, such as prohibitions of destructive fishing gear, small net meshes and the introduction of permit requirements. Sometimes, fishing is prohibited all together during closed seasons and in FPAs (Tweddle, 2009; Hay, pers. comm., 2012). Moreover, incentives are used to change local behavior, such as in the example of promoting financial benefits of FPAs and sustainable fishery management:

*"Of course it will have a positive influence on the lives of the fishing community in the long run, as closed seasons and the establishment of restricted areas will ensure a sustainable supply for the fish market" (MFRM research technician, pers. comm., 2012).*

Lastly, a general advantaged attitude of scientific actors leads to a trust of local communities that external standards are worthwhile achieving (Schusser, 2012). Powerful actors recognize their influence on shaping messages of meaning and valuing and often use it to personal advantage in the guidance of environmental management (Keeley & Scoones, 1999). The statements below show well how highly scientific advisors valuate their guiding function and subtly or bluntly convey the local network in Caprivi:

"*Through environmental education, we would like to make the fishermen feel guilty about what they are doing" (Hay, pers. comm., 2012).*

*"We cannot force the communities to do things, if they are not ready for it; we can only guide them towards it and believe that in time, they will get there…"(Hay, pers. comm., 2012).*

When investigating the impact of scientific knowledge on the local network in Caprivi, it is relevant to consider the position of the actors on the macro-level. In this study, the scientific network consists of individuals trained by universities worldwide who are employed by government agencies, private foundations and knowledge institutions. They are professionals in research and development, economic progress, and globalization in a social context from which they draw power and privilege. In order to understand some political processes on the local platform, it should be recalled that they are paid to generate, transform, or use knowledge for the purpose of benefiting those powerful institutions (Sambo & Woytek, 2001). The self-interest of the scientific network in Caprivi shapes how

the natural environment is perceived and valued and how intervention measures are designed and prioritized. According to Latour (1993), a characteristic of science is to 'access' nature by establishing environmental 'facts', which then serve to portray values in the face of the public. Knowledge and values are often classified as materialistic possessions which can be given to other parties. This 'black-boxing' (Latour, 1993) is a relevant component of the struggles over questions about meaning and valuing in NRM (Long, 2001). Key concepts and notions are selected by powerful actors appointed as experts, who then attempt to convey the others of the concepts' importance (Keeley & Scoones, 1999). In Caprivi's fishery, the scientific network expects knowledge of sustainability management to be a simple set of rules which is handed to local communities. Technical experts and scientists engage in environmental education about the flaws of the shifting baseline syndrome, and the importance of conserving fish species for the purpose of economic benefit. Political processes and locally specific knowledge have often been left aside in the formation of these values, and the resulting fishery regulations and conservation projects become an unrealistic representation of a much more complex local situation (Leach et al., 1999; Keeley & Scoones, 1999; Stuart-Hill, 2005; Danielsen et al., 2008). Local fisher folk display disagreement through incompliance with fishery regulations, which in turn leads to convictions and judgments by the decision-makers, for example reflected in the claim below:

*"The main threats to the rivers are the fishermen themselves. They believe that fish never finishes. When we try to explain to them the importance of sustainability, they don't grasp it" (MFRM research technician, pers. comm., 2012).*

Knowledge in this lopsided form is the foundation for environmental debates, and becomes even further influenced and shaped through interactions with other parties' vested interests (Keeley & Scoones, 1999). Institutionalized knowledge networks open up passages for a variety of powerful actors attempting to push through personal interests (Latour, 1993). A relevant example for this is the financial dependency of fishery monitoring schemes on funding from tourist lodges in Caprivi. Since the conservancy model was established in Caprivi, tourist operators are majorly involved in motivating resource use restrictions for local communities to satisfy recreational hunters and anglers (Abbott, pers. comm., 2012).
In institutionalized forms, constructed scientific knowledge becomes valid and uncontested dogma in NRM. Only if all actors agree with this frame of meaning, power might be delegated to them (Long, 2001). An example of this is the scientific concept of using power and dominion over nature in the form of top-down control over fish resources in Caprivi. Only when this general concept is accepted by local resource users as the way forward, the management power is delegated to local communities (Long, 2001) in the legal context of conservancies and FPAs. Thus it follows that primarily scientific assumptions and approaches form the foundation for environmental intervention strategies in developing countries (Uggla, 2010) and they deeply engrain a marginalisation of deviating perspectives on the natural environment (Nader, 1996).

#### *5.1.3.2. Local participation and self-referencing in fishery management*

The process of 'self-referencing' in systems theory defines well how the scientific knowledge network filters out and transforms local knowledge on the basis of its knowledge space to make it a 'valid' addition to scientifically-developed systems. It describes the reflexive

relation that an individual may make to the own knowledge axioms, personal experiences and contextual setting when interpreting a situation (COFAD GmbH, 2002). It is part of a process of 'universalizing conceptions of thinking in order to provide general rules or principles working in all systems' (Luhmann, 1987. In: Aikenhead & Ogawa, 2007), which is [more or less coincidently] a common goal of modern science (Aikenhead & Ogawa, 2007). Self-referencing thus forms into personal 'specialized knowledge' with which practical application and the degree and the method of local participation are determined by experts.

There are numerous cases of local participation schemes worldwide in which scientific research purposefully extracts selected information from local knowledge to be applied in a different context (Danielsen et al., 2008). This often occurs in the recognition of the encyclopedic value of local knowledge. A very forthright example comes from the field of ethnomedicine. Always in search for new pharmaceutical products for western medicine, scientists study indigenous knowledge to obtain information of traditional medicine (COFAD GmbH, 2002). In a similar manner, local knowledge of fishers has long been exploited by science to fulfill objectives based on scientific worldviews, upon which it is decided what kind of information is valuable (COFAD GmbH, 2002; Danielsen et al., 2008). Wishing to reduce the distinction between applied and theoretical fishery research, conservation biologists seek out the beneficial aspects of local knowledge systems to fill in knowledge gaps (Hughes et al., 2005). Summarized in an impressive compilation of case studies in which 'the knowledge of fishers was put to work', Haggan and Neis (2007) show how scientists often deliberately seek out the encyclopedic value of local information in indigenous NRM. In a study by Souza and Begossi (2007) on the southeast coast of Brazil for example, scientists tapped into fisher's knowledge in order to establish an alternative, taxonomic folk classification of the local cetaceans. This is believed to be useful in conserving whales and dolphins.
Similarly, convinced that local fishery knowledge can contribute to providing information on species ecology and behavior, Rasalato et al. (2010) have studied local knowledge of shark fishers in Fiji. By listening to myths and anecdotes, the scientists used the knowledge of fishers to construct species lists and establish distribution patterns.
Another example of using local fishery knowledge in scientific research comes from Hamilton et al. (2011) and the Solomon Islands. The experiences of local spear fishers were used to set up a 2-year community-based monitoring project for fish spawning aggregations of two vulnerable fish species.
A similar function fulfills the event book system in conservancies and 'dependent data' collected by fishers in the context of the transboundary fishery project in Caprivi. This form of local participation is highly valued by Caprivi's scientists, for its encyclopedic value in monitoring internal changes of fishing efforts and resource use patterns (Hay, pers. comm., 2012).

These examples indicate that scientists contextualize local knowledge within their own knowledge space. They make a self-reference to scientific axioms, such as the wish for predictive validity and structure in quantitative studies of the natural environment. In Caprivi's fishery, community-based initiatives meet the requirements of MFRM, NNF and other scientific institutions, in pursuing global conservation standards for fish resources. However, establishing taxonomic classifications, species lists and predictive patterns of fish stocks are activities which are in its very nature contradictory to the characteristics that local

knowledge is principally valued for: mysticism, intuition, flexibility and adaptability (Agrawal, unpublished data).

An example of how self-referencing contests local knowledge in the discourse over NRM principles and how this complicates the communication of various knowledge holders is described by Daw (2008). He found that local attitudes towards the natural environment are shaped by internal and external forces so complex, that local responses to intervention are almost impossible to predict; for, contrary to western belief, knowledge and perceptions by local resource users are not the main factors influencing personal environmental behavior. In his study of the perceptions on fish stocks by small-scale artisanal trap fishers in the Seychelles, Daw (2008) found that despite the opinion that fish populations are declining dramatically, fishers were not in favour of enforcing effort and access restrictions. The very same phenomenon was apparent in Caprivi's fishery for which local fisher folk though fully support the idea of sustainable management, they sparsely agree and comply with state-enforced resource restrictions. While many scientific experts judge this local attitude as economic self-interest in exploiting a resource market (Harmon-Jones & Harmon-Jones, 2007; Hay, pers. comm., 2012; Abbott, pers. comm. 2012), entirely different forces might be at play in the form of complex interrelationships of perceptions, values, politics, and social and cultural conditions (Daw, 2008). In the fishery co-management arena, such mutual misperceptions reflect very often when scientists desperately complain that *"locals say one thing but do another"* (Hay, pers. comm., 2012).

In Caprivi, these contradictory processes and methodologies of scientific disciplining and selective local participation run parallel to the states' vague attempts to empower local communities in fishery management. Scientific experts and MFMR are responsible for finding rational solutions to the exploitation of the fishery. At the same time they are striving to satisfy international treaties promoting democracy and community empowerment (McGee, 2004), and sustainable development of the rural sector such as in the Agenda 21 of the UNCED Conference of Rio, 1992 (COFAD GmbH, 2002). Therefore, scientific experts selectively draw upon local knowledge to make the regulations and interventions more 'sustainable', 'relevant', 'integrated' and 'community-based' (Pitcher & Pauly, 1998; Stuart-Hill, 2005; Haggan & Neis, 2007; Danielsen et al., 2008). The irony in this attempt is that community participation becomes the tool to establish data bases and deliver environmental facts upon which scientific experts develop policies and rules of the game in NRM (Keeley & Scoones, 1999). In Caprivi, the locally-derived ecological data is used by scientific knowledge institutions to justify further restrictions for local resource users (MFMR research technician, pers. comm., 2012).

How alien scientific knowledge axioms, interests and visions for NRM may be to local resource managers was best shown by the divergent understanding by local people and external experts of the fish monitoring project in place. Local fishers and community fish monitors who are tasked by MFRM to deliver data on fish catches believe that this data serves to improve sustainability management, and at the same time stimulate the growth of the local fish market. Most interviewees were convinced that the monitoring project will have a positive outcome for their lives. The rest of the interview participants did not know what the data is being collected for. In actual fact, the primary purpose of the locally-collected data as intended by MFRM is to show negative trends of fish populations in order to justify closed seasons or FPAs (MFRM research technician, pers. comm., 2012). In this

sense local communities dig their own economic and social grave by participating in the co-management of the fishery. Through scientific concepts, such as the event book system and the collection of 'dependent data' in fisheries, local knowledge is controlled through scientific interpretation, presentation and conclusion, all of which processes have consequences for local people (Shareoff & Campbell, 2007).

## 5.2. Consequences of local knowledge contestation

The consequences of local knowledge contestation through the scientific network in Caprivi became apparent in two processes: (1) the destabilization of the local knowledge network, including the weakening of local knowledge axioms, local NRM structures, cultural institutions and knowledge transfer, but also the adoption of scientific axioms and the formation of hybrid knowledge and (2) the local resistance to and the reworking and reshaping of scientific NRM approaches, rules and regulations.
These processes may be displayed sequentially by local people or they occur separately from each other in different groups of actors. I experienced that the first process was particularly pronounced among study groups which were most exposed to disciplining and communication with the scientific network, such as conservancy staff, fishing village representatives and also commercial fishers and vendors who are influenced by market structures and the commercial fishery industry. The second process was well displayed by least privileged and powerful local actors, namely by the ordinary conservancy and community members who are pressured to adapt to conditions of local knowledge oppression to maintain survival strategies. However, also among fish monitors, community representatives and conservancy staff, this process became apparent in a more subtle way. This group of actors often becomes the direct victim of scientific and local knowledge interfaces. These selected community members act as connecting links between two knowledge spaces and are upwardly positioned within their own network as disciplining agents of local actors. At the same time, they are actors from the local knowledge space with aspirations similar to those of the rest of the community. In the observations and interviews with this study group, the incompatibility of local and scientific knowledge spaces become visible in contradictions of theoretical NRM, in other words what local actors say and envision for FPAs and conservancies, and the actual practices in informal fishery management, which are based on traditions, local axioms and culture-based priorities. These consequences of local knowledge contestation show how local actors accommodate their own interests in the face of scientific influences and pressure. Their responses can be analyzed and understood on the basis of the historical, cultural and social context of the local knowledge space. New forms of informal management structures evolve and constantly adapt in line with local agency, and they influence the sustainability management of the freshwater ecosystem and fish resources in Caprivi.

### *5.2.1. Destabilization of local knowledge network*

As described previously in this chapter, the positivism in scientific knowledge may become the driver for exerting power over local knowledge networks. Regardless of local and scientific knowledge discords, the scientific network attempts to transfer the responsibility for a fishery management that is built on foreign worldviews to the local community. Especially in co-management, the assistance and compliance of all stakeholders is important to achieve a system that is efficient and well-coordinated. In order to reach the local knowledge space and convince local communities of the adoption of scientific concepts and perceptions, the efficiency value of local participation gains meaning. By appointing local representatives as the custodians of scientific concepts, they have uprooted these politically 'privileged' community members from their knowledge space. This results in community conflicts, destabilization of the local network and the gradual disintegration of accustomed local management structures. These processes begin to develop when the scientific knowledge network contests local knowledge in its construction phase.

One example of this is the oppressed monist belief in local fishery management. As elaborated earlier, scientific actors indirectly pass on judgments of culture-based local beliefs and practices as superstitious and inferior to conservancy and fishing village staff. I noticed that this seed planted by the scientific network has taken root in the mind set of local actors. It became apparent in the hesitation of interview respondents to speak freely of interactions between spiritual and natural processes, traditional rituals and black magic. In the recognition that the monist worldview is not taken seriously, conversations were always accompanied by a lot of embarrassed giggling in all villages. This lack of recognition of culture-based methodologies also impedes local resource managers on acting upon perceived threats to the fish resources. The fish monitors explained:

*"Just like NNF and MFRM, some of the committee members do no longer believe in black magic and medicine. This is why we have not received the tools to monitor or control it" (Kasika, 15.04.2012).*

Also many of the scientific approaches to manage wildlife have shown to contest local knowledge, and thus proven to be incompatible with the local reality. Implemented strategies reflect the reductionism, but severely lack the holistic worldview in order to make them sustainable and relevant in the local context. Wildlife conservation in Caprivi for example, is viewed in too much isolation of the decentralization process of local communities. The need to conserve threatened animal species and boost wildlife population numbers is an undisputed exogenous goal controlled by powerful institutions. De Vette (unpublished data) describes how this process conflicts with the wish of conservancy members to protect themselves and the fields from crop raiding and predator attacks. In the face of prearranged goals, local communities feel completely powerless and in constant conflict between what they want, what they need and what they must do to satisfy the legal ties to the scientific network. This separation of local realities also results in ambivalent outcomes: Successes of increasing numbers of wildlife on the one hand and increased killings of fishers by hippos and crocodiles on the other.

The contestation of holistic and survival-strategic approaches to tackle conflicts with animals severely impacts on the quality of life of local actors. State-enforced regulations inhibit the

ability of local communities to address problems and adapt coping mechanisms which are deeply culture-based and specifically target the local reality. Such ties to bodies of the state are experienced as a heavy burden, and conservancy members frequently complaint about the increasing numbers of wildlife threatening crops and people (Sikunga, 29.03.2012; Impalila, 11.04.2012; Kasika, 15.04.2012; Mayuni, 5.06.2012).

*"Since the conservancies, the wildlife populations have increased, but we are no longer allowed to protect ourselves. Hippos, elephants, buffalos and crocodiles are feared. We cannot keep all these animals in check. We are struggling to live here peacefully" (Impalila, 12.04.2012).*

Referring back to the priority of local communities elaborated in chapter 3, not being able to live in peace and harmony with the natural environment is certainly one of the most severe consequences impacting on the local network. In addition to this, a lack of compensation for the damage, that is perceived to be the fault of conservancies and FPAs, results in disbelief and feelings of helplessness.

*"The biggest challenges are that we do not receive enough compensation for wildlife incidents. Hippos and crocodiles damage expensive nets. The committee wants us to pay for the swamp that the fish is coming from. We must also help paying for the rent of the canoe and the fishing permit from the ministry. Nothing is left for us; all the benefits go to the conservancy and the privileged people who support the conservancy" (Sikunga, 29.03.2012).*

The ties to the scientific network moreover lead to a weakening of community structures and knowledge transfer within the local network. Contesting local knowledge inhibits personal growth of community members, such as in the case of the fish monitors who are not allowed to continue far-distance academic studies. For the fish monitors who are still young and ambitious, the situation appears hopeless and incontestable and they do not foresee a promising and fulfilling career within the conservancies. Moreover, the identities of individuals who are subject to reductionism in scientific fishery management are threatened. When delegated one exclusive function by governmental institutions, a fish monitor for example who is a former fisher, vendor, community member and friend of other fishers loses his or her place in the group.

*"We have no good position in the community anymore, and life in the group is a constant struggle…" (anonymous).*

Also elderly community members showed great difficulties in maintaining a position within their communities due to unequal power relations. This was confirmed by De Vette (unpublished data), who investigated the role of elderly people in Caprivian conservancies and found a growing separation and inhibited knowledge transfer and collaboration between young and elderly local actors. One of the consequences of this was felt by the fish monitors, all of them no older than 22 years:

*"….elderly people are losing power and are not heard by the rest of the community anymore. They are frustrated with us, and don't want to listen to us fish monitors. They tell us: 'You are too young to tell me how I should fish' " (Impalila, 11.04.2012).*

It is somehow ironic that many interview respondents explained a feeling of dependency on scientific tools for local participation and community-based conservancy management, in

order to overcome the problems that have arisen from these concepts in the first place. The reliance of support and advice from scientific and state institutions in the overall strive for independency and emancipation becomes a contradiction in itself. The influence of the scientific knowledge network is especially strong on community representatives and conservancy staff who are the direct recipients of scientific disciplining and education in Caprivi. While the way knowledge is constructed by fishers and vendors typically reflected local knowledge axioms, how this local knowledge is prioritized and put into action by 'privileged' and 'empowered' conservancy and fishing village committees seems severely inhibited. I could clearly perceive a process of shifting responsibility to trusted and respected educated experts, who are seen as advantaged and more knowledgeable by many people.

Unmistakeably apparent in Caprivi's fishery was an overall acceptance of scientific methods, technologies and concepts, which replace certain aspects of local knowledge in the local space. De Vette (unpublished data) made the observation that conservancy committees frequently equate scientific conservation methods with being 'more civilised' and desirable for rural development. Through theoretical and practical contestation of local knowledge it seems that it gradually deteriorates; losing velocity and meaning also in the mind sets of fisher folk, as described by a middle-aged fisher with many young siblings:

*"Young people have forgotten the old ways of fishing in a sustainable and responsible manner. The older generations should teach them, but they are losing respect from the younger people more and more" (Impalila, 12.04.2012).*

In the phases in which priorities are set and methodologies developed by the local respondent group, I could thus hardly identify the local knowledge axioms that characterize adaptive management; a fact that clearly indicates the institutionalization of local knowledge contestation. Most frequently observed instead were the dynamic and innovation axioms, showing that change is brought into the local knowledge network through the pressure from the scientific network. Further noticeable in the conservancy management was the anthropocentrism axiom, typically found in western societies and possibly stimulated through scientific disciplining. Visions of the local network regarding the sustainable management of fish to derive long-term economic benefit were expressed through phrases which I encountered frequently in interviews, in project plans and in education programs from the scientific knowledge network.

The contrary extreme of the replacement of traditional local beliefs, structures and management approaches with scientific or hybrid forms of knowledge, is to leave the confines of the conservancies in order to settle in the town of Katima Mulilo, in Windhoek or even South Africa. The aspiration to leave the community was expressed by local actors with the least amount of say in planning phases of conservancy and FPA management. Subsistence fishers, adolescents and elderly people appeared burdened with a feeling of inferiority and self-doubts. Almost all ordinary conservancy and community members said that they would swop their life in the rural setting in Caprivi for academic careers and a life in the city; and the majority of the informants' children have done precisely that, explained an elderly fisherman in Impalila:

"*Now, all the young people are leaving. They see no future here" (Impalila, 12.04.2012).*

### *5.2.2. Local resistance and reworking of NRM approaches*

Although structural changes in NRM as a result of intervention from the scientific network are unmistakably apparent in local knowledge networks, Long (2001) urges not to analyse conditions of oppression and marginalisation purely on the basis of external determination. An actor-oriented approach recognizes that scientifically-driven conservation projects impacting on the daily lives of local resource users are not simply passively borne out by the local network, but that they are uniquely interpreted and assessed, triggering transformation and reworking of alienated rules and regulations in order to accommodate culture-based interests.

In Caprivi, this process has for example shown in the resistance against regulations and conservancy management rules that target sustainable management of wildlife and fish resources. Despite scientifically-driven rules for sustainable NRM, the need to act and respond to threats from wildlife and the need to meet basic livelihood requirements remains a local reality, which pressures the local network into adapting alternative solutions and survival strategies. Particularly elderly people who feel tied to the confines of the villages and conservancies turn their back to the prevailing system in response. This actor group described feeling excluded from conveying knowledge and interest in the knowledge construction phase, and their marginalized position in the conservancy leads to the overall rejection of the model. Many elderly interviewees displayed a careless attitude towards the rules of the conservancy, such as the one below:

*"I don't care what the committee says. We just do our own thing here" (Kasika, 15.04.2012).*

Also supported by findings by De Vette et al. (2012) in an analysis of community structures in Namibian conservancies, elderly conservancy members experience great difficulties in adapting to 'modern' NRM approaches. As conservancy policies severely inhibit elderly members to meet protein needs through hunting and fishing, the laws of 'white men' are met with resistance (De Vette et al., 2012). Elderly people disappointedly and angrily judge the conservancy committees and disobey the rules that come with it. They continue traditional practices, or even intensify hunting and fishing with destructive gear, unlicensed nets with illegal mesh sizes and mosquito nets for example. Such defiant behavior reminds of this situation in a forest community in Malawi described by several authors: The large scale illegal cutting of trees inside a National Park was perceived as morally justified by the local community in response to the grievance against the proclamation of surrounding communal lands for the park (Kayambazinthu & Locke, 2002).
Similarly, through the restrictions on wildlife hunting in Caprivian conservancies, locals might easily feel enticed to exploit the fishery as the only protein source with at least a degree of open-access. Currently, the local knowledge network is not held up much in using illegal or destructive fishing gear, but with the upcoming FPAs and improved infrastructure for patrols and law enforcement, these 'wrongdoers' will be disciplined, even punished, and most certainly hindered in practicing their livelihood in traditional forms (MFRM research technician, pers. comm., 2012). Justly concerned as a conservancy-supporting NGO, IRDNC predicts that closed seasons and FPAs will have severe negative consequences on the

livelihood of fisher folk (Mwema, pers. comm., 2012), which may eventually show in careless, excessive and destructive fish exploitation.

The contestation of local knowledge in the implementation of the conservancy or the FPA model has also created conflicting motivations and priorities for land management in Caprivi. The current land-tenure arrangement reflects the reductionism in scientific knowledge, and the separation of the local realities into distinct units and individual functions. Conservancy members are assigned the custodians and on-the-ground proprietors of conservancy areas of land which remains owned by the state. Ministry staff and scientific advisors motivate, promote and enforce sustainable NRM measures. Scientific disciplining of the local network incentivizes the future benefits of conserving natural assets and resources. However, the uprooting of local resource managers from their home land causes local resource users to become practically and emotionally disconnected from their communal land (Gruber, 2010). Because conservancy members are restricted in limiting unwanted incursions and resource exploitation by outsiders, and because the government does little to change these situations, local resource users start perceiving communal land as open-access. Other examples of CBNRM projects based on this type of land-tenure have indicated that a disconnect of management and ownership motivates local people to exploit natural resources excessively, in order to secure immediate benefits before they become depleted by outsiders (Gruber, 2010).

The contestation of local knowledge also shows to change community arrangements and social institutions. The conservancy model has led to the formation of new elites, formed by conservancy committee staff (De Vette et al., 2012). The findings in this study showed that ordinary conservancy and community members marginalise and boycott wishes of local actors who are assigned privileged community representatives roles. Feeling betrayed and left alone by the conservancy committee, most conservancy members lose the interest in conserving wildlife. As a consequence, conservancy staff no longer makes attempts to motivate, cooperate or even represent the community (De Vette et al., 2012). The conservancy establishment and the idea of sharing benefits equally among community members who no longer stand and vouch by each other, rather stimulated divergent and separate livelihood operations and lives. While more and more engagement with the scientific network leads to a severe weakening of local knowledge axioms among conservancy staff on the one hand, the rest of the community responds with an intensification of traditional local NRM practices. De Vette et al. (2012) have described the increasing gap especially between young generations following the ‘modern’ principles of the conservancy, and older generations who hold onto traditions even tighter. The growing wildlife populations and a greater fear of not being able to supply basic livelihood needs in conservancies and FPAs, for example lead to considerable increase of the use of black magic in Caprivi. According to Kohnert (1996), this phenomenon is well-known among African cultures which become oppressed by powerful state-bodies and restricted in exercising traditional forms of land management. In many African tribes, black magic forms one of only very few powerful tools that allow local people to improve survival strategies in the face of legal resource use restrictions. Despite the scientific Cartesian dualism and the doubts of the working of spiritual and magical forces in conservancy management, the fear of resource exploitation and curses and killings of local people however is undeniable fact, and it grows steadily with increasing use. Two 18-year old community members in Kasika explained to me:

*"Life here is very dangerous. We are no supporters of the conservancy. We are just preparing and hoping to leave this place soon. And we are not the only ones… " (Kasika, 15.04.2012).*

The contestation of local knowledge by the scientific network pressures local actors into reworking local knowledge in Caprivi's fishery to accommodate culture-based priorities. In this process local actors may allow the disintegration of traditional forms of local management and local axioms, they may adopt scientific or hybrid forms of knowledge, or they may entirely resist the scientific network and reshape institutionalized rules of the game.

## 5.3. Conclusive remarks

This study does not serve to dispute scientific knowledge in its inherent sense. It recognizes that it cannot be understood as being less 'situated' than local knowledge. Conventionally it has been argued that local knowledge is deeply embedded in the daily realities of local people and generated through immediate necessities. Scientific knowledge on the other hand was thought to construct general explanations alienated from the daily lives of people. In Western societies, science *is* a major part of the daily lives of people (Agrawal, unpublished data). Scientific knowledge and ways of reasoning can thus be seen as local knowledge, 'situated' in the western world (Haraway, 1988). The scientific network encompasses a powerful way of knowing nature, comprising knowledge appropriated over the ages from many different cultures, which was modified sufficiently to fit the scientific space and modern worldviews (Aikenhead & Ogawa, 2007). Neither fishers nor scientific perceptions of the fishery management and the state of the resources can be considered the 'true' picture (Daw, 2008). The perceptions are formed in different contexts which influence the chosen intervention approach of resource managers. Due to the locally-specific adaptation of technical solutions, I argue that purely Western-oriented methods and policies do not fit into the local knowledge space as a static and blue-printed version, as they fail to address site-specific social, political and cultural problems appropriately (Shakeroff & Campbell, 2007).

In my view, the positivism axiom in the scientific space is the greatest inhibitor in allowing a shift towards autonomous fishery management by the local network. The sincere belief that, through its value-free, objective, neutral and universal mean of viewing nature, scientific knowledge forms the ultimate rationality (Holton, 1978), the local network is denied every possibility to show otherwise in the form of legal management rights. The criticism of scientific experts may be based on negative experiences with local management systems in NRM. Local knowledge is very place-based, and up to this day it has seemingly succeeded in managing Caprivi's fisheries sustainably on a local scale. Problems seem to arise mainly when the local network is challenged to comprise the bigger picture, including illegal fishing, market forces, globalization, commerce and migrations. When local knowledge and forms of resource management have to exceed place-based experiences, skills and emotions, the attributes of local practices seem to lose value in sustainable NRM based on scientific principles and standards. On the contrary, local worldviews and practices in the wide scope of fishery management may even develop into counterarguments held against local resource

managers by scientific experts. This is shown in the example of the tendency of local communities to live sensibly and economically with natural resources, which seems to disintegrate under the influence of intensified commercialization. While no fish ever goes to waste in subsistence fishing communities, in semi-commercial villages increasingly larger amounts of fish need to be transported to the markets. The absence of refrigerators causes fish to rot; a condition which is accepted and unmanaged. It indicates that difficulties regarding sustainability management occur when local becomes regional, national or international. Upon such critical developments in the local network, it appears justified in the scientific network to point fingers and judge the local fisher folk as *'being greedy and wanting profit (Munali, pers. comm., 2012)'.*

The profit-driven attitude may call to mind a similarity to knowledge that has originated in developed, wealthy and industrial countries. Based on the experiences with culture-based, scientific paradigms in his own knowledge space, Mr. Munali from IRDNC expects that: *"…man is ever-wanting. If you give him few, he wants it all. That's why there are wars over natural resources."*

The inhibiting consequences of scientific positivism on community emancipation can also be seen in the more general CBNRM discourse and its long list of opponents' concerns. Child & Lyman (2005) summarized the counterarguments for decentralizing resource management from an extensive amount of critics. From (1) an overall lack of trust in the ability of non-professionals to manage resources sustainably, to (2) the belief that local communities are incompetent, to (3) that traditional management systems are chaotic, informal and lack rigour, coupled with (4) the opinion that commercial use of natural resources is always bad, these concerns represent the opinions of scientific actors in Caprivi very well. Furthermore, it is believed that the top-down governmental control over natural resources is working efficiently and that CBNRM is seeking a non-existing problem. In this regard, some professionals argue that it is not advisable to disenfranchise most viable and relevant national interest for local knowledge driven by economic self-interest (Child & Lyman, 2005).

I argue that changes in local interests and practices are not inherently negative attributes deriving from local knowledge spaces, but that they are the responses of local actors to external influences. They are generated within the context of local knowledge spaces, by local actors somehow aiming at accommodating their interests and requirements in a scientifically-driven and state-controlled NRM system. This study has clearly indicated that the local network is by no mean static and disinclined to changes. Local resource users always have been, and always will be influenced by external environmental, social and political conditions. The dynamic and innovative nature of the local network leads to adaptations which are rationally investigated on the basis of culture-based axioms within the knowledge space. Caprivi's local network has well displayed how receptive local actors are to scientific disciplining and education. Especially those groups engaging most directly with the scientific network showed a tendency to adopt scientific ways of perceiving the environment. In a similar way, the local group of vendors and commercial fishers which is directly exposed to market forces, commercialization and financial incentives has shown a re-orientation of traditional interests and priorities from meeting basic needs to a focus on economic surplus. Considering this argument, it follows that exceeding local boundaries in any practical or theoretical sense often proves conflicting in local knowledge networks. Influences from the scientific network and extraneous priorities and methodologies in fishery management are thus also often locally incompatible and unsustainable.

Instead of imposing alienated concepts to rural communities, the value of local knowledge and decision-making in NRM should be celebrated as important national resources, which can teach lessons to Western societies and scientific knowledge networks (Warren, 1991). In Namibia's striving for rural development, it is only sensible and sustainable to include the adaptive nature of local management systems. Shackeroff & Campbell (2007) thus urge to generate greater tolerance and respect for the diversity of knowing. The local network in this study expressed a strong wish for greater recognition and emancipation of local knowledge, skills and practices. Despite contestations by the scientific network, many local actors are proud of their culture-based knowledge. The conservancy manager of Impalila expressed his faith in local fishery management, but also his concern in the face of scientific disciplining and self-referencing:

*"Our knowledge is important. Scientists watch how we live and they write books about it. They give us advice, on how we can put our knowledge into formal concepts. They combine it with their knowledge and give us books to study this. Most people don't recognize our knowledge, unless it is put into their language" (Impalila, 11.04.2012).*

Indeed, the scientific network in Caprivi mainly recognizes the encyclopedic and efficiency value of local knowledge; knowledge which can be formulated in books and management plans. For this, it stimulates adaptive and institutional changes towards greater incorporation of a diversity of technical strategies and social institutions, such as the conservancy structure or community-managed FPAs. On the one hand this shows that the scientific network recognizes the importance of incorporating the social and cultural context of local knowledge. However, a seemingly skewed self-image makes individuals overlook the context of their own knowledge and the flaws of scientific paradigms in analyzing the local conditions (Forsyth, 2003). Thus, the scientific network often displays one-sided practical and instrumental valuation of local knowledge, which insufficiently addresses cognitive conflicts. A general intolerance to the nature of a different knowledge space is displayed in processes of self-referencing, disciplining and community oppression. As an unfortunate consequence of local knowledge contestation, local resource managers find themselves inhibited in exercising the integrated and adaptive fishery management that local knowledge networks is cherished for in scientific approaches to sustainable NRM (Agrawal, unpublished data).

During the course of this study it remained unclear to me how the scientific network imagines stimulating decentralization in transboundary fishery management. Whether the state and scientific advisors actually wish for autonomous fishery management by the local network is doubtful. Current strategies rather target efficient cooperation of all actors, including increased community participation, in order to build a stable co-management platform with legal and informal ties to the scientific knowledge space. Through scientific methodologies based on self-referencing and conditional local participation, the emancipation value of local knowledge is contested and marginalised. This indicates that the empowerment of local resource managers may be no more than a vague vision for Caprivi's fishery. In reference to the statement by Dr Hay: *"We may fine-tune the local system… but we can only steer a moving ship"* the scientific network represents the captain of a local ship, that carries cargo with encyclopaedic and efficiency value. It indicates that institutionalised fishery management in Caprivi will never exceed the stage of 'local participation' to steer into the harbour of the scientific knowledge space.

A requirement for local emancipation is that, not only the local system, but also the 'knowledge carrier' receives greater attention and recognition (Sanchez, 2001). Considering that *knowing* and *the knower* are inseparable in local networks, it is important for local people to maintain the rights over *all* the elements in their local spaces (Agrawal, unpublished data); including the way knowledge is constructed, prioritized and applied. This postulates that the scientific network fosters a sincere interest in local self-determination and decentralization of NRM. In order to exploit the emancipation value of local knowledge and to generate independency of the local network, Wiersum (2000) predicts that a paradigm shift is necessary. A first step towards true emancipation of the local network is the recognition of the intrinsic value of local knowledge by the scientific network (Wiersum, 2000). Just like the local network is able to adopt scientific ways of knowing nature, such as anthropocentric valuation of resources, I believe the scientific network is able to reconsider scientific axioms by becoming aware of its nature and its flaws. Regardless how deeply local knowledge contestation is engrained in the scientific space, this should not matter if the local knowledge space becomes the generator of knowledge construction, prioritization and methodologies in Caprivi's fishery management, either in a co-managed form with equal power distribution, or an autonomous form of local fishery management.

In reference to the conceptual model of this study (fig. 1), I suggest that autonomous fishery management by the local network can only be achieved by swopping the position of the local space with the position of the scientific space. The local space can thus directly shape and influence the fishery management contextually-specific and in accordance with local agency. This does not exclude the communication and guidance from scientific networks.

Instead of describing local and scientific knowledge as direct opposites in the context of false dichotomies, current views recognizes both ways of knowing as being culturally-based heterogeneous, valuable and potentially co-existent in NRM. This is in line with the suggestion by McGee (2004) that spaces in environmental management debates form opportunities for collaborative learning and the generation of hybrid knowledge within new spaces, which are free of the ideological baggage of either of the two knowledge networks. They have thus great potential in meeting priorities and interests of both knowledge networks alike. Instead of choosing one or the other approach, the manager of Impalila conservancy explains how sensible integration of both may look like in practice:

*"We recognize that things have to change all the time and we appreciate external assistance. But we also want to keep useful aspects from our culture. We now have elements from both worlds: traditional medicine and modern hospitals. Both types of knowledge can be brought together. They can become one and benefit our management. Training can broaden our horizon. New knowledge does not need to replace any of the former knowledge. New technologies, such as more modern fishing gear benefits our fishermen. Fishing with nets provides a better protection against crocodiles, when compared to traditional methods for example" (Impalila, 11.04.2012).*

An important requirement leading to the acceptance of scientific knowledge thus seems to be that it is not forcefully introduced. In order to make NRM strategies truly sustainable and stable in the local context, it is important that local communities receive the opportunity to experience, live and adapt knowledge in order to 'situate' it in the local setting.

For a holistic, efficient and sustainable co-management on the other hand, both knowledge spaces should directly feed management structures. This would prevent that self-referencing and disciplining uproot knowledge from its context before it is constructed, prioritized and applied in fishery management. Also in this scenario, communicating and collaboratively learning between both knowledge spaces should occur. The dynamic and innovative nature of local knowledge spaces may support the development of hybrid forms of local management, as long as they prove culturally-based valid.

CBNRM projects must take into account that deviating worldviews, perceptions and values regarding the environment inherently contain alternative forms of NRM approaches. External intervention through the scientific network might be able to shape these, but they will never have the power to determine and control social structures and local forms of NRM (De Vette et al., 2012). Local actors will always re-orientate the reasoning, planning and acting according to the local circumstances, resulting in specialized knowledge that is mediated in the context of local realities. This study has shown that local knowledge is inimitable in the context of scientifically-driven conservation projects, as responses to external intervention cannot be easily foreseen and anticipated (Long, 2001). It is important that the local actor is not simply viewed as a part of a social category and a passive recipient of external intervention, but as active participant who responds with complex engagements with local and exogenous institutions and actors. In capturing cultural heterogeneity to explain social development and cultural change, sociologists and economists should give up on approaches that are too universal and linear in nature (Alexander, 1995). Clearly missing in NRM discourses are in-depth analysis of the interrelation of modern and traditional forms of livelihood, consumption, production, sustainability management and identity (Long, 2001). Taking on a purely structure-oriented approach to development analysis most often leads to unrealistic, simplified predictions about the outcomes of a conservation project. The actor-oriented approach on the other hand is often too focused on the study of individual's interests, motivations and intentions, but disregards the structural context in which they have formed. A more accurate and meaningful analysis of social development may be a complex mixture of these two approaches. An analysis of knowledge spaces forms such an appropriate opportunity to investigate human agency in response to external intervention and it can aid in understanding heterogeneous local responses and changes in NRM structures.

The empirical findings in this study once more confirm the historical-political repression of local knowledge by privileged and powerful scientific networks. In light of the interference with the construction, the prioritization and the application of local knowledge in the fishery management in Caprivi, I can verify that local knowledge is contested by the scientific knowledge network. This contestation seems to be partly the result of intended oppression in order to enforce scientific goals and interests, such as the wish for a closed season in fisheries, or it may be due to deeply rooted and often subconscious differences in the way the natural environment is perceived, valued, known and managed. However, instead of experiencing a local network which passively receives and accepts interventions and influences from a socially and politically more powerful scientific network, I was exposed to entirely new and informal local management structures, which deserve some further investigation in future studies.

## 5.4. Reflections on theoretical and methodological research approach

I visited Caprivi with the initial intention to study interests, practices, social institutions, values and beliefs of local communities and their relevance for participatory monitoring of freshwater ecosystems. I based my hypothesis on the assumption by Danielsen et al. (2008) that the degree of local participation in CBNRM and the scope of empowerment of local people varies between different projects, as some situations are believed to require more scientific expertise than others (Danielsen et al., 2008). Looking at a variety of CBRNM initiatives in developing countries, the authors have come up with a typology of five categories describing the relative amount of engagement by local people and external scientists. The categories vary from expert-driven and no local involvement in category 1, to autonomous monitoring without external scientific involvement in category 5. The event book system for Namibian conservancies is listed under category 4. I suspected that the scientific network in Caprivi's fishery may, though well recognizing the encyclopaedic and efficiency value of local knowledge by stimulating local participation in resource monitoring, marginalize local opinions, interests and wishes in planning and designing such conservation schemes. In this sense, I expected that scientific actors largely overlook the emancipation value of local knowledge. In an ethnographic study that allowed me to interact with the local network closely, and through an open research approach that left freedom for local actors to express their concerns, problems, wishes and beliefs, I realized that precisely studies like mine contribute to undermining the emancipation of local communities in NRM. Participatory observations of local livelihood practices and open interviews showed that resource monitoring in the conventional sense is a foreign concept and of no priority to local resource users in local fishery management. Introducing resource monitoring schemes like the event book system to CBNRM merely reflects scientific interests and standards.

Having read Aikenhead and Ogawa (2007) and the description of local and scientific knowledge axioms prior to my visit to Caprivi, the characteristic perceptions and views on nature inevitably stroke me as unmistakably apparent in the local network. I also realized that the descriptions of struggles and difficulties that local resource users are facing through the presence of the scientific network are due to fundamental differences in the way natural resources are perceived, valued and managed. Therefore, I decided to focus my study on the mismatches between the local and the scientific worldviews, and to highlight how these lead to the contestation of local knowledge in practice.

As the interface of the local and scientific network is very pronounced in Namibian conservancies, the situation in Caprivi's fishery management formed an excellent case study for the exploration of different knowledge spaces in NRM. Assuming an emic perspective during RRA and semi-structured interviews proved as an important element in investigating the local knowledge space. It made me see the concerns and struggles of local actors and their culture-based knowledge in conservancy and fishery management.

An opinion study and semi-structured interviews in combination with secondary data sources showed to be an appropriate strategy to explore the scientific knowledge space. The

literature study entailed searching documents such as power point presentations for workshops of the scientific network, project plans and regulations. The scan of secondary data sources completed the empirical findings of the opinion-study well. During the course of this study, I experienced the prevalence of scientific axioms in my own perception on nature and conventional ideas of NRM. I became aware of the flaws of scientific axioms in the way I attempted to structure and analyze data. Moreover, the positivism regarding personal standards for sustainability management inhibited me in drawing conclusions and giving recommendations in favour of autonomous management of freshwater resources by Caprivian communities. Investigating the nature of local knowledge spaces by entering their daily realities on the other hand has provided me with a greater understanding of local beliefs and practices, and thus with a greater respect for alternative ways of *knowing nature*.

Thus, I made the personal experience that an analysis of knowledge spaces aids in understanding how new forms of local management develop within the social, cultural and historical context of knowledge, and that such understanding forms the most important step in recognizing the emancipation value of local knowledge in CBNRM.

# *Reference list*


Abbott, J., Campbell, L. Hay, C., Næsje, T., & Purvis, J. 2007. Vendor livelihoods in the Upper Zambezi River floodplains. *Human Ecology 35*: pp. 559-574.

Abbott, J., Campbell, L. Hay, C., Næsje, T., Ndumba, A. & Purvis, J. 2007. Rivers as resources, rivers as borders: Community vs. transboundary management of fisheries in the Upper Zambezi River floodplains. *Canadian Geographer 51*: pp. 280-302.

Abbott, J. & Campbell, L. 2009. Environmental histories and emerging fisheries management of the Upper Zambezi River floodplains. *Conservation & Society 7*: pp. 83-99.

Adams, W. M., Brockington, D., Dyson, J. & Vira, B. 2003. Viewpoint: managing tragedies: understanding conflict over common pool resources. *Science 302(5652):* pp. 1915-1916.

Agrawal, A. & Gibson, C. 1999. Enchantment and disenchantment: The role of community in natural resource conservation. *World Development 27(4):* pp. 629-649.

Agrawal, A. 2002. Indigenous knowledges and the politics of classification. *International Social Science Journal 173*: pp. 325-36.

Agrawal, A. Indigenous knowledge- Some critical comments. University of Florida, unpublished data.

Aikenhead, G.S. & Ogawa, M. 2007. Indigenous knowledge and science revisited. *Cultural Studies of Science Education 2*: pp. 539-620.

Alcorn, J. B. 1995. Big conservation and little conservation: collaboration in managing global and local heritage. In: G. Dicum (ed.). Local heritage in the changing tropics: innovative strategies for natural resource management and control. Yale University Press, USA.

Alcorn, J. B. 1997. Science in service of indigenous communities: How can biologists help local people conserve biodiversity? *American Journal of Botany 84 (6).*

Alexander, J. 1995. Fin de Siécle social theory. Verso, London, UK.

Aswani, S. & Hamilton, R.J. 2004. Integrating indigenous ecological knowledge and customary sea tenure with marine and social science for conservation of Bumphead Parrotfish (*Bolbometopon muricatum*) in the Roviana Lagoon, Solomon Islands. *Environmental Conservation 31*: pp. 69–83.

Aswani, S., Albert, S., Sabetian, A. & Furusawa, T. 2007. Customary management as precautionary and adaptive principles for protecting coral reefs in Oceania. *Coral Reefs 26:* pp. 1009–1021.

Balarin, J. D., Jensen, A. & Ndovi, W. 2001. Developing CBNRM planning and implementation tools. Proceedings at national conference to develop CBNRM strategic plan for Malawi, COMPASS: pp. 14.

Barrett, N., Edgar, G. & Morton, A. 2002. Monitoring of Tasmanian inshore reef ecosystems. An assessment of the potential for volunteer monitoring programs and a summary of changes within the Maria Island Marine Reserve from 1992–2001. *Tasmanian Aquaculture and Fisheries Institute Technical Report Series:* pp. 53.

Barnes, B. & Shapin S. (eds). 1979. Natural order: Historical studies in scientific culture. Sage Publications, UK.

Barnhardt, R. & Kawagley, A. O. 2005. Indigenous knowledge systems and Alaska native ways of knowing. *Anthropology and Education Quarterly 36*: pp. 8–23.

Battiste, M. & Henderson, J. Y. 2000. Protecting indigenous knowledge and heritage. Purich Publishing, Saskatoon, Saskatchewan.

Berkes, F. 1999. Sacred ecology. Traditional ecological knowledge and resource management. Taylor & Francis, Philadelphia, Pennsylvania.

Berkes, F., Colding, J. & Folke, C. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications 10*: pp. 1251–1262.

Boudreaux, K.C. 2010. Community conservation in Namibia: Devolution as a tool for the legal empowerment of the poor. *Working Paper No. 10 – 64 (9).* Mercatus Center, George Mason University.

Brandon, A., Spyreas, G., Molano-Flores, B., Carroll, C. & Ellis, J. 2003. Can volunteers provide reliable data for forest vegetation surveys? *Natural Areas Journal 23:* pp. 254–262.

Brandon, K. & Wells, M. 1992. Planning for people and parks: design dilemmas. *World Development 20*: pp. 557–570.

Bray G.S. & Schramm H. L. Jr. 2001. Evaluation of a state-wide volunteer angler diary program for use as a fishery assessment tool. *North American Journal of Fisheries Management 21*(6): pp. 606–615.

Brody, H. 1982. Maps and dreams. Pantheon Books, New York.

Brosius, J.P. 1998. Representing communities: Histories and politics of community-based natural resource management. *Society and Natural Resources* 11: pp. 157.

Brown, D.N. & Pomeroy, R. S. 1999. Co-management of Caribbean community (CARICOM) fisheries. *Marine Policy. 23(1):* pp. 549–570.

Bunce, M., Rodwell, L.D., Gibb, R. & Mee, L. 2007. Shifting baselines in fishers' perceptions of island reef fishery degradation. *Ocean and Coastal Management 51(4*): pp. 285–302.

Butz, D. & K. Besio. 2004. The value of autoethnography for field research in transcultural settings. *The Professional Geographer 56(3):* pp. 350–360.

Cajete, G. A. 2000. Native science: Natural laws of interdependence. Clear Light, Santa Fe, NM.

Caldecott J. 1998. Designing conservation projects. Cambridge University Press, UK.

Campbell, L. 2000. Human need in rural developing areas: perceptions of wildlife conservation experts. *Canadian Geographer 44(2):* pp. 167-181.

Campbell, L. & Vainio-Mattila, A. 2003. Participatory development and community based conservation; Opportunities missed for lessons learned? *Human Ecology 31 (3):* pp. 417-437.

Castellano, M. 2000. Updating Aboriginal traditions of knowledge. In: G. J. S. Dei, B. L. Hall, & D. G. Rosenberg (eds.). Indigenous knowledges in global contexts: Multiple readings of our world: pp. 1–36. University of Toronto Press, Toronto, Canada.

Chambers, R. E. & McBeth, M K. 1992. Community encouragement: Returning to the basis for community development. *Journal of the Community Development Society (*23): pp. 20-38.

Child, B. & Lyman, M. (eds). 2005. Natural resources as community assets. Sand County Foundation and The Aspen Institute, Madison, USA.

Chinn, P. 2006. Preparing science teachers for culturally diverse students developing cultural literacy through cultural immersion, cultural translators and communities of practice. *Cultural Studies of Science Education, 1*: pp. 367–402.

Chitere, O.P. (ed). 1994. Community development: Its conceptions and practice with emphasis on Africa. Gideon S. Were Press, Nairobi, Kenya.

COFAD GmbH, 2001. Back to Basics- traditional inland fisheries management and enhancement systems in sub-saharan Africa and their potential for development. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Germany.

Combe`s I., Justiniano N., Segundo I., Vaca, D. & Vaca, R. 1998. Kaa-Iya reta: los duen˜os del monte. *Technical Paper No. 40. Kaa-Iya Project.* WCS and CABI, Santa Cruz, Bolivia.

Corsiglia, J., & Snively, G. 1995. Global lessons from the traditional science of long-resident peoples. In: G. Snively & A. MacKinnon (eds.). Thinking globally about mathematics and science education: pp.25–50. University of British Columbia, Centre for the Study of Curriculum and Instruction, Vancouver, Canada.

Danida. 2000. Towards 'best' practice in biodiversity conservation in southern Africa. Royal Danish Ministry of Foreign Affairs, Copenhagen, Denmark.

Danielsen, F.; Burgess, N.D.; Balmford, A. Donald, P.F.; Funder, M.; Jones, J.P.G.; Alviola, P.; Balete, D. S.; Blomley, T.; Brashares, J.; Child, B.; Enghoff, M.; Fjelds°A, J.; Holt, S.; Hubertz, H.; Jensen, A.E.; Massao, J.; Mendoza, M.M.; Ngaga, Y.; Poulsen, M.K.; Rueda, R.; Sam, M.; Skielboe, T.; Stuart-Hill, G.; and Yonten, D. 2008. Local participation in natural resource monitoring: a characterization of approaches. *Conservation Biology, 23(1):* pp. 31–42.

Daw, T.M. 2008. How fishers count: engaging fishers' knowledge in fisheries science and management. Ph.D. Thesis, School of Marine Science and Technology, and School of Geography, Politics and Sociology, Newcastle University, Newcastle upon Tyne, UK.

De Vette, M. 2009. Emergent properties in community-based natural resource management-The case of conservancy formation in Caprivi, Namibia. Wageningen University, unpublished data.

De Vette, M., Kashululu, R. & Hebinck, P. 2012, Conservancies in Namibia: A discourse in action. In: B. Arts, S. van Bommel, M. Ros-Tonen & G. Verschoor (eds.). Forest-People Interfaces: pp. 121-139. Wageningen Academic Publishers, Wageningen.

Denzin, N.K. 1992. Symbolic interactionism and cultural studies. Blackwell, Oxford.

DeWalt, K. M. & DeWalt, B. R. 2002. Participant observation: a guide for fieldworkers. Alta Mira Press, Walnut Creek, CA.

Dulvy, N.K. & Polunin, N.V.C. 2004. Using informal knowledge to infer human-induced rarity of a conspicuous reef fish. *Animal Conservation 7:* pp. 365–374.

Dyck, L. 1998. An analysis of Western, feminist and Aboriginal science using the medicine wheel of the Plains Indians. In: L. A. Stiffarm (ed.). As we see...: Aboriginal pedagogy. University Extension Press, University of Saskatchewan, Canada.

Elkana, Y. 1971. The problem of knowledge. *Studium Generale 24:* pp. 1426–1439.

Etzioni, A. 1996. Positive aspects of community and the dangers of fragmentation. *Development and Change 27*: pp. 301–314.

Fetterman, D.M. 1989. Ethnography: step by step. Sage Publications, CA, UK.

Fishbase Website. 2012. Available at: http://www.fishbase.org/search.php. Accessed on: 27-10-2012.

Forsyth, T. 2003. Critical political ecology: the politics of environmental science. Routledge, London, UK.

Genet K.S. & Sargent L.G. 2003. Evaluation of methods and data quality from a volunteer-based amphibian call survey. *Wildlife Society Bulletin 3*: pp. 703–714.

Government of Namibia. 1996. National Conservation Amendment Act, Government Gazette of the Republic of Namibia.

Granovetter, M. 1973. The strength of weak ties. *American Journal of Sociology 78*: pp. 1360–1380.

Gray, T., Hatchard, J., Daw, T. & Stead, S.M. 2008. New cod war of words: 'cod is God' versus 'sod the cod' - two opposed discourses on the North Sea Cod Recovery Programme. *Fisheries Research 93*: pp. 1-7.

Green, J. & Thorogood, N. (eds.). 2009. Qualitative methods for health research. Sage Publications, UK.

Gruber, JS. 2010. Key principles of community-based natural resource management: a synthesis and interpretation of identified effective approaches for managing the commons. *Environmental Management 45 (1).* pp. 52-66.

Gutiérrez, N. 2011. Co-management holds promise of sustainable fisheries worldwide. Available at: http://www.sciencedaily.com/releases/2011/01/110105131741.htm. Accessed on 7-08-2012.

Haggan, N. & Neis, B. 2007. The changing face of fisheries science and management. In: N. Haggan, B. Neis & I.G. Baird (eds). Fishers' knowledge in fisheries science and management: pp. 421–432. UNESCO, Paris, France.

Hamilton, R.J., Potuku, T. & Montambault, J.R. 2011. Community-based conservation results in the recovery of reef fish spawning aggregations in the Coral Triangle. *Biological Conservation 144:* pp. 1850-1858.

Hammersley, M. & Atkinson, P. 2007. *Ethnography: Principles in practice.* Taylor & Francis, Philadelphia, Pennsylvania.

Harmon-Jones, E. & Harmon-Jones, C. 2007. Cognitive dissonance theory after 50 years of development. Zeitschrift für Sozialpsychologie 38: 7–16.

Haraway, D. 1988. Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies 14(3)*: pp. 575–599.

Hazen, R. M. 2005. Genesis: The scientific quest for life's origin. Joseph Henry Press, Washington, DC.

Hilborn, R. & Walters, C.J. 1992. Quantitative fisheries stock assessment. Choice, Dynamics and Uncertainty. Chapman & Hall, New York.

Hockley, N., Jones, F., Andriahajaina, A., Manica, F., Rakoto, E., Ranambitsoa, H. & Randriamboahary, J. 2005. When should communities and conservationists monitor exploited resources? *Biodiversity and Conservation 14*: pp. 2795–2806.

Hoefnagel, E., Burnett, A. & Wilson, D.C. 2006. The knowledge base of co-management. In: L. Motos & D.C. Wilson (eds). The knowledge base for fisheries management: pp. 85–108. Elserivier, Amsterdam, the Netherlands.

Hoggarth, D., Cowan, V., Halls, A., Aeron-Thomas, M., McGregor, J., Garaway, C., Payne, I., & Welcomme, R. 1999. Management guidelines for asian floodplain river fisheries. Food and Agricul-tural Organization, Rome.

Holton, G. 1978. The scientific imagination: Case studies. Cambridge University Press, Cambridge.

Hoole, A. 2007. Lessons from the equator initiative: common property perspectives for community-based conservation in Southern Africa and Namibia: Center for Community-Based Resource Management, Canada.

Hulme, D. & Murphree, M. 1999. Communities, wildlife and the 'new conservation'. *African Journal of International Development 11*: pp. 277–286.

Illeris, K. 2001. The three dimensions of learning. Roskilde University Press, Denmark.

Inland Fisheries Resources Act, 2003. Ministry of Fisheries and Marine Resources. Windhoek, Namibia.

IRDNC. 2012. WWF-SDC Project Technical Progress Report, Caprivi- 2007. Available at: http://www.irdnc.org.na/reports.htm. Accessed on 13-11-2012.

IRDNC Website. 2012. Available at: http://www.irdnc.org.na/. Accessed on 08-02-2012 and 19-10-2012.

Jennings, G. 2001. Tourism research. John Wiley & Sons Australia Ltd, Old, Australia.

Jennings, S., Kaiser, M.J. & Reynolds, J.D. 2001. Marine fisheries ecology. Blackwell, Malden, UK.

Johannes, R., Freeman, M. & Hamilton, R. 2000. Ignore fisher's knowledge and miss the boat. *Fish and Fisheries 1*: pp. 257-271.

Jones, B. T. 2003. Policy, institutions and practice: The impact of Namibian CBNRM policy and legislation on rural livelihoods. *WILD Working Paper Series, no. 25.* Available at: http://www.met.gov.na/programmes/wild/WILDworkingpapers24.26/WP%2025%20-%20PIPS%20Jones.pdf. Accessed on 23-07-2012.

Jul-Larsen, E., Kolding, J., Overå, R., Raakjær Nielsen, J. & Zwieten van, P.A.M. (eds.). 2003. Management, co-management or no management? Major dilemmas in southern

African freshwater fisheries. 2 Case studies. *FAO Fisheries Technical Paper.* No. 426/2. Rome, FAO. pp. 271.

Junker, B.H. 1960. Fieldwork- An introduction to the social sciences. University of Chicago Press, Chicago, USA.

Kawagley, A. O. 1995. A Yupiaq worldview. Waveland Press, Prospect Heights, IL, USA.

Kayambazinthu, D. & Locke, C. 2002. Forest management and diverse livelihoods in Malawi. *LADDER Working Paper No.24:* pp. 34.

Kohnert, D. 1996. Magic and witchcraft: Implications for democratisation and poverty-alleviating aid in Africa. *World Development, 24 (8):* pp. 1347-1355.

Kohorst, H. 1996. Glossar: Definition zentraler Begriffe. (System, Modell, Simulationen). Available at: http://www.kohorst-lemgo.de/modell/bevchina/glossar.htm. Accessed on 17-10-2012.

Kolawole, O. D. 2001. Local knowledge utilization and sustainable rural development in the 21st century. Indigenous Knowledge and Development Monitor. November.

Latour, B. 1993. We have never been modern. Harvard University Press, Cambridge, MA, USA.

Lavides, M.N., Polunin, N.V.C., Stead, S.M., Tabaranza, D.G., Comeros, M.T. & Dongallo, J.R. 2009. Finfish disappearances around Bohol, Philippines inferred from traditional ecological knowledge. *Environmental Conservation 36*: pp. 235-244.

Leach, M., Mearns, R., & Scoones, I. 1999. Environmental entitlements: Dynamics and institutions in community-based natural resource management. *World Development 27(2):* pp. 225–247.

Lewins, F. 1992. Social science methodology: A brief but critical introduction. Macmillan Educational, South Yarra.

Lincoln, Y. & Guba, E.G. 1985. Naturalistic inquiry. Sage Publications, UK.

Long, N. 2001. Development sociology: Actor perspectives. Routledge, London.

Lundy, P. 1999. Community participation in Jamaican conservation projects. *Community Development Journal 34(2):* pp. 122.

Lynch, O.J. & Alcorn, J.B. 1994. Tenurial rights and community-based conservation. In: Western, D., Wright, M., Strum, S. (eds). Natural connections. Perspectives in community-based Conservation: pp. 373-392. Island Press, Washington, DC.

Macnagthen, P. & Urry, J. 1998 Contested natures. Sage Publications, UK.

Margenau, H. 1950. The nature of physical reality. McGraw-Hill, New York, USA.

Marwick, M. 1970. Witchcraft and sorcery. In: M. Douglas. 1970. Witchcraft confessions and accusations. Tavistock Publications, London, UK.

McGee, R. & Brock, K. 2001. From poverty assessment to policy change: processes, actors and data. *IDS Working Paper 133.* Institute of Development Studies, Brighton.

McGee, R. 2004. Unpacking policy: knowledge, actors and spaces. In: K. Brock, R. McGee & J. Gaventa (eds). *Unpacking policy: actors, knowledge and spaces in poverty reduction.* Fountain Press, Kampala.

McLaren, M.A. & Cadman, M.D. 1999. Can novice volunteers provide credible data for bird surveys requiring song identification? *Journal of Field Ornithology* 70: pp. 481–490.

MET, 2008. Policy on CBT. Ministry of Environment and Tourism, Windhoek, Namibia.

MFRM, 2009. Annual Report 2009. Ministry of Fisheries and Marine Resources. Windhoek, Namibia.

Michell, H. 2005. Ne¯hıˆtha ˆwaˆk of Reindeer Lake, Canada: Worldview, epistemology and relationships with the natural world. *Australian Journal of Indigenous Education 34:* pp. 33–43.

Middendorp, H.A..J., Hasan, M.R. & Apu, N.A. 1996. Community fisheries management of freshwater lakes in Bangladesh. *NAGA, ICLARM Quarterly 19*: pp. 4-8.

Miller, J. & Glassner, B. 2004. The 'inside' and the 'outside': finding realities in interviews. In: D. Silverman (ed.). Qualitative research: theory, method, and practice. Sage Publications, UK.

Milne, C. E. & Taylor, P. C. 1998. Between myth and a hard place. In: W. W. Cobern (ed.). Socio-cultural perspectives on science education: pp. 25–48. Kluwer Academic, Boston.

Morse, J. 1994. Designing funded qualitative research. In: Denzin, N.K. & Lincoln, Y. (eds). 2011. Handbook of qualitative research: pp. 220-35. Thousand Oaks, Sage Publications, UK.

Murray Li, T. 2007. The will to improve: governmentality, development, and the practice of politics. Duke University Press, Durham.

NACSO, 2008. Namibia's communal conservancies: A review of progress and challenges in 2007. NACSO, Windhoek, Namibia.

NACSO, 2011. Namibia's communal conservancies: A review of progress and challenges in 2010. NACSO, Windhoek, Namibia.

Nader, L. (ed). 1996. Naked science: anthropological inquiry into boundaries, power and knowledge. Routledge, New York.

Namibia's Communal Conservancies: A Review of Progress in 2010. 2011. Namibian Association of CBNRM Support Organisations, Windhoek, Namibia.

Namibian Nature Foundation Website. 2012. available at http://www.nnf.org.na/ Accessed on: 7-01-2012.

Næsje, T.F., Hay, C., Purvis, J., Hamukuaya, H., Kapirika, S. & Abbott, J. 2002. Shared resource management on the Zambezi/Chobe systems in northeast Namibia: current practices and future opportunities, report of first river survey and collection of information from fish markets, including survey manuals and forms. *NINA Project Report no. 18*: pp. 72.

NNF. Integrated management of Zambezi / Chobe River system - Transboundary fishery resource, Namibia / Zambia / Botswana. Unpublished data.

Noss A.J., Oetting I. and Cue´llar R.L. 2005. Hunter self-monitoring by the Isosen ˜o-Guaranı´ in the Bolivian Chaco. *Biodiversity and Conservation 14:* pp. 2679–2693.

Ogawa, M. 1995. Science education in a multi-science perspective. *Science Education 79*: pp 583–593.

Ohmagari, K. & Berkes, F. 1997. Transmission of indigenous knowledge and bush skills among the Western James Bay Cree women of subarctic Canada. *Human Ecology 25*(2): pp. 197-222.

Olsson, P., C. Folke, V. Galaz, T. Hahn & Schultz, T. 2007. Enhancing the fit through adaptive co-management: creating and maintaining bridging functions for matching scales in the Kristianstads Vattenrike Biosphere Reserve Sweden. *Ecology and Society* 12(1): pp. 28.

Ossai B. 2010. African Indigenous Knowledge Systems (AIKS). *Simbiosis ISSN 7 (2):* pp. 1548-3436.

Palsson, W. 1998. Monitoring the response of rockfishes to protected areas. In: Yoklavich, M. (ed.). 1998. Marine harvest refugia for West Coast rockfish: a workshop. *NOAA Tech. Memo. NMFS, NOM-TM-NMFS-SWFSC-255:* pp. 64-73.

Pauly, D. 1995. Anecdotes and the shifting baseline syndrome of fisheries*. Trends in Ecology & Evolution 10*: pp. 430.

Penrose D. & Call S.M. 1995. Volunteer monitoring of benthic macroinvertebrates: regulatory biologists' perspectives. *Journal of the North American Benthological Society 14*: pp. 203–209.

Peat, F. D. 1994. Lighting the seventh fire. Birch Lane Press, New York.

Pickering, A. (ed.). 1992. Science as practice and culture. University of Chicago Press, Chicago.

Pitcher, T.J. & Pauly, D. 1998. Rebuilding ecosystems, not sustainability, as the proper goal of fishery management. In: T. Pitcher, D. Pauly & P. Hart (eds.). Reinventing fisheries management. Kluwer Academic Publishers, Norwell, MA.

Pomeroy, R.S., Katon, B., Genio, E. & Harkes, I. 1999. Fisheries co-management in Asia: Lessons from experience. ICLARM, Manila.

Punch, K.F. 1998. Introduction to social research. Sage Publications, CA, UK.

Purvis, J. 2002. Fish and livelihoods: Fisheries on the eastern floodplains, Caprivi. *DEA Research Discussion Paper 52*: pp. 42.

Rasalato, E., Maginnity, V. & Brunnschweiler, J. 2010. Using local ecological knowledge to identify shark river habitats in Fiji (South Pacific). *Environmental Conservation 37:* pp. 90-97.

Reid, K. A., Williams, K.J. & Paine, M.S. 2011. Hybrid knowledge: place, practice, and knowing in a volunteer ecological restoration project . *Ecology and Society 16(3):* pp. 19.

Riester J. 1984. Textos sagrados de los Guaranı´es en Bolivia: una caceri´a en el Izozog. Los Amigos del Libro, La Paz, Bolivia.

van Rijsoort J.& Jinfeng Z. 2005. Participatory resource monitoring as a means for promoting social change in Yunnan, China. *Biodiversity Conservation 14*: pp. 2543–2573.

Rochet, M-J., Prigent, M., Bertrand, J.A., Carpentier, A., Coppin, F., Delpech, J-P., Fontenelle, G., Foucher, E., Mahé, K., Rostiaux, E. & Trenkel, V.M. 2008. Ecosystem trends: evidence for agreement between fishers' perceptions and scientific information. *ICES Journal of Marine Science 65*: pp. 1057–1068

Rodriguez J.P. 2003. Challenges and opportunities for surveying and monitoring tropical biodiversity– a response to Danielsen et al. *Oryx 37*: pp. 411.

Roe, D. & Jack, M. 2001. Stories from Eden: case-studies of community-based wildlife management. *IIED Evaluating Eden Series 9.* IIED, London, UK.

Sadovy, Y. & Cheung, W.L. 2003. Near extinction of a highly fecund fish: the one that nearly got away. *Fish and Fisheries 4*: pp. 86–89.

Saénz-Arroyo, A., Roberts, C.M., Torre, J. & Carinõ-Olvera, M. 2005. Using fishers' anecdotes, naturalists' observations and grey literature to reassess marine species at risk: the case of the Gulf grouper in the Gulf of California, Mexico. *Fish and Fisheries 6*: pp. 121–133.

Sambo, E. Y. & Woytek, R. 2001. An overview of indigenous knowledge as applied in natural resource management. In: Weyl, M. & Weyl, O. (eds.). Proceedings of the Lake Malawi fisheries management symposium. National Aquatic Resources Management Programme. Department of Fisheries and GTZ, Malawi/Germany.

Sanchez, R. 2001. Managing knowledge into competences: The five learning cycles of the competent organization: pp. 3-37. In: R. Sanchez (ed). Knowledge management and organizational competence. Oxford University Press, Oxford.

Schusser, C. 2012. Community forestry: a namibian case study. In: G. Broekhoven, H. Svanije & S. von Scheliha (eds.). Moving Forward With Forest Governance: pp. 213-221. Trobenbos International, Wageningen, the Netherlands.

Sheil, D. 2001. Conservation and biodiversity monitoring in the tropics: realities, priorities, and distractions. *Conservation Biology 15*: pp. 1179–1182.

Sheil, D. & Lawrence, A. 2004. Tropical biologists, local people and conservation: new opportunities for collaboration. *Trends Ecological Evolution 19:* pp. 634–638.

Silvano, R.A., MacCord, M.P., Lima, R.V. & Begossi, A. 2006. When does this fish spawn? Fishermen's local knowledge of migration and reproduction of Brazilian coastal fishes. *Environmental Biology of Fishes 76*: pp. 371–386.

Souza, S.P. & Begossi, A.. 2007. Whales, dolphins or fishes? The ethnotaxonomy of cetaceans in São Sebastião, Brazil. *Journal of Ethno-biology and Ethnomedicine 3*: pp. 9.

Stanford Website. 2012. http://www.stanford.edu/. Accessed on 19-09-2012.

Stuart-Hill, G., Diggle, R., Munali, B., Tagg, J. & Ward, D. 2005. The Event Book System: a community based natural resource monitoring system from Namibia. *Biodiversity and Conservation 14*: pp. 2611–2631.

Topp-Jørgensen E., Poulsen M.K., Lund J.F. & Massao J.F. 2005. Community-based monitoring of natural resource use and forest quality in montane forests and miombo woodlands in Iringa District, Tanzania. *Biodiversity Conservation 14*: pp. 2653–2677.

Tuhiwai-Smith, L. 1999. Decolonizing methodologies: research and indigenous peoples. Zed Books, New York.

Tweddle, D. 2009. Integrated management of Zambezi / Chobe River system - transboundary fishery resource, Namibia / Zambia / Botswana: Final Evaluation Report. WWF-Norway.

Uggla, Y. 2010. What is this 'thing' called nature. The nature-culture divide in climate change and biodiversity policy. *Journal of Political Ecology 17*: pp. 79-91.

UNDP. 2005. Nature in local hands: the case from Namibia's conservancies'. In: UNDP. The wealth of the poor: Managing ecosystems to fight poverty. World Resources, United Nations Development Programme.

van Velsen, J. 1967. The extended-case method and situational analysis. In: A.L. Epstein (ed). The craft of anthropology. Social Science Paperbacks.

Warren, D. 1991. Using indigenous knowledge in agricultural development. *World Bank Discussion Paper 127.* World Bank, Washington DC.

WCED, 1978. Our common future. Oxford University Press, UK.

Weber, M. 1978. In: G. Roth & C. Wittich (eds). Economy and society: an outline of interpretive sociology. University of California Press, Berkeley.

Wells, M.P. & Mc Shane, T.O. 2004. Integrating protected area management with local needs and aspirations. *Ambio 33*: pp. 513–519.

Western, D. & Wright, M. 1994. The background to community-based conservation. In: Western D., Wright M. & Strum, S. (eds). 1994. *Natural Connections. Perspectives in community-based conservation*: pp. 1-12. Island Press, Washington, DC.

Wiersum, K. F. 2000. Incorporating indigenous knowledge in formal forest management: adaptation or paradigm change in tropical forestry? In: A. Lawrence (ed). Forestry, forest users and research: new ways of learning. *ETFRN Publication Series 1.* Wageningen, the Netherlands.

Yin, R. 1994. Case study research, design and methods. Second edition. *Applied Social Research Methods Series 20.* Sage Publications, UK.

***Images retrieved at:***

http://www.globalsecurity.org/military/world/para/caprivi.htm. Accessed on 21-10-2012.

http://www.cerpa.uni-hannover.de/5600.html. Accessed on 21-10-2012.

# *Appendix 1: Application letter for FPA*

**6 December 2010**

**To: Bukalo Traditional Authority, Bukalo**
**To: The Regional Governor, Regional Council, Katima Mulilo**

**Dear Sirs,**

**RECOGNITION OF FISH PROTECTION AREAS UNDER MANAGEMENT OF THE CONSERVANCIES OF SIKUNGA AND IMPALILA**

This is a joint letter from the Conservancy committees of Impalila and Sikunga requesting declaration of fishing reserves in terms of Section 22 of the Inland Fisheries Resources Act of 2003 [see attached section of the Act below].

In our conservancies we are seriously concerned about the continuous decline in fisheries stocks in the Zambezi and its floodplains and would like to prevent further deterioration of our fishery resources. We therefore wish to establish reserves which we will call "Fish Protection Areas". The aim of these Fish Protection Areas is to create areas where fish are able to live, grow and breed without interference, in order to restock surrounding areas with abundant fish stocks to support a healthy fishery. A further aim of these Fish Protection Areas is to derive revenue for the conservancies through the issuing of paid permits for tourists to fish in these areas provided they use the "catch and release" method (this means that all fish caught must be released unharmed back into the water).

After extensive discussions over the last three years and with the assistance of the MFMR/NNF Zambezi/Chobe Transboundary Fisheries Project, we have identified suitable areas to be made into Fish Protection Areas (see attached description of proposed reserves). We hope to propose further protected areas in future.

Section 22 of the Act indicates that the Minister will respond to initiatives of the Regional Council and/or Traditional Authorities, in consultation with such authorities. We therefore propose to approach the Minister with the approval of the Bukalo Traditional Authority and the Regional Council in Katima Mulilo to establish these Fish Protection Areas.

We therefore hereby request the approval of the Traditional Authority in Bukalo and Regional Council in Katima Mulilo to approach the Minister to declare, by notice in the Gazette, the areas proposed in the attached document as fisheries reserves (here called Fish Protection Areas) under Section 22 of the Inland Fisheries Resources Act of 2003.

**Yours faithfully,**

| | | |
|---|---|---|
| Impalila Conservancy, | & | Sikunga Conservancy, |
| P.O. Box 2435, | | P.O. Box 578, |
| Ngweze, | | Ngweze, |
| Impalila Island | | Kalimbeza Area |