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Plants and Pastures
Local knowledge on livestock - environment relationships among OvaHerero pastoralists in north - western Namibia

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Plants and Pastures

Silke Tönsjost

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KÖLNER ETHNOLOGISCHE BEITRÄGE
Herausgegeben von Michael J. Casimir

Heft 23

2007

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Editor`s Preface

Indigenous knowledge has become an important field of anthropological research during the past two decades. The knowledge of rural people on flora and fauna have been extensively documented. Unfortunately many ethnographic documentations of local knowledge were produced without relating local knowledge to western botanical and zoological knowledge. In fact, frequently reference to western scientific model were seen as polluting the ethnography of local knowledge systems. The ethnography of a pastoral community's knowledge of the structure of pastures and the ecological dynamics in such a system shows that anthropological research on emic knowledge of eco-system processes may miss crucial points when putting aside western ecological knowledge completely.

Tönsjost applies a sophisticated methodology drawing upon newly developed approaches in cognitive anthropology to elucidate a community's knowledge of environmental structures and processes. Her study is particularly valuable as she desists from portraying local knowledge as homogeneous and age-old. She is able to show, that in fact, knowledge is distributed fairly differently in the community. This distributional pattern is structured and sex and age play an important role in determining what somebody actually knows and what he or she does not know. Tönsjost's ethnography has been produced in the context of two interdisciplinary programmes: on the one hand her research was embedded in the Collaborative Research Centre *Arid Climate, Adaptation and Cultural Innovation in Africa* and on the other hand she was partaking in the Junior Research Group *Savannah Range Management - Ecological and Economic Sustainability*. The ethnography which was handed in as an MA phil thesis, supervised by Prof. Michael Bollig at the Institute for Social and Cultural Anthropology of the University of Cologne is based on several months of fieldwork which Tönsjost partially conducted on her own but partly also in a team with botanists and ecologists. Tönsjost's work offers a fresh approach to indigenous knowledge and will be of interest to read both for ecological and cognitive anthropologists alike but also for ecologists interested in savannah systems.

Michael J. Casimir

Heartfeld thanks to the inhabitants of the village *Okazorongua*:

Ovandu ami mbu me vanga okutamuna moruveze orutenga, ovaturira vaKazorongua, ovarumendu, ovakazendu, novanatje. Owene mbu mwa tjita kutja oviungura vyantdje virire ondoneno. Pendje nokuhungira ouhunga nomiti novitumbua Vyoponganda twa hanasana tjinene Omwinyo wopevapayuva. Twa yora tjinene nu rukwao atuhungire ouhunga noviune ovinandengu Ouhunga norukapitaveze, Orupeveze noruyaveze, ami me vanga okumûtjera okuhepa komaserekarerwa wenu nongaro yenu yometjiyakuriro ndja tjita kutja mbi ri zuve ponganda moruveze ndwari oruyenda kwami. Mwe ndipa ondjiviro onama mbango tjinene momwinyo wandje. Mberihonga tjinene.
Okuhepa tjinene!

Silke Tönsjost

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1. Introduction

1.1. Research interest and aim of the study

Pastoralism is the subsistence strategy for areas such as deserts, mountains or tundra which are too marginal for alternative uses. Especially the drylands in Africa are relatively low in their productive potential for agriculture due to meagre and variable rainfall and short growing seasons (Mortimore 1998: 4). Thus, pastoralism is the dominant form of land use throughout the drier regions (< 300mm rain per year) of the African continent, including Namibia (Bonte and Galaty 1991: 3). The sustainable management of natural resources is therefore important to guarantee future livelihoods in this region.

In recent years the debate on essential factors for a sustainable use of natural resources in arid savannas has gained new momentum (Ngaido 2002, Niamir 1990, Lane and Morehead 1995, Müller et al. submitted). In order to gain a greater understanding of this, it seems an especially promising approach to analyse local management strategies. Local knowledge is seen as a key to understanding pastoralist strategies of sustainable resource management (Payton et al. 2003, Schareika 2001, Niamir 1990, Niamir- Fuller 1999). It is particularly interesting to investigate how local knowledge is produced and used in a highly unpredictable system, characterised by such non-linear dynamics such as transition and randomness (Little in Bassett 2003: 163).

OvaHerero pastoralists in the arid north-western parts of Namibia have to deal with rangelands that are characterized by a high spatial and temporal variability of resources, such as fodder biomass. My interest is to investigate one important element of local coping systems: the local knowledge of OvaHerero pastoralists regarding livestock-environment relationships. This knowledge enables herders to deal with uncertainty, variability, perturbations and risk[1], such as for example the lack of rain and the variable amount of biomass available. Thus, local environmental knowledge is one coping mechanism, as it contains information and expectation about natural resources and helps to develop strategies that reduce risk.

My interest is to improve the understanding of criteria and indicators guiding herders in their decision towards spatial and temporal aspects of range management. With the help of these

[1] In this work risk is defined as the estimable probability of several possible outcomes (Moran 2006: 98, quoted from Levin 1975:106). Uncertainty is defined by probabilities that cannot be specified. Certainty means that one can predict what will happen (Moran 2006: 98).

findings it will be possible to improve the understanding of essential elements of sustainable natural resource and range management[2] in arid zones of Namibia.
Furthermore, research on local knowledge in Namibia can play an important role as a basis for dialogue, participation and environmental planning in contemporary conservation initiatives as Conservancies[3] (Sulllivan 1999b).

In my research I examine the local livestock-environment knowledge via a protagonist-based approach: the expert-knowledge of OvaHerero pastoralists is viewed as a tool for decision-making. On the basis of perceptional processes management options are adopted or rejected. Based on the field data the local perception, interpretation and explanation of ecological processes in the highly stochastic and sensitive environment of African savannas will be analysed.

Within the broad topic of environmental knowledge I concentrate on the aspect of fodder plants for livestock nutrition as one important element in the process of assessing and decision-making. Thus environmental knowledge in this study refers to knowledge about livestock-environment relationships.

Guiding questions in research

Perception, quality rating of fodder plants and pastoral strategies

- Which fodder plants are regarded as important for animals' nutrition?
- How are important fodder plants rated and ranked?
- How do these features influence the decisions on range management?
- What are other important elements for the assessment of pasture quality?

Observation of vegetation over time

- Which environmental change is reported by local users in the last 20 years on pastures and household areas?
- What are emic[4] explanations of environmental change?

[2] The term "range management" is defined in 2.1.
[3] Conservancies are self-defined common-property management- and social units. The areas are unfenced. In return for responsible management of wildlife the government gives share-holders the rights over consumptive and non-comsumptive use of the natural resources. Conservancies are part of Community based natural resource management (CBNRM) programs, financed by USAID (www.irdnc.org.na/cons.html, visited 31.01.2007).

Distribution of knowledge

- How is environmental knowledge distributed among men and women, the elderly and younger people in the study area?

Local knowledge and range management

- Which advantages and disadvantages are connected with mixed herds regarding the use of fodder plants from a local perspective?
- Which local strategies are used to secure the sustainable use of fodder plants?

1.2. Structure of this work

Firstly, in section 2.1., the term "local knowledge" and its connotations are defined. Next the political implications of research on local knowledge and land use on are presented (2.2., 2.3.). After this I describe the theoretical framework for this work (2.4., 2.5.): I chose the concept of schemata and scripts in order to explain the decision-making processes of local herders for or against pastures and herding strategies with diverse livestock. Using this theoretical framework as a basis, I present research methods to investigate the leading questions and hypotheses (3.). In 4. the study area is described, together with brief information on local livelihood and economy (4.2.- 4.5.).
In 5. data and results of the methods used are presented following the issues of salient fodder plants (5.1.), livestock diversification, fodder needs, range management (5.2.) and the disribution of knowledge (5.4.). Data on environmental change is presented in 5.3.
In the interpretation chapter the results of my work are presented in the same structure (6.). I place emphasis on comparing results of similar case studies in this interpretation chapter.

2. Theoretical framework

2.1. Definition and terminology of local knowledge

I decided for the term "local knowledge" instead of "traditional" or "indigenous knowledge" because it underlines the spatial and theoretical aspects of this knowledge. Here, in the spatial

[4] Definition of emic: insiders' point of view, here OvaHerero pastoralists. In contrast "etic" refers to the outsiders view, i.e. in this work that of ecologists and me.

category, the local knowledge of OvaHerero pastoralists in the local context of the Kunene region in north- western Namibia is emphasised. This work focuses on the diverse knowledge components of actors and on diverse forms of knowledge, i.e. daily routine, expert and specialist knowledge as well as hybrid knowledge, which is situated between scientific and daily routine and imported knowledge (Schareika 2004: 271, Maddalon 2003, Siebert 2004). In a theoretical perspective local knowledge contains conscious and unconscious interpretation and relevance structures, as well as classification orders. This knowledge about processes is organized in the form of schemata and scripts[5].

There is a variety of definitions and concepts of local knowledge. In general local knowledge is regarded as the sum of experience, abilities and world views which emerged in a specific cultural background and which is constantly changing (Schareika 2004: 95, Kempton 2001, Siebert 2004, Ellen and Harris 2005: 5). With reference to this definition, knowledge can be realised in a specific place or environment, it can be found with people and institutions; it is movable and its meaning depends upon the local environment and situation it is found in.

Further characteristics of local knowledge are

1. It is holistic: embededded in a set of meaning, local knowledge is situated in a broader cultural context. This local embededdness makes it a successful strategy.
2. It has local roots, bearing in mind that the contents of local knowledge are also influenced from the "outside".
3. Local knowledge is the consequence of practical engagement, reinforced by experience, trial-and-error tests and experiments.
4. Local knowledge is constantly changing; it is produced, reproduced, surrendered and lost.
5. It is distributed unequally with regard to e.g. status, gender and age (Ellen and Harris 2005: 5).

By considering these characteristics of local knowledge it is possible to meet the diverse realities of the actors, its situational use and the change of knowledge. All these components of local knowledge make clear that there are multiple factors which influence the complex process of decision-making (Neubert and Macamo 2004: 95, 266).

[5] Definition of scripts: see 2.5.

Distribution of local knowledge

Local knowledge is embedded in power relations defined by e.g. status, gender, and age. It is transferred in the process of socialisation. The influence of various actors and their roles in the decision-making process in social, political and economic contexts shape environmental practices and have to be regarded in research. Social roles, based on gender and age, determine the access to information, knowledge and resources (Thomas-Slayter et al. 1996: 297). Gender differences in experience of, responsibilities for and interest in the environment are not rooted in biology, but in the social interpretations of biology and gender roles (Rocheleau et al. 1996: 3).

By using men as representatives and leaders to control communities and resources the status of women in Namibia was diminished by the colonial powers (Sullivan 2000a: 148). Especially women are often seen as weak and are not involved in the process of decision-making (Rocheleau et al. 1996:4). Sullivan (2000a) criticises the fact that the role of women as decision-makers is under-represented and female areas of production are overlooked (Sullivan 2000a: 148). This ignores the demographic fact that 40 % of the households in the Kunene region today are women-headed (Republic of Namibia 2005: 4). In the study area women are responsible for day-by-day herding tasks, the sustenance of housing facilities, garden activities, preparation of food and child-care.

In this work I wish to explore the influence of age and gender on local environmental knowledge.

Range management and local knowledge

Heady and Child (1994) define range management as a discipline and an art that skilfully applies an organized body of knowledge accumulated by range science and practical experience. Range management serves two purposes:

1. the protection, improvement, and continued welfare of the basic natural resources (e.g. soils, vegetation, animals, and water);
2. the optimum production of goods from these resources which are needed by the society .

This definition actually focuses on academic range science as a basis of knowledge. Both scientific and local knowledge are based on experiments, repetition and criticism which lead to refinement.

In this regard, local knowledge cannot be separated structurally from so-called scientific knowledge.

Therefore the definition of Heady and Child (1994) is suitable for this work as well. However, the "measurement of pasture quality is conducted in a more standardized and more "controlled" manner in so-called scientific knowledge. The comparison between the emic the and etic viewpoint in this work (5.1.2.) is based on the differences between insiders' and outsiders' viewpoint. Here, the outsiders' view stands for insights gained by standardized ecological measurement techniques.

Elements of range management that are to be investigated in this work are:

- herding strategies with regard to mixed livestock (e.g. the organisation of herds)
- choice of pastures in order to guarantee livestock needs
- strategies of securing grazing areas by spatial movement.

The institutional elements of communal range management cannot be investigated in this work.

2.2. Local environmental knowledge from a cultural ecology and cognitive anthropology perspective

According to the materialistic approach of cultural ecology, the environment is seen more or less as a dynamic element to which human culture reacts passively. Julian Steward regards environment as active and human beings as passive "re-actors", determined by the environmental situation. Thus the environment (and technology) is seen as a cause, and culture is seen as the resulting effect (Steward 1977:45 ff). Marvin Harris states that both factors, nature and culture, equally influence each other being coupled through feedback relationships (Harris 1999:144 ff). From this perspective human beings are part of the ecological system. They are driven and determined by effects of the environment with very little room for decision-making. The behaviour of, in this case, pastoralists is a response to the challenges and hazards of the habitat. Range management is viewed as a mere reaction. Culture is seen as an instrument of adaptation, with its values, norms and attitudes being secondary. According to this materialistic approach values, norms and attitudes are not the determining factors for decisions and the resulting behaviour (Schareika 2001: 39).
One objection to this is that the alternatives to react to an environmental situation are numerous. Pastoralists have space to decide and to react; the decision is based on their knowledge, values and norms as well as the context (Schareika 2001: 27). The cognitive

approach that I use in this work helps to analyse this decision-making behaviour as holistic, actor-centred and process-orientated while regarding herders as being active. Decisions are regarded as dependent on the context and as dynamic. The way herders perceive and interpret their natural environment depends on their cultural context. Pastoralists act creatively, curiously and experimentally. The way herders perceive the natural environment shapes their herding strategies. For example, the assessment of pastures can be diverse in a community of pastoralists, which influences the strategies and movements of livestock strongly. Local environmental knowledge is not only a key to adaptation, but a conscious means of decision-making in order to organise natural resources. Local knowledge enables herders to manage uncontrollable environmental conditions (Schareika 2001: 38). According to this so-called idealistic approach, pastoralists can be viewed as good or bad managers of their natural resources.

Based on a cognitive approach, my work on local environmental knowledge focuses on the interaction between the environment and human beings. By taking this actor-centred interaction into consideration, the environment is not an "untouched ground" or a sum of ecosystems, but a product and motor of human behaviour. Thus, culturally motivated behaviour influences and shapes the environment, which ultimately means that all landscapes are anthropogenic (Bassett and Cummey 2003: 5, Luig and von Oppen 1997: 27).

2.3. Implications of local human- environment knowledge on the debate on sustainability, degradation and desertification

In the debate about the sustainable use of natural resources, local knowledge serves as one important element for understanding the coping mechanisms of land users. Today, local environmental knowledge is appreciated as a strength (Diawara 2000). It enables local land users to understand environmental processes, which in turn can allow sustainable land use and the ability to cope with changing conditions. It is the value of time-proven methods that makes people organize resources in a situation where "no condition is permanent" (Bassett et al 2003: 19, Imbamba 2004).

In the past culture-specific perception and local mismanagement were seen as being responsible for the degradation of natural resources and desertification[6]. Recent studies underline the effectiveness and sustainability of local management practices and state that desertification in the Kunene region in north-western Namibia is not empirically proven (Ward et al. 1998): According to Sullivan's findings the discussion on good or bad management has more of an ideological debate, and is driven by linear-system assumptions and colonial ideas of local mis-management (Sullivan 1999a: 257f, Sullivan 2002: 256). The simple assumption that overgrazing and unsustainable land use by local groups is the decisive factor causing degradation is no longer tenable.

According to the paradigm of the disequilibrium model in Range Ecology, it is rather the erratic and variable precipitation in savanna ecosystems that is seen as the main contributing factor to degradation and events such as drought (Behnke et al 1993, Gillson and Hoffman 2007, Linstädter and Bolten 2006). This concept has been vividly discussed by ecologists in the past years. Disequilibrium is defined as a situation with annual rainfall variability of over 30 %, which is the situation in the study area (Behnke et al 1993). Resources such as grasses, trees, and water in the form of precipitation are inherently variable. There is no balance or model following precipitation and geomorphologic gradients, but patchiness, discontinuity and disequilibrium are the decisive characteristics of these situations. Natural resources, as a prerequisite for successful pastoralist land-use, are distributed with a high spatial variability. Climate, soil, topography and latitude create conditions favourable to distinct plant communities with their own dynamics. Human behaviour and action is only one of many forces at work in these systems.

Human actions such as cultivation, hunting and pastoralism contribute fundamentally to the patchy and mosaic pattern of landscapes in disequilibrium environments (Bassett and Crummey 2003:7). Due to the dependency on precipitation, savanna ecosystems in northern Namibia are event-driven: change is seldom gradual. It occurs in rapid transitions after long stable states (so called state and transition models) linked to specific events such as drought or rainfall[7]. Especially in the paradigm of the disequilibrium model, human action is an

[6] For the "construction" of desertification in northern Namibia as a scientific fact see Sullivan 2000 b and 2002. She discusses statements of VanWarmelo 1962, Rhode 1997, Hahn et al. 1928: 222, Malan and Owen-Smith 1974:140, and Seely and Jacobson 1994:31

[7] By contrast equilibrium models are defined by a stable mixture of trees and grasses; their balance is determined by the climate, i.e. rainfall and duration of the dry season. Dynamicity occurs due to two kinds of perturbations: bio- physical (e.g. wildfire, drought, uneven rainfall, herbivory) or human-induced (e.g. burning, farming, hunting, and tree-cutting) Bassett and Crummey 2003: 6.

interesting factor: the environmental situation challenges land users and the need for elaborated management and regulations to sustain the ecosystem as a basis for livelihood (Behnke et al. 1993). Coping strategies are built on local environmental knowledge (Schareika 2001).
The discourse about human-induced degradation often emphasises devastation, degradation and human-ecological decline, which often causes a negative image of Africa, farmers and pastoralists. The focus on local knowledge put land users in a position of actors and knowledgeable and responsible environment managers (Bassett and Cummey: 2003: 5, 1ff).

2.4. Cognitive concepts and cultural domains

To examine the issues described above I decided for the cognitive approach as a theoretical framework. One main assumption in cognitive anthropology is that people with a high proximity to and dependency on natural resources have an extensive knowledge of and a great number of terms for their surroundings (Maffi 2001: 28). This extensive terminology is an outcome of thinking about and perceiving the outer environment. Knowledge of and terms for plant species are necessary to communicate, and are a basis for classification. The whole environment is categorized, not only plants which are useful e.g. for animals' nutrition (Kempton 2001: 52). The group or list of things that belong together from an emic perspective is called the "cultural domain" (Borgatti 1993).

> "Cognitive Anthropology is the study of the relation between human society and human thought. The cognitive anthropologist studies how people in social groups conceive and think about objects and events which make up their world including everything from physical objects like wild plants to abstract events like social justice." (D´Andrade 1995:1)

Perception is shaped by a great deal of factors, which acquire coherence and meaning through organisation into larger frames of reference and interpretation. This process is the mode of structuring reality.

2.5. Schemes and scripts

Human beings have to filter the extensive amount and heterogeneity of incoming information in order to organise these surroundings and to structure the mass of information which they are exposed to. This process leads to a separation of bits of information which are incorporated and other bits which are rejected and regarded as unimportant. The process of filtering is individually and culturally shaped. It allows individuals to cope with their social and natural environment and to react and behave appropriately to the challenges that occur. By regularly repeating this information-processing, scripts or schemes are developed (Schwarz 1985, Esser 1996). Schemes are defined as internal structures on how to behave. They are built on concrete experiences which are abstracted and generalized (Strube 1996: 601). The term "script" refers to broader generic structures of knowledge that represent types of events, including prototypical chains of actions (Strube 1996: 630). As mental structures and components of thinking and knowledge, schemes and scripts are unconscious (Kathage 2004: 50).

Schemes and scripts in the process of decision-making

Schemes and scripts are proven modes of perception and guide the human behaviour: they help individuals to react and decide economically in various situations in daily life where decisions have to be made for a particular mode of behaviour. Schemes and scripts are time and energy saving and thus a tool to make decision-making more economic and effective. Multi-layered situations and complexity are reduced and the flow of information is simplified (Schwarz 1985, Esser 1996, Moran 2006: 99, Descola 1996: 87).

Applied to the perception and decision-making process of herders, schemes help to assess grazing situations, options and choices, and guarantee appropriate behaviour in deciding for a management option, e.g. choosing an optimal or sub-optimal grazing area.

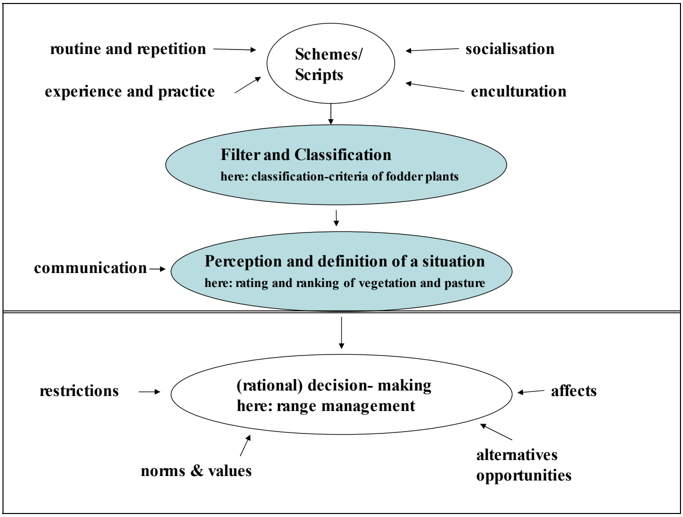

Figure 1: Elements that influence the decision-making process with focus on cognitive concepts: Schemes and scripts are shaped by various factors (socialisation, routine and repetition, ...) which influence the process of filtering and classification of, in this case, fodder plants. This, together with communication, influences the perception and definition of a situation which leads to decision-making. Rational decisions are restricted by various factors again, such as e.g. norms, affects, etc.
Source: Silke Tönsjost after Esser (1996) and Schwarz (1985)

Cognitive models alone cannot be used to predict behaviour, but they are one important part in the decision-making process (Moran 2006: 37). The challenge for research lies in the fact that cognitive processes are unobservable and unconscious.

I decided to focus on plants for animal's nutrition in combination with the application of knowledge in the form of a local assessment of pasture areas. This is ultimately one factor in the process of decision-making. The grey parts of figure 1 show how this small part is linked with the whole process of perception and decision-making.

Framing

The process of defining a situation by schemes and scripts takes place against the background of culturally and socially accepted frames. Every action is predetermined by an interpretative process that considers background information (Esser 1996: 12). The subjective definition of a situation and the possible behaviour, here moving patterns, are embedded in a process of framing (Esser 1996:5). Framing means to simplify and to act according to dominant cultural aims, drawing on perceived symbols, cues and indicators (Esser 1996: 19). The interpretation process of symbols and cues cannot be regarded as a reflex only, but as an intelligent and reflecting process: human beings are able to make these objects aware of themselves and other people (Esser 1996: 30). Thus the actor is not simply determined: definition and perception works on a social and cultural background. The active part of humans is to interact, to bring restrictions and options into balance and thereby create a new condition.

“Die Menschen definieren ihre Situation ohne Zweifel selbst, aber sie tun es nicht aus freien Stücken, nicht unter selbst gewählten, sondern unter unmittelbar vorgefundenen, gegebenen, überlieferten, stets von ihnen selbst aber in Interaktion neu als Gleichgewicht konstituierten und keineswegs so immer beabsichtigen Umständen.“ (Esser 1996: 32)

Applied to subsistence-orientated pastoralists, the dominant cultural and economic aim is to maximize a large standing crop of animals. The “Off-take” of these producers does not require animal slaughter in the first place but milk and traction power (Behnke et al 1993: 7). Basing decisions about grazing and herding on cognitive schemata and scripts generally aims at minimizing risk and uncertainty (Moran 2006: 100).

3. Methods

The multiplicity of relevant factors makes research on local knowledge challenging in methodology. Local knowledge varies depending on age, sex, and status, which require a representation of these variables in sampling. Apart from this, outsiders may be unable to understand it, because local knowledge is embedded in a cultural situation which is not understandable in short periods of research. Additionally, it is very likely that one fills the gaps occuring with one’s own assumptions, or that one is in danger of taking “the most expedient path of interpretation in order to make it simple”: local knowledge then serves as foil for “superior” scientific knowledge (Bassett and Crummey 2003: 27).
I did not wish to collect knowledge about plants only, but to investigate where this plant knowledge is used and taken into consideration in the process of decision-making.

3.1. Situation of fieldwork

Fieldwork was conducted for a period of 13 weeks from April to July 2006 and from December 2006 to January 2007. It took place in the village *Okazorongua* in the Kunene region in northwestern Namibia in the emerging *Orupupa* Conservancy. Geographic data on the study area is presented in 4.1.

The water situation in the village was determined by a broken engine-driven waterpoint throughout the whole duration of fieldwork from April to July 2006. This had large effects on my work: herders chose only pastures in the direction of waterpoints of neighbouring villages in order to guarantee water for livestock. Vegetation, especially the grass layer, was in a very good condition due to precipitation having been far above average between January and April 2006.

The village was chosen because soil conditions are similar to other case studies of the *Volkswagen* Junior Research Group, and can thus be compared with these. My work is connected to the Geo- ecologist Jenny Eisold, who compares local and ecological knowledge.

Fieldwork was conducted with Uripoye Mburura from Opuwo who guided me and translated for me. He has been working as a guide for 10 years, is a native Otji-Herero speaker and is related to some people in the village through the matrilinear side.

3.2. Analytic approach

It is difficult to measure knowledge, to decide what knowledge comprises and to determine who knows more or less than another person. As described above, it is not appropriate to reduce local knowledge to an easy-to-handle issue and to extract it from its cultural system. Nevertheless I had to define the term in order to be able to deal with it.

Definitions

Within the context of this work I defined local knowledge on livestock-environment relationships as

- the knowledge about quantity and quality of fodder plants;
- the knowledge about regional and seasonal occurrence on pastures;
- the preferences of diverse kinds of livestock regarding fodder plants.

The measurement of this local knowledge serves as a basis to examine the role of plant knowledge in the choice for or against pasture areas.

In this work I defined parameters of environmental change as

- Appearance of one selected pasture and the household area (approximately 500 m distance from houses) at time of settling in comparison to 2006. Observation criteria were density, height and dominance of herbaceous and woody species;
- Natural variations in precipitation, wind, and temperature;
- Change in soil quality;
- Occurrence or absence of plants species or animals such as insects, game, etc.

3.3. Axioms, hypotheses and research questions

In the following I will present axioms, hypotheses and questions for research. I generated questions based on the axioms of cognitive science (see 2.4).

1st Axiom: Perception functions as a filter by which form scripts and schemes

I assumed that herders order plants in groups and categories when describing their environment. This reveals indicators of classification. This assumption is the basis for the methodological tool of Cultural Domain Analysis (3.4.) used in this study.

Questions were:

- Which kinds of plants are perceived as important for animal nutrition? Why?
- Which criteria are used for classification?
- How do local actors rate and rank the quality and quantity of species for animal nutrition?

2nd Axiom: The perception leads to a definition of a situation and is then the basis for decision-making.

Hypothesis 1: I assumed that fodder plants are a key natural resource and an important factor in the decision-making process for or against a pasture. The way in which fodder plants are perceived (rated and ranked) influences the decision regarding mobility.

Questions were:

- Which pastures are used by each household?
- How are pastures rated?
- What are other important elements for the assessment of pasture quality?

3rd Axiom: Schemes and scripts are generated by experience, practice and socialisation

Hypothesis 2: I assumed that knowledge about livestock-environment relationships is distributed unequally in the population regarding age and sex, and is transferred in the process of socialisation. I assumed that elders and men know more about fodder plants and livestock needs than women and younger people.

Questions were:

- What kind of environmental knowledge do men, women, older and younger people share and what do they not share?
- How do children learn about plants, livestock and pastures?

Additionally, to specify on diverse livestock needs and foraging behaviour I examined the following questions regarding **livestock composition**:

- Which advantages and disadvantages are connected with herds consisting of different kinds of livestock?
- What are the challenges and risks for maintaining pasture quality when farming with diverse livestock?

To add the dimension of time I examined the perceptions of **environmental change.** This allows insights in change regarding range management and resource use based on the observations and emic explanations.

- How is environmental change regarding vegetation and precipitation on selected pastures described?
- What are the emic explanations of environmental change? Do herders explain using endogenous or exogenous factors[8]?
- Which environmental changes are reported over the last 20 years?
- What are the consequences of the observations?

[8] Endogenous factors can be meta-physical or social explanations, such as e.g. overgrazing, settling, building of permanent waterpoints, and change in social structure.
Exogenous factors can be climatic factors, such as e.g. precipitation.

3.4. Methods used in the study

To measure the variables described above the following methods were used:

3.4.1. Participant observation

I carried out **participant observation** throughout the whole duration of fieldwork, but most intensively during the first three weeks. The aim was to gain an insight into the following activities:

- Daily routine;
- Pastures: where is livestock?
- Herding: herding and tasks according to gender and age;
- Social relationships, interactions, and kinship.

I gained insights into daily tasks and activities such as e.g. herding techniques, choice of pastures, production of sour milk, harvesting of maize, transport of water, and also into family relationships, the organisation of the household, herd size, and kinds of livestock. After the first three weeks, which consisted solely of participant observation, it was as an element during the whole period of time. It helped me to gain a basis for efficient interviews and to choose interview partners to work with. Hence the observations in the first three weeks supported my idea of considering all kinds of livestock: herds in the village mostly consisted of cattle, goats and sheep. By taking part in daily life I learned about the importance of donkeys for daily tasks, e.g. in water and maize transportation. The engine-driven water point was broken throughout the whole time of my first stay, so people often had to rely on donkeys to transport water from neighbouring villages. I thus decided to include donkeys in the Cultural Domain Analysis.

3.4.2. Cultural Domain Analysis

In the next step I concentrated on important plants for animals' nutrition and chose methods of Cultural Domain Analysis. Cultural Domain Analysis examines e.g. the items that comprise the cultural domain of fodder plants. The main goals of this method are to investigate how the fodder plants are related to each other in people's minds (Borgatti 1993: 261).

In order to examine the most important plants for animal's nutrition, I opted for the **Freelisting** technique, which made it possible to determine the most salient plants. Interview partners were

asked to name all the fodder plants for cattle, goats and donkeys which came into their mind. After finishing, the so called Freelist was read again in order to motivate partners to recall more plants (Brewer and Devon 2001, Borgatti 1993). Data was processed with Borgatti 1996 (*ANTHROPAC 4.0*. Natick, MA Analytic Technologies).

To cope with the high number plant items mentioned, 211, I chose the first 24 plant species with a response frequency > 37 %, which meant that plant species which were mentioned less than seven times by all interview partners were excluded. Being aware that this exclusion could cause under-representation of naturally rare species, I tried to reduce this risk by involving 19 interview partners in the Freelisting method.

Free and structured Pile-sorting

Pile-sorting is a technique to judge the emic perceptions of similarity of items, here fodder plants, which can also be carried out with non-numerate and non-literate partners (Borgatti 1993: 271). The underlying assumption is that interview partners calculate a kind of correlation based on their own knowledge (Borgatti 1993: 272). In the process of analysis one can form hypotheses about the attributes of items and the indicators for classification.

In order to examine the emic criteria for classification of fodder plants I conducted **Free Pile-sorting** with 10 interview partners. Processed with Borgatti 1996 (*ANTHROPAC 4.0*. Natick, MA Analytic Technologies) emic perceptions of similarities can be identified. Displayed as a hierarchical cluster, it is possible to identify fodder plants that form groups or clusters across all interview partners and their Pile-sorting solutions (see fig. 6). Interpretation of the clusters was carried out by me and seven local interview partners during my second stay in December 2006. I asked for their interpretation of the similarities of the plant groups (see 5.1.3.).

The results of Freelisting, the names of the 24 most frequent fodder plant species, were written on small cards: Free Pile-sorting was conducted with these 24 cards.

The task for the interview partners was to sort the cards into piles according to the similarity of the fodder plants. The names of the plants were read to the non-literate interview partners. Interview partners sorted the set of 24 cards into a self-chosen number of piles.

Picture 1: Pile-sorting: Uripoye Mbururа and interview partner while sorting piles with the set of 24 cards.
Photo: Silke Tönsjost

To examine important fodder plants for each livestock **structured Pile-sorting** was conducted. My aim was to detect the variance in fodder needs and habitat types regarding the advantages or disadvantages of herding with mixed livestock. My questions were:

Which livestock species competes with another?

Which livestock can function as a good supplement without endangering the fodder of other livestock species?

Apart from this, this method served as a tool to analyse the differences in knowledge according to sex and age (see 5.4.1. and 5.4.2.).

10 interview partners were asked to group the plants into three piles according to livestock-specific fodder plants: one pile for cattle-fodder plants, one for goats and one for donkeys. Each of the 24 plant species could occur in each pile.

Due to the high ratio of woody species in Freelisting I assumed that people mainly focused on scarce times. To test this assumption I asked for the fodder plants for the scarce budding season (*oruteni,* October-December) during my first stay and for the fruitful rainy season (*okurooro,* January-March) during my second stay.

To identify the important plants for the budding season (*oruteni,* October-December) the same 10 interview partners ranked five plants of each pile according to the following task:
"Imagine it is the hard time in oruteni and you have to decide for a grazing area for your livestock. You are taking a look at diverse areas. Which plants are the ones you like to find to say, "This is a good pasture"? Which are the five most important plants for cattle, goats and donkeys? Please order them according to their importance."

During my second stay I conducted the same procedure for the most fruitful time during the rainy season (*okurooro,* January-March). The procedure was identical in order to make results comparable. This structured Pile-sorting for the most fruitful season was conducted with two women and two men who were identified as very knowledgeable (see 5.4.1).
The outcomes of the cognitive methods and observations led to the refinement and generating of leading questions before starting with interviews.

3.4.3. Interviews

13 **semi-structured interviews** (Bernard 2005: 212) on the issues of livestock herding, transfer of knowledge, environmental and change sustainability were conducted with 18 interview partners, each about 1.5 hours long. Some of them were group interviews with two or three partners. The interviews were tape-recorded and transcribed by Uripoye Mburura, Uhangatenua Kapi[9] and me.

The data was completed by field notes from participant observations and numerous informal talks.

3.5. Sampling

The sampling universe was the population of the village *Okazorongua*, which comprised 184 people in 2005. Census data of the village was collected by Uhangatenua Kapi in June 2005. I considered the variables of age and sex in sampling in order to compare plant knowledge

[9] Uhangatenua Kapi from Opuwo worked for ACACIA as a translator and assistant for ecological work for a period of 13 years.

were chosen who were for instance members of grazing and settlement committees, elders, and people who had been settled in *Okazorongua* for a long time. Representative random sampling was unrealistic.

The sample size was restricted to the situation in the field: due to "good rain" the harvesting period in May and June 2006 was long and labour-intensive, so that potential interview partners were very busy in the distant maize fields.

Free Listing was conducted with 19 interview partners, 9 women and 10 men. The year of birth ranged from the 1920s to the 1980s.

Pile-sorting was conducted with 10 interview partners, 6 men and 4 women, whose year of birth ranged from the 1940s to the 1980s.

Interviews were conducted with 11 men and 1 woman. Partners were chosen according to their position in the community: members of committees, key interview partners with above-average results at cognitive methods (i.e. long Freelists), elders, people that had lived in the settlement for a long time, and known experts for livestock. Unfortunately it was difficult to motivate women for interviews, so only one woman gave an interview about environmental change in the household and nearby pastures. When asked about herding techniques or environmental issues women often referred to their husbands or male household members. In future research it will be helpful to work with a female translator and guide to encourage the responses of women.

For the distribution of age and sex in the samples see the tables 16-18 in the Appendix.

Independent variables such as education (school years, attendance in workshops and trainings, and language skills) and age were collected systematically with each interview and cognitive method conducted.

4. The location: *Okazorongua* in the southern Kunene region

4.1. Geography and climate

The study area is situated in an arid African savanna in the north-western part of Namibia called the Kunene region. Namibia is the driest country in Southern Africa, characterized by frequent droughts (Hutchinson 1995). The Kunene region is framed by the Kunene River in

the north, bordering Angola. Omusati region is met in the east, Erongo regio and the Hoanib River in the south. The western Kunene area is framed by the Atlantic Ocean.
Population density in the Kunene region is low: in 2001 there were 0.6 persons living per km^2 (Republic of Namibia 2005:4).
Precipitation is highly variable in Namibia. In the study area most of it falls as showers with a patchwork distribution of wet and dry areas (Hutchinson 1995).

Monthly precipitation-mean and OtjiHerero terms for the seasons

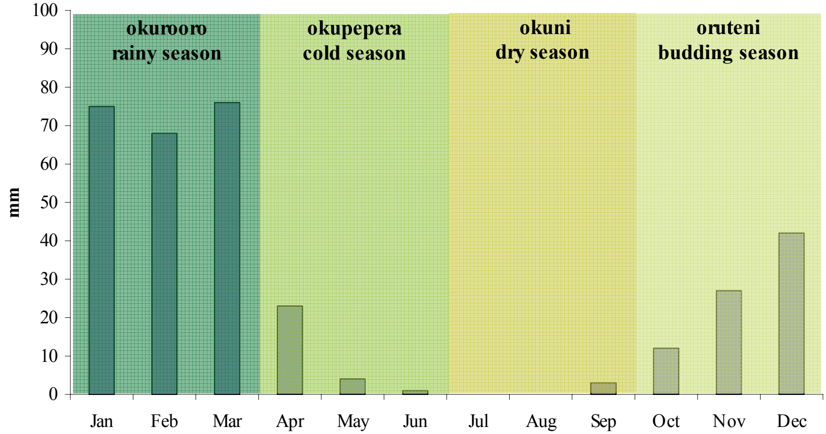

Figure 2: Monthly precipitation- mean distribution measured in Opuwo from 1941-1998. OvaHerero divide the year into four seasons.
Data- source: Sander and Becker 2002

Rainfall averages 300 mm/a, and its variability exceeds 30%. Vegetation is a secondary Mopane savanna.

4.2. The village *Okazorongua*

Research took place in a village of OvaHerero pastoralists in the emerging *Orupupa* Conservancy. OvaHerero pastoralists have been settling in *Okazorongua* since the 1960s. It were household members of the neighbouring settlement called *Omatapati* who began to settle permanently in *Okazorongua*. The grazing areas were known and used before. The installation of an engine-driven waterpoint worked as a pull-factor for permanent settlement. Relatives of the first settling household followed and the village grew.
A trail of 30 km leads to the main road between Kamanjab and Opuwo.

4.3.Inhabitants of *Okazorongua*

The OvaHerero are a semi-nomadic pastoralist group. They speak Otji-Herero, a language belonging to the South-western Bantu group (Möhlig 2000, Bollig 2000: 272)[10].
Social organisation is based on kinship, which is unilinear and based on double descent. Every individual is a member of a patriclan (*oruzo*) and matriclan (*eanda*), linked to the biological father and mother (Delius 1990:27). The membership of the matriclan determines the inheritance of material goods, such as cattle. Ritual goods and clan-specific cattle taboos, for instance, are inherited in the line of patriclans (Delius 1990: 27ff, Malan 1994: 77fff).
OvaHerero divide the resident units into the categories of "main households" and "cattle posts"; both are located at different places[11]. Livestock herds are distributed among the two household types. The difference is the existence of an ancestral fire, which turns the resident unit into a main household. The ancestral fire is one ritual location for ancestor worship and represents the ancestors within the homestead[12].
Okazorongua consists of 1-2 main households (Sg. *Onganda,* Pl. *ozonganda*) and 9-11 so-called cattle posts *(*Sg. *Ohambo,* Pl. *ozohambo).* Both types of residential units are constructed in the same way: with permanent houses and pens, both are inhabited permanently by members of the extended family. In *Okazorongua* all household heads are male. In the case of polygynous marriages the wives of the household head live in different

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[10] For the history of OvaHerero see for instance Henrichsen 2000, Gewald 2000.
[11] In this work I use the following definition of households: people that live together in one unit, care together for livestock, and share food and income from "outside" sources such as wages and pensions. Co-residence in the study area is mainly based on kinship.
[12] For the history and religious function of the ancestral fire see Bollig 2001.

households. Marriage rules are polygynous, with patrilocal residence after marriage. In the study area the bridewealth has to be paid in the form of three cattle to the family of the bride.

In June 2005, when census data was collected, the village of *Okazorongua* was inhabited by a total of 186 people. In April 2006 three new cattle posts (*ozohambo*) were located there: one family came back at the beginning of 2006, and two other already-existing cattle posts formed separate cattle posts (*ozohambo*). In December 2006 one main household (*onganda*) was not inhabited. Two households (*ozohambo*) defined themselves as OvaHimba households, the rest as OvaHerero[13].

By comparing census data of the village with Kunene census data of rural areas of 2001 regarding the variables age and sex it is visible that the population of *Okazorongua* is relatively similar to the Kunene census data. The main group (48%) consists of young people: children between 0 and 14 years. 42 % of the inhabitants are between 15 and 59 years old. The rest ist older than 59 years or they do not know their age.

Table 1: Comparison of local census data with rural Kunene census data

[age groups/ % of the age group in the area]	Kunene rural areas 2001	*Okazorongua* 2005
0-4	16.2	18
5-14	27.9	30
15-59	44.2	42.5
60+	7.7	4
Not stated	4.1	5.5

Source: Population and Housing Census (2005:13): population distribution in rural areas

The proportion of men and women is nearly equally distributed: 48.4 % of the population is female and 51.6 % male.

[13] When asked about differences between "OvaHimba and OvaHerero" the villagers emphazised that there is no difference apart from "a few small differences in language". OvaHimba speak a dialect of OtjiHerero. For the discourse about the construction of ethnic differences by the colonial state in Namibia see Bollig 1998.

4.4. Livelihood and economy

The inhabitants of the village of *Okazorongua* are pastoralists herding cattle, goats and sheep. Range management is based on the division of wet and dry season pastures: for 2-3 seasons the pastures nearby the village are used. During the scarce and dry season a few household members and livestock move to more distant pastures in order to guarantee fodder for livestock. These household members form a non-permanent cattle post at the dry-season pastures (Ziess 2004: 24, 50ff, Bollig 1997: 77f, Bollig and Schulte 1999: 301 ff). Land tenure is communal and organized in the form of Conservancies (see page 2). In the Conservancy areas of Namibia committees for several topics as water, grazing, settlement are common. These institutions are demanded by the ministry of rural water supply or are a prerequisite for Conservany building. The aim is to built a democratic structure on local level in order to govern and maintain natural resources

The human diet consists of animal products such as sour milk, butter fat, and occasionally the meat of goats and sheep. Cattle are slaughtered for ritual use, such as for weddings and funerals, or in the case of them getting too old to reproduce, whereas goats are slaughtered more often to get meat. Each household has a share in the garden area nearby the village which is cultivated in the form of dryland gardening without watering. Garden products serve as the basic food, especially maize throughout the year and pumpkins during the harvesting season (May and June). Maize is eaten fresh, roasted in the fire and boiled, and it is additionally dried on shelters to preserve it. The dried maize serves as food when milk supply is scarce in the late dry season; it can be prepared as porridge. Inhabitants reported that due to good rain at the beginning of 2006 the maize harvest was so plentiful that it provided food for about 12 months. Normally the harvested maize supplies about 6 months and people have to buy additional maize flour in shops. The next shop can be found in *Omuramba- South* which is about 7 km west of *Okazorongua*. Forms of transport are cars, donkey-cars and horses.

4.5. Livestock

Livestock consists of cattle, goats and sheep owned and borrowed by various household members. Members of the grazing committee estimated that there were 1000 cattle herded in the village in the middle of 2006. Cattle and goats are sold as the main factor of income to get cash for various needs: e.g. school fees, clothes, cars, construction material for houses, fences, and food. Cattle and goats can be sold to traders driving through the villages. Achieving better prices for cattle is only possible with high transaction costs: cattle have to be driven to the quarantine camp *Omutambo Maowe* run by MeatCo, approximately 70 km northeast of *Okazorongua*. There cattle sellers have to stay several weeks with their cattle until they can be sold.

5. The data: Knowledge on human-livestock relationships among OvaHerero

5.1. Local knowledge on fodder plants

In this work I aim to investigate one important element in the local range management system: the knowledge of pastoralists in *Okazorongua* regarding plants for animal nutrition. In the evaluation of suitable pastures the condition and occurrence of plant species plays a major role.

5.1.1. Salient plants for animals' nutrition

The outcome of the Freelisting method was a list of 211 plant species mentioned by 19 interview partners, with a total of 576 mentions (for a full list in OtjiHerero see table 19 in the Appendix, for a full list of determined species see table 29 in the Appendix). On average an interview partner mentioned 30.3 plant species. The assignment of vernacular plant names to scientific names was carried out by the ecologists Jenny Eisold and Anja Linstädter consulting available ethno-botanical information in publications (Malan and Owen-Smith 1974, Von Koenen 1996, Schulte 2002a, Claassen and Craven 2004). Furthermore an unpublished manuscript (Craven 1994) and own unpublished data were used. From the 211 plant species mentioned by the interview partners 58 species could be identified. All species with either a local or an ecological rank > 0.02 were identified.

Table 2: Freelist of the 24 fodder plants for cattle, goats and donkeys mentioned most frequently by the interview partners (n=19)

Plant ID	**Vernacular name**	**Scientific name**	**Frequency in the Freelist**
1	*Omuhama*	*Terminalia prunioides*	18
2	*Omukaravize*	*Catophractes alexandrii*	17
3	*Omutati*	*Colophospermum mopane*	17
4	*Omumbuti*	*Combretum apiculatum ssp.apiculatum*	13
5	*Ongumba*	*Stipagrostis uniplumis*	12
6	*Omuzumba*	*Commiphora multijuga*	10
7	*Omutendeeti*	*Boscia albitrunca*	10
8	*Omusaona*	*Acacia mellifera*	10
9	*Otjinautoni*	*Boscia foetida ssp. Foetida*	9
10	*Onyase*	*Eragrostis nindensis*	9
11	*Omutungi*	*Commiphora glaucescens*	9
12	*Omuvapu*	*Grewia bicolor*	9
13	*Omukaru*	*Ziziphus mucronata*	8
14	*Omunguindi*	*Boscia albitrunca*	8
15	*Ongorondji*	*Schmidtia kalahariensis*	8
16	*Omuve*	*Berchemia discolor*	8
17	*Omumborombong a*	*Comretum imberbe*	8
18	*Omungondo*	*Acacia reficiens ssp.reficiens*	7
19	*Omue*	*Faidherbia albida*	7
20	*Okatjirakonduno*	*Stipagrostis hirtigluma ssp hirtigluma*	7
21	*Ohongo*	*Tribulus sp*	7
22	*Orusu*	*Acacia nilotica ssp kraussiana*	7
23	*Otjipembati*	*c.f. Monechma cleomoides*	7
24	*Omupanda*	*Lonchocarpus nelsii*	7

To assess local knowledge on fodder plants, additional ecological information on plant species mentioned by the interview partners is considered. In the context of this study three parameters are analysed:

1. Ecological performance

"Ecological performance" is an ecological term describing the relative success of plant species within a plant community. In Eisold et al. (2006) and in the context of this chapter it is used to explain the relationship between species abundance and species frequency considered in Smith´s Index (see below). As this index and the underlying principle of salience is not common in ecology, no specific term for this value exists[14].

2. Habitat preferences of plant species

Habitat preferences and performance were classified using an expert classification by Anja Linstädter. Each species was assigned to at least one of the four habitat types: sandy plains, loamy plains, mountains and riverbeds.

3. Plant Functional type of plant species

The ecological concept of Plant Functional Types (PFTs) is used to classify plant species with respect to their resource use and their response to disturbances such as grazing. For savannas, a functional classification of plant species has been done by Skarpe (1996). She considers trait catalogues including the life form according to Raunkiaer's approach (Raunkiaer 1934), leaf size, leaf life span, photosynthetic pathway, and root depth.

For the purpose of this study, Skarpe´s eleven functional types were simplified into seven categories: (1) **Trees** (woody species > 200cm), (2) **bushes** (i.e. small- and leaf-shedding, broad- leaved trees 50-200 cm high), (3) **shrubs** (woody species < 50 cm), (4) **geophytes**, (5) **perennial grasses**, (6) **annual grasses** and (7) **annual forbs**. This means that Skarpe`s three functional types of tree species > 200 cm and three functional types of perennial grasses were lumped to the functional types "trees" and "perennial grasses" respectively.

All identified species either occurring on the ecological plots and/or mentioned by the interview partners were assigned to one of the six Plant Functional Types by the ecologists Jenny Eisold and Anja Linstädter as an "*a priori* classification". The functional type "geophytes" was not represented by any species in this study. A description of the Plant Functional types can be found in Schulte 2002a.

Plant Functional Types

Taking a closer look at the ecological features of the most salient plants of the Freelist it becomes obvious that most of them are woody species (trees, bushes and shrubs) (80 %). Only 20 % are herbaceous species (annual or perennial grasses and forbs).

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[14] Data on species' abundance and frequency stem from visual ground cover estimations of all plant species on nine vegetation plots with a size of 1000m^2, situated along a grazing gradient in the pasture area around *Okazorongua*. All plots are situated in plains, which does not represent all habitat types used by pastoralists in the study area. Field data was collected at the end of rainy season 2006 (unpublished data from A. Linstädter and J. Eisold).

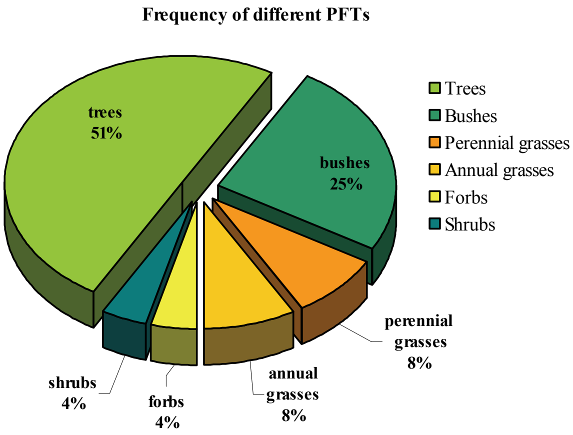


Figure 3: PFT proportion of salient fodder plants for cattle, goats and donkeys. According to the frequency in the Freelists woody species are the major PFT (80 %) whereas herbaceous species are mentioned less frequently (20 %).

The high proportion of woody species in local ratings indicates a high value of those PFTs in local perspective. Similar studies (Bollig and Schulte 1999) focused on grasses as indicators for good pastures. Thus, following these results it will be discussed what makes woody species important from a local perspective.

5.1.2. Comparing emic and etic views on vegetation

To answer the questions as to why interview partners perceive woody species as being of such importance, local and ecological salience of plant species are contrasted[15]. The aim is to detect parameters that are decisive for local ranking.

Ecological methods to assess the performance of the vegetation in the local grazing areas were: composition of vegetation, plant biodiversity and species coverage. The parameters were estimated on nine 1000 m² plots. Ecological fieldwork was also conducted between April and June 2006.

[15] This chapter is based on Eisold et al. 2006.

Synthesis of anthropological & ecological data

Local and ecological datasets on fodder plants are directly contrasted by analysing them with the Smith´s Index (Borgatti 1999), a weighted index of item salience. It determines the salience of an item (here: plant species) within the dataset. The Smith's Index in Freelisting data determines the salience of the plant within its data set considering:

- The rank of the item in the Freelist of each interview partner
- Its frequency in all collected Freelists and
- The individual length of the interview partner's list (Sutrop 2001).

This approach is directly transferred to the ecological dataset:

- The ecological plot is taken as equivalent to the interview partner,
- The species list of the monitoring plot is taken as equivalent to the Freelist
- The rank coverage of the species is equivalent to the rank in the Freelist.

For simplicity, Smith's Index will be referred to as the "Weighted Rank". Furthermore, the "Weighted Rank" of the ecological data set is taken as synonymous to the term "ecological performance" (see above).

Contrasting local perception and ecological performance

A total of 71 plant species were recorded on the vegetation plots, while the interview partners named a total of 211 plant species. For data processing in this comparison only species with either a high local and/or a high ecological importance (>0.02) were selected. In sum, 60 species met this criterion.

There is no correlation between the weighted rank index of local perception and of ecological perception of fodder plants ($R = 0.161$, $p > 0.05$).

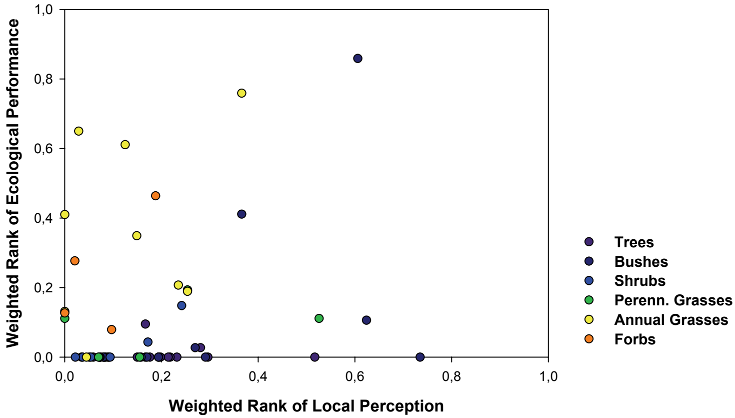


Figure 4: Local vs. Ecological Ranking - Weighted Ranks of the 60 most frequent species (with local and/or ecological Weighted Ranks > 0.02). Source: Eisold et al. 2006.

This means that ecological performance (i.e. above-ground biomass, measured as ground cover) and local salience of fodder plants differ. While the most frequent and abundant (S > 0.5) plants of the scientific dataset are mainly herbaceous species, the most salient plants of the local dataset are woody species. It is visible that there is a very small number of plants having both a high ecological performance and a high local salience, at least if the ecological performance in the ecological habitat type “plains” is considered. There is only one plant species with a high ecological and a high local value (fig. 4 right upper quarter) which is *Omutati* (*Colophospermum mopane*). Since one important aspect of ecological performance was measured as plant ground cover, this reflects local perception of natural resources: valuable resources in plains are scarce. The ecological performance is not a main determinant of local ranking as there is no correlation between ecological and local ranking regarding plain areas. Due to the lack of representative ecological samples it is yet not possible to assess whether ecological performance is one determinant of local ranking with regard to all habitat types.

Local criteria for ranking

Looking at the data it becomes obvious that there is a difference in PFT distribution within the most salient fodder plants as well (S>0. 5).

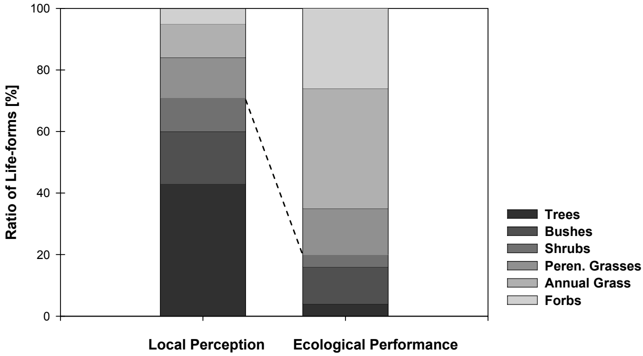


Figure 5: Spectra of PFTs - Local and ecological ratio of PFTs. The dotted line points out the different proportions of woody and non-woods species in local perception and ecological performance. Source: Eisold et al. 2006

While the most frequent (S>0.5) plants of the ecological data set are mainly herbaceous species (81 %), the most frequent plants of the local Freelist data are woody species (71 %). The higher proportion of woody species in local ranking indicates a higher value of those PFTs in the local perspective. This leads to the question: Why are herbaceous species despite their ecological performance not so important from a local perspective?

5.1.3. Fodder plants for the scarce time of the year

My aim was to investigate one possible criterion for the overall importance of woody species in Freelists: focus on times of scarcity. In order to test the relevance of woody species for times of scarcity a ranking of plants for scarce times was conducted (see 3.4.2.).

Table 3: PFTs of important fodder plants for different kinds of livestock in the scarce budding season (o*ruteni*, September-December)

[%]	**Cattle**	**Goats**	**Donkeys**
Woody species	72	88	72
Perennial grasses	14	6	14
Annual grasses	14	0	7
Forbs	0	6	7

The results in table 5 show that woody species are seen as the main and most reliable source of fodder in times of scarcity for all kinds of livestock. At least 72 % of the fodder species are either trees, bushes or shrubs. For the full list of plant species for the budding season see tables 20-22 in the Appendix.

5.1.4. Fodder plants for the most fruitful time of the year

I wanted to examine whether cattle's preference for woody species in grazing is a consequence of local scarcity-perception or whether cattle in the study area really like to eat woody species, not only in scarce times. My aim was to control for the PFT preference of livestock when fodder resources are plenty. Does the focus on woody species especially for the grazing of cattle and donkeys persist?

Table 4: PFTs of important fodder plants for different kinds of livestock in the rainy season (okurooro, January-March)

[%]	**Cattle**	**Goats**	**Donkeys**
Woody species	56	84	55
Perennial grasses	22	8	18
Annual grasses	22	0	9
Forbs	0	8	18

The results of the ranking task for the rainy season (*okurooro,* January-March) show that the fodder preferences of livestock for the fruitful season in general tend towards herbaceous species: Cattle rely more on herbaceous species during the rainy season, although the ratio of woody species is still high (56%). Goats need the same kind of PFTs as fodder for both seasons. Donkeys graze more on herbaceous fodder during the rainy season as well. But together with cattle their woody proportion is still high for animals categorized as grazers (55%).
For the full list of plant species for the rainy season see table 23-25 in the Appendix.

5.1.5. Classification of fodder plants

Thus, an indicator for classification seems to be the PFT with the inherent feature of availability in scarce times. To test this assumption the results of Free Pile-sorting are helpful. The task for the interview partners was :

"*Here is a set of 24 plant species. Please sort them into piles according to their similarity. You can make as many piles as you like. There is no right or wrong answer. I am interested in your answer.*"

Results are displayed in a hierarchical cluster.

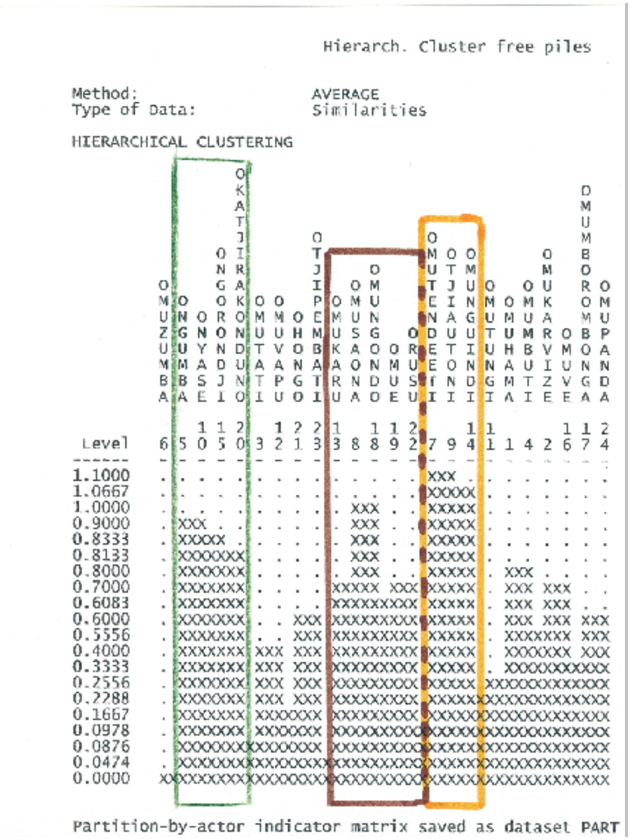


Figure 6: Display of Free Pile Sorting results: Hierarchical clustering of fodder plants

In the hierarchical cluster of fodder plants, similarity level (the column on the left-hand side) ranges from 0.0, which indicates a lack of similarity, to 1.1, which indicates the highest similarity. I assumed indicators for classification and interpreted the data considering PFT (bush, shrub, tree, grass, forb) and habitat type (riverbed, mountain, sandy plain, loamy plain). On first inspection three groups of plants with a high level of similarity (> 0.6000) can be identified:

1st Group: items 7,9,14 (orange mark)

Omutendeeti (*Boscia albitrunca*), *Otjinautoni* (*Boscia foetida ssp. Foetida*), *Omunguindi* (*Boscia albitrunca*) are in the first group, and are perceived as the most similar fodder plants. The clear similarity of *Omutendeeti* (*Boscia albitrunca*) and *Otjinautoni* (*Boscia foetida ssp. Foetida*) is the result of about 50 % of the interview partners saying that the plants are the same, with the other half stating that they are different plant species. From an etic point of view all three species belong to the PFT "bush". The habitat type is also similar: all plant species grow on sandy plains. Another common feature is that all species have whitish barks. When asked for similarities, all interview partners mentioned the trees' common features, the bark, leaves and fruits: the bark is whitish, the leaves are small and the fruits look nearly the same. Additionally, the roots of all tree species are used for the fermentation of sourmilk.

2nd Group: items 13,8,18,19,22 (brown mark)

Omusaona (*Acacia mellifera*), *Omungondo* (*Acacia reficiens ssp.reficiens*), *Omue* (*Faidherbia albida*), and *Orusu* (*Acacia nilotica ssp kraussiana*) are perceived as similar. Apart from *Omukaru* (*Ziziphus mucronata*) all the sorted species are trees. The habitat type seems not to be the criterion of classification in this group: three different habitat types are encountered: river, mountains, and loamy plains. One common criterion is that all species have thorns.

Asked for similarities, interview partners mentioned "trees with thorns" and the production of a sticky juice as the similarities.

3rd Group: items 5,10,15,20 (green mark)

Ongumba (Stipagrostis uniplumis), *Onyase* (*Eragrostis nindensis*), *Ongorondji* (*Schmidtia kalahariensis*) and *Okatjirakonduno* (*Stipagrostis hirtigluma ssp. hirtigluma*) are sorted in one group. The four plant species are all grass species (two are annual and two perennial grasses) and grow in sandy plain areas. Interview partners mentioned the same similarity: all species are grasses, having the same colour during all seasons.

The PFT seems to be an indicator for classification. In all cases the local classification reflects the scientific classification of savanna plant species into functional groups.
However, behind this classification could also be another hidden indicator which is inherent to the PFTs and is related to use and effect of the plants for animal nutrition. For instance, availability in scarce times is an inherent feature of woody species. When asked for similarities habitat types were not mentioned by the interview partners.

5.2. Livestock

In order to apply these results to strategies of range management it is important to understand livestock needs and characteristics from an emic point of view. Livestock herds in the study area consist of cattle, goats and sheep. Cattle and calves are herded separately. Goats and sheep are herded in one unit, but separated from cattle and calves. All kinds of livestock are driven half-way to the chosen grazing area and return back home on their own.

Cattle

Daily activities regarding cattle are conducted by men and women: mainly women milk cattle in the morning and the evening, and men and teenage boys drive them to the waterpoint and pastures.
Female cattle have to be separated from their calves during the day in order to secure the milk for human consumption. After returning home to the household female cattle are chased into pens to milk them. To support the milk-flow the calves are brought by men and women one by one to their mother to start drinking a little bit before the milking procedure begins (Informal talks with Kaijere Thom,Vekombua Tjikundi in May 2006).

Picture 2: Mainly women milk cows in the pen. Photo: Silke Tönsjost

Goats and sheep

Goats and sheep are herded in one unit. Herding goats is regarded mostly as a task of women and children. Before driving the herd to the pasture the small goats are separated from their mothers and kept in a small goat's pen near the household. After the adult goats and sheep are driven to the grazing area, the small goats roam around the household area and are driven back into the goat-pen in the afternoon before the adult goats and sheep return. In the evening time each small goat is brought to its mother to drink milk (Hiyandongo Tjawiramo, 16.5.06).

Both cattle and goats' offspring have to be sorted to their mother-animal; otherwise clan-specific taboos are violated. Eating rules were fixed by patriclan members in the past. The rules are inherited by the livestocks offspring. Rules concern only a few animals and regulate for instance who is allowed to eat the meat and drink the milk of the animal. Apart from this it is important to "structure" the milk-drinking procedure in order to guarantee that small goats and calves get enough milk. The calves, goats and cattle are recognized by colour and each livestock is well-known by the family members (Hiyandongo Tjawiramo, 16.5.06).
Livestock addditionally consists of donkeys, chicken, horses, cats and dogs.

5.2.1. Diversification of livestock

Interview partners emphasise the importance of herding with mixed livestock:

> "Different kinds of livestock are a sign for high status; one can care for the family well." (Kaeve Hinu, 5.5.06).

Apart from their importance for meat and milk production **cattle** are described as a bank and a mean of exchange. The number of cattle is a measure of status; they are described as clever and are highly esteemed (interview with Christof Tjikumisa and Tezeeko Muhuka, 27.5.06). The local ideal is to work as a farmer and accumulate cattle.

> "We in the OvaHerero culture don't support and really hate it that young men of Uripoye's age are working instead of buying ten cattle. When you are like that, you are disgraced or criticised in the OvaHerero tradition. For us OvaHerero, if our son is going to work, but he has not yet bought animals, he is regarded as lost in value. People even don't like to give sour milk to this person. Why is he looking at animals and not buying them, why should he be given sour milk to drink? What for? Let him go and eat sugar, these people are even not given meat. [...] That's the reason for OvaHerero to have such a big number of cattle. [...] If a person doesn't has butter, doesn't has fat, what is she/he going to do?"
> (Interview with Humbehu Thom, 29.5.06).

Cattle are of high symbolic and religious importance as well: the meat is mainly reserved for celebrations, weddings, funerals and for paying a bridewealth.
Goats are described as a bank, too, but as "a secondary one". The decision to sell livestock in order to get cash is described as easier for goats than for cattle.

> "Goats are sold to buy clothes for children and maize flour for us. Normally we do not harvest such big amounts of maize like this year, and then we are saved by the goats."
> (Interview with Mukande Tjiurua, 30.5.06).

When asked about the advantages of goats all interview partners answered that goats are easy to offer to a visitor as a gift. When asked about advantages and disadvantages of farming with goats the interview partners reported that goats serve as good food for human consumption: the slaughtering of a goat is more likely if one likes to eat meat, especially in the dry season (*okuni,* July - September) and the rainy season (*okurooro,* January - March) to change the diet (Interview with Hiyandongo Tjawiramo, 16.5.06).

Goats are mostly milked in the budding season (*oruteni*, October- December), to balance the lack of cattle milk, which is less during this time of the year (Bollig and Casimir 2002: 192). Goat milk is regarded as strong and fat and is prepared as sour milk, as well. One further advantage of goats is that they are described as more resilient in case of drought and can be sold easier in times of drought to get cash.

Disadvantages are that farming with goats is regarded as more exhausting: they walk faster than cattle and are more active. In contrast to cattle, goats do not learn very easily to which household they belong. When household members move to the cattle post the goats "run to the wrong household for weeks". Apart from this a loss is more likely: goats are an easier victim for predators and thieves (Interview with Hiyandongo Tjawiramo, 16.5.06).

Sheep are milked in the budding season (*oruteni,* October - December) as well. They are described as important for ritual use, e.g. for celebrations of maturity. The skin is appreciated as "warm good clothes" (Interview with Christof Tjikumisa, and Tezeeko Muhuka, 27.5.06).

Donkeys are appreciated for their assistance in ploughing, pulling donkey cars and riding. Especially during the time of drought, or when the waterpoint is broken, donkeys are an important means of transporting water, food and wood. Maize and pumpkin from the distant garden areas are transported by donkey cars as well. Donkeys are valued as being more robust than horses.

Horses are appreciated as "a car in case of emergency" and a more convenient means of transport. During the cold season (*okuperera,* April-June) horses and donkeys are brought to the mountain areas nearby the household in the evening and collected again the next morning. Their tracks can be found more easily in the mountains, thus searching time is reduced (Interview with Pita Thom, 27.5.06).

5.2.2. Livestock characteristics, fodder needs and their implications for local range management

When asked about the fodder needs of livestock, interview partners began to describe the cattle and goats` ways of grazing and browsing. Goats are regarded as a threat to the pastures, especially to the grass:

> CT: When goats are too many they take all the grass away, they are not grazing very far away and eat the grass in the HH area. [...]
> ST: They eat everything to the bare ground?
> TM: [...] They walk over the grass until it is completely gone, because goats are walking in bigger group, not lifting up their head. [...]
> CT: For example, when goats walk in the area from here to that tree, than the whole grass is broken here. Where they walked the grass lies down, on the way back they are taking another way. The next day another part again. Then the wind blows this lying, broken grass away. Cattle are walking in bundles, even if they are thousand, 30 here, 30 there, there will be a space for grass in between."
> (Interview with Tezeeko Muhuka and Christof Tjikumisa, 27.05.2006)

Donkeys are perceived as a threat to the availability of fodder biomass as well. "The donkey can eat throughout, even during night; it is constantly eating and not resting." (Interview with Pita Thom, 27.5.06). In order to examine the competitional and supplemental aspects of herding with diverse livestock it is important to take a closer look on livestock's fodder needs.

Fodder needs

As an outcome of structured Pile-sorting (for the method see 3.4.2.) the interview partners sorted nearly all plant species for each kind of livestock. This means that all of the 24 salient woody and herbaceous plant species are eaten by donkeys, cattle and goats. At first sight all kinds of livestock seem to compete with each other for fodder.

Taking a closer look at the plant species which the livestock have in common, it is obvious that goats and donkeys use all 24 plants species as fodder respectively. 23 plant species were sorted into the pile for cattle. This means that nearly all plant species, woody or herbaceous, are used by each kind of livestock. Hence these outcomes do not reveal competition at first sight. Nearly all herbaceous species grow in plains, whereas woody species are mostly found in mountain areas.

The result is not so surprising for goats and donkeys, as both livestock species are classified as being browsers or having mixed grazing/browsing behaviour. But even for cattle, mainly classified as grazers, mainly woody species (78 %) are named as fodder plants.

To determine whether livestock species compete with each other the frequency of plant species in the piles has to be considered. The basis of the analysis is formed by the first 14 species of each pile, because they are the most frequent and salient ones (for full lists see tables 26-28 in the Appendix). From this reduced list the common species are chosen in order to compare for competition.

Competition between cattle and goats

Four out of five fodder species used by cattle and goats are woody. This is a hint for there being particular competition in the scarce budding season (*oruteni*, October-December). In this season herbaceous biomass is very scarce. Three of the species mentioned grow in the mountains, and two in the plains. Thus, goats minimize the cattle's fodder resources, which are concentrated in the plains. Driving goats onto the mountains saves the plains for cattle.

Table 5: Fodder plants used by cattle and goats. Example first line: 9 of 11 interview partners named *Omukaravize* as fodder plant species for cattle, 11 of 11 interview partners named it for goats.

Plant ID	Vernacular name	Scientific name	PFT	Biotope	Frequency in the cattle pile (n= 11)	Frequency in the goat pile (n=11)
2	*Omukaravize*	*Catophractes alexandrii*	bush	mountain	9	11
1	*Omuhama*	*Terminalia prunioides*	tree	mountain	9	10
7	*Omutendeeti*	*Boscia albitrunca*	bush	sandy plain	7	10
12	*Omuvapu*	*Grewia bicolor*	bush	mountain	8	10
21	*Ohongo*	*Tribulus sp*	forb	sandy plain	6	11

Competition between goats and donkeys

All five species which goats and donkeys had in common were woody, three species grow in plains, one in riverbeds, which are also in the plains, and one species grows on the mountains.

This shows that donkeys and goats endanger fodder biomass on plains, which are the the first-choice habitat for cattle.

Table 6: Fodder plants used by goats and donkeys

Plant ID	Vernacular name	Scientific name	PFT	Biotope	Frequency in the goat pile (n=11)	Frequency in the donkey pile (n=11)
3	*Omutati*	*Colophospermum mopane*	tree	sandy plain	11	6
7	*Omutendeeti*	*Boscia albitrunca*	bush	sandy plain	10	9
8	*Omusaona*	*Acacia mellifera*	tree	loamy plain	10	5
18	*Omungondo*	*Acacia reficiens ssp.reficiens*	tree	mountain	10	5
17	*Omumborombonga*	*Combretum imberbe*	tree	riverbed	9	5

Competition between cattle and donkeys

Four of the seven species which are subject to competition species are grasses, and three woody. Their main habitat type are plains (6 species), and one species grows in riverbeds. Thus, donkeys and cattle compete with each other for fodder. Donkeys minimize the availability of fodder plants for cattle in plain areas.

Table 7: Fodder plants used by cattle and donkeys

Plant ID	Vernacular name	Scientific name	PFT	Biotope	Frequency in the cattle pile (n=11)	Frequency in the donkey pile (n=11)
5	*Ongumba*	*Stipagrostis uniplumis*	perennial grass	sandy plain	11	7
10	*Onyase*	*Eragrostis nindensis*	perennial grass	sandy plain	11	9
15	*Ongorondji*	*Schmidtia kalahariensis*	annual grass	sandy plain	11	8
20	*Okatjirakonduno*	*Stipagrostis hirtigluma ssp. hirtigluma*	annual grass	sandy plain	10	6
9	*Otjinautoni*	*Boscia foetida ssp. Foetida*	bush	sandy plain	8	11
23	*Otjipembati*	*c.f. Monechma cleomoides*	shrub	sandy plain	8	8
24	*Omupanda*	*Lonchocarpus nelsii*	tree	river	6	5

In summary, the plain area is the habitat type that provides fodder plant species for all kinds of livestock; plains are therefore highly competed. The herbaceous biomass which is important for cattle especially in the scarce budding season (*oruteni*, October-December) is to be found in plains mainly and endangered by goats and donkeys.

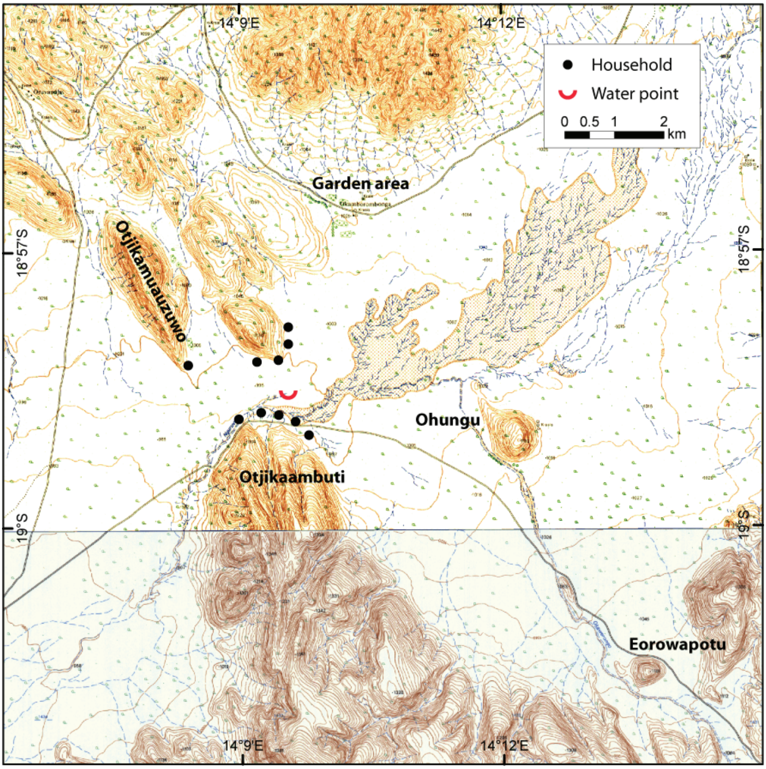
5.2.3. Spatial mobility in the cold season and budding season in *Okazorongua*

In order to investigate how plant perception influences decisions on grazing patterns, I observed grazing patterns during my stay. In general all kinds of livestock are driven half-way to the chosen grazing area. After grazing they come back home on their own to drink and for milking.

Range management during the cold season (*okuperera*, April- June)

In the cold season (*okupepera*, April - June) the leaves of trees and bushes turn yellow because the leaves burn from the sun, a process called *omiti vyaoto*. The grass gets dry and whitish. Livestock is at its best stage; it is "very fat" and can be vaccinated. At the end of the season in June goats start to give birth (informal talks with Kaeve Hinu, Josua Hinu, Humbehu Thom: 7.5.06, 15.5.06, 18.5.5.06).

During the first period of field work (April –July 2006) the waterpoint was broken. In the first two weeks surface water was left in a nearby riverbed due to heavy rains in rainy season 2006. After this water was finished most inhabitants relied on water from neighbouring villages that was transported by cars and donkeys. Thus livestock had to be driven to the nearby villages in order to drink. Pastures were areas on the way to these waterpoints.



Picture 3: The grazing area of *Okazorongua* consists of plains and mountains. In general, small livestock is driven in the mountains nearby the households during all seasons. The area called *Eorowapotu* is a reserve area for severe dry times. The area to the south- and northwest is used for cattle during the cold season (*okuperera*, April to June). During budding season (*oruteni*, September- December) pregnant cattle and calves graze/browse in the mountains as well. Older cattle graze in the plains around the mountain *Ohungu*.

In the cold season cattle and calves are herded separately. Goats and sheep are herded in one unit, but separated from cattle and calves. The grazing observed during May 2006 was concentrated on mountains nearby the households for goats and calves. Small livestock and calves got water from a waterhole dug in the riverbed. Cattle grazed in the plain areas in the direction of the villages *Omuramba-South*, *Oruvandjai* and *Omatapati* in order to drive them to the waterpoints.

By participant observation I found that exceptions from general rules and patterns were made regularly to meet current situations of the household members. A lack of family members for instance forced herders to drive livestock to pastures that were actually supposed to be saved for scarce times.

Range management during the budding season (oruteni, September- December)

The descriptions of the budding season (*oruteni,* October - December) are the most detailed ones in interviews. The budding season is the hottest season, where animals try to find shade under trees. The leaves bear new fruits (*ozunda*), no strong winds can be observed and the sky is covered with white clouds that "do not move and one can see that there is water in [them]". Especially the month of October, before the first rain starts, is described as the hardest month of the year. Livestock is thin and suffers, they can die due to lack of grazing (informal talks with Kaeve Hinu, Josua Hinu, and Humbehu Thom: 7.5.06, 15.5.06, 18.5.5.06).

In December 2006 the *Okazorongua* had not yet received "good" rain. A few showers of rain in October allowed the grass to start to grow, but the process was stopped after a lack of rain in November and December.

During the budding season (*oruteni*, September- December) livestock is herded in units again: as during the cold season (*okuperera*, April to June) sheep and goats are herded in one unit. Cattle are divided into two or three groups depending on labour force: pregnant ones and calves are mostly in one unit and the second unit consisted of males and females that had calved already, referred to as older cattle.

In December 2006 nine households (all cattle posts, *ozohambo*) still settled in *Okazorongua* whereas one household (also a cattle post, *ohambo*) moved to the mountain *Ohungu* to built a new cattle post (*ohambo*) . Nine out of these 10 households drove their older cattle to the plain area around and behind the mountain *Ohungu*. Interview partners observed that in the plains around *Ohungu* there is enough grass left for cattle. One household drove older cattle to a mountain nearby the homestead. Calves and pregnant cattle were driven into nearby mountains by all households: six different mountain areas served as a mountain pasture. Cattle browse the green leaves of the trees and bushes and graze the left-overs of grass. Interview partners said that the main reason to drive them into the nearby mountains is the security aspect: they are not that far from the household whereby attacks by predators can be

reduced. If they are kept on the plains, the pregnant ones would reach distant areas and the newborn offspring could not be saved and brought back to the pen.
Goats were mostly driven to mountain areas: six households drove goats to five different mountains which are nearby the homestead. One household drove goats to the *Ohungu* plains. The donkeys of three households grazed in the distant mountains near the village *Omatapati*. Two households let their donkeys graze in the plain area of *Ohungu*. During the budding season they are mostly not used for assistance.

5.3. Environmental change

To add the dimension of time in the perception of fodder plants I asked interview partners for their observations on rainfall and vegetation. This allowed insights in change regarding range management and resource use based on the observations and emic explanations.
In the interviews I concentrated on two areas: the pastures directly surrounding the households (up to approximately 500 m distance) and the major grazing area for cattle in the nearby plains of *Ohungu*. This area consists of big plains and the mountain itself. The mountain is culturally very important because it is "linked" to ancestors of a few households in the village. Special taboos regulate access to it in the form of housing patterns for the budding-season cattle posts[16].
In all interviews the descriptions regarding vegetation and precipitation have one aspect in common: in general rain and vegetation in former days is described as more and "better": game was plenty, livestock and people were less.

5.3.1. Rain

When asked about the quality of rain, the interview partners made the division into "good" and "bad rain". Good rain is characterized by a controllable amount of precipitation: "The water stops flowing after a big amount of rain, it ends by dropping, it is a kind of diminishing rain. It is raining without a lot of noise" (Informal talk with Josua Hinu, 21.6.06). As a consequence the grass in the household area, the surrounding mountains and plains grow well and high (Informal talk with Humbehu Thom, 18.5.06).

[16]For a detailed example of ancestral actions influencing environmental behaviour see Horowitz 2001.

In contrast “bad rain” is described as “a strong rain, which is too cold for cattle, so that it can die. Bad rain does not make the grass in the household area grow, one has to go deep in the mountains for grazing.” (Informal talk with Humbehu Thom, 18.5.06).

The last rain from February to April 2006 was appreciated as the best one for decades.

> CT: “Since my childhood it is the first time to experience very good rain. A rain which rained like long time ago, which renewed the environment. The whole environment became very good due to the good rain.
> ST: Are you referring to this last rain a few weeks ago?
> CT: Yes. Now, the environment looks very good. Like the time when I was a child. For many years the rain did not rain good. There was a shortage of trees, they were dry and there were areas where the grass did not grow.
> ST: Which age are you referring to?
> CT: Me myself, I was born in 1943. I think since 1950s, or let me say, when I started to get mature as from the beginning 1960s. Those days the rain was raining very well. From there on to independence and from independence until now the rain was not good. It came only in February and during March it went back. But this last rain was very good; it was as good as the one long time before.
> (Interview with Christoph Tjikumisa, 26.5.06)

When talking about smaller units of time people observed that since 2000 rain had not been good until the beginning of the year 2006 (Interview with Tjisumbu Tjiumbwa, 23.6.06, and Josua Hinu, 24.6.06).

Markers for the change in rainfall are the lack of fruits and roots for human nutrition:

> “The rain has changed, in former times it was raining well and it brought different flowers on trees and plants. Nowadays those things are not coming any longer. I have experienced in this rainy season, after a lot of maize had been harvested. The fruits of trees and the vegetable on the ground didn’t grow. Nowadays the rain is not raining well, in former times it was raining and people got happy, in nowadays it doesn’t make people happy. Then when it was raining well, fruits and vegetables like *ozombe* (fruits of *Berchemia discolor*), *ozohamati* (fruits of *Grewia villosa*), *omandjembere* (fruits of *Grewia flava*), *omaore* (fruits of *Grewia schinzii*), *ozombapu*, *ozondjenya*, *ozohe*, *ozombanyu*, *ozonduvi* (roots of *Lapeirousia sp*.), *ovitungo* and *otunwe* were growing.
> (Interview with Kaeve Hinu, 25.5.06, identification of fruits and roots: Bollig and Casimir 2002: 197)

5.3.2. Vegetation

When asked about the condition of the vegetation at the beginning of settlement in *Okazorongua* the elder describes that grass was more abundant in the 1960s, but that it was the same type of grass. Shrubs were bigger and trees were roughly as numerous, although he observed that there were more *Omumbonde* trees (*Acacia erioloba*) in the past (Interview with Kaeve Hinu, 25.5.06).

> **MH:** When I settled here, there was a lot of trees here in the household area, even there where the maize is growing were *Omumbonde* trees *(Acacia erioloba)*. There were *Omumbonde* trees, all those trees died while I am here. There was a forest here of *Omukaravize* trees (*Catophractes alexandri*) and *Omungondo* trees (*Acacia reficiens ssp.reficiens*). [...]
> **ST:** What about the grass in the household area?
> **MH:** The grass was not different, it was as it is. The difference is that the grass was many, because I had few cattle. By that time there was plenty of grass, in the area where you have been, that one of *Eorovapotu*, there was very many grass. That side of *Orongombe* had very many grass as well.
> (Interview with Kaeve Hinu, 25.5.06).

5.3.3. Emic explanations of environmental change

All four partners interviewed on environmental change gave the following reasons for environmental change: the lack of "good" rain, the big amount of cattle and the changes in soil quality (Interviews with Kaeve Hinu 25.5.06, Humbehu Thom, 29.5.06, Christoph Tjikumisa 26.5.06, Mukande Tjurua 30.5.06).

> **"**Nowadays, shrubs are worked over by livestock, they are not looking good. Shrubs are also getting smaller due to livestock; they are not like in former times. They are decreasing now; the grass is also getting less."
> (Interview with Kaeve Hinu, 25.5.06).

Natural processes for bad soil are caused by livestock. "Livestock is stepping over it too much, which causes dryness and then the loss of shrubs and bushes" (Interview with Humbehu Thom, 29.5.06, Interview with Kaeve Hinu 25.5.06).

> ST: What is the cause of soil being blown away: cattle or wind?
> CT: When the soil is blown away, there are little holes developing where cattle are stepping in. This makes the area getting deeper and deeper. [...] If you dig the soil like this you see that the top soil is different, if you dig deeper you will find another kind of soil again. Soil layers are like fingers and we experience this

> when we are digging water holes [...] and when we plant maize. This top soil which was burned by the sun, the maize does not grow well in it; it grows better in the bottom soil.
> (Interview with Christoph Tjikumisa, 26.5.06)

The elder anthropomorphizes the processes of soil getting old.

> "In former time people even got older, young people were not dying like today. As the soil gets older, young people are dying. The soil is getting old; even those white people are dying, those young ones, and the elders died already."
> (Interview with Kaeve Hinu, 25.5.06).

It is obvious that interview partners connect human behaviour and cultural change with the change in precipitation and soil quality.

5.3.4. Environmental change and cultural change

The change in rainfall, vegetation and soil seems to be connected with elements of cultural change. Lack of rain, for instance, is connected with the lavish use of food and lack of solidarity in the community.

> "People did it like this in former days: If a person wanted to slaughter an animal, he or she could not do it himself. The person had to call the children of a poor person to kill the animal and prepare the meat. So at the end the children took meat and fat along home. But nowadays many people are not behaving like this any more, they say: "I don't care about anybody". Things started to change, we don't have this attitude and behaviour any more. Long time ago a person could not throw food away, when he or she was satisfied. According to our OvaHerero norms and values it is not good to throw food away. This is the cause of the rain not to rain. God gets angry. After eating one should not throw food away but offer it to somebody, even give it a dog. Long time ago food could not be thrown away, but nowadays it happens. [...]
> But in case that the food gets rotten and one wants to throw it away, you should dig a hole and cover it afterwards. So that nobody passing by can see that food have been thrown away. Otherwise people are teasing you saying "that one is rich and throws food away". That saying will make God punish you." (Interview with Christoph Tjikumisa, 26.5.06)

Sharing among the community members is regarded as a behaviour that influences rainfall positively.

> "It is like that. It will only rain if I will give something, like the way I am giving pumpkins to you. I did not give it only to you but also to God. You are saying "thank you", but not saying it to me, but to God. For me this is doing something good to God." (Interview with Christoph Tjikumisa, 26.5.06)

This does not mean that rain and soil erosion are regarded as being influenced by supernatural forces only. Range management plays also a major role. All interview partners emphasise the negative effect of high cattle densities and their consequences on vegetation and soil. It is especially the uncontrollable amount of rainfall which is connected with supernatural forces.

> Katjirondwa Kuvare: "Even when you are trying to save the environment and there is no rain, or you have a lot of rain and didn't save the environment, there will be no grass. There are two things: the good rain and the good management. The rain is coming from someone whom we don't know, we have no guarantee. The outcome of the rain should be managed in such a way until the next rain comes."
> (Interview with Katjirondwa Kuvare and Johannes Undari, 18.6.06).

5.4. Distribution of knowledge on fodder plants

Knowledge is a means of controlling resources, and influences the access to resources. As knowledge is embedded in power-relations the distribution of knowledge is interesting because it reveals domains of resource use with relation to gender and age. Apart from this, status is linked to knowledge as well. I wish to investigate how gender and age influence the knowledge on fodder plants. In informal talks and interviews partners often mention a decline of environmental knowledge in the younger generation. From their point of view the main reasons are the absence from rural life due to formal schooling in urban areas and disinterest in livestock care.

> "I grew up with animals and parents. Nowadays, the children don't grow up with their parents, they grow up in school, not like me. The knowledge they have is from school, they don't have knowledge from their fathers. They are asking me about OvaHerero-things."
> (Interview with Kaeve Hinu, 21.6.06).

> Tjisumbu Tjiumbwa: "When they are coming back from school they play soccer. [...] Some of them stay in Opuwo during the holiday. When they are here and realise that it is only one week of holiday left, they come and tell you that they have to learn for exams. And we, the parents, do not know anything, and then we can only give money for school. Often they are refusing to be taught about livestock. To teach a person who is not interested is not easy compared with one who is interested."
> (Interview with Jakwaterua Tjawiramo and Tjisumbu Tjiumbwa, 22.6.06).

Regarding cattle, men expect themselves to be more knowledgeable than women. Women also often said that they rarely go out with cattle and cannot say a lot about their fodder needs. Goats are herded by women more often.

I am aware that knowledge is difficult to measure. For the purpose of exploring the differences in livestock-environment knowledge among younger and elder interview partners, men and women, I use two indicators for knowledge. The first indicator is the length of the Freelist. Naming large numbers of fodder plants is one indicator for extensive environmental and livestock knowledge. As a second indicator I take the "correctness of answers" of structured Pile-sorting, i.e. meeting the consensus of knowledge analysed by a Consensus Analysis. In this way it is possible to examine the differences in environmental knowledge. One can measure which group of interview partners gives the most consensual or the most heterogeneous answers.

5.4.1. Gender

Length of the Freelist

Displaying the length of the Freelists in combination with age and sex, it is visible that men mention more fodder plants than women. Apart from this, the values of women are closer to each other, all occurring in a cluster in the lower left quarter.

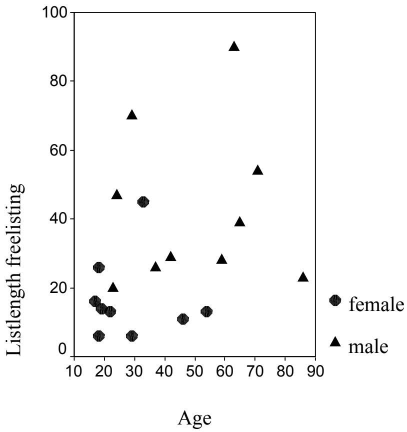


Figure 7: Correlation between sex and the length of the Freelist

This means that specialisation among men is more extensive: it is men who have outstandingly long Freelists with e.g. 90 and 70 items.

Means of the Freelist length are determined to compare men and women. The mean comparison supports the first impression of the scatter plot. Men's Freelists range from 20 to 90 items with a mean of 42.60 items. Women's Freelists range from 6 to 45 plants, with a mean of 16.67 plants.

Table 8: Mean comparison between sex and list length

Listlength freelisting

Sex	Mean	N	Std. Deviation
male	42.60	10	22.921
female	16.67	9	12.166
Total	30.32	19	22.482

The T-Test shows that a positive correlation between sex and list length is highly significant ($p <= 0.01$), i.e. men can name more fodder plant species than women.

The length of the Freelist cannot be the sole indicator for knowledge on fodder plants. Further on, I examine the application of knowledge in the form of knowledge on fodder needs of livestock.

Consensus Analysis

The results of Pile-sorting data are analysed by the method of Consensus Analysis. The data was processed with *ANTHROPAC 4.0*. Natick, MA Analytic Technologies.

Interview partners had to sort plants according to livestock species' needs (see 3.4.). *ANTHROPAC* processes the sorted items while displaying a core of overlapping answers. This "core of knowledge" is taken as the "consensus" of the sample (here: 10 interview partners) on the given question. The higher this value, the more interview partners agree with the core of knowledge, the more consensual and "correct" their answers are.

Taking a look at the scatter plots it is visible that women's value are more homogenous and occur in a kind of cluster, while men's values are more heterogeneous and deviate from this cluster. In all cases (cattle, goats and donkeys) it is obvious that the knowledge values for the younger interview partners are higher than for the elder interview partners. Women's values are situated in the upper left quarter; they are in all cases higher than the men's.

Tables 9-11: Correlation of knowledge values for all kinds of livestock with regard to age (in years) and sex

Table 9: Knowledge on cattle fodder needs

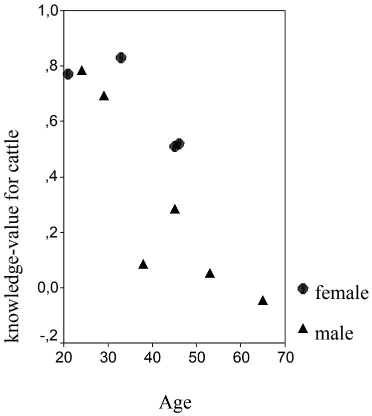


Table 10: Knowledge on goats fodder needs

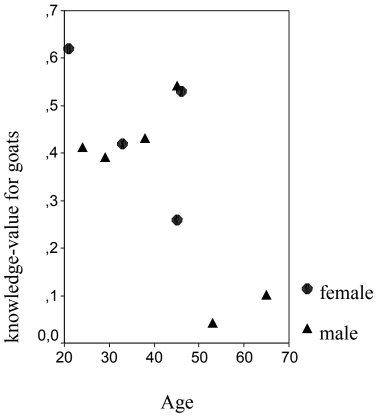
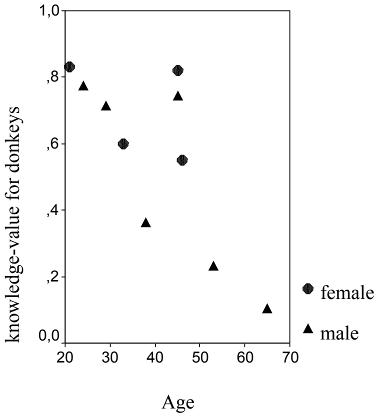


Table 11: Knowledge on donkeys fodder needs



Mean Comparison

When comparing men's and women's means of knowledge values it is visible that women have higher values for each kind of livestock than men. In rank women know most about donkeys' and cattle's fodder needs (0.70 and 0.65) and least about goats (0.46).

Table 12: Mean comparison: knowledge on different livestock species

	Knowledge on cattle	**Knowledge on goats**	**Knowledge on donkeys**
Male	0.31	0.32	0.49
Female	0.65	0.46	0.70
Total	0.40	0.35	0.51

These results are in contrast to the results of the mean comparison of Freelist lengths. Apart from this they are in contrast to the learning process of boys and girls and the division of labour among OvaHerero pastoralists. Interview partners described the learning process of girls and boys as the same until teenage age for all kinds of livestock. Then the division of labour comes in: in general herding cattle and the care for donkeys are regarded as the job of men. It is women, boys and girls who herd goats mainly. The elder of the village differentiates clearly between the domains of men and women: female domains of learning and working are house building, food preparation, washing, perfume production and sewing (Interview with Kaeve Hinu, 21.6.06).

When asked about livestock fodder needs women meet the “core of knowledge” to a higher proportion than men. They build a kind of homogenous group. In this case the consensus is mainly defined by the homogenous group of interview partners, which are all women. Thus, the heterogeneous group, constituted by men, miss the consensus automatically. This result leads us to question whether the method of consensus-building as described above may be failing.

Picture 4: Children start to care for small livestock at around the age of three
Photo: Silke Tönsjost

5.4.2. Age

Length of the Freelist

First, the correlation between age and the length of the Freelist is calculated. There is a significant, positive correlation between age and list length (r = 0.335).

Table 13: Correlation between age and list length

		Age	Listlength freelisting
Age	Pearson Correlation	1	.335
	Sig. (2-tailed)	,	.161
	N	20	19
Listlength freelisting	Pearson Correlation	.335	1
	Sig. (2-tailed)	.161	,
	N	19	19

This supports the notion of the interview partners who perceive elder people as more knowledgeable.

Consensus Analysis

Again analysis is based on the results of structured Pile-sorting and the processing as described above in 5.4.1. First, the means of age-groups are compared.

Mean Comparison

It is visible that interview partners with a date of birth between the 1960s and the 1980s have higher mean values. Their answers meet the consensus of knowledge, whereas the values of the older age groups (1940s and 1950s) are lower.

Table 14: Comparison of knowledge value means regarding age groups

Decade of birth	Mean for cattle	Mean for goats	Mean for donkeys
1940s	-0.05	0.10	0.10
1950s	0.05	0.04	0.23
1960s	0.35	0.44	0.62
1970s	0.80	0.41	0.66
1980s	0.78	0.52	0.80

This can be explained by the small sample: for the two age groups 1940s and 1950s there is only one interview partner each. Additionally, each of them has especially low knowledge values (see interview partners # 9 and 21 in the table below). This distorts the mean values.

Table 15: Distribution of knowledge in the sample

ID Interview partners	Sex	Year of birth	Knowledge value for cattle	Knowledge value for goats	Knowledge value for donkeys
9	♂	1941	-0.05	0.10	0.10
21	♂	1953	0.05	0.04	0.23
3	♀	1960	0.52	0.53	0.55
20	♂	1961	0.28	0.54	0.74
27	♀	1961	0.51	0.26	0.82
22	♂	1968	0.08	0.43	0.36
6	♀	1973	0.83	0.42	0.60
11	♂	1977	0.69	0.39	0.71
17	♂	1982	0.78	0.41	0.77
24	♀	1985	0.77	0.62	0.83

Elders in the village complain about a decrease and loss of environmental knowledge among the younger generation. The results of the Freelist lengths support this observation. The results of Consensus Analysis do not support the perception of the elders. There are relative low values in the age group 1940s (-0.05; 0.10; 0.10) and 1950s (0.05; 0.04; 0.23). However, the results of Consensus Analysis are problematic because it is the values of the only two elders in the sample that constitute the means of the elder age groups.

5.4.3. Effects of formal education

Whether going to school influences the knowledge on fodder plants cannot be investigated statistically, because going to school is linked with age in the sample: With one exception interview partners above 37 years did not go to school, whereas all interview partners under the age of 37 went to school.

6. Interpretation and discussion

6.1. Local perception and knowledge on fodder plants

The mentions of very high numbers of fodder plants illustrate the detailed and extensive environmental knowledge of OvaHerero pastoralists in the study area. They possess a broad knowledge about livestock-environment relationships and use this knowledge in the decision-making process for or against pastures and habitats.

Local perception of fodder plants

In the study, local salience and ecological performance of fodder plants do not correlate because local land users perceive woody species to be more important than herbaceous species. This means that local actors see trees and bushes as essential constituents of their savanna environment. Thus, local classifications and rankings do not directly mirror the coverage of the species as described with ecological methods (Eisold et al. 2006). By analysing the perception of salient plants in comparison with the etic (ecological) view. It can be shown (for plains) that perception of resources is not connected to a great extent to the abundance of plant species, but is influenced by the emic focus on scarcity. Since ecological performance was measured as ground cover, this reflects local perception of natural resources: valuable resources are scarce. So the emic perception on fodder plants is influenced by the focus on scarcity (Eisold et al. 2006).

Focus on scarce times

In local perception woody species have a higher rank than fodder plants, because they are an important source for animal nutrition in times of scarcity. Scarce and dry times turn woody species into alternative fodder for grazers such as cattle and sheep (Lautenschläger 2005: 81). In the rainy season herbaceous species increase in their importance but the woody proportion is still very high. Thus, bushes, shrubs and trees serve as a reliable long-term fodder source in a highly variable environment.

Hence woody species are valued as more salient than herbaceous species, e.g. grasses, which does not reflect the importance of grasses from a range-ecological point of view. It is not so much ecological performance but relevance for livestock herding under stressful conditions which explains the local ranking of plants (Eisold et al. 2006).

The focus on scarce times as one indicator for fodder plant ranking can be found in a study with OvaHimba pastoralists as well: one criterion for the ranking of the plants, in this case only grasses, was the species' resilience to drought (Bollig and Schulte 1999: 508). Another study situated in a communal rangeland used by OvaHerero in the eastern part of Namibia reveals the same result: the most important criterion in the ranking of fodder plants is their availability in scarce times: grass is regarded as valuable but not as reliable as woody species (Homann and Rischkowsky 2001: 7).

Habitat type

Plant species that grow in plain areas are not sufficient for animals' nutrition during the course of the year. In interviews and informal talks herders emphasised especially the importance of mountains, which serve as pasture for donkeys and goats mainly. The highly estimated livestock cattle mainly graze in mountains during scarce times. The scarce time of the year seems to be an important indicator for the perception of fodder plants and grazing habitats.

I assumed in my **first hypothesis** that fodder plants are a key natural resource and an important factor in decision-making process for or against a grazing area. I concluded that the way fodder plants are perceived (rated and ranked) influences the decision regarding mobility. This hypothesis is confirmed by the results of the Cultural Domain Analysis: the perception of fodder plants is orientated by the PFTs, with woody species as salient ones, and with the habitat types inherent in this category. However, my first hypothesis is not sufficient and has to be extended. The perception of plant species is influenced by the cultural frames as well. A mere utilitarian description of resource use does not convey the full importance of resource use practises.

Cultural importance of woody species

The salience of woody species cannot be explained by the focus on scarcity only. It is very likely that the high local ranking of trees in Freelists point not only to relevant fodder plants but to culturally important functions of trees, such as for instance for the construction of houses and pens, and for ritual use. Ancestor-worship of OvaHerero is connected with trees as well: in the traditional origin myth the first human beings were born out of the *omumborombonga* tree (*Combretum imberbe*). Worshipping of different tree species followed in dependence on this origin myth (Brauer 1925:17). In practice branches of the *Omutati* tree (*Colophospermum mopane*) are used to construct the background site of the ancestral fire.

Picture 5: The elder, Kaeve Hinu, sitting at the ancestral fire. Branches of *Omutati* (*Colophospermum mopane*) and horns of cattle are piled at the side of the ancestral fire. It is situated at the main household, in the line between the main traditional house and the pen.
Photo: Silke Tönsjost

The fact that mainly *Omutati* (*Colophospermum mopane)* and *Omuhama* (*Terminalia prunioides)* are used as firewood (Eichhorn 2004: 317f) could explain the high frequency in the Freelist of fodder plants as well: the species occur on rank 1 and 3 in the Freelist. *Omutati* (*Colophospermum mopane)* (rank 1 in Freelist) is especially appreciated, due to its ability to burn slowly while producing a lot of heat and a good smell (Lautenschläger 2005: 26). Apart from this, *Omutati* (*Colophospermum mopane)* is valued as good wood for construction because it is heavy, hard, long-living and insect-resistant (Lautenschläger 2005: 26).

Messages from "outside" might influence the salience of trees and woody species as well (Sullivan 1999b:4). Trees are highly appreciated for their shade during the hot season.

> "The experts tell us that trees are the sources of the world breath, where people get their oxygen. Even the shadows of the trees are good for the animals when it is hot. Therefore it is very important not to cut trees like that."
> (Interview with Christoph Tjikumisa, 26.5.06)

The importance of woody species can be found in the medical domain as well. In informal talks about local medicine, woody species such as *Omukaru* (*Ziziphus mucronata*), *Omutendeeti* (*Boscia albitrunca*), *Omumborombonga* (*Comretum imberbe*), *Omutati* (*Colophospermum mopane*), *Omuhama* (*Terminalia prunioides*) and *Otjinautoni* (*Boscia foetida ssp. Foetida*) are named as being able to cure minor diseases such as for instance fever, headache, menstruation problems or stomach problems. Additionally, the roots of the *Omusaona* (*Acacia mellifera*) tree are used by women to prepare sour milk, one main source of food.

Thus, the perception and the categorization criteria of fodder plants are reflected in local range management. The herder's decision for pastures is influenced by the criteria of local perception and classification, here the focus on scarce times (woody species), PFTs and their habitats as plains and mountains. The perception of fodder plants as such is influenced by the cultural importance of woody species as well.
However, my **first hypothesis** has to be extended again. It is not only the abundance of fodder plant species in the habitat types, but additionally the emic view on livestock species' "status" which influence the herder's decision, as will be shown in the following chapter.

6.2. Livestock: diversification, fodder needs and range management

6.2.1. Livestock diversification

Although care for small livestock is described as very time-consuming, 10 of 13 households herd small livestock due to their resistance in scarce times. Advantages of goats during drought can also be observed in the northern Kunene region. Bollig et al. (1997, 2002) found that in comparison to cattle small livestock losses during drought are considerably lower, and numbers of goats and sheep recovered faster after drought (Bollig and Göbel 1997: 8f, Bollig and Casimir 2002: 191): during the drought in 1980/1981 31.5 % of the small livestock died, whereas cattle loss was at 85.5 %. The resistance of goats in dry times is higher than with cattle as well: Bollig describes for example that in 1994/1995 during the water and food shortage small livestock were still in a good condition in contrast to cattle (Bollig 1997: 70).
Additionally the decision to sell small livestock is easier, and therefore small livestock works as a flexible and reliable source of cash for daily expenditures such as food, school fees, sugar and clothes.

Thus, herd diversification can be regarded as a means to reduce risk by "a more thorough exploitation of resources; however, it needs a wider set of resources." (Bollig and Göbel 1997: 14). These findings support the role of goats as a supplementary and robust livestock species in case of scarcity, and thus as a means of risk reduction. The effects of herd diversification on range management are described in the following chapter.
Although goats are an important element of risk minimization, the status of cattle is higher. The value attributed to cattle in contrast to goats corresponds to the functions cattle serve in the OvaHerero and other pastoralist societies: social networks are established by cattle loans, and cattle function as key symbols for bridewealth, funerals and other rituals (Sperling and Galaty 1990: 76, Bollig and Casimir 2002: 196f). Both goats and cattle function as a store of wealth and objects of investment, whereas goats are reserved for minor cash needs.

6.2.2. Livestock and range management

My aim is to analyse the decision-making process regarding livestock and pasture management on the basis of the investigated perception of fodder plants. As shown above there are two likely elements of categorisation of fodder plants: the PFTs with habitat types as an inherent category (see the results of Hierarchical clustering in 5.1.5.) and the availability in scarce times (see the results of Freelisting in 5.1.1.) influenced by the cultural importance of woody species (see 6.1.). I would like to analyse the effect of this plant categorisation together with the emic view on livestock species' "status" on the decision-making processes regarding pastures. In this work I consider the herd movements in the cold season (*okupepera*, April- June) and the budding season (*oruteni*, September –December) only.

6.2.3. Livestock fodder needs and spatial mobility

The pastoral risk-minimizing strategies in the Kunene region in the form of dividing grazing areas into seasonal using zones have already been described in rich detail: seasonal mobility in the form of dry-season and wet-season pastures guarantee and enlarge the production of biomass in areas that are preserved (Müller et al.: submitted, Schulte 2002, Ziess 2004, Bollig and Casmir 2002, Linstädter and Bolten 2006).

Cattle need 5-7 % protein in their fodder biomass to maintain their body weight. In scarce times grasses do not provide enough protein to guarantee sufficient protein intake (ARC 1965, quoted from Bollig and Casimir 2002: 216). Thus, browsing is a valuable component and provides the largest amount of consumable biomass in dry times (Schlecht et al. 1999: 172, Schareika 2001: 81). Bollig and Casimir found that the leaves of trees can act as a supplement with regard to protein: especially *Omutati* (*Colosphermum mopane*), *Omuvapu* (*Grevia bicolor*) and *Omuhama* (*Terminalia prunioides*) provide large amounts of protein (Bollig and Casimir 2002: 216). This explains the high local ranking of woody species for cattle in this study.

According to the results of Cultural Domain Analysis and interviews it is obvious that three essential elements have to be considered in local range and livestock management.

1. Cattle's fodder is minimized by goats and donkeys

The competition between cattle and donkeys for herbaceous and woody species can lead to a decrease of grazable biomass. Donkeys minimize the fodder biomass for cattle and goats by eating throughout, day and night. When goats and donkeys find 100 % of their herbaceous fodder in plain areas, they minimize cattles' fodder in plains, a habitat on which cattle mostly have to rely for their well-being. Thus, a good range management is necessary to supplement fodder and habitat effectively.

In interviews donkeys are valued negatively for their foraging behaviour, and complaints about the number of donkeys are especially strong. Interview partners mentioned a clear-cut maximum number of donkeys per household which is regulated by a grazing committee. In contrast interview partners did not give a clear cut maximum number regarding the herd sizes of cattle or goats. Especially cattle are estimated as very valuable and "clever" animals. Whether sanctions and regulations are enforced more strictly regarding the number of donkeys in comparison to cattle and goats could not be investigated yet.

2. Plains are the first-choice habitat for cattle

Although woody species are rated as important for cattle they do not serve as high-quality fodder for cattle: In a case study situated in central Namibia Schneiderat et al. found that cattle rely on leaves at the end of the dry season but that the condition of cattle relying on leaves was not that good in comparison with goats. They found that goats were still in a good condition, in contrast to cattle, who are seen as not that flexible (Schneiderat et al. 2005: 4).

These findings are supported by the results of the ranking of fodder plants for the fruitful rainy season (*okurooro*, January- March). Cattle rely more on herbaceous fodder when herbaceous biomass is plenty.

3. Driving goats into mountains saves fodder in plains

During the observed time in the cold and budding season, herders drove their goats into the nearby mountains. Driving goats onto the mountain pastures allows the highly valued cattle to graze on herbaceous species in the plains; it prevents overgrazing of herbaceous species by goats. Additionally fodder for cattle in plains is saved by driving donkeys into the mountain areas during the nights, and much more likely and pragmatic: donkeys can be found more easily in the morning time. Thus, the threat of goats and donkeys overgrazing cattle's main grazing plain areas, reducing herbaceous and woody fodder, can be minimized. Additionally, goats can climb stony mountains more easily than cattle, which only graze in mountains in times of scarcity. Herders describe it as harder for cattle to climb mountains, especially for female and younger ones. Extensive trekking and fodder shortage causes higher mortality for cattle than the sum of all animal diseases (Bollig 1997: 73). Securing herbaceous fodder for cattle in plains is a form of care for cattle (Gall 1981: 583).

With this strategy pastoralists pursue different goals: cattle graze with first priority in plain areas. By driving goats and donkeys in mountain areas the best herbaceous fodder resources are saved for the highly valued cattle. Thus, mountains as a habitat type and their biomass play a major role in local range management.

Goats and donkeys work as an important economic and ecological supplement in herding. An extensive number of goats and donkeys is critically dangerous, because they could endanger reserve pastures for cattle in the mountains. Herders are very conscious about the threat of the overgrazing of vegetation and the degradation of the soil.

Thus, herding strategies for cattle and goats are based on the perception and assessment of fodder plants and habitats. Herding strategies are additionally influenced by the cultural importance of cattle.

The data of this study shows that the diversification of livestock can be regarded as a strategy of optimal resource use. The resources for the different kinds of livestock are distributed spatially. Livestock is driven in an elaborated pattern so that suitable and highly variable fodder can be offered first to cattle and then to goats and donkeys. The spatial movements balance the seasonal variability of biomass. Neither the disequilibrium nor the equilibrium model considers this spatial variability of resource availability (Linstädter and Bolten 2006).

6.3. Local perception of environmental change and emic explanations

Local understanding of the availability of natural resources is rooted in the observation of effects of unpredictable and rainfall-driven variations. The perception of environmental change and its causes agree with the reasoning of Western science, i.e. the characteristics of the disequilibrium debate: people regard rain as the main driving force for the condition of the vegetation. Local herders regard themselves as responsible for maintaining and managing the outcome of the uncontrollable precipitation. On the basis of "good rain" successful organisation of pastures and the control of livestock numbers are reported as crucial factors for the well-being of livestock and humans.

The cause of rainfall is explained by intra-societal and supernatural causes. The origin of rain is regarded as supernatural: observations of change in rainfall and environment are often linked with elements of cultural change, such as for instance the loss of environmental knowledge, the conflicts between juniors and seniors, the decreasing respect and antisocial behaviour. Similar explanations could be found with the Pokot in Northern Kenya, although the Pokot internalize the problem of decreasing biomass (Bollig and Schulte 1999: 511). Sullivan found similar results in the southern part of the Kunene region: The report of change in rainfall is often linked with political situations such as the apartheid regime and rising costs of living (Sullivan 2002: 262).

It is difficult to check whether interview data on environmental change and data about change in vegetation and precipitation are congruent, since scientific data from the study area is still scarce. Due to the high variability of precipitation, the data of nearby stations is also not representative for the study area. Measurement of precipitation in *Okazorongua* began in 2005. Taking the precipitation data of the Kamanjab station which is 100 km distant, the local observations about the lack of rain is in accordance with the statistics: between 1977 and 1996 precipitation was lower than the mean of previous decades (Bollig 1997: 69). This is in line with the observations of the herders in the village.

Vegetation change is described for three areas or zones: the household area (approximately 500 m around the village), *Ohungu* Mountain, which is 3 km distant from the households, and an area called *Eorowapotu*, 9 km distant, which was used as a grazing area for the last time in 1988. All interview partners observed a loss of trees and herbaceous species in the household area. This is not only due to increasing numbers of livestock but to increasing use of wood for construction and firewood.

The vegetation of the *Ohungu* area used for grazing is described as having been more or less stable during the last 15 years with a tendency to bush encroachment ("trees getting smaller and turning into bushes"). The area around the mountain is valued as a good grazing area.

Of the areas that are further apart than *Ohungu,* an area called *Eorowapotu* is assessed as ideal. But this pasture cannot be used without building a cattle post. It is too distant from waterpoints and the village.

These observations and assessments are in line with studies in the northern Kunene region. Bollig found that degradation is observed and measured in household areas, called zone 1, only, and that more distant pastures (called zone 2 and 3) are in good condition (Bollig 1997:71).

Sullivan states for her study area in the southern Kunene region that degradation in household areas is a logical effect of settlement and that the loss of vegetation is within the range of variability. She stresses the importance of woody species as a long-term indicator of environmental change, because they are long-lived and able to withstand the effects of drought (Sullivan 1999a: 260, Sullivan 2002: 258). From a local perspective there is no severe negative impact of land-use pressure on woody species observable, except on local scale close to settlements. Local reactions on decreasing trees in the household area are to minimize the use of trees for the construction of pens.

Picture 6: Construction of pens: In order to save trees new pens and extensions are constructed with wire and poles instead of using poles only.
Photo: Silke Tönsjost

Ecological work in the study area is still in progress. The question regarding long-term ecological data is whether there is a consistent evidence for the degrading effect of resource use. The results can contribute to the debate concerning long-term degradation and desertification in Namibia.

6.4. Distribution of knowledge: Who knows what?

As assumed, knowledge on livestock- environment relationships differs in the sample. The results have to be interpreted on the background of the different methodological approaches. Outcomes show that men name more fodder plant species, and their knowledge on fodder plants is very extensive, specialised and heterogeneous. Women's knowledge is rather consensual and homogenous. This can be explained by the division of labour and the mode of communication. When "going out" with livestock men have the opportunity to observe directly which plant species are eaten. Women, being trained in their childhood about fodder needs, know the basic needs but do not have the opportunity to observe, "test empirically" and broaden their knowledge. They stay mainly in the area of the homestead. They take part in daily conversation about plants and pastures, but their knowledge is not that extensive.

Further on, the domain of fodder plants and herding tasks is perceived, by men and women, as a male domain. Part of the male gender role is to be a good and successful herder, which includes the eager presentation of an extensive knowledge on fodder plants in the interaction with me. Women's role and ideal is to be shy, calm and meek. In interviews women often emphasize that they do not know a lot and referred to men as being more knowledgeable.

Thus, the results are in line with my **second hypothesis**: the distribution of environmental knowledge differs and can be explained by the socialisation and the division of labour. Knowledge as it is measured in this work reflects the kind of resources that men and women use. As fodder plants are a part of the male labour domain, men's knowledge on livestock-environment relationships is more extensive and specialised. Resources used by women are firewood, plant species for the production of perfume, and plants for human consumption such as fruits and seeds.

However, my **second hypothesis** has to be extended in more detail. The contents of environmental knowledge differ between men and women. It is not only the division of labour, but the gender-shaped mode of communication, profiling and self-perception which additionally explains the differences.

It has not yet been possible to investigate whether the result implies that women have less power or control over resources. Examples of power owned by women are the milk management, which is the decision about milking and distribution of milk, the decision about the consumption of food in the household, and the ownership of cattle. In a study situated in Niger Wezel et al. found the post-marital residence and division of labour to be the main factors for the differences in environmental knowledge. Women could name more species that grew in the household area, which were trees, whereas men additionally named more distant species, which were grasses. This could not be investigated yet in this study. Another factor for the knowledge differences was that women were less trained by outsiders on the topic (Wezel and Haigis 2000: 531). This can be found in the Cultural Domain Analysis sample as well: only one woman participated in an environment related training course or workshop, whereas there were four men. However, the sample is too small to investigate any positive effect of workshop training on environmental knowledge. The findings highlight the role that local knowledge regarding resource use practice can play as a basis for dialogue and participation in contemporary conservation initiatives (Sullivan 1999b: 4).

7. Conclusion

The theoretical approach of schemes and scripts is a helpful tool to explain the decisions of local land-users on livestock and range management. Herders assess fodder plants, pastures and livestock needs based on the background of social and cultural frames. The process of perception is influenced by the use of plants for ritual, medical and practical purposes such as the construction of houses.

From a local perspective woody plant species are salient and rated as very important for animals' nutrition, for grazers as well as for browsers. Thus, the importance of herbaceous biomass in Range Ecology is not reflected by the local salience in this study and has to be re-adjusted for secondary savannas. The interdisciplinary approach contributes valuable information for identifying local preferences: Not the plant species' ecological performance, but the relevance for livestock herding under stressful conditions is an explanation for the local ranking of plants.

This perception is reflected in the local range management: local range management is orientated by Plant Functional Types, their spatial distribution in different habitat types and the cultural importance of livestock when assessing and choosing pastures. Good fodder for the highly-esteemed cattle is scarce and is minimized by goats and donkeys. Thus, herders "organise" scarce and valuable fodder resources for the diverse fodder needs by spatial movements into different habitat types. In this way fodder is secured for the highly estimated cattle. Livestock diversification and its spatial distribution are used to gain economical, ecological and social benefits. Herders act and decide according to their extensive knowledge on plants and pastures. Their knowledge helps them to react to an unpredictable environment where fodder resources are distributed temporary and spatially with a high variability.

Local explanations of environmental change are in accordance with the explanations of Western science. OvaHerero herders view rainfall as the major driving force in savanna ecosystems. Apart from the household area vegetation is perceived as still in good condition, and more or less the same as in the past. They regard themselves as responsible for managing the outcomes of the unpredictable rainfall events properly.

The knowledge on livestock-environment relationships differs among the population. This should be considered in the process of Conservancy set-ups: A prerequisite for successful community-based natural resource management is the empowerment of all actors involved in land use. As shown above it is especially the local management of woody species that plays a crucial role in sustaining resources for human beings and livestock. Here it is women who play a major role regarding the use of woody species.

8. Perspectives

It will be interesting to make further investigations on “ecological issues”, such as e.g. the use and application of plants for special livestock needs, which will reveal emic grazing values. Additionally it would be fruitful to complete the ranking of seasonal important fodder plant species in order to compare this with ecological data. In this way it could be investigated whether the ecological assessment of selected pastures is in accordance with the locally perceived features of “good” pastures considering the essential elements of local range management: habitat types and livestock fodder needs.

Another interesting issue would be to check whether interview data on environmental change and data about vegetation and precipitation change are congruent. For this purpose aerial photographs and satellite pictures of the past are required in order to compare them with the observations of OvaHerero herders in the study area.

Apart from this it will be promising to further investigate the influence of social networks determining the flow of information on environmental knowledge and resource use. Factors such as wealth, status, age and gender that might form these networks should be considered.

It would also be interesting to investigate the effect of formal schooling on herding tasks and local range management. Sperling and Galaty, for example, found that elders and women get more involved in herding in addition to increasing the hired labour force due to increased formal schooling (Sperling and Galaty 1990: 91).

In this way the strengths and weaknesses of community-based natural resource management could be investigated in a broader cultural and social context.

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11. Appendix

Table 16-18: Sampling: Distribution of age and sex

Table 16: Sample Freelisting

decade of birth	women	men
1920		1
1930		1
1940	1	3
1950	1	
1960	1	2
1970	2	1
1980	4	2

Table 17: Sample Free and structured Pile-sorting

decade of birth	women	men
1920		
1930		
1940		1
1950		1
1960	2	2
1970	1	2
1980	1	

Table 18: Sample semi-structured Interviews

decade of birth	women	men
1920		
1930		1
1940		2
1950		2
1960	1	1
1970		2
1980		1

Table 19: Outcome of Freelists: all mentioned plant species in OtjiHerero

Task for the interview partners (n=19):

"Please name all the fodder plants for cattle, goats and donkeys that come into your mind. "

Table 19: Outcome of Freelists: all mentioned plant species in OtjiHerero

FREELIST
ÄÄ

Sensitivity level: OFF
Max respondents: 50
Max items: 500
Input dataset:
C:\DOKUME~1\A\DESKTOP\MAGIST~1\MAGIST~2\FORSCH~1\ANTHRO~1\FODDERPLANTS

SORTED BY FREQ

	ITEM	FREQUENCY	RESP PCT	AVG RANK	Smith's S
1	OMUHAMA	18	95	5.722	0.735
2	OMUKARAVIZE	17	89	8.294	0.624
3	OMUTATI	17	89	8.294	0.606
4	OMUMBUTI	13	68	7.077	0.517
5	ONGUMBA	12	63	7.417	0.526
6	OMUZUMBA	10	53	17.100	0.296
7	OMUTENDEETI	10	53	14.900	0.281
8	OMUSAONA	10	53	22.900	0.214
9	OTJINAUTONI	9	47	10.000	0.366
10	ONYASE	9	47	20.556	0.254
11	OMUTUNGI	9	47	20.778	0.218
12	OMUVAPU	9	47	15.556	0.291
13	OMUKARU	8	42	25.875	0.176
14	OMUNGUINDI	8	42	10.125	0.270
15	ONGORONDJI	8	42	6.625	0.366
16	OMUVE	8	42	29.375	0.127
17	OMUMBOROMBONGA	8	42	25.875	0.167
18	OMUNGONDO	7	37	19.143	0.194
19	OMUE	7	37	34.000	0.085
20	OKATJIRAKONDUNO	7	37	16.571	0.235
21	OHONGO	7	37	15.571	0.188
22	ORUSU	7	37	16.571	0.232
23	OTJIPEMBATI	7	37	15.286	0.242
24	OMUPANDA	7	37	30.429	0.150
25	OMUHAKO	6	32	36.333	0.138
26	OMUKUYU	6	32	31.833	0.090
27	OMURENDA	6	32	16.667	0.194
28	OMUMBONDE	6	32	19.000	0.167
29	OMUNINGA	6	32	29.167	0.143
30	OMUNDJEMBERE	6	32	22.333	0.170
31	OHANDUKAZE	6	32	29.667	0.127
32	ONGUMBATI	6	32	15.833	0.198
33	OMUHAMATI	6	32	38.500	0.119
34	OMUWORE	6	32	23.500	0.125
35	OMUNDITI	5	26	11.600	0.172
36	OTJIMBUKU	5	26	26.200	0.083
37	EHOZU	5	26	1.400	0.254
38	OMUNGAMBU	5	26	16.800	0.158
39	OMUKANGE	5	26	43.800	0.081
40	ORUU	5	26	31.400	0.098
41	OHOKE	5	26	23.600	0.149
42	OMUHE	4	21	27.500	0.112
43	OMURIANGAVA	4	21	22.500	0.132
44	OMUHANDUA	4	21	44.750	0.035
45	OTJIRURUHOZU	4	21	20.250	0.134
46	OMUTAPATI	4	21	35.750	0.073
47	OMBOWA	4	21	17.750	0.097

48	OTJISEPA	4	21	18.250	0.155
49	OMUSEPA	4	21	52.250	0.037
50	OMUTIKAIKO	4	21	27.500	0.096
51	OMUMBUNGURURU	4	21	28.750	0.074
52	ORURENDA	3	16	19.000	0.106
53	OKARIAHERE	3	16	25.333	0.068
54	OMBOO	3	16	20.000	0.091
55	OMUNDJENDJERE	3	16	38.000	0.072
56	OMUTJETE	3	16	20.333	0.080
57	ONDOMBORA	3	16	42.333	0.057
58	OMUNDJENYA	3	16	35.333	0.059
59	OMUHINDA	3	16	26.000	0.067
60	OKAHUNOKONDU	3	16	18.667	0.072
61	OMUZU	3	16	21.667	0.091
62	OMUNGWINDI	3	16	5.667	0.107
63	OTJINDUMBA	3	16	16.000	0.094
64	OTJIYEKEYEKE	2	11	4.000	0.084
65	OMUAMA	2	11	48.000	0.043
66	OMATANGA	2	11	26.500	0.037
67	ONDONDOMBARI	2	11	20.500	0.079
68	OTJIPIVA	2	11	44.500	0.022
69	ONGANGAHOZU	2	11	17.500	0.070
70	ERARA	2	11	36.500	0.024
71	OMUKONGO	2	11	44.000	0.032
72	ORUEYO	2	11	58.500	0.029
73	OKAKUYU	2	11	38.500	0.052
74	OTJIMBUIYA	2	11	70.000	0.007
75	OTUKARAKAKA	2	11	4.500	0.093
76	ONDUYATURAWA	2	11	18.500	0.054
77	ETOVETI	2	11	54.000	0.025
78	OMUTINDI	2	11	22.500	0.073
79	ORUPUNGUIYA	2	11	23.000	0.075
80	OHUANGA	2	11	32.500	0.013
81	OUNAWAKAHANDJA	2	11	47.000	0.049
82	OMUNOVA	2	11	59.000	0.033
83	OKATIKIRAMBE	2	11	22.000	0.056
84	OMUPARARA	2	11	66.500	0.017
85	OMUWONGA	2	11	46.500	0.023
86	OMUNGONGOMUI	2	11	25.500	0.051
87	OMUYAVANDUNGU	2	11	42.500	0.031
88	OTJIUNDANDUZU	2	11	33.000	0.066
89	ORUMUARI	1	5	10.000	0.019
90	OMUTAURAMBUKU	1	5	37.000	0.011
91	OMUMBA	1	5	20.000	0.014
92	OVINGENGE VYOZOMINUA	1	5	9.000	0.020
93	ORUKOMBO	1	5	9.000	0.023
94	OMUKAVIZE	1	5	12.000	0.024
95	OMUTJETERE	1	5	5.000	0.033
96	OMUYARANDUNGU	1	5	28.000	0.021
97	OTJIVARE	1	5	23.000	0.002
98	OTJIRAURA	1	5	43.000	0.004
99	OMUTAAREKAMEVA	1	5	26.000	0.023
100	OTJIAUTONI	1	5	11.000	0.041
101	OMUKEKA	1	5	33.000	0.015
102	OTJONGUA	1	5	21.000	0.007
103	OMURATU	1	5	50.000	0.007
104	OTJINANGURUVE	1	5	51.000	0.006
105	ORUNGUIYA	1	5	18.000	0.014
106	OKAINAKOMBE	1	5	3.000	0.049
107	ORUPUNGUINYA	1	5	42.000	0.005
108	ETUNDO	1	5	55.000	0.003

109	OKAURUKONDE	1	5	4.000	0.045
110	ONYOSE	1	5	6.000	0.043
111	OTJINDUMBU	1	5	52.000	0.006
112	OMUNDI	1	5	12.000	0.038
113	ONDUNDUMANE	1	5	14.000	0.026
114	OVYONGWA	1	5	16.000	0.032
115	OMUNDJOZE	1	5	23.000	0.023
116	OMUPONDORORUA	1	5	24.000	0.022
117	OMONGORUA	1	5	25.000	0.020
118	OMISAMASITU	1	5	29.000	0.015
119	OTWEYO	1	5	30.000	0.013
120	OMUHOHO	1	5	33.000	0.009
121	ONGONGAHOZU	1	5	16.000	0.013
122	ONGWENA	1	5	37.000	0.004
123	ONYAINYO	1	5	17.000	0.025
124	OHEKE	1	5	5.000	0.047
125	OTUSU	1	5	14.000	0.043
126	OMUSINDANDJOU	1	5	38.000	0.018
127	OTUZETWOUZERA	1	5	17.000	0.041
128	OHONA	1	5	22.000	0.037
129	OVINGENGE	1	5	23.000	0.036
130	OZONDUMBUIRIRI	1	5	24.000	0.035
131	ONDITI	1	5	29.000	0.032
132	OMURIAUSINO	1	5	25.000	0.004
133	ORUTANGA	1	5	33.000	0.029
134	OMUNDOVE	1	5	34.000	0.028
135	OMUTETE	1	5	36.000	0.026
136	OMUNDUMISE	1	5	41.000	0.023
137	OMUZUVAKUVARE	1	5	52.000	0.014
138	OVIPEMBATI	1	5	7.000	0.024
139	OTJEKUA	1	5	55.000	0.012
140	MAIZE	1	5	7.000	0.030
141	OMUPIA	1	5	57.000	0.011
142	ONGWEHE	1	5	58.000	0.010
143	OMURIANGUARI	1	5	60.000	0.008
144	OKANDAKANDA	1	5	61.000	0.008
145	OPENDARUUWA	1	5	67.000	0.003
146	ONGORUNDJI	1	5	2.000	0.051
147	OMBONDE	1	5	70.000	0.001
148	OMUTIATUPA	1	5	21.000	0.034
149	OTJINGWINDI	1	5	3.000	0.045
150	OTJIKURAMUINYO	1	5	5.000	0.036
151	OMUTJIRAWOKAKAMBE	1	5	8.000	0.038
152	ONGUMBUTI	1	5	11.000	0.012
153	ORUPATANGOMBE	1	5	3.000	0.035
154	ORUPUNGWIYA	1	5	4.000	0.043
155	OMUTIWOTUKARAKAKA	1	5	7.000	0.033
156	OMUPETA	1	5	9.000	0.026
157	OMUPEPERE	1	5	10.000	0.023
158	OMUZEMA	1	5	14.000	0.010
159	ETENGU	1	5	9.000	0.036
160	ONANDI	1	5	12.000	0.030
161	ONDOMBURA	1	5	14.000	0.026
162	OMUNDUMBA	1	5	15.000	0.024
163	WELWICHIA	1	5	16.000	0.022
164	OMUTETA	1	5	19.000	0.016
165	OMURE	1	5	15.000	0.036
166	OTJIMBURU	1	5	12.000	0.040
167	OMUNGONGO	1	5	13.000	0.039
168	OMUNDENYA	1	5	17.000	0.035
169	OMUPOPO	1	5	28.000	0.022

170	OMBINDAMATONI	1	5	30.000	0.020
171	OMUSINDA	1	5	33.000	0.017
172	MUNGONGOMUI	1	5	37.000	0.012
173	OMUKUYUMBUA	1	5	45.000	0.003
174	ORUKUMBONGO	1	5	47.000	0.001
175	OMBORAMBONGA	1	5	3.000	0.051
176	OMUNGONGOMWI	1	5	13.000	0.046
177	OHANDUA	1	5	22.000	0.040
178	OMUTUMISE	1	5	23.000	0.040
179	OZOMBINDAZONDANA	1	5	40.000	0.030
180	ONYANYARE	1	5	44.000	0.027
181	ONONA	1	5	45.000	0.027
182	OHENGAHENGE	1	5	46.000	0.026
183	OMUKUYAMBA	1	5	47.000	0.026
184	ONDIYE	1	5	51.000	0.023
185	OZONDUVI	1	5	52.000	0.023
186	OZONYANGA	1	5	53.000	0.022
187	OMUKANDAKANDA	1	5	54.000	0.022
188	ONYIVA	1	5	55.000	0.021
189	ORUZENGA	1	5	56.000	0.020
190	OMUSIAMASITU	1	5	58.000	0.019
191	OMUTJENYA	1	5	59.000	0.019
192	OMIRIPETE	1	5	61.000	0.018
193	OVIRAURA	1	5	63.000	0.016
194	OMUNI	1	5	66.000	0.015
195	OMUPENDARUUWA	1	5	67.000	0.014
196	OTJINDUNDU	1	5	68.000	0.013
197	OMUMBIRI	1	5	70.000	0.012
198	OMUMBARA	1	5	71.000	0.012
199	ORUKAHATJINYO	1	5	77.000	0.008
200	OEUKANUNAMBARA	1	5	79.000	0.007
201	ORUKAMO	1	5	81.000	0.006
202	OMUMUNU	1	5	82.000	0.005
203	OZONDJASEE	1	5	83.000	0.005
204	OMUNDUMBUIRIRI	1	5	84.000	0.004
205	OMUKUNGUNGA	1	5	85.000	0.004
206	ONGORANDJII	1	5	8.000	0.040
207	OMUNANDI	1	5	11.000	0.034
208	ORUKATA	1	5	14.000	0.029
209	OEUSU	1	5	22.000	0.015
210	ONDEKA	1	5	26.000	0.007
211	OKAHUKONDU	1	5	27.000	0.005
	Total/Average:	576	30.316		

Tables 20-22: Outcomes of fodder plant- ranking for the scarce budding season (oruteni, October- December)

Task for the interview partners:

"Imagine it is the hard time in oruteni and you have to decide for a grazing area for your livestock. You are taking a look at diverse areas. Which plants are the ones you like to find to say, "This is a good pasture"? Which are the five most important plants for cattle, goats and donkeys? Please order them according to their importance."

Table 20: Ranking: fodder plants used by cattle during budding season (*oruteni*, October- December), n=8

Plant ID	Vernacular	Scientific name	Frequency in the pile	PFT
5	*Ongumba*	*Stipagrostis uniplumis*	7	annual grass
9	*Otjinautoni*	*Boscia foetida ssp. foetida*	5	bush
4	*Omumbuti*	*Combretum apiculatum ssp.apiculatum*	5	tree
10	*Onyase*	*Eragrostis nindensis*	4	annual grass
15	*Ongorondji*	*Schmidtia kalahariensis*	3	annual grass
2	*Omukaravize*	*Catophractes alexandri*	2	bush
1	*Omuhama*	*Terminalia prunioides*	2	tree
24	*Omupanda*	*Lonchocarpus nelsii*	2	tree
20	*Okatjirakondun o*	*c.f. Stipagrostis hirtigluma*	2	annual grass
12	*Omuvapu*	*Grewia bicolor*	2	bush
23	*Otjipembati*	*c.f. Monechma cleomoides*	2	shrub
14	*Omunguindi*	*Boscia albitrunca*	1	bush
3	*Omutati*	*Colophospermum mopane*	1	tree
11	*Omutungi*	*Commiphora glaucescens*	1	tree

Table 21: Ranking: fodder plants used by goats during budding season (*oruteni*, October- December), n=8

Plant ID	Vernacular	Scientific name	Frequency in the pile	PFT
3	*Omutati*	*Colophospermum mopane*	8	tree
1	*Omuhama*	*Terminalia prunioides*	7	tree
2	*Omukaravize*	*Catophractes alexandri*	4	bush
12	*Omuvapu*	*Grewia bicolor*		bush
13	*Omukaru*	*Ziziphus mucronata*	3	tree
23	*Otjipembati*	*c.f. Monechma cleomoides*	2	shrub
4	*Omumbuti*	*Combretum apiculatum ssp.apiculatum*	2	tree
19	*Omue*	*Faidherbia albida*	2	tree
24	*Omupanda*	*Lonchocarpus nelsii*	1	tree
14	*Omunguindi*	*Boscia albitrunca*	1	bush
21	*Ohongo*	*Tribulus sp.*	1	forb
9	*Otjinautoni*	*Boscia foetida ssp. foetida*	1	bush
8	*Omusaona*	*Acacia mellifera*	1	tree
5	*Ongumba*	*Stipagrostis uniplumis*	1	annual grass
18	*Omungondo*	*Acacia reficiens ssp.reficiens*	1	shrub

Table 22: Ranking: fodder plants used by donkeys during budding season (*oruteni*, October- December), n=8

Plant ID	**Vernacular**	**Scientific name**	**Frequency in the pile**	**PFT**
9	*Otjinautoni*	*Boscia foetida ssp. foetida*	8	bush
14	*Omunguindi*	*Boscia albitrunca*	4	bush
5	*Ongumba*	*Stipagrostis uniplumis*	4	annual grass
10	*Onyase*	*Eragrostis nindensis*	4	annual grass
23	*Otjipembati*	*c.f. Monechma cleomoides*	4	shrub
21	*Ohongo*	*Tribulus sp.*	3	forb
7	*Omutendeeti*	*Boscia albitrunca*	3	bush
15	*Ongorondji*	*Schmidtia kalahariensis*	2	annual grass
18	*Omungondo*	*Acacia reficiens ssp.reficiens*	2	shrub
8	*Omusaona*	*Acacia mellifera*	1	tree
11	*Omutungi*	*Commiphora glaucescens*	1	tree
12	*Omuvapu*	*Grewia bicolor*	1	bush
4	*Omumbuti*	*Combretum apiculatum ssp.apiculatum*	1	tree
2	*Omukaravize*	*Catophractes alexandri*	1	bush

Table 23-25: Outcomes of fodder plant- ranking for the most fruitful rainy season (*okurooro*, January - March)

Task for the interview partners:

> *"Imagine it is the best time in okurroro and you have to decide for a grazing area for your livestock. You are taking a look at diverse areas. Which plants are the ones you like to find to say, "This is a good pasture"? Which are the five most important plants for cattle, goats and donkeys? Please order them according to their importance."*

Table 23: Ranking: fodder plants used by cattle during rainy season (*okurooro*, January- March), n=4

Plant ID	**Vernacular**	**Scientific name**	**Frequency in the pile**	**PFT**
10	*Onyase*	*Eragrostis nindensis*	4	annual grass
15	*Ongorondji*	*Schmidtia kalahariensis*	3	annual grass
4	*Omumbuti*	*Combretum apiculatum ssp.apiculatum*	3	tree
5	*Ongumba*	*Stipagrostis uniplumis*	2	annual grass
20	*Okatjirakonduno*	*c.f. Stipagrostis hirtigluma*	2	annual grass
23	*Otjipembati*	*c.f. Monechma cleomoides*	2	shrub
9	*Otjinautoni*	*Boscia foetida ssp. foetida*	2	bush
14	*Omunguindi*	*Boscia albitrunca*	1	bush
1	*Omuhama*	*Terminalia prunioides*	1	tree

Table 24: Ranking: fodder plants used by goats during rainy season (*okurooro*, January- March), n=4

Plant ID	**Vernacular**	**Scientific name**	**Frequency in the pile**	**PFT**
11	*Omuhama*	*Terminalia prunioides*	4	tree
3	*Omutati*	*Colophospermum mopane*	4	tree
21	*Ohongo*	*Tribulus sp.*	3	forb
23	*Otjipembati*	*c.f. Monechma cleomoides*	2	shrub
10	*Onyase*	*Eragrostis nindensis*	1	perennial grass
2	*Omukaravize*	*Catophractes alexandri*	1	bush
12	*Omuvapu*	*Grewia bicolor*	1	bush
18	*Omungondo*	*Acacia reficiens ssp.reficiens*	1	tree
8	*Omusaona*	*Acacia mellifera*	1	tree
11	*Omutungi*	*Commiphora glaucescens*	1	tree
9	*Otjinautoni*	*Boscia foetida ssp. foetida*	1	bush

Table 25 : Ranking: fodder plants used by donkeys during rainy season (*okurooro*, January- March), n=4

Plant ID	**Vernacular**	**Scientific name**	**Frequency in the pile**	**PFT**
10	*Onyase*	*Eragrostis nindensis*	3	perennial grass
21	*Ohongo*	*Tribulus sp.*	3	forb
15	*Ongorondji*	*Schmidtia kalahariensis*	2	annual grass
23	*Otjipembati*	*c.f. Monechma cleomoides*	2	shrub
9	*Otjinautoni*	*Boscia foetida ssp. foetida*	2	bush
5	*Ongumba*	*Stipagrostis uniplumis*	2	annual grass
20	*Okatjirakonduno*	*c.f. Stipagrostis hirtigluma*	2	annual grass
14	*Omunguindi*	*Boscia albitrunca*	1	bush
22	*Orusu*	*Acacia nilotica ssp kraussiana*	1	tree
7	*Omutendeeti*	*Boscia albitrunca*	1	bush
3	*Omutati*	*Colophospermum mopane*	1	tree

Tables 26-28: Outcome of structured Pilesorting

Task for the interview partners:

"Here is a set of 24 plant species. Please sort them into three piles: One pile for fodder plants eaten by cattle, one for fodder plants eaten by goats and one for fodder plants eaten by donkeys."

Table 26: Fodder plant species used by cattle

Plant ID	**Vernacular**	**Scientific name**	**Frequency in the pile**	**PFT**
5	*Ongumba*	*Stipagrostis uniplumis*	11	perennial grass
10	*Onyase*	*Eragrostis nindensis*	11	perennial grass
15	*Ongorondji*	*Schmidtia kalahariensis*	11	annual grass
4	*Omumbuti*	*Combretum apiculatum ssp.apiculatum*	10	tree
20	*Okatjirakonduno*	*Stipagrostis hirtigluma ssp. hirtigluma*	10	annual grass
1	*Omuhama*	*Terminalia prunioides*	9	tree
2	*Omukaravize*	*Catophractes alexandri*	9	bush
9	*Otjinautoni*	*Boscia foetida ssp. Foetida*	8	bush
12	*Omuvapu*	*Grewia bicolor*	8	bush
23	*Otjipembati*	*c.f. Monechma cleomoides*	8	shrub
7	*Omutendeeti*	*Boscia albitrunca*	7	bush
14	*Omunguindi*	*Boscia albitrunca*	7	bush
21	*Ohongo*	*Tribulus ssp.*	6	forb
24	*Omupanda*	*Lonchocarpus nelsii*	6	tree
3	*Omutati*	*Colophospermum mopane*	5	tree
8	*Omusaona*	*Acacia mellifera*	5	tree
11	*Omutungi*	*Commiphora glaucescens*	5	tree
17	*Omumborombonga*	*Comretum imberbe*	5	tree
19	*Omue*	*Faidherbia albida*	5	tree
22	*Orusu*	*Acacia nilotica ssp kraussiana*	5	tree
13	*Omukaru*	*Ziziphus mucronata*	4	bush
16	*Omuve*	*Berchemia discolor*	3	tree
18	*Omungondo*	*Acacia reficiens ssp.reficiens*	3	tree

Table 27: Fodder plant species used by goats

Plant ID	Vernacular	Scientific name	Frequency in the pile	PFT
2	*Omukaravize*	*Catophractes alexandri*	11	bush
3	*Omutati*	*Colophospermum mopane*	11	tree
13	*Omukaru*	*Ziziphus mucronata*	11	bush
21	*Ohongo*	*Tribulus ssp.*	11	forb
1	*Omuhama*	*Terminalia prunioides*	10	tree
7	*Omutendeeti*	*Boscia albitrunca*	10	bush
8	*Omusaona*	*Acacia mellifera*	10	tree
12	*Omuvapu*	*Grewia bicolor*	10	bush
16	*Omuve*	*Berchemia discolor*	10	tree
18	*Omungondo*	*Acacia reficiens ssp.reficiens*	10	tree
22	*Orusu*	*Acacia nilotica ssp. kraussiana*	10	tree
11	*Omutungi*	*Commiphora glaucescens*	9	tree
14	*Omunguindi*	*Boscia albitrunca*	9	bush
17	*Omumborombonga*	*Comretum imberbe*	9	tree
19	*Omue*	*Faidherbia albida*	8	tree
4	*Omumbuti*	*Combretum apiculatum ssp.apiculatum*	8	tree
9	*Otjinautoni*	*Boscia foetida ssp. Foetida*	8	bush
10	*Onyase*	*Eragrostis nindensis*	8	perennial grass
23	*Otjipembati*	*c.f. Monechma cleomoides*	7	shrub
24	*Omupanda*	*Lonchocarpus nelsii*	6	tree
15	*Ongorondji*	*Schmidtia kalahariensis*	4	annual grass
5	*Ongumba*	*Stipagrostis uniplumis*	2	perennial grass
20	*Okatjirakonduno*	*Stipagrostis hirtigluma ssp. hirtigluma*	2	annual grass
6	*Omuzumba*	*Commiphora multijuga*	1	tree

Table 28: Fodder plant species used by donkeys

Plant ID	Vernacular	Latin name	Frequency in the pile	PFT
9	*Otjinautoni*	*Boscia foetida ssp. Foetida*	11	bush
7	*Omutendeeti*	*Boscia albitrunca*	9	bush
10	*Onyase*	*Eragrostis nindensis*	9	perennial grass
14	*Omunguindi*	*Boscia albitrunca*	8	bush
15	*Ongorondji*	*Schmidtia kalahariensis*	8	annual grass
21	*Ohongo*	*Tribulus ssp.*	8	forb
23	*Otjipembati*	*c.f. Monechma cleomoides*	8	shrub
5	*Ongumba*	*Stipagrostis uniplumis*	7	perennial grass
3	*Omutati*	*Colophospermum mopane*	6	tree
20	*Okatjirakonduno*	*Stipagrostis hirtigluma ssp hirtigluma*	6	annual grass
8	*Omusaona*	*Acacia mellifera*	5	tree
12	*Omuvapu*	*Grewia bicolor*	5	bush
17	*Omumborombonga*	*Comretum imberbe*	5	tree
18	*Omungondo*	*Acacia reficiens ssp.reficiens*	5	tree
24	*Omupanda*	*Lonchocarpus nelsii*	5	tree
1	*Omuhama*	*Terminalia prunioides*	4	tree
2	*Omukaravize*	*Catophractes alexandri*	4	bush
4	*Omumbuti*	*Combretum apiculatum ssp.apiculatum*	4	tree
11	*Omutungi*	*Commiphora glaucescens*	4	tree
22	*Orusu*	*Acacia nilotica ssp kraussiana*	4	tree
13	*Omukaru*	*Ziziphus mucronata*	3	bush
19	*Omue*	*Faidherbia albida*	3	tree
16	*Omuve*	*Berchemia discolor*	2	tree
6	*Omuzumba*	*Commiphora multijuga*	1	tree

Table 29: Inventory of determined fodder plant species of the Freelist

Vernacular name	**Scientific name**	**Frequency in the Freelist**
Omuhama	*Terminalia prunioides*	18
Omutati	*Colophospermum mopane*	17
Omukaravize	*Catophractes alexandri*	17
Omumbuti	*Combretum apiculatum ssp.apiculatum*	13
Ongumba	*Stipagrostis uniplumis*	12
Omutendeeti	*Boscia albitrunca*	10
Omuzumba	*Commiphora multijuga*	10
Omusaona	*Acacia mellifera*	10
Otjinautoni	*Boscia foetida ssp. foetida*	9
Omuvapu	*Grewia bicolor*	9
Onyase	*Eragrostis nindensis*	9
Omutungi	*Commiphora glaucescens*	9
Ongorondji	*Schmidtia kalahariensis*	8
Omunguindi	*Boscia albitrunca*	8
Omukaru	*Ziziphus mucronata*	8
Omumborombonga	*Combretum imberbe*	8
Ohongo	*Tribulus ssp.*	7
Okatjirakonduno	*c.f. Stipagrostis hirtigluma*	7
Otjipembati	*c.f. Monechma cleomoides*	7
Omungondo	*Acacia reficiens ssp.reficiens*	7
Orusu	*Acacia nilotica ssp kraussiana*	7
Omupanda	*Lonchocarpus nelsii*	7
Omue	*Faidherbia albida*	7
Omumbonde	*Acacia erioloba*	6
Ongumbati	*Sesamothamnus guerichii*	6
Omurenda	*Commiphora mollis*	6
Omundjembere	*Grewi flava*	6
Omukuyu	*Ficus sycomorus*	6
Ohoke	*Aristida adscensionis*	5
Ehozu	*Urochloa brachyura*	5
Omunditi	*Rhigozum virgatum*	5
Omungambu	*Salvadora persica*	5
Otjimbuku	*Acacia hebeclada*	5
Omukange	*Commiphora pyracanthiodes*	5
Ombowa	*Cleome sp*	4
Omumbungururu	*Ptaeroxylon*	4
Omutapati	*c.f. Combretum watii / herroense*	4
Omusepa	*Ehretia rigida*	4
Omuhandua	*Zanthoxylum ovatifoliolatum*	4
Omboo	*Commiphora glandulosa; (small C. pyracanthoides)*	3
Otjindumba	*Pechuel-Loeschea leubnitziae*	3
Omutjete	*Dichrostachys cinera*	3
Omundjendjere	*Grewia tenax*	3
Omundjenya	*Vangueria infausta*	3
Orueyo	*Eragrostis prorsa*	2
Ongangahozu	*Eragrostis nindensis*	2
Omutindi	*Cyphostemma uter / curorii*	2
Onduyaturawa	*Crotalaria argyraea*	2

Table 29 continued:

Omungongomui	*Acacia erubescens*	2
Erara	*Tinospora fragosa*	2
Otjipiva	*Tylosema esculentum*	2
Omuparara	*Peltophorum africanum*	2
Onyiva	*c.f. Indigofera sp.*	1
Okaurukonde	*Anthephora schinzii*	1
Ongwengwe	*Eragrostis annulata*	0
Okatejanduwombe	*Eragrostis echinochloidea*	0
Ombanga	*Entoplocamia aristulata*	0
Okamuti kovipindo	*Geigeria acaulis*	0