1 INTRODUCTION

Livestock plays an important role for the Ethiopian national economy. The country has the highest share of livestock in Africa and is one of the world's centres of domestic animal genetic resources diversity (FAO, 2000; ESAP, 2003). Livestock production currently provides about 15% of the Ethiopian GDP and 30% of its agricultural GDP (MEDaC, 1999). For low-income producers, livestock provides cash, physical products and services as well as socio-economic functions, including liquidity and security, and is therefore an important resource of sustainable livelihoods (Delgado *et al*., 1999; Ayalew *et al.,* 2003; Anderson, 2003).

Pastoral livestock production remains the principal economic activity in the arid and semi-arid rangelands of Ethiopia. Pastoralism provides a living for about 6 Mio Ethiopians, an estimated 10-12% of the country's total human population. Pastoralists keep about 40% of the national cattle, half of the small ruminants and nearly all the dromedaries[1]. Through extensive rangeland management they use about 60% of the total area, mainly peripheral areas where no alternative production exists. Despite a strong subsistence orientation, pastoralists provide about 90% of the legal livestock exports in live animals, and 20% of the draught animals for the highlands (Coppock, 1994; Hogg, 1997; Sandford and Habtu, 2000). In addition to that, a considerable unofficial cross border trade occurs (Teka *et al.,* 1999).

The Borana pastoralists were once known for their high productivity in cattle husbandry. With a focus on milk off-take for subsistence and sale of males to maintain a high proportion of cows in the herd, they achieved a higher profitability in cash and energy than is expected of extensive beef production (Cossins and Upton, 1988). Studies on the productivity of indigenous pastoral systems compared to commercial ranching showed that under similar ecological conditions the Borana pastoralists performed 57% better than the Kenyan ranch productivity, using MJ per ha and year of gross energy edible by humans as an indicator (Cossins (1985) in: Behnke and Abel (1996)). In comparison to Kenyan Massai pastoralists, the Borana herds yielded more milk per cow and year (Borana 219-251 kg, Massai 50-235 kg), and obtained higher cash output per head and year (Borana 20-27 US$, Massai 16-24 US$) (Bekure *et al.* (1991) and de Leeuw (1995) in: Behnke and Abel (1996)).

[1] Sandford and Habtu (2000) estimated in a recent study that about 10.9 Mio cattle, 10.2 Mio sheep, 7.7 Mio goats and 2.5 Mio dromedaries are herded by Ethiopian pastoralists.

Result of the Borana pastoralists' successful breeding and selection strategies is the Ethiopian Boran cattle. Exported for commercial ranching to countries like Kenya, Australia, USA or Mexico, the Improved Ethiopian Boran cattle reached body weights of up to 850 kg (Rege, 1999). Under the current conditions of its native environment in the Borana rangelands, the typical Ethiopian Boran cattle are conserved at the government-owned Did Tuyera breed improvement ranch.

The nature of the Borana natural resources and management system reflects typical characteristics of east African pastoralism. Pastoral production systems have evolved under high-risk conditions in dryland regions. Traditionally, they were remarkably resilient to the climatic variability and to external perturbations like droughts. Herd mobility and common property regimes were used to exploit key resources at a larger scale. Thereby the pastoralists sustained the utilisation of scattered rangeland vegetation throughout the year (Ellis *et al*., 1988; Westoby *et al*., 1989; Scoones, 1993; Behnke, 1994). The households' as well as the communities' ability to co-operate in the utilisation and maintenance of the common pool resources was of great importance for maximised livestock production and successful risk management (Blench and Marriage, 1999; McCarthy, 1999).

The Borana pastoralists have been in a favourable position to develop an exceptionally efficient natural resource management. They were specialised on extensive cattle breeding in a semi-sedentary production system. The limited availability of permanent water at the traditional deep wells was the key variable that determined the rules for the utilisation of pastures. Through flexible natural resource use strategies and stratified herd management they matched the livestock to the available grazing and water resources during times of abundance as well as in scarcity. Institutional arrangements and networking within and between pastoral groups were elaborated to enforce decisions among multiple resource users. Thereby, the Borana pastoralists generated a distinct ecological, technological and organisational indigenous knowledge (IK), which enabled them to preserve the Borana rangelands at highest grazing potential in east Africa (Helland, 1982; Coppock, 1994; Hogg, 1997).

However today, the Borana pastoralists are in a deteriorating situation. During the last 30 years the deeply rooted indigenous natural resource management of the Borana pastoralists has experienced severe forms of external disturbances. The pressure to the Borana pastoral system is recent compared to other African pastoral systems and, therefore, it is particularly suitable to illustrate the effects. Notably the establishment of additional watering ponds in traditional rainy-season pastures, a well-intended but poorly designed pastoral development

intervention, has disturbed the IK-based natural resource management through an imbalance between water and forage resources. The imposition of a formal administration which is alien to the indigenous institutions interfered with the co-ordination of access to grazing and water resources. The most direct deprivation of the natural resource base was the formal alienation of valuable grazing and water resources by the federal regionalisation policy. The official ban on burning and the establishment of private commercial ranches exacerbated the disruption of the Borana traditional pastoral system. The extension services favoured crop cultivation within valuable grazing areas and claimed key resources from the pastoral production.

The rapid growth of the human population of about 2.5-3% put further pressure on the natural resources, and has severely reduced the per capita availability of these resources. Recurrent droughts aggravated the problem by causing loss of livestock and grazing resources as well as unsustainable exploitation of the surviving resources. The combined impact of all these factors is a progressive degradation of rangeland resources, destruction of important social structures and poverty for the majority of the Borana population (Coppock, 1994; Helland, 1997; Kamara, 2001).

The devastating trends aggravate, because despite the growing recognition of the value of IK for sustainable pastoral livelihood development little incorporation in development concepts and formal legislation has been achieved. Opposed and partly emotionalised views on pastoralists' capability in natural resource management hampered a concerted action among the stakeholders involved. Pastoralists were blamed for destroying the environment by accumulating animals and over-exploiting natural resources. Alternatively, pastoralism was seen as a dynamic adaptation to variable and unpredictable environments (Dahl and Hjort, 1976; Dyson-Hudson and Dyson-Hudson, 1980). There is a general consensus, that the results of the enormous research and development efforts vested in the Borana rangelands have remained far below the expectations (Coppock, 1994). The IK-based natural resource management of the Borana pastoralists has lost the potential to contribute to sustainable livelihoods. It seems that pastoralism which was once capable for efficient production can no longer be continued in the traditional way. Also the capacity for extensive range management is limited.

The above observations have created a re-orientation in research priorities, development planning processes, and policy implementation (UNSO and UNDP, 1994; Lane and Morehead, 1995). Priorities include the dynamics of pastoral management systems and the manner in which they evolve in response to environmental risk and external influences (FAO

and ILRI, 1995; Mortimore, 1998; Kirk, 1999; Ngaido, 2002). The establishment of adequate access agreements to rangelands and water is seen as an important precondition to preserve the viability of pastoral production systems. Revitalising the utilisation of pastoralists' IK is considered as fundamental for the sustainable management of dryland eco-systems.

The Borana Lowlands Pastoral Development Programme (BLPDP/GTZ) seeks to follow the new insights, based on an integrated participatory development approach with emphasis on livestock production. The main objective of the BLPDP/GTZ is to develop concepts and technologies appropriate for the promotion of pastoral and agro-pastoral households, in particular those with a low economical status. The project seeks to facilitate participatory approaches in testing, implementation and evaluation of appropriate natural resource management options in the Borana rangelands. It aims at strengthening the co-operation among the stakeholders involved, networking of the relevant institutions and policy advocacy for the Borana pastoralists. The project management has called for a research study on the potentials and constraints of the Borana pastoralists' IK for sustainable rangeland and water development.

The present research study was therefore carried out in collaboration with the BLPDP/GTZ. The main objective of the research was to analyse the Borana pastoralists' IK and thereby to support the BLPDP/GTZ in developing a pastoral-orientated livestock development and extension concept. The expected results were 1. Appropriate research sites are selected and their natural resource potential is determined; 2. Indigenous strategies and institutions for natural resource management are documented; 3. Interactions between technological and socio-economic determinants of the use of natural resources are evaluated; 4. Interactions between land use strategies and the natural resource potential are evaluated; 5. Organisational adaptations to seasonal supply of natural resources and long-term development trends are discussed; and 6. Recommendations for sustainable IK-based natural resource management procedures are formulated. The research operated at the interface of IK-based natural resource management and the ongoing development processes, laying emphasis on applicability and transferability of research results.

The research study investigates the pastoralists' indigenous ecological, technological and organisational knowledge in rangeland and water management under externally induced constraints. However, in the process of promoting IK, it has become an obfuscate expression, encompassing all sorts of local disposition to development. Therefore, a functional definition of pastoralists' IK has been formulated. It refers to the typically opportunistic range

management, comprising herd mobility, variability in stocking densities and herd diversification (Sandford, 1983). The underlying decision-making structures based on common property regimes were further investigated.

The research could not address the many other facets of pastoralists' IK such as soil taxonomy, forestry utilisation, ethno-veterinarian practices, drought mitigation and gender aspects[2]. This might be a shortcoming, but it was assumed that on the long run, the application of most aspects of pastoralists' IK depends on continuing opportunistic range management.

The applicability of IK under ecological and socio-economic constraints is important for pastoral livelihood systems in Africa. The current situation was specified for the Borana region, where most complex natural resource management structures were assumed. The research was designed as an in-depth case study to develop a more complex understanding of the pastoralists' IK. A multi-disciplinary approach was selected, combining socio-economic and ecological disciplines. Two management systems with a different extent of external interference and differences in functionality in the traditional system were compared. It was tested, whether the preconditions for the Borana pastoralists to apply IK have been destroyed by external interference, and whether still existing IK can be helpful to revitalise pastoral orientated rangeland and water management.

[2] Women are formally excluded from range management decisions. However, they often have social, economic and cultural means of contributing to decisions, difficult to detect for outsiders (Abdullahi Shongolo, anthropologist, pers. comm., 2002). This issue was largely beyond the scope of this study.

2 THEORETICAL FRAMEWORK

2.1 CHARACTERISTICS OF PASTORAL NATURAL RESOURCE MANAGEMENT

Complex pastoral management systems have evolved from the pastoralists' successful adaptation under the harsh conditions of arid and semi-arid rangelands[3]. However, the pastoralists' knowledge and strategies in rangeland and water management are disturbed by inadequate development concepts and policies, and this leads to environmental degradation and the erosion of important social structures (Kirk, 1999). The existing pastoral systems including their local adaptations are highly divers, although they share common development trends (Blench, 2001).

The insights gained on pastoral development in the Borana rangelands are considered meaningful for other pastoral systems. To make the transferability of experience and information possible, first pastoral systems and key management strategies are introduced, and the changing development concepts pertaining to it. Then, the integration of pastoralists' IK for more sustainable development concepts is described. The special situation of pastoral development in the Borana rangelands and the consideration of the Borana pastoralists' IK is characterised in the subsequent chapter.

2.1.1 Pastoral management systems and their environment

Pastoral management systems have been developed under high risk conditions in dryland regions. They are determined by natural environments with high variability in rainfall and recurrent extreme climatic conditions, associated with spatial heterogeneity (Galvin *et al*., 2003). Livestock husbandry is the principal economic activity, often controlled by heavy drought-induced mortality (Ellis and Swift, 1988). Livestock productivity depends on extensive grazing on native pastures, with herd movements in search of forage as the basic strategy (Sandford, 1983; Coughenour *et al*., 1985). Pastoral grazing practices are economically the most efficient form of land use, and reach higher total returns per area land surface than sedentary or commercial ranching (Breman and de Wit, 1983; de Ridder and Wagenaar, 1984; Behnke, 1985; Scoones, 1995b). Crop cultivation is not appropriate under

[3]Typical examples are documented by Dahl and Hjort (1976), Dyson-Hudson and Dyson Hudson (1980), and Bekure *et al.* (1991).

high uncertainty of rainfall conditions.

Pastoral systems are defined as a particular form of range-livestock production systems[4], in which more than 50 percent of all household revenue is derived from livestock or livestock products, and a substantial part of the diet from home-produced meat, blood and milk (Swift 1984). Apart form the economic definition of pastoral systems, there are definitions of pastoral production which include the devotion of labour to livestock and communal ownership of natural resources (Sandford, 1983). In the broadest sense is the self-definition of pastoralists' identity by those who consider themselves as members of a pastoral society, regardless whether they are presently living primarily from pastoral products or not (Waters-Bayer *et al.,* 2003).

Pastoral systems are supply driven (Schiere, 1995; Bayer and Zemmelink, 1998). Herders have to adjust the type and level of livestock production to the available range resources. The high risks of production and survival require highly adaptive management approaches (Niamir-Fuller and Turner, 1999). For quick responses to unpredictable natural events range resources and livestock management are closely associated with the predominant social structures (Upton, 1987; Lane and Morehead, 1995). Dynamic responses to the interplay of ecological and societal factors sustain the long term development of pastoral systems (Morton and Meadows, 2000).

Effective pastoral natural resource management is based on a sound knowledge of local user groups of their environment, referred to as pastoralists' IK in chapter 2.2.2. Pastoralists generate their technical and organisational knowledge by moving their herds across fairly large areas (Niamir, 1990; Niamir-Fuller and Turner, 1999; Schareika, 2003). Recent studies support herd mobility as the key strategy to exploit the heterogeneous rangelands and to improve the survival of herds during droughts (Oba *et al*., 2000a; Fernandez-Gimenez and Swift, 2003). It is embedded in local biological, legal-political, socio-cultural, and economic frame conditions.

The primary productivity of African rangeland eco-systems is distinguished by a remarkable resilience to external perturbations like droughts and episodic grazing pressure (Ellis and

[4] Jahnke (1982) defines range-livestock production systems as those which are based on the utilisation of natural vegetation through domestic ruminants. Pastoral systems are one form of range-livestock production, to be differentiated from sedentary ranching systems.