



# **Pastoral Risk Management**

## **The Importance of Cooperative Production**

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## ABSTRACT

An important problem facing nomadic pastoralist in stochastic environments is the ability to manage production risk so as to maximise long term survival in the ‘pastoral game’. Herd maximization is one widely discussed risk reducing strategy, as herd size may act as buffer against falling below a threshold of long-term survival during occasional environmental catastrophes. Labour investment have been argued to be an important prerequisite for building herds, although the few studies that have tried to quantify the relationship have been characterized by contradictory results. By combining two review studies, three observational studies and one theoretical model, I show that: (1) herd accumulation is a risk reducing strategy for Saami reindeer herders as larger reindeer herds perform better than smaller ones over time. (2) Earlier contradictory results pertaining to the relationship between pastoral labour and production can be explained with reference to: (i) a lack of consistency regarding which areas of pastoral production that is considered being influenced by labour investment; and (ii) the relationship between effect size and sample size. (3) More importantly, measurements of pastoral labour investment have been characterized by a within-household bias, neglecting possible between household cooperative labour investments. (4) From a theoretical point of view, it is possible that pastoral labour is characterized by scale dependency consisting of changed cost-benefit relationships where cooperative labour investment may be a least-cost strategy. (5) Scale dependency of pastoral labour was shown to be present in the Saami reindeer husbandry, where number of possible cooperating husbandry units and genealogical relationship had a significant effect on: (i) individual husbandry unit herd size; (ii) density of female reindeer; and (iii) offspring body mass. These results suggest that future studies have to investigate possible cooperative labour related effects on pastoral production, and more importantly that cooperative labour investment is an important mechanism for efficiently buffering risk in stochastic environments. Moreover, if herd maximization is an important risk reducing strategy facilitated by cooperative labour investment, this has important implications not only for our understanding of pastoral systems in general but also in relation to how these systems should be managed.

*Keywords:* Fennoscandia; nomadic pastoralism; labour; cooperation, production, reindeer; *Rangifer tarandus*; quantitative approach, Norway.

## PAPERS INCLUDED IN THE THESIS

### Paper 1

Næss, M. W., and Bårdsen, B.-J. (2010). Environmental stochasticity and long-term livestock viability - herd-accumulation as a risk reducing strategy. *Human Ecology* 38(1):3-17. <http://dx.doi.org/10.1007/s10745-009-9288-4>.

### Paper 2

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### Paper 3

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### Paper 4

Næss, M. W. (2012). Cooperative pastoral production - reconceptualizing the relationship between pastoral labor and production. *American Anthropologist* 114(2):309-321. <http://dx.doi.org/10.1111/j.1548-1433.2012.01427.x>.

### Paper 5

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### Paper 6

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## INTRODUCTION

“It should be known that differences of condition among people are the result of the different ways in which they make their living ... Some people live by agriculture, the cultivation of vegetables and grains; others by animal husbandry, the use of sheep, cattle, goats ...” (ibn Khaldun, AD 1332-1406, the *Muqaddima* quoted in Cribb 1991:23).

The overall objective for this thesis was to investigate whether the accumulation of large herds of livestock is a risk reducing strategy and whether pastoral labour investment is a prerequisite for successfully exploiting this strategy. In general terms nomadic pastoralists’ (see **Appendix I**) dependence and relationship to their herds of animals have been described differently in the literature. For example, Herskovits (1926) showed how cattle were a dominant element among east African pastoralists’ culture and life. Cattle were important in many ways, e.g. as a symbol of wealth, dowry, and in ceremonies. As such, the preoccupation with having large herds have been explained as having nothing to do with economic considerations, but rather with values lying outside the economic domain (this was not Herskovits intention, however, he merely wished to stress the importance of cultural values, see e.g. McCabe 1994). This has been defined as the “East African cattle complex”, where focus was put on the social value of cattle, often without reference to the consumption requirements of households (Dahl and Hjort 1976).

As a consequence, nomadic pastoralists have been viewed as non-rational as they have been accused of having an economically unreasonable attachment to livestock. Professionals and governments viewed problems, such as dramatic droughts causing the death of animals and humans, and pasture degradation in many pastoral areas, as inherent in the nomadic pastoral adaptation itself:

”Their [the pastoralist themselves] retention of pastoral economic structures based upon the maximal increase of herd size, under new conditions of limited movement and growing dessication because of rainfall failure, were seen to have led to overgrazing of pastures, environmental degradation, and the physical decline of livestock. Eventual economic collapse and famine were thus seen to follow the logic of the ‘tragedy of commons’, the inevitable outcome of lack of individual restraint on livestock production in the face of collectively owned pasture resources [...]” (Galaty and Salzman 1981:6).



According to Fratkin & Smith (1994) the study of the *pastoral production system* in anthropology first started out with Evans-Pritchard (1940) study of the cattle keeping Nuer in Africa. Evans-Pritchard described the many aspects of pastoral production, such as milk production and the organisation of labour in great detail. As such, Evans-Pritchard paved the way for the study of pastoralism in Africa that focused on the “[...] unique fit between livestock-keeping peoples and the arid lands they inhabit, between their particular social organizations and the demands of mobile livestock production” (Fratkin et al. 1994:1, see also Dyson-Hudson 1972, Dyson-Hudson and Dyson-Hudson 1980).

In 1976 Dahl and Hjort wrote in the introduction to their seminal book *Having herds: pastoral herd growth and household economy*:

“Ever since Herskovits' definition of the "East African cattle complex" in 1926 much interest has been focused on the social value of cattle, often without relating it to the consumption requirements of the household. Such a preoccupation with the cosmological aspect of cattle easily leads to a misunderstanding of the rationale for an individual household keeping many cattle (i.e. to provide sufficient food, to provide security against droughts and disease); the focus is then rather on the prestige aspects of having large herds, beautiful cattle etc. [...]” (Dahl and Hjort 1976:16-7).

This point seems to be well taken as most commonly the rationale for keeping large herds of livestock has been framed in economical or ecological terms. Explanations pertaining to the importance of keeping large herds range from Barth's (1961, 1973) theory that nomadic pastoralists maximise livestock numbers in conditions of communally owned pastures, nomadic pastoralists are risk avoiders (Galaty and Johnson 1990), nomadic pastoralists seek reliable food intake (Roe et al. 1998), and value long term household survival (Mace 1993, Mace and Houston 1989).

Nevertheless, Chatty (2006:1-2, italics added) argues that *nomadism*

“[...] may not have been specifically linked to any particular ecology and thus was a purely practical adjustment to the ecological environment. It may be that we overestimate the role played by ecological pressure in creating these ways of life that the nomads of the Middle East and North Africa continue to exhibit. Thus we may find that a cultural initiative, for example, a specific ideology favoring mobility has played a role in the development and adaptive

continuance of these lifestyles. *Mobility and movement may, contrary to what some have suggested, be an important reason for being a nomadic pastoralist.*”

While not suggesting that ideological and cosmological aspects of keeping livestock and moving with them are irrelevant for an understanding of nomadic pastoralism, it could be argued that “[...] *that the social value system primarily reflects [...] economic/ecological aspects*” (Dahl and Hjort 1976:16-7, italics added). It is the starting point of this thesis that the keeping of large herds of animals is best understood with reference to economic and ecological consideration. Accordingly,

“The tendency that pastoralists try to keep as large herds as possible is not, however, solely a result from the value system. [...]. For example the unreliable rainfall leads to great fluctuations in the availability of water and grazing, both seasonally and over longer periods. For a pastoral household it is necessary to keep a margin against the risk of having part of the herds killed from a drought or an epidemic [*sic*]. The number of animals needed to maintain a longtime continuous production is also much larger than the number of animals immediately utilized at a certain period.” (Dahl and Hjort 1976:16-7, emphasis added)

Moreover, Barth (1961, 1964, 1973) has argued that nomadic pastoralists maximise herd growth not only when pastures are communally owned but also because of the dangers connected with falling below some subsistence threshold (see also Fratkin and Roth 1990, Hjort 1981, Roth 1996, Templer et al. 1993). The economic rationale for having relatively large herds have been summarized by Coughenour et al. (1985:619) as (1) milk requirements necessitates a large fraction of mature females, giving herds excessive reproductive capability, (2) lactating animals must provide milk to both humans and young animals, (3) pastoralist herd 50 to 100% more animals than required for subsistence purposes only to secure survival of some animals during droughts to form the basis of a new herd (see also Fratkin and Roth 1990, Hjort 1981, McPeak 2005, Roth 1996, Templer et al. 1993), and (4) individual animals are in general characterized by low productivity, necessitating more animals per person. In short, one compelling reason for pastoralists to keep a large herd of livestock may be viewed with reference to *risk*.

## Risk

According to Kuznar (2002:265, abstract) “Risk sensitivity is important for modeling behavior since organisms live in a stochastic world and must respond to risk by either avoiding it to the extent possible or taking chances.” According to Cashdan (1990) there is little consensus on how risk and uncertainty should be defined<sup>1</sup>. *Uncertainty*, in a very broad sense of the word, refers to an individual’s lack of knowledge about the state of the world (Cashdan 1990). *Risk*, on the other hand, may be defined as unpredictable outcomes of behaviour and decision and their subsequent consequences for an organism's *fitness* (the ultimate currency in evolutionary biology), *utility* (an economic currency which can be broadly defined as referring to a measure of satisfaction with a decision or good, Kuznar 2001, Colman 1995) or *value* (a synonym for both currencies: cf. Winterhalder 2007, Winterhalder et al. 1999). Moreover, according to Cashdan (1990:2) “An individual facing a future of several possible states may be uncertain about which one will actually occur, but he may be able to assign probabilities to each of them”. If able to assign probabilities, the individual faces a problem of “risk”, but if this is impossible the individual faces a situation that is “uncertain” (Cashdan 1990)<sup>2</sup>. While the probability distribution of outcomes can be known based on past experience, stochasticity makes it impossible to predict with certainty any particular future outcome (Kacelnik and Bateson 1996).

Moreover, Winterhalder (2007:433) argue that risk is different from uncertainty (or incomplete knowledge) as uncertainty can by definition be overcome by acquiring more information<sup>3</sup>. Risk may be present in any behaviour if the choice of behaviour can result in more than one relatively unpredictable outcome and where the outcomes have a nonlinear

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<sup>1</sup> Following Winterhalder (2007:433) risk is differentiated from the common sense understanding of risk as pertaining to exposure to danger and hazards.

<sup>2</sup> Although this distinction has been somewhat ignored by turning problems of uncertainty into problems of risk by using subjective probabilities, Cancian (1980) has argued that the distinction should be maintained since the behaviour of people faced with known risk (e.g. variable rainfall) and the behaviour of people faced with uncertainty (e.g. new technology) is very different.

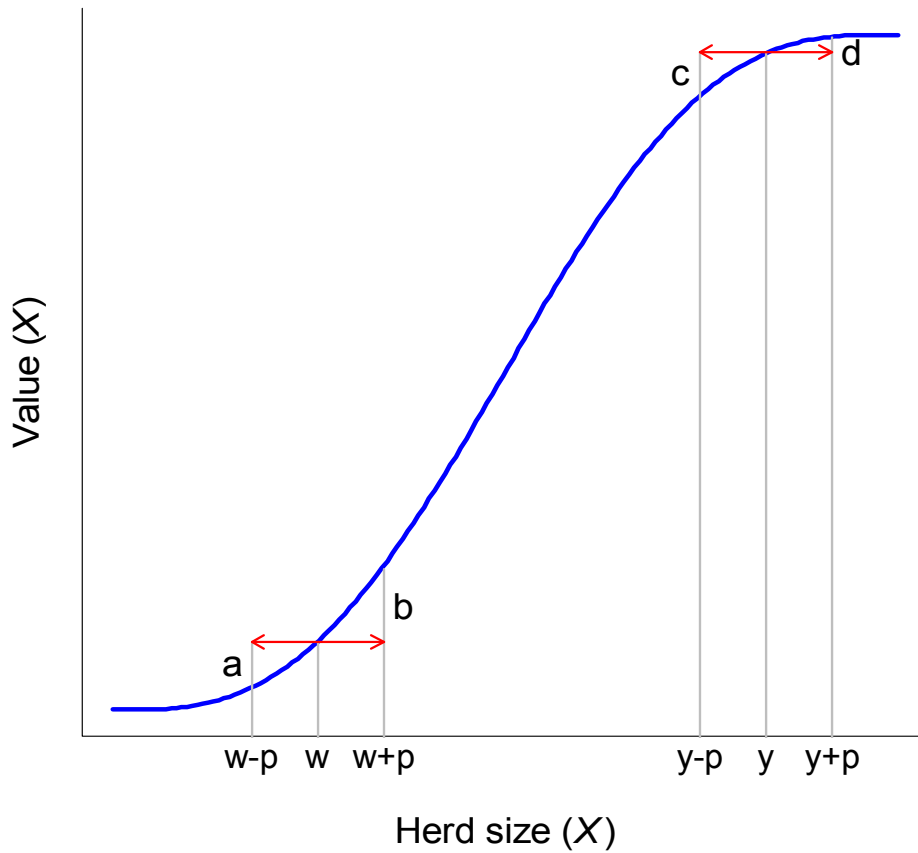
<sup>3</sup> Winterhalder (2007:433, italics added) illustrates the difference with an illuminating example “[...] I can alleviate uncertainty by the day’s weather forecast by reading the meteorology section of the newspaper, but there is no escaping the unpredictability implied in the statement that there is a 40% chance of rain. *The outcome – precipitation – can be assigned odds, but otherwise is not known in advance.*” Nevertheless, both risk and uncertainty “[...] imply a degree of ignorance about the future, but uncertainty is a profounder type of ignorance than risk” (Colman 1995:23). This because a lack of information may not always be possible to overcome prior to decisions.

effect on some measure of utility (Kuznar 2001, Colman 1995). Winterhalder et al. (1999) argue that much risk-sensitive behaviour can be understood by applying a sigmoid utility function to model people's preferences. An important fact about utility, which was recognised by Daniel Bernoulli, is that the value or satisfaction with a certain good need not be equivalent with the quantity of the good (Colman 1995:19). In short, utility theory recognizes the fact that e.g. winning 100\$ may be more valued by the poor than by the millionaire, i.e. that an individual's willingness to take risk or avoid risk may depend on wealth or well-being<sup>4</sup> (Kuznar 2002).

Assuming that for pastoralists a reasonable measure of wealth is herd size and moreover that herd size has consequences for pastoralists' utility (or value, e.g. long-term household survival as suggested by Mace 1993, Mace and Houston 1989), a sigmoid utility functions predicts that poor pastoralist should take risk so as to increase herd size, while rich pastoralist should be averse to risk so as not to significantly decrease herd size. For example, in Figure 1, a pastoralist with herd size,  $w$ , if offered an equal chance to either increase or decrease herd size with  $p$ , should accept the gamble because the increase in value,  $b$ , is larger than the potential loss in value,  $a$ . In contrast a pastoralist with herd size,  $y$ , will decline the same gamble because the most he or she can win,  $d$ , is less than the potential loss,  $c$  (see Figure 1).

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<sup>4</sup> To *take a risk* implies gambling on a bet where the long-term expected payoff is less than the short-term cost when entering the bet (i.e. a *convex* utility function). In contrast, to *avoid risk* implies the acceptance of a bet when the long-term expected payoff is higher than the cost of entering the bet (i.e. a *concave* utility function). *Risk neutrality*, implies accepting a bet if long-term expected payoff is equal to the cost of entering the bet (i.e. a *linear* utility function) (Kuznar 2002:205-6).



**Figure 1.** An example of a sigmoid utility function and its relevance to risk. Pastoralists at wealth,  $w$ , in the convex section of the curve are attracted to risky prospects of winning or losing  $p$  because the value of winning,  $b$ , is greater than the potential loss,  $a$ . In contrast, people with wealth,  $y$ , in the concave section of the curve avoid risky prospects of winning or losing  $p$  because their potential gain in value,  $d$ , is less than the potential loss,  $c$  (Adopted from Kuznar 2002:268).

In a study of the Gabbara in Africa, Mace (1993) found evidence of flexible herd management, i.e. decisions pertaining to controlling the breeding rates of sheep or not, aimed at accommodating long-term household survival. For example, Mace (1993) found that wealthy herders controlled breeding by restricting ewes' access to males, and consequently increased the longevity of females but reduced the number of offspring per year. Poor households did, however, not engage in this practise, but rather focused on increasing the number of offspring per year. The *choice* pastoralist makes in relation to the controlling of breeding rates or not, could be explained with recourse to risk sensitivity. In short, many large terrestrial herbivores, including domesticated species, experience a considerable cost of reproduction, especially during occasions of harsh weather conditions where the survival rate of pregnant and/or lactating females can be substantially lowered (Clutton-Brock et al. 1996,

Skogland 1985, Tveraa et al. 2003). As such, wealthy herders control breeding rates because the cost of losing pregnant or lactating females during droughts is higher than the potential gain in number of offspring (i.e. they are risk averse, see Figure 1). In contrast, poor households have less to lose as they are already poor and for them the potential gain in utility by focusing on increasing the number of offspring per year far outweighs the potential loss of utility (i.e., they are risk prone, see Figure 1).

While risk sensitivity analyses may provide a valuable tool for explaining differential behaviour depending on e.g. social status, wealth etc. (Kuznar and Lutz 2007) this is not the topic for the risk analyses undertaken in this thesis (**Paper 1**). Following Cashdan (1990), risk is defined as unpredictable variations in ecological or economic variables and outcomes are viewed as riskier depending on their degree of variability (Halstead and O'Shea 1989). Risk then may be evaluated in terms of shortfall, i.e. the probability of falling below some minimum level of income or food intake (Winterhalder 2007). In essence, rather than evaluating the degree of risk sensitivity among Saami reindeer herders, **Paper 1** takes the starting point that stochasticity<sup>5</sup> involves a degree of production risks that have to be managed (see below and **Paper 1** for details).

### **Pastoral risk management**

Halstead & O'Shea (1989) argues that societies, in general, employ a wide range of strategies or 'buffering mechanism' to counteract scarcities, including everything from myths to alternative modes of subsistence (see also Bollig and Göbel 1997). Following Halstead & O'Shea (1989), strategies for countering risk can be grouped into four major categories; (a) *diversification*, ranging from the keeping of multiple livestock species (e.g. Khazanov 1994, White 1997) to investing in non-pastoral activities (e.g. Bayer and Watersbayer 1990, Berzborn 2007, Lesorogol 2008, Mearns 2004, Sperling 1987, Thornton et al. 2007), (b) *exchange*, livestock exchange networks such as stock-friendship (e.g. Bollig 2006:287, Göbel

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<sup>5</sup> In general, nomadic pastoralists inhabit marginal areas characterized by large temporal stochasticity in environmental conditions. For example, in semi-arid grazing areas low and erratic rainfall cause unpredictable variations in livestock forage that influence livestock survival (Behnke 2000, Mace 1991, Behnke and Scoones 1993). The same has also been observed in northern and clearly seasonal environments, where late winter conditions have profound effects on individual survival and reproduction for large herbivores (Coulson et al. 2001, Coulson et al. 2000, DelGiudice et al. 2002, Patterson and Messier 2000).. Historically, mass starvation due to severe winter conditions have dramatically reduced reindeer populations in Norway (Bjørklund 1990:79).

1997, White 1997), (c) *mobility*, e.g. taking advantage of spatial and temporal heterogeneity in available forage (e.g. Bollig and Göbel 1997, McCabe 1997, Thompson et al. 2008, Behnke et al. 1993) and (d) *storage*, e.g. large herd size (Bollig and Göbel 1997, Hjort 1981, Ingold 1986, see e.g. Colson 1979 for other categories). The underlying logic of these strategies is to minimize the impacts of risks and to reduce uncertainties (Bollig and Göbel 1997). The strategies usefulness depends on the social and environmental context, including both the structural characteristics of the society at large and the structure of resource failure the society is likely to experience (for a short review of other buffering mechanisms, see Bollig 2006:13-4). *Diversification* includes a broad range of both passive and active practices, the underlying principle being that broadening the base of the subsistence system, either by using a wider range of plant and animal species or by exploiting broader and more varied areas (i.e. niches), reduces the risk of catastrophic shortages (Halstead and O'Shea 1989). As a strategy for buffering scarcity, *exchange* functions in similar fashion as storage, i.e. present abundance is converted, this time through social transactions, into a future obligation if needed (Halstead and O'Shea 1989). *Mobility* works by taking advantage of the spatial and temporal structure of resource failure in effect to move away from scarcity towards abundance. Movement because of droughts in Africa is a good example; both hunter-gatherers and pastoralists use this strategy to move away from areas that are much affected to areas that are less affected (Halstead and O'Shea 1989). *Physical storage* refers to strategies that are directed towards stabilizing available food so that it may be consumed at some later stage<sup>6</sup>. This principally is a means of dealing with temporal structures of food availability (Halstead and O'Shea 1989).

“All four categories of buffering mechanism exploit favourable aspects of the temporal and spatial structure of variability to mitigate the risk of scarcity. Mobility and diversification use local abundance to counter local scarcity, while storage balances seasons of plenty against lean seasons and good year against bad. Exchange secures a stable food supply by playing off temporal variability. As a result, different types of responses are suited to buffering different sorts of risk”(Halstead and O'Shea 1989:4).

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<sup>6</sup> Colson (1979:21) gives five somewhat different strategies that are commonly used for countering possible disasters: (1) diversification, (2) food storage, (3) storage and transmission of information of famine foods, (4) conversion of surplus food into storable valuables which can be traded during crisis and (5) engaging in social relationships enabling individuals to get access to food resources in other regions.

Of importance in the context of the present thesis is the category of *storage*, as the accumulation of animals as a buffer against future loss have been argued to be a distinct form of storage, i.e. pastoralists store food on the hoof (Bollig and Göbel 1997, Hjort 1981, Ingold 1986). Following this line of reasoning the *accumulation* or *maximization* of large herds can be viewed as a strategy for countering what Göbel (1997:41) terms ‘production risk’, i.e. how to secure a reliable flow of food. This implies that pastoralists have to be, to some degree, risk averters by attempting “[...] to decrease uncertainty by anticipation.” (Galaty and Johnson 1990:20).

### **Herd size as buffer against risk**

McCabe (1997:55), however, argues that pastoral management strategies are best understood as rigged towards *risk aversion* rather than maximisation, implying that “Pastoral strategies are directed primarily toward securing a predictable food supply rather than maximising animal numbers” (White 1997:94). This view is presented by Galaty & Johnson (1990:20-21) as:

“The essential pastoral strategy is probably neither maximisation nor optimisation but risk aversion, an attempt to decrease uncertainty by anticipation. Domestic security is increased through creating alliances across ecological zones, distributing livestock among friends, securing rights in dry season pastures, increasing herds in anticipation of future losses. Short term tactics include punctuated movements to take advantage of new grass, depriving humans of milk to feed calves, or keeping animals within the home to increase security.”

In this view, pastoral strategies are not viewed so much as directed towards maximising animal numbers, but rather directed primarily towards securing a predictable food supply in a highly unpredictable environment.

Roe et al. (1998), however, argue that nomadic pastoralists are concerned with maintaining peak herd size at all time so as to provide a *reliable* source of food. This view understands pastoralism as high reliability institutions, which “[...] seek and attain reliable peak performance by managing highly complex technologies to better manage risks” (Roe et al. 1998:39). Accordingly, a perspective focusing on pastoralists as risk averters assumes that avoiding hazards is the central issue for pastoralists, while reliability seeking pastoralists actually accept hazards and aim at managing them better. Risk-averting pastoralists are then seen as attempting to avoid or escape the hazards of ecological unpredictability, since they



cannot control the probability of the occurrence of hazards. Reliability seeking pastoralists, on the other hand, are actively engaging in ongoing efforts to reduce the probability they cannot avoid by “[...] managing temporal and spatial diversity in grazing opportunities and diversity in livestock capabilities. Far from ‘risk averse’, pastoralists accept and even take risks to use rangelands” (Roe et al. 1998:40). Nevertheless, the difference between these two perspectives seems to be exaggerated, as no strategy said to be risk avoiding can be interpreted as a strategy aimed at completely avoiding risk, i.e. making risk absent.

Although there has been a considerable debate concerning maximization and accumulation, it could be argued that the aforementioned arguments against maximization conflates *strategy* with *goals* or intentions (see **Paper 1** for details). As a consequence, I agree with Hjort (1981) who view maximisation as a buffer strategy analogous to storage. In other words, herd maximisation or accumulation can be interpreted as a strategy that aims at the goal of securing a predictable food supply and/or reducing/averting risk in an unpredictable environment, and not as contrast to risk aversion. Following this line of reasoning, *risk avoidance* in an unpredictable environment may be defined as strategies that (1) *reduces the possibility of exposing oneself for risk, e.g. reduces the probability of loss*, and (2) *buffers the impact of a loss when it occurs*.

## **Previous studies**

Despite of the many debates concerning pastoral strategies of maximizing herd size few studies have actually quantified possible relationships (Roth 1996:219). More importantly, studies that have undertaken to analyze the effectiveness of herd maximization have been characterised by contradictory results. For example, Sperling (1989 in Roth 1996:219) found no evidence of a positive effect of large herd size prior to a drought on post-drought herd size for Samburu cattle pastoralists in Kenya. In contrast Fratkin & Roth (1990), found that the same drought resulted in increased wealth differences between rich and poor among the Ariaal Rendille, Kenya. Comparing post-drought herd size and species-specific herd losses to pre-drought counts, rich households tended to stay rich in contrast to middle and poor households who became poor or even poorer (Fratkin and Roth 1990:386). It was also showed that households keeping a large proportion of camels, i.e. rich households, lost proportionally less animals than those relying on cattle and small stock.

In a follow up study Roth (1996) wished to test the effectiveness of traditional maximizing strategies through analysis of sedentary Rendille pastoralists during the Kenyan drought of 1984/85. Roth (1996:221) hypothesized that: “For maximization to be effective,

wealthier households should suffer greater absolute animal losses, but fewer, or comparable, relative losses. In this scenario, large herd sizes buffer wealthy households from the ravages of drought”. In short, Roth (1996) found that all households lost a major part of their animals, even more than 50% of pre-drought herd size. Moreover, when it comes to proportional losses, there were insignificant differences between camels and small stock, but poor households lost proportionally more cattle than rich ones. As a consequence, Rendille herd maximization strategies for the 1984/85 drought “[...] were highly effective” (Roth 1996:221).

Further on, McPeak (2005) investigated whether livestock accumulation can be empirically identified as a rational strategy to adopt in a variable environment, i.e. boom-and-bust periods of livestock populations where herd size grows steadily over a period of years in a boom period, only to have these gains erased during a short bust period – facing Gabra pastoralists in northern Kenya. On overall the conclusion is that herd accumulation makes a great deal of sense as a response to the highly risky production environment of the study area (McPeak 2005:172). The results of the analyses indicates the accumulation of animals in this system was rational because (i) more animals means more income (McPeak 2005:181); (ii) alternative strategies like converting some animals to less risky formal savings in banks as a buffer against future food shortages is less profitable compared to investing in more animals (McPeak 2005:183-5); and (iii) in terms of loss, larger pre-crisis herd size is correlated with larger post-crisis herd size. In essence, the more animals a herder has going into a crisis period, the more animals the herder can expect to have once the crisis has passed (cf. McPeak 2005).

### **Mechanisms for building herds – the importance of pastoral labour**

If the building of large herds of animals can be argued to be a risk reducing strategy it follows logically that pastoral herd size has to be influenced by what pastoralists do, otherwise herd size would only be the result of factors outside of the pastoralists’ control such as e.g. chance or luck. Thus, for herd accumulation to be a risk reducing strategy we have to assume that the behaviours that pastoralists undertake in relation to their animals have to have some effect on either the herd’s size or its demographic parameters. This should not be interpreted as a controversial argument as it is relatively self-evident that e.g. guarding against predators, taking animals out to the best available pastures should have an effect on e.g. animal survival and thus herd size.

Even more fundamentally, however, it could be argued that without human input and investment in the keeping of a herd of animals, pastoralism as a meaningful analytical category ceases to exist as pastoralism is predominantly about *the exercising of control over a herd of animals through the use of human inputs* (**Appendix I**). While how this exercising of control may vary cross-culturally, the *necessity* of it does not. As such, all pastoralists have to invest human labour into their herds and as a consequence *labour* represents an interesting starting point for pastoral research. Moreover, labour has been argued to be an important prerequisite for successful pastoral management (e.g. Cribb 1991, Dahl 1979a, Paine 1994). Following this rationale, human investment into pastoral production must have an effect, and this effect should also be easily measurable. Nevertheless, there *exists no shred of reliable quantitative evidence* that pastoral labour have had positive effects on herd size or herd demography. For example, Scoones (1992) found no significant relationship between labour and *livestock survival* during drought. Similarly, Sieff (1997) found no significant relationship between labour availability, *herding strategies* and *cattle herd dynamics*. If we broaden our perspective, however, and not only look at the relationship between labour investment and herd size but look at pastoral production in general the picture changes (see **Paper 2**). For example, Turner and Hiernaux (2008) found a significant, but small, effect of labour availability on the probability of herders continuously *herding animals*, although labour availability did not have an effect on the probability of undertaking both *night grazing* and *wet-season transhumance* (see **Paper 2** for details). In addition, Berhanu et al. (2007) found a positive relationship between labour and pastoral production, measured as the *sum of values of milk and meat off-takes*, both marketed and unmarketed (for a review of these and other studies see **Paper 2**). A common explanation for somewhat contradictory results has been that nomadic pastoralists exchange and share herding labour (Grandin 1989, Næss 2003, Scoones 1992, Sperling 1985, Sperling and Galaty 1990, Torry 1977) and form *cooperative* herding groups with other households. Scoones (1992:307), for example, argues that it may not be labour availability at the household level that is critical for the Karanga – instead herding labour may be shared among clusters of households. Furthermore, Sieff (1997:542) argues that the fact that labour availability within households does not influence herding practices or cattle herd dynamics among the Datoga, may suggest two things: (1) households are not limited by labour, or (2) “[...] they [the Datoga] are circumventing any labor shortages within their households either by borrowing herders from another household, or by having their animals herded in conjunction with the herds of another household.”

In light of the apparent importance of pastoral labour investment, contradictory results may be argued to be surprising. Even more surprisingly is the fact that so few studies have tried to quantify this relationship (see **Paper 2**). Nevertheless, there exists a prevalent assumption of a positive effect of increasing labour inputs on pastoral production in the literature (Bollig 1997, Bonte and Galaty 1991, Dahl and Hjort 1976, Göbel 1997, Khazanov 1994, Borgerhoff Mulder and Sellen 1994, Sperling 1985, White 1997 for a review see **Paper 2**). This assumption seem to be so well integrated that the literature concerning pastoral labour is predominantly focusing on topics related to (1) the division of labour, i.e. the gender and age division of labour (see e.g. Curry 1996, Fratkin 1987, Fratkin 1989, Fratkin and Smith 1994, Grandin 1989, Jacoby 1991, Morton 1990, Roberts 1996, Turner 1999, Wangui 2008), (2) changes in labour patterns as a response to commercialisation (cf. Sikana and Kerven 1991, Behnke 1987), (3) economic diversification (see e.g. Bayer and Watersbayer 1990, Berhanu et al. 2007, Berzborn 2007, Lesorogol 2008, Mearns 2004, Sperling 1987, Thornton et al. 2007).

In general, it has been argued that pastoral labour can be partitioned into *quantitative* and *qualitative* aspects (Sikana and Kerven 1991). In short, the quantitative aspect of labour is mainly related to measures of the amount and types of labour inputs, while the qualitative aspects of labour relates to the kinds of labour used, how labour is managed, what tasks are undertaken, and by whom the tasks are undertaken (see e.g. Fratkin 1987, Fratkin 1989, Grandin 1989, Morton 1990, Sikana and Kerven 1991, Turner 1999). Moreover, the definition of labour have been argued to differ in the literature where labour have usually been conceptualized as *physical* inputs at the expense of labour as *management* inputs, i.e. the continuous monitoring of herds and environment (both social and physical) that forms the basis for decision-making in pastoral production (Grandin 1989). While both the qualitative aspects and management aspects of pastoral labour are important for an understanding of pastoralism, e.g. that variation in individual herders' management inputs may have substantial effects on pastoral performance; it could be argued that a possible quantitative relationship between pastoral labour and production has not been satisfactorily explored.

### **Main objective and research questions**

Consequently, the overall objective for this thesis was to investigate whether the accumulation of large herds of livestock is a risk reducing strategy and whether labour investment and cooperation is a prerequisite for successfully exploiting this strategy. The following research questions were addressed:

- (1) Is the accumulation of large herds a *risk* buffering strategy (**Paper 1**)?
- (2) Why has previous studies of the relationship between pastoral *labour* and production been characterized by contradictory results (**Paper 2-3**)
- (3) Is *cooperative* production important for pastoralists (**Paper 3-6**)?

## METHODS & STUDY DESIGN

### Theoretical and methodological perspectives

“[...] we now know that all aspects of the human phenotype are products of organic evolution – exactly the same processes that create the diversity of life around us” (Boyd and Silk 2006:488).

This thesis is highly influenced by the perspective commonly referred to as human behavioural ecology (see e.g. Cronk 1991, Smith et al. 2001, Winterhalder and Smith 2000), and more importantly its methodological and theoretical approach towards understanding socioeconomic/ecologic systems. With its explicit biological and economical foundations human behavioural ecology has as one of its point of departure that individuals “[...] strategically interact to maximize their own selfish interest” (Paciotti and Hadley 2004:122)<sup>7</sup>.

Human behavioural ecology (HBE) as a perspective can be traced back to the middle of the 1970s, and started by applying optimal foraging models in relation to decisions made by human gatherers in relation to resource selection and land use (Winterhalder and Smith 2000:51). According to Cronk (1991:25), HBE can be defined as “[...] the study of the evolutionary ecology of human behaviour”<sup>8</sup>. In other words, HBE can be viewed as a

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<sup>7</sup> See also (Barth 1966, Barth 1967) and his generative approach that stresses that social forms are the results of individual actors strategic actions: “The determinants of the form must be of a variety of kinds. On the one hand, what persons wish to achieve, the multifarious ends which they are pursuing, will channel their behaviour. On the other hand, technical and ecological restrictions doom some kinds of behaviour and rewards other; while the presence of others imposes strategic constraints and opportunities which modify the allocation people can make, and will benefit from making. I will therefore argue that it is unfruitful to explain social form, a pattern, directly by hypothesizing a purpose for it. Individual actors and individual management units have purposes and make allocations accordingly; but a social form, in the sense of an over-all pattern of statistical behaviour, is an aggregate pattern through which ecologic and strategic constraints channelize, defeat and reward various activities on the part of such management units” (Barth 1967:4). This approach can be subsumed under the heading of methodological individualism.

<sup>8</sup> In short this implies that HBE focus on an evolutionary understanding of human behaviour. This, however, have been argued to be problematic by social scientists ever since Wilson’s (1975) final chapter generated

perspective that aims at investigating the relationship between ecological factors and adaptive behaviour (Smith 2000). More specifically, the research strategy is to develop and test models that can explain observed variations in behaviour both within and between human populations. In essence, this implies that humans are capable of learning to use different behaviours in different ecological and social context so as to maximise *inclusive fitness*<sup>9</sup> (Borgerhoff Mulder 1988:260). Moreover, HBE aims at investigating how behaviours among modern humans is linked to our evolutionary history (Cronk 1991).

According to Cronk (1991), HBE was developed from three theoretical perspectives: (1) the study of the evolutionary basis of animal behaviour during the 1960s and 1970s; (2) a dissatisfaction with previous ecological anthropological perspectives such as Steward's Cultural Ecology (see e.g. Moran 1982 for a summary), neo-functionalism as proposed by Rappaport (e.g. Rappaport 1979) and Harris (e.g. Harris 1964); and (3) the development within anthropology of the actor-based perspective, usually subsumed under the heading methodological individualism (e.g. Barth 1966, Barth 1967), and the use of game theory. Especially the last point was important as it resonated well "[...] with the growing emphasis in evolutionary biology and animal behavior studies on individual-level selection and the strategies of individual organisms" (Cronk 1991:26, for a thorough discussion of the relationship between HBE and methodological individualism see Smith and Winterhalder 1992).

### *Assumptions of human behavioural ecology*

According to Smith (2000) the key assumptions of HBE include: (1) an ecological selectionist approach; (2) a piecemeal approach to the study of behaviour; (3) a focus on building models as an intake for understanding behavioural variation; (4) a focus on decision rules or conditional strategies; and (5) the phenotypic gambit.

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uproar by trying to apply sociobiological thinking to humans (for a detailed exposition of the debate see Segerstråle 2001). Nevertheless, times have changed and HBE and other evolutionary approaches to the understanding of human behaviour cannot longer be argued to be illegitimate scientific perspectives (although e.g. Ingold 1996 argues exactly that). This can be illustrated by the fact that a search on ISI Web of Knowledge containing "human AND behavioural OR behavioral AND ecology" generates 5347 hits. As a consequence, the general problem aspect of using evolutionary thinking in relation to human behaviour will not be addressed here.

<sup>9</sup> An organism survival and reproductive success is usually designated as fitness (Ridley 1995). Inclusive fitness can then be defined as own fitness plus the effect the behaviour has on relatives' fitness weighted by the average coefficient of relatedness ( $r$ ).

*Ecological selectionism* refers to the fact that when analyzing behaviour one have to ask “what are the ecological factors selecting for behaviour x?” (Smith 2000:29). The ecological part of this argument implies that one have to look at environmental conditions, e.g. resource density, competition etc., and look for correlations between these conditions and the behaviour one wishes to investigate (e.g. territorial behaviour). The selectionist part of this argument implies that one develops predictions pertaining to a possible correlation based on expectations related to what kind of behavioural patterns one believes will be (or have been) favoured by natural selection (Smith 2000:29).

The *piecemeal approach* implies that complex “[...] socioecological phenomenon are most fruitfully studied in a reductionist rather than holistic fashion” (Winterhalder and Smith 2000:52)<sup>10</sup> by splitting up the problem into different components of decisions and constraints (Smith 2000:29). In relation to e.g. cooperation one can look at how hunting group size may vary as a function of differential benefits and costs related to different resources. Moreover, conflicts in relation to how many individual should be allowed to join a group or not may partly be explained by different benefit functions for individuals within the group versus individuals wanting to join the group (Smith 1997a). This approach also relies on series of simple *analytical models* (e.g. kinship) where the assumption is that these models can generate valuable testable hypotheses (e.g. kinship relations as a positive predictor for cooperation) (see Smith 2000:30 for other examples).

Furthermore it is common to frame the study of adaptation in terms of *decision rules* or *conditional strategies*: “These are abstract and somewhat metaphorical ways of conceiving the covariation of behaviour and socioecological environment, having the general form “In context X, do  $\alpha$ ; in context Y, switch to  $\beta$ ”” (Smith 2000:30). In other words, behavioural variations are explained as adaptive responses to environmental variation, or more specifically

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<sup>10</sup> Winterhalder and Smith (1992:14) argues that reductionism for HBE implies “the “dissection of phenomena, events, and processes into the constituents of which they are composed” (Mayr 1988:10)”, i.e. that aggregate phenomena are constituted by lower level events and processes. This is a stark contrast to Dennett’s (1995:81) designation *greedy reductionism* which can imply that “[...] reductionists want to abandon the principles, theories, vocabulary, laws of the higher-level sciences in favor of the lower-level terms”. Accordingly, such a preposterous understanding of reductionism may imply papers written pertaining to ““The Role of Oxygen Atoms in Supply-Side Economics”” (Dennett 1995:81). For an argument against the more sober understanding of reductionism as argued by Winterhalder and Smith (1992:14) see Miller and Page (2007:41-2).

that “Behavioral variation arises as individuals match their conditional strategies to their diverse socioenvironmental settings” (Winterhalder and Smith 2000:54).

HBE also takes a calculated risk to ignore the unknown details pertaining to the inheritance (cultural or genetic) of cognitive mechanisms forming the basis of, and phylogenetic history (i.e. the evolutionary history of a species or other grouping of organisms) of specific behavioural rules as one hopes that they will not influence the end result (Smith 2000:30). This is usually referred to the *phenotypic gambit*. For example, behaviour is complex and multi-causal and depends on the environment in ways that are not easily captured by genetic models. As a consequence, HBE treats observed phenotypes, e.g. behaviour, as adaptations and avoid detailed notions of inheritance. In other word, strategies or decision rules have been shaped through natural selection and resulted in adaptive phenotypes (Smith and Winterhalder 1992:33). As few, if any, of the traits studied by HBE is controlled by a single gene the phenotypic gambit is based on the premise that natural selection will favour traits with high fitness regardless of the specific mechanisms of inheritance (Smith and Winterhalder 1992:33).

Winterhalder & Smith (2000:52) argues that HBE stands in contrast to current social anthropology because of its commitment to a hypothetico-deductive research strategy, where testable hypotheses are developed from mathematical and graphical models based on the basic evolutionary principle of natural selection (Smith 1983, Winterhalder and Smith 2000). Moreover HBE focus on being general and the models that are used aims at being both simple and parsimonious. Furthermore, HBE tries to capture the essential characteristics of a adaptive problem and disregard to a certain degree the many other variables that the more particularistic social anthropology is preoccupied with (Winterhalder and Smith 2000:52).

### *The ecology and economy of human behaviour*

Nevertheless, Smith (1997b) have argued that too much of the current human behavioural ecological research is about sex, more specifically concerning mating and parenting. While this may be natural as differential replication forms the basis for evolution, Smith (1997b:70) argues that “[...] the realities of thermodynamics have been around a long time – even longer than those of natural selection – and they continue to exercise a profound influence even in that upstart realm of the universe that we call life”. In short this implies that important avenues for research should also include perspectives in relation to economic activities such as food production (Smith 1997b). Moreover, Robin Fox (1997:192), one of the pioneers together with Lionel Tiger (Tiger and Fox 1971, Fox 1975) in applying evolutionary thinking



in anthropology have argued that he never thought that the maximization of reproductive fitness could describe and explain all aspects of human behaviour.

While not explicitly evolutionary in approach, this thesis' theoretical underpinnings have been greatly influenced by the human behavioural ecological framework pertaining to production broadly understood. For example, the theoretical understanding of the formation of cooperative (and measuring of cooperation) herding groups among pastoralists (**Paper 4-6**) have been highly influenced by the basic premise of optimality theory (see details below), which is a commonly used tool within HBE, focusing on the cost and benefits associated with a specific choice or behaviour. Nevertheless, the explanations developed are more couched in an economic language rather than an evolutionary language as an explicit link to fitness is never made. As such one could argue that there may be inconsistencies arising in the papers that make up this thesis, i.e. whether pastoral behaviour should be understood in economic or evolutionary terms. Fox (1997:149), however, have argued that "If economics is the science of self-interest then so is evolutionary biology (and hence anthropology)". Moreover, Darwinism has been argued to simply be "[...] the imposition of classical market economics onto the natural world [...]" (Fox 1997:151). Moreover, Ingold (1996:26) has argued that natural selection is the "[...] mirror-image of rational choice". Furthermore, with specific reference to the use of optimality theory Smith (1983:627) argues that ecological optimization theory can be viewed as a version of the standard neoclassical economic logic applied to non-money based production systems<sup>11,12</sup>. As such there is a close link between economy and evolutionary approaches such as HBE.

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<sup>11</sup> Nevertheless, fundamental differences exists, e.g. the main *causal* factor in evolutionary theory is natural selection while in economy and other perspectives based on rational choice it is individual decision making (Smith and Winterhalder 1992:41-2).

<sup>12</sup> Note, however, that rationality does not require self-interest, but rather that individuals have consistent preferences (Gintis 2009). Moreover, the assumption that individuals are entirely self-interested seems to be increasingly relaxed in e.g. behavioural economy. In short, cross cultural evidence have shown that "[...] in addition to their own material payoffs, many [...] subjects appears to care about fairness and reciprocity, are willing to change the distribution of material outcomes at a personal cost, and are willing to reward those who act in a cooperative manner while punishing those who do not even when these actions are costly to the individual" (Henrich et al. 2001:73, see also Alvard 2004, Gintis et al. 2005, Henrich 2004). Gintis et al. (2005:8, italics in original) argues that humans have evolved to become strong reciprocators, where strong reciprocity is "*a predisposition to cooperate with others, and to punish (at a personal cost, if necessary) those who violate the norms of cooperation, even when it is implausible that these costs will be recovered at a later date.*"

## *Optimality theory*

A common form of modelling both within the social sciences and ecology is the application of optimality models (e.g. Smith 1983, Stephens and Krebs 1986, Borgerhoff Mulder and Sellen 1994, Thomas 2007a, Thomas 2007b, Pyke et al. 1977, Deboer and Prins 1989, Hawkes et al. 1982, Hill et al. 1987). Optimality models have been used to analyse dilemmas or problems facing individuals, e.g. how to allocate time, energy and resources between different activities such as work and leisure etc., whether to cooperate or undertake actions alone (Borgerhoff Mulder and Sellen 1994:205). One of the fundamental assumptions is that behaviour should be “[...] viewed as an outcome of individual decisionmaking in response to social and ecological challenges” (Borgerhoff Mulder and Sellen 1994:206).

Optimality theory as used within human behavioural ecology is rooted in a set of assumption derived from an understanding of adaptation through natural selection (Smith 1983). More specifically, optimality theory assumes that behaviour has been designed by natural selection so as to respond to changes in environmental conditions in such a way that the specific behaviour gives individuals the best possible advantages in relation to survival and reproductive success. In other words, optimality models focuses on the *cost* and *benefits* that follows from individual actors’ choices or behaviours, i.e. which trade off between costs and benefits will maximize net benefit for the individual (Houston and McNamara 1999). As a consequence, optimality models avoids the idea that group benefits structure behaviour that seems to be common within parts of the social sciences (Smith 1983:626). Moreover, Pianka (1978:12, quoted in Winterhalder 1981:15) argues that “*Natural selection and competition are inevitable outgrowths of heritable reproduction in a finite environment*” (italics in original). In short, this implies that direct or indirect competition gives advantages to individuals that apply efficient techniques for acquiring energy and nutrition something which again may have fitness consequences. In other words, optimisation may be understood as efficiency in relation to the costs and benefits from undertaking a specific activity. The assumption is that increased efficiency, compared to some standard of performance, leads to a relative increase in fitness<sup>13</sup> (Winterhalder 1981:15).

Fitness, however, have been argued to be difficult to measure directly and as a consequence other more easily measures of success, such as food intake, mate acquisition or

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<sup>13</sup> Note that an evolutionary link is not necessary when dealing with optimality models, e.g. microeconomic analyses assuming that individuals are self-regarding maximisers of utility will use optimality models in the same manner when finding efficient strategies (e.g. Maddala and Miller 1989).

numbers of surviving offspring, have been used (Borgerhoff Mulder and Sellen 1994:206). According to Borgerhoff Mulder and Sellen (1994:206), used in this way “[...] optimality models have greatly advanced our understanding of how behavior patterns might constitute adaptations to the socioecological environments”. A typical optimality model consists of three elements or assumptions: (1) currency; (2) decision rules; and (3) constraints (Borgerhoff Mulder and Sellen 1994:206, for suggestion of somewhat different elements see Houston and McNamara 1999, Smith 1983, Stephens and Krebs 1986).

In short, the *currency* may be viewed as any outcome, such as maximisation, minimisation or variance reduction (commonly used in studies of risk sensitivity) “[...] in a scarce commodity such as food, labor, or productivity” (Borgerhoff Mulder and Sellen 1994:206). While currencies are usually thought of as proxies for fitness (the ultimate currency in HBE), this is not necessary as the concept of currency makes just as much sense under a rational choice paradigm common in economics and other disciplines where actors are seen as pursuing their ends (i.e. some form of currency) as effectively as possible (Smith and Winterhalder 1992:45).

Furthermore, the *decision rule* may be thought of as the behaviour whose adaptive significance (or efficiency) the model aims at testing (Borgerhoff Mulder and Sellen 1994:206). As previously mentioned, HBE is ignorant concerning the heritability of these rules, but they are most likely “[...] to be reached through social learning, with the occasional input of trial-and-error deduction [...]” (Borgerhoff Mulder and Sellen 1994:206).

Finally, *constraints* refer to assumptions linking decisions to the relevant currency and that restrict the outcome of the decision (Borgerhoff Mulder and Sellen 1994:206). In essence, constraints can “[...] consist of any combination of physiological, ecological, and social factors” (Borgerhoff Mulder and Sellen 1994:206). While the ideal is to incorporate the full set of constraints in an optimality model, this is almost impossible. As a consequence, optimality models should try to incorporate and explicitly consider all assumptions and constraints that are relevant for the problem examined. To sum up, it can be argued that optimality models represents an attempt at specifying a set of decision rules based on cost-benefit considerations that again can be derived from the overarching principles of adaptation through natural selection (or by assuming the individuals are self-interested maximisers of own utility) (Smith 1983:627).

Nevertheless, optimality theory both within economy and HBE is not without difficulties. For example, Bowles (2004:60) argues that:

“[...] while optimization is a behavioural postulate in the economic approach, it is necessarily a *as if* shortcut in biological modelling, where the work of optimization is done by the process of competition and selection rather than through the conscious choice of strategies by individual members of a species”

This points to a fundamental problem of optimality models: (1) the economic approach with its strong focus on rationality makes excessive demands on the level of information available to individuals (i.e. a purely rational agent needs in some models so much information that it becomes unrealistic, Smith and Winterhalder 1992, Colman 1995, Dixit and Skeath 2004, McCain 2003); whereas (2) biological models may be argued to make far too few demands (Bowles 2004:60). Moreover, with reference to the applicability of biological models to explain human behaviour Sahlins (1977:44-45) attacks the relevance of kin selection for humans in this manner:

“In passing it needs to be remarked that the epistemological problems presented by a lack of linguistic support for calculating, *r*, coefficients of relationship, amount to a serious defect in the theory of kin selection. Fractions are of very rare occurrence in the world’s languages, appearing in Indo-European and in the archaic civilizations of the Near and Far East, but they are generally lacking among the so-called primitive peoples. Hunters and gatherers generally do not have counting systems beyond one, two and three. I refrain from comment on the even greater problem of how animals are supposed to figure out how that  $r$  [ego, first cousins] =  $1/8$ . The failure of sociobiologists to address this problem introduces a considerable mysticism in their theory.”

This argument has been refuted by e.g. Dawkins (1989:291-2) with the following analogy “A snail shell is an exquisite logarithmic spiral, but where does the snail keep its log tables?” The point is that even though our understanding of different behaviours may be enhanced by mathematical models, this does not by any means imply that the organism themselves need any understanding of mathematics in order to behave (Irons and Cronk 2000).

Far more problematic is, however, Bowles (2004:60, italics added) argument that “Application of the biological model to human evolution has produced insights but misses the important fact that humans produce novelty *intentionally* [...]”. The answer, according to Bowles (2004:60) is to brush aside the zero intelligence agents of classical biological models and the perfect information agents of classical economy, and rather look at how humans are *adaptive agents*.

“Adaptive agents adopt behavior in a manner similar to the way people come to have a particular accent or to speak a particular language. Forward-looking payoff-based calculation is not entirely absent [...], but conscious optimizing is not the whole story. The answer to “why do you talk like that?” is generally “because I was born where people talk like that” not “because I considered all the ways of speaking and decided that my utility would be maximized by speaking this way”” (Bowles 2004:60).

With this in mind, this thesis’ application of an optimality model (**Paper 4**) have, following Smith (1983), as its starting point that assumptions connected to optimality has to be viewed as a *heuristic* starting point for making models and to generate testable hypotheses, and not as a naïve understanding of how the world actually works. They are mere models focusing on a few key variables that help us to explain certain phenomena. Our understanding of natural selection (or the assumption that individuals are self-regarding maximisers) makes some kinds of assumptions in relation to optimality credible guides for developing theory, but we have to acknowledge that they are only shortcuts that we make use of in understanding the world (Smith 1983, see also below).

### **Different tools for answering different questions**

“Theories can, and should, be separated from the tools used to derive them. [...] Different tools are good for different things. Some tools, like mathematics, are good for developing precise theories based on simple sets of assumptions. Other tools, like prose, offer the opportunity to explore subtle features of institutions and behavior. *Tools need to be judged by their ability to enhance the scientific enterprise; theories need to be judged by how well they are able to improve our understanding of the world around us, and not by what tools we used to derive them*” (Miller and Page 2007:60, italics added).

### *Review as a basis for generating hypotheses and theories*

“A review tells a straightforward tale of a circumscribed question in want of an answer” (Bem 1995:173).

This thesis is not particularly concerned with the Saami reindeer husbandry, but more specifically oriented towards exploring specific aspects of pastoral production, i.e. labour and risk, and how this has been conceptualized as influencing pastoral production. The underlying starting point for the collected articles in this thesis is comparative where empirical evidence from a wide array of nomadic pastoral societies are used to frame questions and hypothesis in

relation to e.g. the general relationship between pastoral labour and production. As such the Saami reindeer husbandry can be thought of as a pastoral society where the more *general* questions and hypotheses developed are investigated (I have, however, tried to collect more detailed information pertaining to the reindeer husbandry than given in the individual papers **Paper 1, 5 & 6** in **Appendix II**).

In essence this indicates a focus on *reviewing* the pastoral literature pertaining to the aforementioned objective(s). This, however, may be viewed as problematic as e.g. Barfield (1993:6-7) argues that reindeer herding is “[...] best analyzed as the most sophisticated variation in a wide continuum of arctic reindeer exploitation that ranges from simple hunting, to raising the animals for meat harvest alone, to their use for milking and traction”. This because reindeer herders depend on a single regionally unique species that cannot survive anywhere else while at the same time no other domesticated animals can survive in areas designated for reindeer herding (Barfield 1993:7). Moreover, reindeer husbandry is historically relatively recent, only 3-400 years old (Paine 1994, see e.g. Bostedt 2001, Bjørklund 1990:76 for different estimates) and probably evolved from a hunting culture based on wild reindeer. This in contrast to pastoralism elsewhere who have roots back several thousands of years (for example Goldstein and Beall 1990, Miller 1998 argues that nomadic pastoralism originated about 9,000 years ago in the mountains of southwest Asia, today known as Iraq and Northwest Iran with the domestication of sheep and goats)<sup>14</sup>. Moreover, the ecosystem in which reindeer husbandry is practiced is different from e.g. semi-arid African pastoralism. For example, while the major constraining factor limiting plant growth and herbivore survival in semi-arid Africa is variable rainfall, in the Arctic plant growth and livestock survival may be limited by: (1) precipitation; (2) snow; and (3) temperature (Behnke 2000). These different ecosystem factors present different problems facing reindeer herders, which arguably may diminish the relevance of using evidence from other pastoral societies to frame questions in relation to the reindeer husbandry. Furthermore, it could be argued that the

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<sup>14</sup> See, however, Cribb (1991:15) for different estimates that range over 4 millennia, e.g. three different origins: (1) seventh millennium, (2) third millennium, and finally (3) the first millennium BC. Cribb (1991) argues that one of the reasons for why estimates differ is due to definitional differences, e.g. when is it correct to designate an economic adaptation as nomadic pastoralism? The same problem is also present in the dating of reindeer husbandry, i.e. can the reindeer husbandry be characterised as pastoralism when using reindeer predominantly as decoys, when having small herds consisting of draft and milk animals, or only when subsistence was based on relatively large herds? See e.g. Bergström (2005:91-98) for a discussion of the transition from keeping relatively few reindeer to pastoral herding of a large number of reindeer.

keeping of only one species of livestock present, although some Saami reindeer herders have kept both sheep and goats (e.g. Evjen 2007, Hultblad 1968), different managerial problems than the keeping of several, again making comparison difficult. Moreover, the reindeer husbandry can be viewed as an example of a modernized pastoral system with its extensive dependence on technology (e.g. ATV, snowmobiles, helicopters etc.), and on both sale of reindeer meat and governmental subsidies (Pelto 1973, Riseth 2000, Riseth 2003). Again, it could be argued that using empirical evidence from pastoral societies in less developed countries to pinpoint important areas of research in the reindeer husbandry may be viewed as a cause for concern.

Nevertheless, I will argue that this approach is valid. First and foremost, as previously mentioned one of the fundamental aspects of a pastoral adaptation shared by all pastoralists is the exercising of control over a herd of animals by the use of human inputs. While how this exercising of control may vary cross-culturally, the *necessity* of it does not. As such, all pastoralists have to, in one way or another, invest labour into their herds and as a consequence the problem of pastoral labour as discussed in relation to different pastoral societies represents a valid starting point for developing general hypotheses and questions which are again investigated in a Saami reindeer husbandry context.

Following Silvia (2007:105) the two review papers (**Paper 2 & 3**) in this thesis aimed at: (1) finding problems in the existing literature pertaining to pastoral labour, and moreover tried to identify topics that should be the focus for more research; and (2) describing what I perceive as fundamental problems in relation to the relationship between pastoral labour and production while at the same time proposing a solution to the problems. With this in mind a review may be argued to represent efforts at systematizing previously published results, and, more importantly, should point out problematic areas in relation to the topic of interest that should be solved. In general terms, review articles have the possibility of framing future discussions related to important areas of scientific research. More specifically, Baumeister and Leary (1997:311) argues that reviews

“[...] serve a scientific field by providing a much-needed bridge between the vast and scattered assortment of articles on a topic and the reader who does not have time or resources to track them down. Reviews also present conclusions of a scope and theoretical level that individual empirical reports cannot normally address”.

In short, a review could be viewed as a systematic attempt at gathering up and integrate evidence across studies (Cooper 2003:3). Following the taxonomy developed by Cooper (2003) the review papers are summarized in Table 1.

**Table 1.** Placement of review papers according to the taxonomy developed by Cooper (2003)

<b>Taxonomic category</b>	<b>Paper 1</b>	<b>Paper 2</b>
Focus <sup>a</sup>	Research findings, method	Research findings, method, theory
Goal <sup>b</sup>	Integration of previous research, identification of central issues and/or problems, surveying the state of knowledge, questions stimulating future research, methodological problems	Integration of previous research, identification of central issues and/or problems, surveying the state of knowledge, questions stimulating future research, methodological problems, theoretical problems
Point of view <sup>c</sup>	Neutral representation	Espousal of a position
Coverage <sup>d</sup>	Selected central work	Selected central work
Organization <sup>e</sup>	Conceptually	Conceptually
Audience <sup>f</sup>	Specialists	Specialists

<sup>a</sup> Usually centered around research findings, methods, theory and application (Cooper 2003).

<sup>b</sup> Concerns what one hopes the review will accomplish. A common goal is to integrate previous research that is believed to relate to a common topic, including “[...] (a) formulating general statements from multiple specific instances, (b) resolving conflict between contradictory ideas or statements of fact by proposing a new conception that accounts for the inconsistency, and (c) bridging the gap between theories or disciplines by creating a common linguistic framework” (Cooper 2003:3-4). Furthermore, Baumeister and Leary (1997:312) argues that (i) theory development, (ii) theory evaluation, (iii) surveying the state of knowledge on a particular topic, (iv) problem identification, which purpose is to “[...] reveal problems, weaknesses, contradictions, or controversies in a particular area of investigation.”, (v) historical account of the development of theory and research pertaining to a specific topic are valid goals of literature reviews.

<sup>c</sup> Reviewers point of view that may influence the discussion of the literature. This can be viewed as a continuum where two endpoints may be called *neutral representation*, where the reviewer presents all arguments or evidence for and against different interpretations, *espousal of a position*, where the reviewer presents the literature with the explicit aim of demonstrating a particular point of view (Cooper 2003:4).

<sup>d</sup> Refers to the extent that reviewers find and include all relevant publications in the review. Four types of coverage have been suggested: (i) exhaustive, where an effort is made to include the entire literature (ii), exhaustive selection, where the entire literature forms the basis of a sample that is presented in the review, (iii) representative, works that are representative for a field where one of the points is to discuss what makes the chosen works representative, (iv) central, where the reviewer concentrates on literature that have been central to a specific topic or area.

<sup>e</sup> “Reviews may be arranged (a) historically, so that topics are introduced in the chronological order in which they appear in the literature; (b) conceptually, so that works relating to the same abstract ideas appear together; or (c) methodologically, so that works that use similar methods are grouped together” (Cooper 2003:5).

<sup>f</sup> Whether writing for specialists or a general audience should have important consequences for the review (Cooper 2003).



Following Cooper (2003:4) the review articles included in this thesis aims to be a research synthesis which “(a) focuses on research findings and (b) is undertaken with the principal goal of integrating research findings so as to make claims about their collective results and, of course, identify the limits of these claims”. Moreover, such work “[...] also pursues both the goal of conflict resolution by identifying inconsistencies in study results and the goal of bridge building by identifying points of contention in the theories, conceptualizations, and methods in which the research is embedded [...]”(Cooper 2003:4).

### *Modelling & simulation*

“Creating a model is much like trying to solve a brain teaser. Finding such solutions is often an extremely difficult task involving a combination of theory, practice, and a bit of art. Yet, once discovered, the answer has a strong intuitive appeal and appears all too obvious” (Miller and Page 2007:43).

According to Kohler and Leeuw (2007:1) every time researchers try to answers questions in relation to “how” or “why”, “[...] we build a model to try to answer it”. In this sense a model may be thought of as, however informal, a candidate explanation. More technically, a model may be thought of as an imaginary system, which is represented in its own language such as e.g. mathematics or computer code “[...] *that has useful similarities to the aspect of the target system in the real world*” (Kohler and Leeuw 2007:3, italics added). Thus, a model cannot be true or false in the same sense as hypotheses, but is rather evaluated on the basis of whether it fits some portion of the real world with respect to the specific purpose the model is developed for investigating (Kohler and Leeuw 2007:3). Whether the model fits or not has to be investigated empirically, but models have an important property that e.g. generalisations do not have: while a generalisation may be discredited by one contrary observation, a model that does not fit one case may nevertheless be useful for another (Kohler and Leeuw 2007:3).

In short, models should be thought of as thinking aids that do not investigate nature, but “[...] investigate the validity of our thinking, i.e. whether the logic behind an argument is correct” (Kokko 2007:7). This implies that a model may be highly simplified “[...] omitting details that are thought to be noncritical to the aspects of the target system being explored. It might be viewed as an abstraction, a simplification, an idealization, or a conceptual device” (Kohler and Leeuw 2007:4). More critically, Kokko (2007:8) argues that “[...] a model should include all the relevant details for the particular question at hand, but it should be kept so simple that it can be understood”. Following Axelrod (1997:4-5), a model does not aim at providing “[...] an accurate representation of a particular empirical application”, but the goal

is rather to “[...] enrich our understanding of fundamental processes that may appear in a variety of applications”. With this in mind, Axelrod (1997:5) suggest that modellers should adopt the KISS (“keep it simple, stupid”) principle. According to Axelrod (1997:5) this principle is important due to the character of the research community:

“Both the researcher and the audience have limited cognitive ability. When a surprising result occurs, it is very helpful to be confident that we can understand everything that went into the model. Although the topic being investigated may be complicated, the assumptions underlying the [...] model should be simple.”

In short, the complexity of a model should lie in the results it generates and not in the assumptions (Axelrod 1997:5).

In the same vein Levins (1966:421) argued that “[...] we have to simplify the models in a way that preserves the essential features of the problem”. Ideally, a model should achieve: (1) generality; (2) realism; and (3) precision at the same time (Levins 1966:422). This is, however, hardly possible and most types of modelling sacrifices one of the three aspects, “[...] with the choice depending on the nature and goals of the investigation” (Winterhalder 1981:18).

Following Bårdsen (2009:6) the model developed in this thesis (**Paper 4**) should be thought of as “[...] an idealized, or simplified, representation of reality”, what Kokko (2007:9) designates as “conceptual models” that “[...] can be viewed as tools for testing arguments in a formal mathematical setting, where models can be used to test if specific patterns emerge from known processes and mechanisms given a set of more or less realistic assumptions [...]” (Bårdsen 2009:6). In short, the simple optimality model developed in **Paper 4** aims at illustrating how one important mechanism for maximising long term household survival may be related to cooperative labour investment. Cooperation may result in reduced labour investment related costs and as such may increase the optimal level of labour investment. This may again have the potential of positively influence pastoral production. As the question I aim at answering is whether cooperation can, *in principle*, lead to higher production returns, the model focuses first and foremost on achieving *generality* and secondly *precision*.

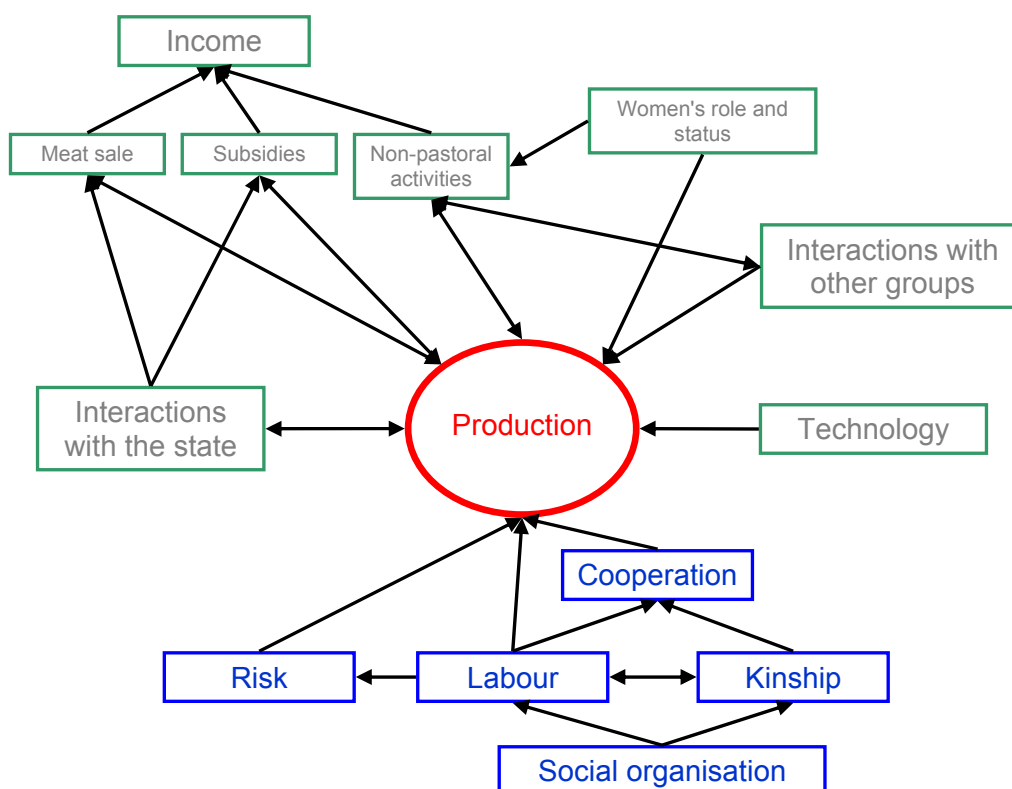
### *Statistical analyses*

Three papers in this thesis apply statistical analyses of empirical data when exploring the aforementioned overall objective(s) in relation to the Saami reindeer husbandry (**Paper 1, 5 & 6**). In contrast to descriptive narratives, the use of quantitative data allow hypotheses to be

tested statistically and opens up for the possibility of cross-cultural comparisons on a statistically basis (Borgerhoff Mulder and Caro 1985). This has been argued to both increase the confidence and the strength of results (Borgerhoff Mulder and Caro 1985). Furthermore, the use of quantitative data offer the possibility of cross-culturally and intra-culturally comparison of quantifiable relationship in relation to a predictor of interest as for example labour (Borgerhoff Mulder and Caro 1985). Nevertheless, the use of quantitative data does not negate the use of traditional anthropological fieldwork as fieldwork can be used to gather both qualitative and quantitative data.

A reasonable question then may be why the analyses pertaining to the: (1) accumulation of large herds as a buffer strategy (**Paper 1**); and (2) relationship between labour and production in the Saami reindeer husbandry (**Paper 5 & 6**) are based on data collected by the Norwegian reindeer husbandry administration (see **Paper 1, 5 & 6** for details) rather than data collected through long time fieldwork. The underlying rationale for this choice is related to *sample size*. In general, fieldwork undertaken by one researcher constrains the realistic sample size that one can possibly hope to base quantitative analyses on. Moreover, sample size can be argued to be of vital importance for questions pertaining to both risk and labour. For example, one of the main arguments developed in **Paper 2** is that one of the reasons why previous studies have been characterized by ambiguous results in relation to the relationship between pastoral labour and production may be partly due to relatively low sample size. Low sample size is known to have a negative impact on the possibility of detecting significant effects (see e.g. Anderson et al. 2001, Crawley 2002, Johnson 2002, Yoccoz 1991), which may be argued to be especially pertinent if the effect of pastoral labour is marginal as some evidence suggests (Berhanu et al. 2007, Turner and Hiernaux 2008, **Paper 4-6**). Similarly, the question of herd size as a buffer for risk can be argued to also be best investigated by the use of relatively large sample sizes as previous studies have again been characterized by somewhat contradictory results (see above). Moreover, if risk sensitivity is viewed as an adaptation (as argued by e.g. Winterhalder 2007, Winterhalder and Leslie 2002, Winterhalder et al. 1999) it could be argued that it is important to have data from several years, something which is difficult to obtain by the use of traditional anthropological fieldwork. Consequently, rather than doing extensive fieldwork in the Saami reindeer husbandry as a basis for data collecting, the present thesis take advantage of data compiled annually by the Norwegian reindeer husbandry administration covering the period from 1998-2004. The drawback of basing analyses on a database is the apparent constraints in relation to how to operationalise relevant variables. Labour had to be measured as number of people or

number of husbandry units (see **Paper 5** for details), whereas production was measured as herd size or calf body mass (see **Paper 1, 5 & 6** for details concerning the variables used). Furthermore, this also naturally constrained what could *not* be considered in the specific analyses (see Figure 2 for an overview of what has been considered in this study and possible important aspect that have not been considered due to data constraints). For example, income from both sale of reindeer meat and governmental subsidies are without doubt important factors in the reindeer husbandry. Measures pertaining to these important aspects of Saami reindeer husbandry production was, however, not available so this aspect could not be investigated (see however **Paper 1** for some tentative suggestions). While not indicating that factors not included in these analyses (see Figure 2) are unimportant this merely reflect the point that all studies are constrained by data and as such the analyses pertaining to the Saami reindeer husbandry represent no particular exception to a general consideration that underlies all scientific investigations.



**Figure 2.** Conceptual figure illustrating factors that influence pastoral production investigated in this thesis and important factors that have not been considered. Boxes with *grey text* indicate important factors not considered. Note: factors not investigated should not be thought of as representing a complete list or to be unimportant (see the individual papers for rationale for the factors chosen). Other important factors influencing production, such as year to year variation and geographic variations in e.g. climate and pasture, and variations in reindeer density have been dealt with in the individual papers (1, 5 & 6).

## RESULTS

### **Production in risky environments (paper 1)**

The main finding of this study was that large herd size maximizes long term viability for Saami reindeer husbandry units in Finmark, Norway. This was supported as husbandry units with large herds are performing better relative to husbandry units with smaller herds due to the fact that larger herds were on average larger the following year relative to smaller ones. This study also found evidence of negative density-dependence as reindeer density had a negative effect on the husbandry units' future herd size, and this negative effect was more prominent in some years compared to others. Finally, this study found that when the relative effect of own herd size and reindeer density was assessed simultaneously the positive effect of own herd size represented a significantly stronger force on future herd size compared to the small negative effect imposed by density.

### **The problem of pastoral labour (paper 2-3)**

The two review studies incorporated in this thesis has pointed out several problems in the literature concerned with the relationship between pastoral labour and production. First and foremost, it is a widely held belief that there is a positive effect of increasing labour inputs on pastoral production in spite of contradictory quantitative evidence. In terms of future research, these studies have raised important issues in relation to study design that has to be addressed: (1) the relationship between statistical significance and sample size (**Paper 2**); (2) how different measures of pastoral production can affect the inference drawn from such analyses (**Paper 2**); and (3) how the contradictory results in the literature may be caused by inadequate measurements of pastoral labour (**Paper 3**). Future quantitative research has to incorporate the fact that nomadic pastoralists exchange and share labour with other households in what has been termed cooperative herding groups. One of the main arguments in **Paper 3** has therefore been that to fully investigate possible effects of pastoral labour on production one also have to test for possible effects on higher levels of social organizations (the same was also noted by Grandin 1989:145).

### **The importance of cooperative production (paper 4-6)**

**Paper 4** found that one important mechanism for maximising long term household survival may be related to cooperative labour investment. Cooperation may result in reduced labour

investment related costs and as such may increase the optimal level of labour investment. This may again have the potential of positively influence pastoral production. In essence, the model developed showed that cooperation can, *in principle*, lead to a relatively small increase in production returns (measured as an increased birth rate) for nomadic pastoralists which again may have positive *long term* consequences for household survival.

From this point of view, it may be that pastoral labour related effects is characterized by scale dependency consisting of tradeoffs between the costs and benefits of labour inputs on varying levels of social organization. Consequently, it may be expected that a variation in the number of potential labourers per individual household will not lead to a variation in production between different households. A variation in the number of cooperating households, on the other hand, may lead to a variation in production because this can increase the total amount of labour input per cooperative unit without significantly increasing the cost per household. One should therefore expect that cooperating units consisting of many cooperating household should, on average, perform better than cooperating units consisting of relatively few cooperating households.

**Paper 5** aimed at investigating whether labour availability, in general, have an effect on pastoral production, and second whether there is a *scale dependent* effect of pastoral labour in the Saami reindeer husbandry. To put it briefly, this study found both support for a general effect of pastoral labour on production and that this effect also have a scale dependent component as this study found: (1) a positive relationship between within-husbandry labour and herd size; and (2) a positive relationship between the number of cooperative husbandry units within districts and calf carcass body mass and density. This study clearly shows that assuming a zero effect of pastoral labour on production is incorrect for the reindeer husbandry. The state of the cost-benefit model developed in **Paper 4**, however, can be said to be less certain as the study found positive results on both the husbandry unit level and district level of social organization.

**Paper 6** aimed at investigating whether important mechanisms facilitating cooperative behaviour, such as *kinship* relations may be an important factor influencing pastoral production in the Saami reindeer husbandry. The main finding in this study was that cooperative labour investment is important for Saami reindeer herders, but that the effect of kinship and labour needs to be understood in relation to each other. When we assessed the effect of labour and kinship simultaneously, both labour and genealogical relationship had positive effects on herd size. Moreover, the positive interaction between them shows that high

levels of relatedness coupled with a large potential labour pool had an increasingly positive effect on herd size.

## DISCUSSION

The collected articles in this thesis found first that herd accumulation is a risk reducing strategy for Saami reindeer herders as a larger reindeer herds performed better than smaller ones over time (**Paper 1**). Second, previous attempts to quantify the relationship between pastoral labour and production have been characterized by somewhat contradictory results due to a lack of consistency regarding which areas of pastoral production that is considered being influenced by labour investment and by a limited sample size given the strength of effect sizes (**Paper 2**). Third, measurements of pastoral labour investment have been characterized by a within-household bias neglecting possible between household cooperative labour investments (**Paper 3**). Fourth, from a theoretical point of view it was shown that pastoral labour can be characterized by scale dependency consisting of changed cost-benefit relationships where cooperative labour investment may be a least-cost strategy (**Paper 4**). Fifth, evidence of scale dependency of pastoral labour in the Saami reindeer husbandry was found as the number of possible cooperating husbandry units and genealogical relationship had a significant effect on individual herd size, animal density and offspring body mass (**Paper 5 & 6**). These results suggest that future studies have to investigate possible cooperative labour related effects on pastoral production, and more importantly that cooperative labour investment is an important mechanism for efficiently buffering risk in stochastic environments.

### **Pastoral labour, cooperation and risk**

#### *Pastoral labour and production*

In contrast to e.g. Scoones (1992) and Sieff (1997), **Paper 5** found a positive effect of labour on herd size for Saami reindeer herders. In other words, in the Saami reindeer husbandry herd size is positively correlated with number of persons within husbandry units (see **Paper 5** for details). In short this result supports the general assumption of a positive effect of labour on pastoral production (see **Paper 2** for a review) and more importantly that assuming a zero effect of pastoral labor on production, as suggested by e.g. Schneider (1974) and Helland (1980), is incorrect for reindeer husbandry. Nevertheless, **Paper 5** argued that it may not be the number of people per husbandry units' that influence herd size, but rather that the size of

livestock holdings may positively influence the number of people per husbandry unit (see **Paper 5 & 6** for details). In other words, it could be argued that results pertaining to within-household (or within-husbandry unit) labour is *ambiguous* at best when measuring labour as number of persons (see **Paper 5 & 6** for details).

As argued in **Paper 3 & 4**, however, pastoral labour is not merely a question for individual households, but also a question for possible cooperative herding groups. As **Paper 3** shows, pastoral labour cooperation is relatively prevalent which goes to show that it is important to measure labour not only in relation to household labour but also in relation to between household labour. Moreover, the explicit assumption underlying the argument developed in **Paper 4** is that previous contradictory evidence related to the effect of pastoral labour on production for individual households may be associated with the *costs* related to labour inputs for individual households and that labour related effects on pastoral production may be found on levels of social organization above the household level. In other words, it may be that pastoral labour related effects is characterized by *scale dependency* consisting of tradeoffs between the *costs* and *benefits* of labour inputs on varying levels of social organization. Assuming a benefit from increasing labour inputs, however small, and that cooperation is based on a sharing and exchange of labour, *cooperation* could be a least-cost combination among a set of feasible labour input combinations incorporating *herding alone* and *herding cooperatively* (see **Paper 4** for details). A possible change in trade-off between costs and benefits of labour inputs when investing cooperatively may help explain the prevalence of cooperative herding groups among pastoralists as this may make it possible to reap a marginal increase in benefit.

In line with this **Paper 5 & 6** also investigated possible cooperative aspects of pastoral labour investments and its relationship with production for the Saami reindeer husbandry. In sum, **Paper 5** found a positive effect of number of husbandry units within reindeer districts on: density of female reindeer within districts and offspring body mass. Moreover, the importance of the cooperative aspect of labour investment was corroborated in **Paper 6**, where number of husbandry units together with the degree of genealogical relationship within reindeer districts had a positive effect on *individual husbandry units' herd size*<sup>15</sup>. In short, this

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<sup>15</sup> The reason why **Paper 6** did not look at the relationship between offspring body mass and both labour and degree of genealogical relatedness was connected to sample size. **Paper 5** found a relatively small effect of labour on offspring body mass which detection can be argued to be related to a relatively large sample size. In contrast, **Paper 6**'s sample size was reduced as information pertaining to kinship relations was available



indicates that looking for possible scale-dependent effects of pastoral labour is important. Nevertheless, **Paper 5** argued that the analysis dealing with female reindeer density may not be connected to actual labour investment, i.e. the number of husbandry units may not represent a measure of labour input *per se*, but only a measure of the effect that districts consisting of more husbandry units and, as a consequence, more herds, have naturally a larger total number of animals (see **Paper 5** for details).

The same line of reasoning cannot be applied to the positive effect of number of husbandry units on offspring body mass (**Paper 5**) and to the positive effect of number of husbandry units together with the degree of genealogical relationship on individual husbandry units' herd size (**Paper 6**). **Paper 5** demonstrates that the density of reindeer within districts have a negative effect on offspring body mass and **Paper 6** demonstrates that the density of reindeer within districts have a negative effect on individual husbandry units' herd size. In effect, cooperative labour investment had a positive effect on both offspring body mass and individual husbandry units' herd size after controlling for the important effect of negative density-dependence (e.g. Clutton-Brock et al. 1996, Albon et al. 1983, Saether 1997, Tveraa et al. 2007), i.e. Saami reindeer herders can to a certain degree *compensate for the negative effect of density by the application of cooperative labour investment*.

While **Paper 5** argued that applicability of the cost-benefit model developed in **Paper 4** is somewhat uncertain due to somewhat contradictory results (i.e. the detection of a positive relationship on the husbandry unit level, but see above) the combined results from **Paper 5** and **6** indicate that cooperation is important for pastoralists and that the cost-benefit model is a valid starting point. Moreover, there is some evidence indicating that pastoral labour may have a relatively small effect on pastoral production (Berhanu et al. 2007, Turner and Hiernaux 2008, **Paper 4-6**). In essence, this may be taken to indicate that the cost of investing labour is relatively high in comparison to a possible small benefit. However, the model developed in **Paper 4** indicates that this may be true in the short term, i.e. investing labour may have a small positive effect on birth rate, but the long term effect may be significant indeed (see simulation in **Paper 4**). This again may be taken to strengthen the model and argument developed in relation to the importance of cooperative labour investment – by cooperating the short term cost may be significantly reduced something which again may have significant long term benefits for individual households.

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only for 20 reindeer husbandry districts which represents around 26% reduction in number of districts compared to **Paper 5** (which was based on 27 districts).

### *Cooperative production*

“Many of the benefits sought by living things are disproportionately available to cooperating groups. While there are considerable differences in what is meant by the terms “benefits” and “sought,” this statement, insofar as it is true, lays down a fundamental basis for social life. The problem is that while an individual can benefit from mutual cooperation, each one can also do even better by exploiting the cooperative efforts of others” (Axelrod 1984:92).

As the above quote indicates cooperation is an important aspect of social life, more so because it carries with it the possibility of attaining benefits not available if not cooperating. Smith (2003), in a review of the various domains of human cooperation lists: (1) resource sharing; (2) cooperative production; (3) aid-giving; and (4) coalition-based conflict as important cooperative domains. Discussions pertaining to cooperation have been predominantly focused on different aspects of and explanations for e.g. resource sharing (cf. Gurven 2004a, Gurven 2004b, Gintis et al. 2005, Smith 2004b, Smith 2004a, Smith and Bird 2005), while the aspect of *cooperative production* has been given comparable less attention. One aspect of cooperative production that have been given some attention is group hunting, where Smith (1981), for example, has argued that group formation by Inuit (Canadian Eskimos) hunters can potentially benefit individual foraging behaviour (see also Smith 1997a). The same has also been observed for whale hunters in Indonesia where cooperative whale hunting resulted in greater per capita returns than solitary fishing (Alvard and Nolin 2002). One of the reasons for why cooperative production have been given less attention may be because, as the studies referred to above indicates, cooperative hunting may imply some sort of mutual benefits to all cooperating individuals. As such cooperative production may not represent as difficult a problem needing an explanation as the sharing of already obtained food resources where the giver usually experience a reduction in net returns (Smith 2003). Cooperative situations characterised by some degree of mutualism have usually been subsumed under the heading coordination games where the structural property of the game is that the players’ payoff is related to one another so that the players’ preferences coincide (Colman 1995:11). Coordination games “[...] are characterized by common interest among players [...]” and “[...], benefits accrue to individuals through collective action, and individuals are better off cooperating than they are defecting” (Alvard 2003:149).

Thus, if cooperative production among Saami reindeer herders is characterized by mutualism it is to be expected that cooperative labour investment is important regardless of possible important mechanisms, such as kinship relations, explaining cooperative behaviour.

Nevertheless, both **Paper 5** and **6** included measures of possible cooperative mechanisms that were important. More importantly, the results in **Paper 6** suggests that while both labour and kinship had a positive effect on individual husbandry units' herd size when assessed simultaneously, the interaction between them was important. As the effect of possible cooperative labour was not significant when assessing labour alone, in the Saami reindeer husbandry cooperative labour investment may be mediated through kinship relations (see **Paper 6** for details). As such, for the reindeer husbandry mutualism alone is not a sufficient condition for efficient cooperative behaviour. This is in line with Alvard and Nolin (2002:547) who argue that

“Substantial coordination is required to subsist on cooperatively acquired resources. Behaviors must be synchronized, rules must be agreed to (even if tacitly), and assurance, trust, and commitment must be generated among participants for the collective benefits of cooperative hunting to be realized.”

These important aspects underlying cooperative behaviour may be argued to be positively influenced by kinship relations (see e.g. Borgerhoff Mulder and Coppolillo 2005). In essence, this implies that important mechanisms facilitating cooperative behaviour, such as kinship relations (see e.g. Borgerhoff Mulder and Coppolillo 2005, Hamilton 1964, Alvard 2003), may be an important factor influencing pastoral production (see also Paine 1994, Pehrson 1964 in relation to the Saami reindeer husbandry).

#### *Herd size and risk*

Following Mcpeak (2005), Roth (1996) Fratkin and Roth (1990) **Paper 1** aimed at investigating whether the keeping of a large herd of reindeer works as a risk buffering strategy in the Saami reindeer husbandry. In short, the results support the general assumption that the keeping of large herds is an efficient risk reducing strategies for nomadic pastoralists (see **Paper 1** for details). This was supported as husbandry units with large herds are performing better relative to husbandry units with smaller herds due to the fact that larger herds were on average larger the following year relative to smaller ones both during periods of overall decrease and increase in reindeer numbers. **Paper 1** also found evidence of negative density-dependence as reindeer density had a negative effect on the husbandry units' future herd size, and this negative effect was more prominent in some years compared to others. More importantly, when the relative effect of own herd size and reindeer density in the district was assessed simultaneously it was clear that the positive effect of own herd size represents a

much stronger force on future herd size compared to the negative density-dependence (see **Paper 1** for details). This may be seen to indicate that Mace & Houston (1989) have a point when arguing that pastoralists maximize long term household survival, i.e. they want to stay in the game as long as possible, by minimising the risk of destitution. As **Paper 1** show, in the reindeer husbandry one viable path for obtaining this goal is to accumulate reindeer numbers and consequently, following McPeak (2005), the overall conclusion is that herd accumulation makes a great deal of sense as a response to the risky production environment of the Saami reindeer husbandry.

From a more theoretical point of view it may, however, be argued that **Paper 1** have not properly investigated herd size as a buffer strategy. This study used future herd size as a response variable while Roth (1990), Fratkin & Roth (1990) and McPeak (2005) used livestock *loss* as a response. First, **Paper 1** used future herd size as a response due to the unreliability of data connected to reindeer loss. Loss due to predation, for example, is to a large degree subsidized by the Norwegian government (Anonymous 2008). Furthermore, as this data is based on self-reporting, measures related to loss may be biased as it could be argued that the subsidies presents an incentive for reindeer herders to overestimate losses.

Second, both absolute loss and relative loss may be argued to not be good indicators of herd size as a buffer strategy. This can be illustrated with two somewhat different understandings of the relationship between loss and herd size. For example, Roth (1996:221) argues that “For maximization to be effective, wealthier households should suffer greater absolute animal losses, but fewer, or comparable, relative losses”. This view fits nicely within the perspective that risk buffering strategies are aimed at reducing variations in e.g. food production (Bollig and Göbel 1997, Halstead and O'Shea 1989, Winterhalder 2007, Winterhalder et al. 1999). The second understanding can be summarized with the following quote from Fratkin and Roth (1990:387): “[...] a rich man may lose half of 100 animals and survive, where a poor man will lose half of ten animals and perish”. While these two views may appear to be closely linked, they could be argued to be quite different as they have different implications concerning what absolute loss and relative loss can tell us with reference to herd size as a buffer strategy. In contrast to the first view, the second view incorporates an understanding of the importance of herd size prior to e.g. a climatic event. In other words, it could be argued that the second view opens up for a view that households with relatively larger herds of livestock may lose a larger percentage of the herd during a climatic event than households with fewer animals, but still ends up in better post-event position than poorer households. For example, a pre-event herd consisting of 100 animals compared with

one consisting of 50 sustaining a 70 and 50 percent loss respectively will result in that the relatively wealthy household will continue to be wealthy compared to the poor household even though it has lost larger percentage of its herd during the event (post-event herd sizes are 30 vs. 25). *This indicates that it is possible to find a positive relationship between herd size and both absolute loss and relative loss but that a large herd size may still be an effective risk reducing strategy.* The first understanding, however, does not carry the same implication as it assumes that such a positive relationship in terms of relative loss shows that a large herd size does not work as a buffer against risk. The question then arises if it is meaningful to argue that the keeping of a large number of animals results in a reduction in variation (i.e. relative losses). It could be argued that it is meaningless to discuss the keeping of a large herd as variation reducing strategy without explicitly stating some sort of level that numbers vary around. In short, wealthy households with a large herd of animals may reduce the probability of variation around some level of minimum subsistence, while at the same time experiencing greater percentage variation around its own herd size. Herd accumulation may then be argued to be a different risk reducing strategy than e.g. diversification. For pastoralist, a classical diversification strategy is the keeping of multiple species of animals. This strategy can have several advantages: herds tend to be more stable, and permit a wider use of pasture. Also, if one species experiences great losses another available species can, to some extent, compensate for this loss because the different species' capacity to cope with different natural disasters and reproductive ability varies (Khazanov 1994). Also, species diversification reduces the danger of losing an entire herd from one disease (White 1997). Species diversification then reduces variation in the classical sense: when losing a number of animals from one species it is still possible to survive if other species fare better. The building of large herds, however, may be viewed differently as it could be understood as a strategy that aims at building up a herd of the size where it is possible to experience a greater percentage variation in animal numbers, but still fare better than a household with fewer animals. Consequently, losses in itself may not be good indicator of whether large herd size works as a risk management strategy – rather one have to look at individual households' relative position in terms of livestock numbers vis. a vis. other households and/or a threshold indicating the minimum number of livestock necessary.

### *Cooperation and risk*

One of the most important findings in this thesis is that one important mechanism facilitating the accumulation of large herds of reindeer is cooperative labour investment. As was argued

in **Paper 1**, one of the biggest challenges facing the Saami reindeer husbandry in Finnmark, Norway, both from a governmental management perspective and from the perspective of individual herders, is the perceived notion of overstocking in terms of number of reindeer. Consequently, the Norwegian government has initiated several economic incentives and subsidies with the explicit aim of motivating reindeer herders to reduce the size of their herds (Anonymous 2008). Nevertheless, the number of reindeer in Finnmark has experienced an increase in recent years (see **Paper 1** for details). As argued in **Paper 1**, this implies that governmental assumed objectives and the Saami reindeer herders' objectives may not be exactly corresponding, i.e. that reindeer herders are not purely motivated by financial gains as the economic incentives and subsidies seem to presuppose. A classical explanation for pastoralists' accumulation of livestock has been that rather than being motivated by market economic goals of efficient production of meat for sale, e.g. reindeer herders are motivated by non-economic values such as prestige and status where large herds are the ultimate sign of status and prestige (e.g. Sara and Knudsen 2001, see also Paine 2009 who argues that one of the reasons that reindeer herders 'hoard' reindeer is for "conspicuous display"). In contrast, this thesis has shown that one of the reasons for accumulating reindeer is related to risk buffering (see above).

As argued in **Paper 1**, governmental subsidies may in fact positively interact with the risk beneficial aspects of having a large herd: as previously mentioned, loss due to predation is to a large degree subsidised by the Norwegian government (Anonymous 2008). As losses again are based on self-reporting it could be argued that the subsidies presents an incentive for reindeer herders to overestimate losses<sup>16</sup>. The beneficial aspect of having a large herd in such a subsidised system is self-evident: having a large herd gives reindeer husbandry units the possibility to report much larger losses than husbandry units with comparable smaller herds. Consequently, the economic incentives and subsidies aimed at increasing production efficiency and thereby reducing herd sizes may not work in the fashion that they were supposed to. More to the point, it may be that Saami reindeer herders' trade off long term survival (increasing herd size) and economic gain through slaughter by slaughtering the minimum necessary to obtain governmental meat production subsidies, but at a level that still make them capable to accumulate animals for maximizing long term husbandry unit survival.

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<sup>16</sup> Compensation due to loss increased from 22 400 000 NOK in 2004 to 29 500 000 NOK in 2005 (Anonymous 2005). In 2007 this compensation was 43 000 000 NOK (<http://www.reindrift.no/?id=4547&subid=0>). 100 NOK = 14.34\$ per 11.12.08.

If this is true, governmental management initiatives aimed at reducing herd size have to change so as to incorporate factors associated with risk reducing strategies in their management plans. At present management initiatives can be viewed as being based on a faulty assumption of what the objectives of reindeer herders are, i.e. increased meat production efficiency.

Moreover, **Paper 4** has demonstrated that it is a distinct possibility that pastoralists in general use cooperative labour investment to increase herd size and thereby increase long terms household survival. This can be argued to indicate that cooperative labour investment is an important risk reducing mechanism, and more to the point that Göbel (1997) is correct when arguing that bottlenecks in the availability of labour, has to be considered as a risk factor in pastoral production systems. As for the Saami reindeer husbandry, this has been demonstrated to be the case, as **Paper 6** found that substantial cooperative efforts are used to increase individual husbandry units' herds size. Moreover, **Paper 5** found also that cooperative labour investment had a positive effect on offspring body mass. In sum, it could be argued that cooperative labour investment increases long term survival probability in the Saami reindeer husbandry.

Finally, **Paper 4, 5 and 6** may be argued to support the important general questions pertaining to pastoral labour raised in **Paper 2 and 3**: (1) that sample size is important for detecting pastoral labour related effects, i.e. that relatively large samples sizes are necessary for detecting a possible small effect. (2) More importantly, that the prevalence of cooperative herding groups may be aimed at attaining increasing production returns, i.e. that it is important to incorporate measurement of cooperative labour investment when investigating labour related effects. (3) Coupled with a risk perspective, it could also be argued that the timeframe for investigating labour related effects, i.e. it is important to have data from several years.

## **COOPERATION, COMPETITION AND MANAGEMENT – PROSPECTS FOR FUTURE RESEARCH**

This thesis found that the accumulation of large herds is an efficient risk buffering strategy, and more importantly that one important mechanism for building large herds is cooperative labour investment. Nevertheless, there are reasons to believe that investing cooperative labour in herd building may be sub-optimal in the Saami reindeer husbandry. For example, it is relatively well known that density has a negative effect on herbivore body mass (Albon et al.

1983, Clutton-Brock et al. 1996, Saether 1997) and consequently survival during harsh environmental conditions. This is also the case for the reindeer husbandry where it has been demonstrated that reindeer density has a negative effect on body mass (Næss et al. 2009, Tveraa et al. 2007, Bårdsen 2009) – and consequently survival (Tveraa et al. 2003). From a risk perspective it could be argued that for the Saami reindeer herders, the best long term strategy may be to invest in livestock body mass and *not* herd size.

One of the reasons why this pattern is not observed may be explained with reference to *between-district competition over access to common winter pastures* (Riseth et al. 2004, Riseth and Vatn 2009). Most of the summer districts in this thesis share the same winter grazing area where access is to a large degree determined by herd size (Anonymous 2009b, Ulvevadet 2000:65, Nilsen and Mosli 1994:102-103). Riseth (2004), for example, argues that after the introduction of technological herding aids, such as snowmobiles (see **Appendix II**), herd sizes increased and some winter siidas expanded their relative share of winter pastures at the cost of other siidas (changes in relative pasture from 1957 to 1997). In short, larger herds use more extensive pasture areas and thereby may exclude other herds from grazing in the same area. Building of large herds through cooperative labour investment may thus be a viable strategy for gaining access to winter pastures. Furthermore, while summer districts consist of relatively few husbandry units and with the possibility of an efficient cooperation through kinship relations, common winter pastures are used by a relatively large number of husbandry units. As such, the use of common winter grazing may represent a problem of large-scale cooperation (Paciotti and Hadley 2004, Bowles and Gintis 2003) where kinship relations are not sufficient to provide the basis for cooperative behaviour. From a theoretical point of view, competition rather than cooperation for access to common winter grazing could easily develop if just one or a few herders initiate herd accumulation (cf. Hardin 1968 and the 'tragedy of the commons'). If this is the case, other herders have to adopt the same strategy so as to not be excluded from the grazing areas.

Ultimately, *competition* for access to winter pastures may explain the adoption of herd accumulation as the only viable risk reducing strategy. Moreover, **Paper 6** demonstrates that herd accumulation may be constrained by the availability of cooperative labour, and that husbandry units within districts with a lower degree of relatedness have, on average, access to a smaller cooperative labour pool. This entails that access to more cooperative labour enables husbandry units to be more successful in following whatever strategy that is best in a given context. For example, we could expect that in contexts where between district competition is highly controlled, e.g. where all grazing areas are controlled by individual districts, or where



there exists both formal and informal regulations in terms of access to common grazing areas, husbandry units experiencing high degrees of cooperation should invest cooperative labour into livestock condition. It could be hypothesized that one of the reasons for problems in relation to overstocking may be that reindeer herders adopt herd accumulation as the best available risk reducing strategy when access to common winter pastures is characterized by competition.

Nevertheless, the Norwegian government are taking steps to reduce the possible problem connected to possible competition in relation to winter pastures. Presently, the Norwegian government is in the process of initiating a redistribution of common inland winter pastures to smaller managerial units as this is assumed to ease both governmental and regional management (Anonymous 2007c, Anonymous 2007a, Anonymous 2007d). In principle, this redistribution is reinstating power to the traditional Saami *siida* system by giving *siidas* exclusive user rights to geographical delineated winter areas (Anonymous 2007c, Anonymous 2007a). Up until this redistribution, winter pastures has been informally regulated according to *siida* membership, i.e. Saami reindeer herders have a clear understanding of the fact that different winter pasture areas belong to different *siidas*, although when in need everybody had right to access alternative pastures (Riseth 2000:132, see also Paine 1994). The *siida* was (and still is) a flexible system of cooperation, i.e. *siida* membership changes over time so as to optimise the relationship between herds and personnel (Bjørklund 2004:126, Paine 1994:14). Consequently, it could be argued that a legal consolidation of *siida* user rights may reduce pastoral flexibility. While not trying to provide a critique of the apparent positive step that the Norwegian government is taking in implementing a higher degree of local co-management in the Saami reindeer husbandry, it could be argued that if the *legal* consolidation of *siida* user rights is viewed as a step towards a greater privatisation of a previously semi-communally used grazing area this can, following Thompson et al. (2008:26), be argued to increase the *fragmentation* of the aforementioned grazing area.

According to Thompson et al. (2008:25) “Human action has modified the earth in many ways, but one of the most pervasive effects of humans on the environment is the dissection of natural systems into spatially isolated parts, a process generally known as fragmentation”. One current source of fragmentation of pastoral grazing areas is the transformation of land ownership from common to more or less private land tenure (Reid et al. 2008:10). In The Tibetan Autonomous Region (TAR), China, for example, land was traditionally owned by monasteries and pastures were re-allocated on a three-year interval on the basis of individual households’ herd size. Additional pastures were allocated to

households whose herds had increased, and pastures were taken away from those whose herds had decreased (Goldstein et al. 1990). Under Chinese rule, however, this relative flexible pasture allocation system has changed and up till relatively recently, land was owned exclusively by the state. This form of land tenure is, however, changing and according to Ho (2000) the land tenure system in The People's Republic of China is of a nature where individuals or groups "lease" land from the government for long periods of time, which can be interpreted as a step towards a privatization of grazing areas, with the underlying rationale to minimise the impact of the 'tragedy of the commons'<sup>17</sup> (Ho 2000). This process has recently become even more prominent with the fencing off of grazing areas in the western parts of TAR (Fox and Dorji unpublished result).

While privatization in itself may not be a cause for concern, privatization is often followed by *exclusivity* in terms of use. This exclusivity pertaining to land tenure can again be viewed as increasing rangeland fragmentation and may have as some of its consequences the restriction of the movement of people and livestock, again limiting pastoralists' access to resources that varies over time and space (Reid et al. 2008:13). As a consequence, both pastoralists and their animals may have their options for responding to temporal variations in terms of both vegetation and precipitation, a variation that is common for many of the areas that pastoralists usually inhabit, reduced (Thompson et al. 2008:26).

Furthermore, Thompson et al. (2008:26) argue that

"A diminished ability to compensate for temporal heterogeneity in vegetation and water by exploiting its spatial heterogeneity has interrupted ecological processes that sustain natural and human economies. Degradation of human welfare has followed, requiring substantial inputs of policy and capital to offset the effects of fragmentation."

A more "traditional" view of the management of pastoral systems holds that exclusivity of use promotes human welfare and sustains natural processes without resulting in overexploitation of e.g. natural pastures, and thereby prevents the development of "the tragedy of the

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<sup>17</sup> Due to a perceived notion of increasing land degradation: "It is said that the rapid increase of grazing animals in the pastoral areas (from approximately 29 million in 1949 to 90 million in the early 1990s), as well as a decline in the area of rangeland due to reclamation (an estimated loss of 6.5 million hectares over 1949-92), has led to serious rangeland degradation and desertification [i.e. in PRC]. In 1994, over one-third of usable rangeland had been reported degraded to a certain degree, while total biomass production per hectare had declined to 30-50 percent of that in the 1950s." (Ho 2000:241).

commons” (Thompson et al. 2008:26). “The traditional view holds that the sum of the productivities of privately-owned parcels is greater than the whole landscape productivity because of the incentive for land stewardship provided by property rights (Lund 2000)” (Thompson et al. 2008:26). In contrast, Thompson et al. (2008:26 italics added) argues that “[...] in many systems, *the sum of the productivities of land fragments may be less than the productivity of the unfragmented landscapes.*”

The effect of possible fragmentation have been documented in Mongolia, where changes have been undertaken that aims at modifying the “[...] major administrative boundaries to allow greater access to natural resources and seasonal grazing lands to better sustain pastoral livelihoods [...]” (Ojima and Chuluun 2008:188). This policy is being implemented to counter the negative effects of privatization after the collapse of the Soviet Union. With privatization the Soviet initiated collective state farms were dissolved, and ownership of livestock was again in private hands. Furthermore, the suspension of collective farms reduced mobility as the costs of moving was carried by individual households rather than the collectives (e.g. household have less access to trucks) (Ojima and Chuluun 2008:183). Of importance here is that during the Soviet period the *spatial extent* of administrative units were reduced, a reduction that has been accelerated since independence (Ojima and Chuluun 2008:183). As a consequence, land-use areas have decreased which “[...] have resulted in the destabilization of the pastoral system by decoupling the herders from regional landscapes and forcing them to utilize resources within fragmented units, which do not provide the diversity of settings needed to sustain their pastoral systems without external inputs.” (Ojima and Chuluun 2008:184). More to the point, these processes has resulted in an increased concentration of both people and livestock in small areas and as such resulted in increased grazing intensification and consequently rangeland degradation (Ojima and Chuluun 2008:188, Potkanski 1993, Sneath 2003, Williams 1996).

Contrary to Saami reindeer husbandry management, who attempts to attain sustainability through redistribution of grazing rights to relatively low levels of social organization (i.e. siida), the Mongolian reforms attempts to enlarge administrative and territorial units as this is proposed to “[...] enhance socio-economic optimality, environmental sustainability, and historical and cultural acceptability by citizens [...]” (Ojima and Chuluun 2008:188). Within a framework of the negative effect of fragmentation on rangelands, these reforms makes sense as “[...] enlarging administrative and territorial units may provide greater flexibility in managing livestock densities across a more diverse set of landscape types within a more comprehensive administrative unit. The overall result would be a greater

utilization of the natural landscapes now restricted in the fragmented smaller *sums*<sup>18</sup> (Ojima and Chuluun 2008:188 footnote added).

If the winter pastures in Finnmark is characterized by a moderate or high degree of heterogeneity (such as varying vegetation or varying snow cover that leads to varying vegetation cover), and if one of the goals of the partly privatization of winter pastures is to create a sustainable balance between reindeer and pastures (apart from an increase in co-management), then this management initiative should be rethought. This because it has been documented that fragmentation of heterogeneous grazing areas has as one of its consequences that overall landscape productivity decreases as the ability to move according to temporal and spatial variation in heterogeneous environments have been argued to impact the overall carrying capacity (Thompson et al. 2008, Reid et al. 2008, Behnke and Scoones 1993). Consequently, it could be argued that the planned semi-privatization of common inland winter pastures should be looked upon with care, as it has been demonstrated in several pastoral areas that rather than decrease overexploitation of grazing areas, privatization has in many places exacerbated overgrazing (see above).

Apart from the possibility of reducing flexible movement patterns aimed at utilizing heterogeneous environments, this planned semi-privatisation may also hinder the development of cooperative risk reducing strategies, such as labour investment, necessarily for dealing with increasing production risk in relation to global climate change. Scenarios for future climate change generally predict an increase average, variance and even a changed distribution of important climatic variables like precipitation and temperature (e.g. Rowell 2005, Sun et al. 2007), i.e. an increase in factors contributing to production risk. Moreover, these changes are predicted to vary both temporally (e.g. Rowell 2005, Tebaldi et al. 2006) and spatially (e.g. Hanssen-Bauer et al. 2005, Rowell 2005, Sun et al. 2007, Tebaldi et al. 2006). Global climate change will most likely result in more frequent extreme precipitation events (e.g. Benestad 2007, Semmler and Jacob 2004, Sun et al. 2007, Tebaldi et al. 2006, Wilby and Wigley 2002), a trend that is already empirically evident on several continents (e.g. wet regions may get wetter and dry regions may become drier mostly because of a simultaneous increase (decrease) of precipitation frequency and intensity, Sun et al. 2007: 4801). As for the reindeer husbandry, expected changes due to climate change are expected to happen both sooner and to be more prominent in the northern hemisphere (e.g. Tebaldi et al.

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<sup>18</sup> County level administrative units, “Currently Mongolia is divided into 331 *sums* and 1,671 *bags* (administrative units similar to municipalities)” (Ojima and Chuluun 2008:188).

2006). Hanssen-Bauer et al. (2005), in a review of several studies, indicates that future Fennoscandia climate change may be characterised by: (1) increased warming rates with distance to the coast; (2) higher warming rates in winter compared to summer; and (3) increased precipitation especially during winter. The shifts between warm and cold periods during winter coupled with an year-round increased precipitation intensity (Hanssen-Bauer et al. 2005) may again result in increased frequency of wet weather, deep snow and ice crust formation that has negative consequences for large herbivores (e.g. Solberg et al. 2001). Furthermore, Rees et al. (2008:214-15) argue that “Environmental pressures on reindeer husbandry in the European North [...]” as a consequence of projected climate change [...] are predicted to be generally negative in Scandinavia, neutral in Finland and mildly positive in Russia, largely through a combination of changing vegetation distribution, winter temperature and wind regime.” Nevertheless, they argue that the effect of these changes on the reindeer husbandry is expected to be relatively small and well within the range of previous experience of reindeer herders (Rees et al. 2008:215). However, as almost all climate models predicts future winter climatic conditions to be more stochastic than present day for most of the areas inhabited by reindeer herders, efficient risk buffering strategies may be even more important in the future.

This thesis found that the accumulation of large herds is an efficient risk buffering strategy in an already stochastic environment, and more importantly that one important prerequisite for efficiently building large herds may be cooperative labour investment. Faced with increased stochasticity, as a consequence of climate change, cooperative risk reducing strategies may become increasingly important for the reindeer husbandry. For example, Mearns (1996:297) has argued that the more a given group of herders find reason to cooperate with each other across a range of activities, the more likely they will find solutions in relation to the transaction costs<sup>19</sup> inherent in controlling the use of the commons. Again, it could be argued that management initiatives aimed at semi-privatising common winter grazing areas may hinder the development of flexible cooperative networks necessary for dealing with increasing production risk in terms of climate change. Rather than encourage the development of cooperation such initiatives may be argued to reduce the possibility of between herder cooperation.

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<sup>19</sup> Transaction costs can be defined as costs in relation to (1) search costs – i.e. identifying possibilities for cooperation; (2) bargaining costs – i.e. agreeing on one form of cooperation rather than another; and (3) monitoring and enforcement costs – i.e. ensuring that the cooperation of other members is enforced (Mearns 1996:301).

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## **APPENDIX I: NOMADIC PASTORALISM – A DEFINITION**

“More of the land surface of the earth is used for grazing than for any other purposes” (Reid et al. 2008:1).

The land where most herding peoples and livestock make a living can be characterized as open grazing lands, including savannas, grassland, prairies, steppe and shrublands (Reid et al. 2008:1). “These grazing lands cover 61.2 million km<sup>2</sup> or 45% of the earth’s surface (excluding Antarctica), 1.5 times more of the globe than forests, 2.8. times more than cropland and 17 times more than urban settlement.” (Reid et al. 2008:1). Grazing lands cover around 77% of Australia, 61% of Africa, 49% of Asia and around 18% of Europe (Reid et al. 2008:2).

Pastoral people are ethnically diverse, and in eastern Africa alone more than 70 different linguistic/cultural groups have been observed (Reid et al. 2008:3). “Even though extensive grazing lands [ $<20$  people/km<sup>2</sup>] support only 3% of the world’s people, they keep 35% of the world’s sheep, 23% of the goats, and 16% of the cattle and water buffalo.” (Reid et al. 2008:3). Compared to settled farmers in Africa, pastoralists produce 50-70% of all the milk, beef and mutton produced on the continent (Reid et al. 2008:3). Also, in Iran, while comprising only 1.5% of the total population, pastoralists keep 25% of the national herd (Reid et al. 2008:3). Generally speaking, pastoralists keep a wide variety of domesticated animals depending on region, with alpaca and llamas as the main species in the Andes, camel and horse in east-central Asia, the dromedary in Africa and West Asia, reindeer in northern Eurasia, and yak on the Tibetan plateau (Reid et al. 2008:3).

According to Dyson-Hudson (1972), the traditional anthropological study of nomadic pastoralism was concerned with establishing typologies of “pure pastoralists or nomads” where the units of analysis were not societies but “ideal types”. Pastoral and nomadic societies were classified according to how much of the “ideal types” they contained. In contrast, the modern study of nomadic pastoralists has demonstrated that the concept of “pure pastoralists or nomads” is fictional; rather, nomadic pastoralism as an adaptation is characterized by variations (Dyson-Hudson 1972). Rather than being occupied by typologies, Barth (1966) has argued that it is important to look for processes that produce social forms by seeing a society as patterns of human behaviour or patterns of allocation of time and resources. Following this line of thought, Dyson-Hudson and Dyson-Hudson (1980) conceptualizes nomadic pastoralism as a social form that may be defined as the coexistence of

dependence on livestock with spatial mobility. More specifically, Khazanov (1994:16) have five characteristics for nomadic pastoralism:

“(1) Pastoralism is the predominant form of economic activity. (2) Its extensive character connected with the maintenance of herds all year round on a system of free-range grazing without stables. (3) Periodic mobility in accordance with the demands of pastoral economy within the boundaries of specific grazing territories (as opposed to migrations). (4) The participation in pastoral mobility of all or the majority of the population (as opposed, for example, to the management of herds on distant pastures by specialist herdsmen, into which only a minority is involved in pastoral migrations). (5) The orientation of production towards the requirements of subsistence (as opposed to the capitalistic ranch or dairy farming of today).”

Following this definition, nomadic pastoralism can be viewed as a distinct form of *food-producing economy*, distinguishing it from other forms of economic activity, where mobile pastoralism is the dominant activity, and where the majority of the population undertakes seasonal movements. There are many examples of societies being nomadic, but not pastoral, and pastoral societies that are not nomadic. Also, since it involves everyone in the various aspects of production, it distinguishes nomadic pastoralists from shepherds in Western Europe or the American cowboys who also make a living by herding animals. As Barfield (1993:5) states: “*Heidi* is not the story of a Swiss nomad girl even though she herded cows and goats each summer.”

According to Spooner (1973:3) the term “nomadism” has been applied to any society that is not settled in permanent dwellings, although etymologically it implies a pastoral subsistence base. According to Seymour-Smith (1986) the word ‘*nomad*’ is derived from the Greek word *nemo*, which roughly means, “to pasture”. Although the word ‘nomad’ refers both to mobility and to a pastoral base of subsistence, it is useful to distinguish between nomadism<sup>20</sup> as referring to *mobility*, and pastoralism as a *mode of subsistence*. The term mobility has to comprise both seasonal and daily movement along with who participates in

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<sup>20</sup> However, Humphrey & Sneath (1999:16) argues that the category nomadism is useless analytically, and prefers the term ‘mobile pastoralism’, since “Mobility here is seen as a technique that is applicable in a range of institutions, rather than as a holistic lifestyle suggested by the word ‘nomad’.” However, my usage of the term ‘nomad’ here refers exactly to the aspect of mobility, as ways of moving spatially, i.e. as a strategy used in *a way of making a living*, and *not to a value orientation* (see Salzman and Galaty 1990 for further discussion on the difference).



the actual moving, making it possible to conceptually distinguish nomadic pastoralism from *transhumance*. According to Jones (1996) transhumance refers to an economic system that is based on both agriculture and livestock herding, with a permanent “home base” occupied by all members during most of the year. Herding of livestock and agricultural activities are divided between the members of a household<sup>21</sup> so that not all of the members are involved in the pastoral production, i.e. production is diversified. Marx (2006), however, calls for redefinition of nomadic pastoralism in the Middle East and North Africa on the basis of diversification. In essence, nomadic pastoralism can be argued to have been defined as being primarily rigged towards subsistence (see e.g. Khazanov 1994), based mainly on animal products such as meat, milk, wool and hides (Marx 2006:81). Subsequently, any involvement in the commercialization of livestock and livestock products have been viewed as a modern invention and not part of the “traditional” way of life (Marx 2006:81 and references therein). In relation to Middle Eastern pastoralism Marx (2006:81-2) argue that a new model/definition of nomadic pastoralism has come to terms with: that (1) pastoralists produce, at least to some degree, for markets and therefore depend on the city and the state, (2) pastoralism cannot be treated as a self-contained or as only a subsistence economy, (3) pastoralists engage in a variety of occupations, the relative importance of which change according to economic changes (for the full list see Marx 2006:81-2).

Similarly, Dyson-Hudson & Dyson-Hudson (1980:18) argues that discussing movement patterns of nomadic pastoralists with reference to categories like transhumance and *semi-sedentary* has “[...] proved to be an intellectual sterile enterprise.” Movement patterns are empirically constituted and have to be investigated and not discussed in relation to a firm typology. For example, one of the main reasons given for why pastoralists in Africa move is the seasonality of pastures, i.e. different pastures have different growing seasons and the nomads move accordingly (Dyson-Hudson & Dyson-Hudson, 1980). This is, however, not necessarily the only explanation for pastoral movement, e.g. political and social factors have been argued to be important factors (see e.g. McCabe 1994, Gulliver 1975, Woodburn 1972, Chatty 2006, Dyson-Hudson and Dyson-Hudson 1980).

Pastoralists fall into the category of food-producing economies, since they rely on domesticated animals that are controlled by the pastoralist and as a consequence “[...] the sex

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<sup>21</sup> Defined as “[...] the smallest group of people which can take independent decisions over the allocation of its members’ domestic and herding labour, and over the use, allocation, and location of their livestock capital” (Dahl 1979b:70).

and age composition of a herd is, ideally, an artifice of the pastoralists, who, at the same time, allocates different ‘tasks’ to his animals” (Paine 1994:15). Pastoralists exert control over their animals based on their preferences for livestock’s products they make a living of either directly, or indirectly, through the usage of products from the domesticated animals (Spooner 1973). Directly in the form of meat, blood, milk, hair, wool and hides, usually referred to as primary pastoral products. Secondly, (but nonetheless direct) pastoral products are butter, cheese, cloth and carpets. Indirect use of pastoral products refers to subsistence via trading and bartering, formal and informal markets.

Although pastoralism refers to a subsistence based on livestock, what kind of livestock they rear and what kind of pastoral products they make use of, varies across cultures. Nevertheless, nomadic pastoralists have to be differentiated from nomadic hunters-gatherers, which economy can be classified as a *food-extracting economy*, i.e. hunter-gatherers do not physically change the animals they live of, as nomadic pastoralist do through selective breeding (domesticated animals tend to give more milk and more wool than their wild counterparts because of breeding) (Khazanov 1994). Nevertheless, not all anthropologists agree in separating nomadic pastoralists from nomadic hunter-gatherers based on these criteria, for example Ingold (1986) prefers to classify both nomadic pastoralists and hunter-gatherers in terms of mobility and resource appropriation, and does not distinguish them on the basis of food-extraction and food-production. Ingold (1980) distinguishes between nomads and hunters on the basis of their relationship to the animals they subsist on. Whereas the relationship between a hunter and animals is that of a predator-prey relationship, the relationship between a pastoralist and his herd is that of a protector-protected. Ingold (1980.) also divides them on the basis of access to land and animals, where for a pastoralist access to land is normally common and access to animals divided, access to both land and animals are common for hunters.

As seen, there are differences in how researchers define nomadic pastoralism. However, what constitutes a nomadic pastoral adaptation in one society cannot be described and compared with a basic “ideal type”, but has to be investigated empirically in order to be properly understood. As Spooner (1973:3) writes “[...] there are no features of culture or social organization that are common to all nomads or even that are found exclusively among nomads”.

## APPENDIX II: SAAMI REINDEER HUSBANDRY

### Historical origins

Saami reindeer husbandry has been said to be the cornerstone of the Saami culture in northern Fennoscandia (Bostedt 2001). Although it is difficult to come up with accurate dating of the origin of reindeer husbandry as a pastoral economy, it developed at least 400 years ago (Riseth and Vatn 2009:89-90, Paine 1994, see e.g. Bjørklund 1990:76, Bostedt 2001, Hansen and Olsen 2004, Bergstrøm 2005 for other estimates) and probably evolved from a hunting culture based on wild reindeer. During glacial time in Fennoscandia, the presence of wild reindeer was most likely an important reason for stone-age settlement of hunting people (Riseth 2000:120). According to Riseth (2000:120) in older times the Saami adaptation was semi-nomadic, consisting of a limited number of households that migrated between different seasonal locations, and for which the hunting of wild reindeer was the most important economic activity. These bands were furthermore organized according to the term *siida*, who described both the territory used and the band: “The hunting *siida* can be defined as *an organization of households, which utilize common-pool-resources for hunting, trapping, and fishing in a geographic area and which claim exclusive rights to these resources.*” (Riseth 2000:120, italics in original). Furthermore, from the 17<sup>th</sup> century, *siida* borders delineated property rights that were legally recognized by nation-state rulers (Riseth 2000:120). By the end of the 16<sup>th</sup> and during the 17<sup>th</sup> century the Saami hunters used tame reindeer as draft animals and as decoys during hunts (Riseth 2000:120). Increased hunting pressure on wild reindeer, coupled with the already use of tame animals, provided, according to Riseth (2000:120, the basis for the transformation of the hunting culture to full nomadic reindeer pastoralism as tame reindeer provided a much more stable source of livelihood than the decreasing population of wild reindeer (see also Vorren 1978, Bergstrøm 2005, Holand 2003).

Riseth (2000:122) has summarized the changes from a hunting culture to nomadic reindeer pastoralism as follows: (1) the *siida* areas became larger to incorporate the longer migration necessary for reindeer pastoralism, (2) a reduction of the number of households per *siida*, (3) the household became a more important economic unit, and (4) labor cooperation combined with a privatization of production. Traditionally, reindeer pastoralism was based on families, or households that followed their herds’ year-round where the pastoral economy was primarily tied to reindeer products (Vorren 1978). Central to the reindeer husbandry is the two levels of social organization: (i) *baiki* (household) and (ii) *siida* (Bjørklund 1990, Nilsen and

Mosli 1994, Paine 1964, Paine 1972, Paine 1994, Pehrson 1964, Riseth 2000). The household consisted, according to Riseth (2000:121), of a family group comprising a nuclear family but may have also included servants or old people e.g. the parents of the wife or husband. In general terms, members of the household own their own animals privately and make decisions in relation to slaughter and reproduction on their own, although under the supervision of the household leader (Riseth and Vatn 2009:90). New households were usually formed upon marriage, i.e. reindeer has traditionally been individually owned and inherited by both women and men (Paine 1994:14), and upon marriage both the groom and bride will bring with their own reindeer, which they have accumulated since birth into a new household (Paine 2009:36)<sup>22</sup>.

The *siida* can be defined as a cooperative unit composed of one or more reindeer management families, usually organized on the basis of kinship, which joined in a social and labour community for keeping control over a herd of reindeer through herding (Pehrson 1964). Generally speaking, the *siida* is both a social and a working community normally consisting of several households. Moreover, the *siida* was (and still is) a flexible system of cooperation, i.e. *siida* membership can change over time so as to optimise the relationship between herds and personnel (Bjørklund 2004:126, Paine 1994:14, see below). As the *siida* can be defined as a unit composed of one or more reindeer management families, Riseth and Vatn (2009:90) argues that the *siida* carries with it potential sources of conflict related to differences between individual and collective interests. Consequently, the *siida* has traditionally been regulated by a number of principles: (1) all herd owners are their own masters; (2) solidarity between *siida* partners, which sometimes can be stronger than sibling solidarity (but see **Paper 6**); (3) a network of mutual obligations; (4) unanimity in relation to collective decisions and (5) a spiritual land-man relationship. According to Riseth and Vatn (2009:90) inter-*siida* conflicts were resolved through the use of 3-5.

A central concept in reindeer husbandry is that of *herd management*. Paine (1964, 1971, 1972, 1994) conceptualize herd management to embody two principles of interdependence, i.e. between herd, personnel and pasture (the principal factors of production) and between herding and husbandry (however, see Dyson-Hudson 1972:14 for a discussion on the analytically use of the terms). An important aspect in viable herd management is the

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<sup>22</sup> It should be noted, however, that at present the establishing of a new husbandry unit (or *siida* share) has to be officially recognized as the Norwegian government controls the recruitment of reindeer herders through the use of a quota system (Bjørklund 1999, see below).

possession of the three principal factors of production in commensurate proportions. Failure to reach commensurability results in difficulties for the pastoralist, e.g. herds without sufficient manpower available to herd them will probably suffer continuous depletion of the herd (Paine 1994). Paine (1964) defines herding as the relationship between herd/pasture in connection to the welfare of the animals in the terrain, which is the responsibility of the siida group (Nilsen and Mosli 1994). Husbandry on the other hand, relates to the reindeer herd as a resource of its owners (Paine 1964). Husbandry for Paine (1964:79) is “[...] the efforts of the owners in connection with the growth of capital and the formation of profit”. Decisions in connection to husbandry are the responsibility of the household (see Nilsen & Mosli 1994).

### **Reindeer husbandry in transition**

The newer history of Saami reindeer husbandry can be summarized as being influenced by an increased meat and market adaptation coupled with an increased sedentarisation (Riseth 2006). According to Riseth and Vatn (2009:87) after the Second World War the life of the Saami reindeer herders changed as herding changed to become more an occupation than a way of life. Moreover, during the 1950s access to markets increased. Furthermore, from the middle of the 1960s the reindeer husbandry underwent major technological changes with the introduction of snowmobiles and later all terrain vehicles (ATV). During the late 1970s the Norwegian government became more and more directly engaged in the reindeer husbandry through subsidies and regulations. Reforms during the end of the 70s and early 80s had as one of its main aims to increase both production and co-management (Riseth and Vatn 2009).

Herd sizes in Finnmark were at their lowest after the end of the Second World War, but were normalised by the end of the 1950s. At the beginning of the 1950s the Norwegian government tried to help reindeer herders to increase their herds to a pre-war level by supplying capital for buying animals for breeding and by erecting fences between summer districts (Riseth and Vatn 2009:100). The Norwegian government also started to build slaughterhouses throughout the 1950s something which gave herders good opportunities for slaughtering during the 1950s and 1960s. According to Riseth and Vatn (2009) and Riseth (2006) one of the main underlying ideas for increased governmental involvement in the reindeer husbandry was to rationalise the industry. During this period the reindeer husbandry underwent major technological, economical and political changes (Riseth 2003, Riseth 2000), which had as one of its consequence that, in Finnmark, one has observed a doubling of number of reindeer from around 1970-1990 (Riseth and Vatn 2009:95), while the number of husbandry units have doubled from 1950 to 1990 (Riseth and Vatn 2009:96).

In Finnmark, the snowmobile was introduced in the middle of 1960 and was adopted by almost all herders within a relatively short time period. Moreover, where it was possible, i.e. in areas with not too steep terrain, all terrain vehicles (ATV) were being used more and more during summer. Generally speaking, during this period the reindeer husbandry experienced a high degree of technological modernization within the limits set by economy and geography (Riseth and Vatn 2009:95). This was a change that, according to Riseth and Vatn (2009) was welcomed by the reindeer herders. During this period cars and trucks were used more and more for transporting both reindeer and people. For example, trucks could be used to move the weakest animals or the whole herd during spring migration if necessary (Riseth and Vatn 2009:95). Moreover, both helicopters and military transport boats were used in the reindeer husbandry e.g. military transport boats were being used for moving reindeer over water to summer grazing areas. More and more fences were also put up as well as a general modernisation of the corral system (Riseth and Vatn 2009:95). In sum, during this period the production system started to change from being subsistence based to a motorised and market oriented industry (Riseth 2003, Riseth 2000, Riseth and Vatn 2009:100). The technological change, illustrated by the increased dependence of e.g. snowmobiles, were financed by converting animal capital something which Riseth and Vatn (2006) and Nilsen and Mosli (1994) has argued provides a partial explanation for why the number of reindeer experienced a temporary decrease prior to and around 1970.

During the 1970s most of the reindeer herders had moved into modern houses in central areas in Finnmark. This was due to official policies such as housing programmes (1958 and 1969) that made modern houses affordable for herders. Moreover, nine years compulsory school made it impossible for families to live close to their herd (Riseth and Vatn 2009:100). Furthermore, the public sector grew considerably from the end of the 1960s and new ways of making money became more and more available, especially for women. All these factors made it possible for reindeer herders to attain a “modern” standard of living (Nilsen and Mosli 1994, Riseth and Vatn 2009). Furthermore, at the end of the 1970s a new step in governmental involvement in the reindeer husbandry was initiated. The Saami Reindeer Herders’ Association of Norway (NRL)<sup>23</sup> lobbied for recognition and support for viewing the reindeer husbandry as an industry (Riseth and Vatn 2009:100). In short, they achieved two important goals: in 1976 the General Agreement for the Reindeer Industry was negotiated between NRL and the Norwegian government. This agreement achieved that

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<sup>23</sup> The national interest organisation of the reindeer husbandry established in 1948 (Berg 2008:188)

reindeer pasture areas should be protected from encroachment from other industries and secured both welfare and income for Saami reindeer herders (Riseth and Vatn 2009:100). This agreement was approved by the Norwegian parliament. Far more important, however, is the fact that this agreement laid the foundation for annual agreements pertaining to official subsidies and development that continues to this day (Riseth and Vatn 2009:100, see also Ulvevadet 2008). A prerequisite of achieving the goals of the agreement necessitated a number of official subsidies, e.g. direct and indirect price support, cost reducing actions and support for husbandry units (Riseth and Vatn 2009:100). Riseth and Vatn (2009:101) has argued that the subsidies had an unintended consequence in Finnmark: the increased income generated from e.g. subsidies was partly converted to larger herd sizes (see also **Paper 1**).

In 1978 a new Reindeer Management Act was adopted, focusing on (1) the establishment of formal institutions for access to the reindeer husbandry and pasture management; (2) co-management. While the establishment of formal institutions was based on the rationalisation and efficiency paradigm, co-management was based on herder representation in the administration of the reindeer husbandry, both regionally and nationally (Riseth and Vatn 2009:101). Locally, democratically elected districts boards were established for each reindeer district (Ulvevadet 2008:61). The intention was to establish a framework for governance that should limit the growth of both husbandry units and herds as well as making sure that reindeer herders and their representatives should be accountable for their decisions (Riseth and Vatn 2009:101, see also Ulvevadet 2008). The number of husbandry units was controlled by the use of a quota system (Bjørklund 1999). The Reindeer Management Act placed weight on active management for members of the husbandry unit as well as restricted the possibility of keeping reindeer in other husbandry units (Riseth and Vatn 2009:101). Furthermore, the act also established a structure for governance where the boards were given authority in relation to e.g. herd quotas on both district and husbandry unit level (Riseth and Vatn 2009:101). According to Riseth and Vatn (2009:102) several changes followed: (1) the status of the husbandry unit seems to have been strengthened at the expense of the *siida* system (see also Nilsen and Mosli 1994). One of the reasons for this is that governmental subsidies targeted the husbandry unit. (2) At the same time husbandry units got increased opportunities for generating income from non-pastoral activities, i.e. increased sedentarisation lead to a closer link with the overall society which again increased income generating opportunities (Riseth and Vatn 2009:102). Berg (2008) has argued that the Reindeer Management Act of 1978 and the General Agreement for the Reindeer Industry of 1976 lay the foundation for a change into a *corporate* reindeer husbandry, i.e. not only production of

meat for subsistence and sale but also for official subsidies. Accordingly, in many districts it has been common that half of the income has been generated by different support and compensatory arrangements (Berg 2008:189).

The focus on co-management has been broadened in the Reindeer Management Act of 2007. The committee in charge of proposing the 2007 Reindeer Management Act wanted “[...] more power-sharing between the government and industry and more influence on the part of reindeer owners [...]” and that the “[...] industry should have self-determination and influence but also more responsibilities for its actions [...]” (Ulvevadet 2008:66). To accommodate increased co-management the traditional siida system has been recognised as an important managerial unit and where different siidas should elect boards that is to work as a contact point between the siida and the district boards (Ulvevadet 2008:67-8, Anonymous 2007a). In short, it is assumed that “[...] a well-arranged management system at the local level will lead to better social relations, increased trust and better co-operation among the reindeer owners [...]”(Ulvevadet 2008:68).

In sum, the reindeer husbandry have undergone substantial changes, the most important being: (1) more extensive management (decrease in contact between man and animals, see Beach 2000 for a discussion concerning the erosion of herding skills); (2) the subsistence economy was replaced by a money based economy; (3) sedentarisation; (4) reindeer husbandry as an occupation and not as a way of life; (5) an increase in the use of modern technology; and (6) increased dependence on governmental support (Berg 2008, Bergstrøm 2005, Bjørklund 1999, Bjørklund 2004, Paine 1994, Riseth 2000, Riseth and Vatn 2009). Also, Bjørklund (1999) argues that while in traditional reindeer husbandry the principal factors of production were under the control by traditional institutions, during 1960-90 the Norwegian government assumed the control by e.g. setting a limit on the number of animals, and by controlling the recruitment of reindeer herders by the use of a quota system.

### **Present organisation and administration**

From a national point of view the Saami reindeer husbandry is a relatively small industry. Nevertheless, the Saami reindeer husbandry is important from a local and Saami point of view both in terms of economy and culture (Anonymous 2007b). Moreover, around 40% of Norway’s landmass is utilized as reindeer pastures from Hedmark in the South to Finnmark in the North (Anonymous 2007b). According to Ulvevadet (2008:55), management of the reindeer husbandry consist of a complex co-management system with participants from the bottom to the top. Moreover, “[...] there are three organizational systems with vertical and



horizontal interaction among all its organizational parts” (Ulvevadet 2008:55). First and foremost is the administrative system that goes from the Parliament to the Ministry of Agriculture and Food and further to the Reindeer Husbandry Administration with its six different reindeer husbandry areas at the regional level (Figure II.1 & II.2). Accordingly the six different reindeer husbandry areas “[...] provide reindeer owners with assistance and advice [...]” (Ulvevadet 2008:65). Another part of the system consist of the corporative system that goes from NRL to six regional associations located within the six different reindeer husbandry areas (Ulvevadet 2008:65). As previously mentioned NRL negotiates with the government concerning annual agreements pertaining to official subsidies and development of the reindeer husbandry (Riseth and Vatn 2009:100, see also Ulvevadet 2008). Finally, there is an extensive co-management system that consists of different *boards* within the (1) Reindeer Husbandry Administration; (2) the six different reindeer husbandry areas; (3) reindeer districts; and (4) *siidas* (see Figure II.2). “Reindeer owners are the sole members of the *district* boards. Members of the *area* boards are appointed by the Sami Parliament and the County Council [...], while members of the *Reindeer Husbandry Board* are appointed by MAF [Ministry of Agriculture and Food] and the Sami Parliament” (Ulvevadet 2008:55, italics added). Members of the *siida* board are elected from the reindeer herders within the *siida* (see above).

As for *social organization*, the Saami reindeer husbandry can arguably be distinguished into three different levels: (1) husbandry unit; (2) *siida*; and (3) district (see below for rationale, Figure II.2). The *husbandry unit* is the basic unit in the social organization of the reindeer husbandry, and operates on the basis of a license given by the government which entitles a person to manage a herd of reindeer within a delimited area (Ulvevadet and Klovov 2004). The husbandry unit is similar to a household, as defined by Dahl (1979b:70), but as a husbandry unit can also consist of reindeer belonging to family members of the husbandry unit’s manager, a husbandry unit *de facto* similar to an extended family unit. This level of social organization has, however, changed name in the new reindeer husbandry law, where the former designation husbandry unit has now changed to *siida share* (Ulvevadet 2008, Anonymous 2007a). In contrast to the husbandry unit, the *siida* is a cooperative unit composed of one or more reindeer management families, and is part of the traditional reindeer husbandry system. The *siida* is usually organized on the basis of kinship joined together in social and labor communities for keeping control of herds of reindeer through herding (Bjørklund 2004, Nilsen and Mosli 1994, Paine 1994, Pehrson 1964, see above). Moreover, this level of social organization is formally recognised by the Norwegian

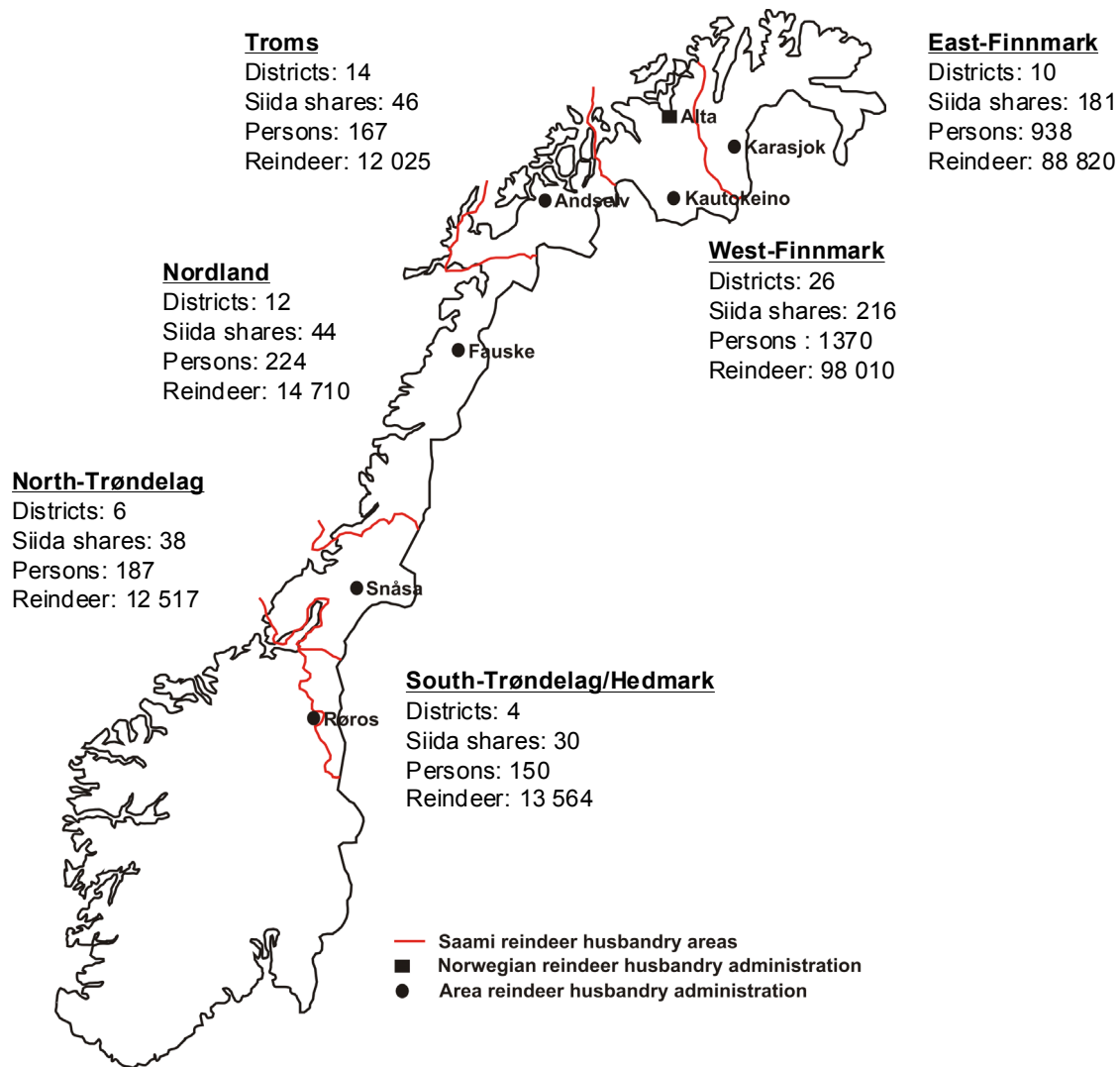
government in the new reindeer husbandry law (Ulvevadet 2008, Anonymous 2007a). *The Saami reindeer husbandry districts* are formal management units with the responsibility to provide the Norwegian reindeer husbandry administration with information connected to the reindeer husbandry, and also to help the authorities with the administration of the reindeer husbandry. The district also has the responsibility of ensuring that the reindeer husbandry is managed in accordance with the rules and regulations that are stipulated by the Norwegian government (Bull 1997). As such district may be argued to not be a level of social organization, but rather as the lowest level of governmental management for the reindeer husbandry (Ulvevadet 2008). However, members of reindeer districts has to cooperate in e.g. maintaining fences or fulfilling governmental demands pertaining to the maximum number of reindeer per districts, and as such may also be conceptualized as a level of social organization.

### **Pasture use**

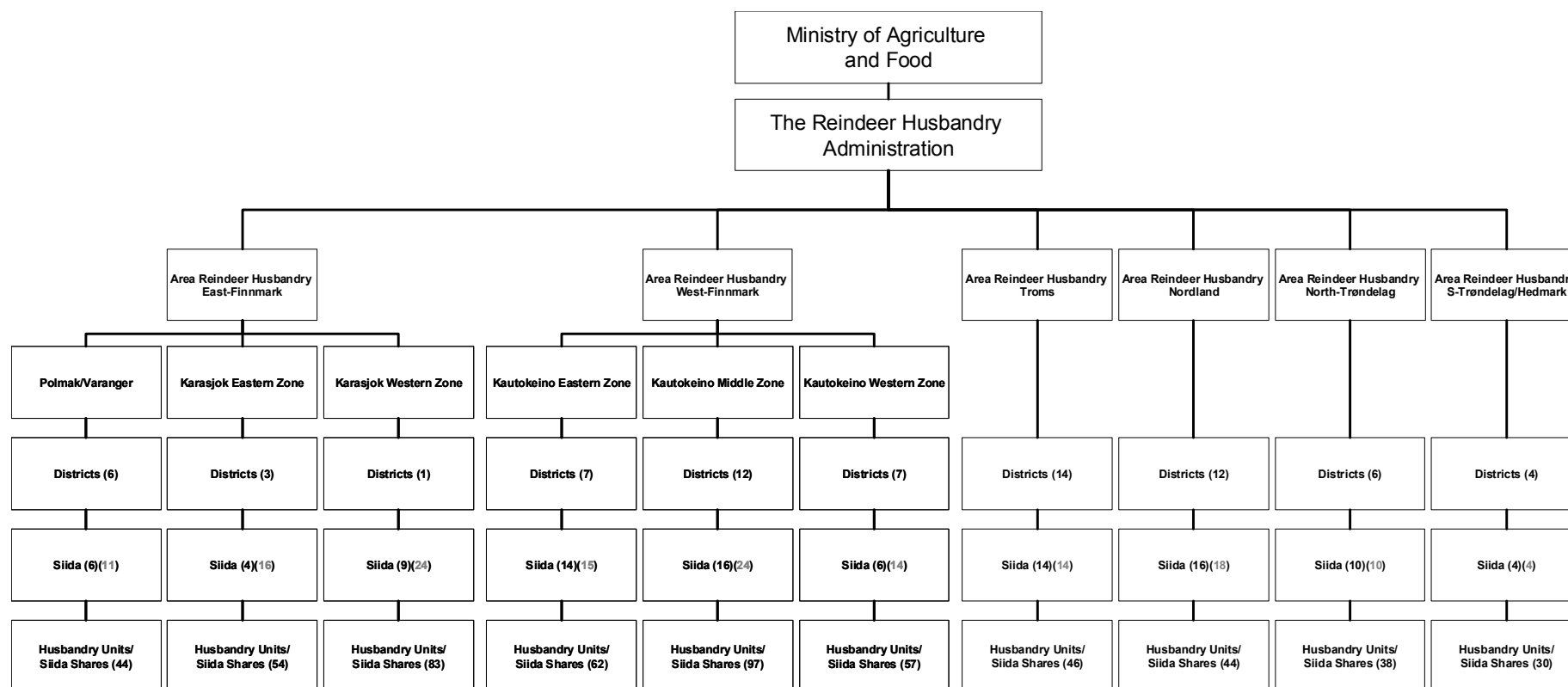
Important prerequisites for the reindeer husbandry have arguably been land, herd and personnel (Paine 1972, Paine 1994, Riseth and Vatn 2009). Pastures are, however, seasonal and have specific physical and geographical locations than necessitates migration between them. For reindeer, the most important diet during winter is ground lichens which are commonly distributed in relatively dry continental areas (Riseth and Vatn 2009:89). During summer, reindeer subsist mostly on herbs and grasses which are most commonly distributed in nutritious mountain areas. Spring and fall pastures consist usually of both this types of resources (Riseth and Vatn 2009:89). Riseth and Vatn (2009:89) argues that as lichens are a stock resource that experience optimal growth during relatively low grazing pressure, the capacity of winter grazing areas determines to a large degree herd size. In contrast, the capacity of the green summer pastures determines the production potential (Riseth and Vatn 2009:89, Tveraa et al. 2007).

In short then, the herding of reindeer is based on following the natural migration patterns of reindeer. In Finnmark the summer pastures are localized in the northeast close to the coast and fjords while winter pastures are on the continental inland plateau (see Figure II.3). Summer pastures are moreover geographically delineated on the basis of *district* borders, i.e. the aforementioned formal management units (Figure II.1). Summer pastures are shared between several husbandry units, e.g. the number of husbandry units per summer district ranged from 2 to 28 in **Paper 6**. The combined spring and fall pastures are localized between the summer and winter pastures (see Figure II.3). Spring, fall and winter pastures consist of large common grazing areas that in some periods includes five to six dozen winter

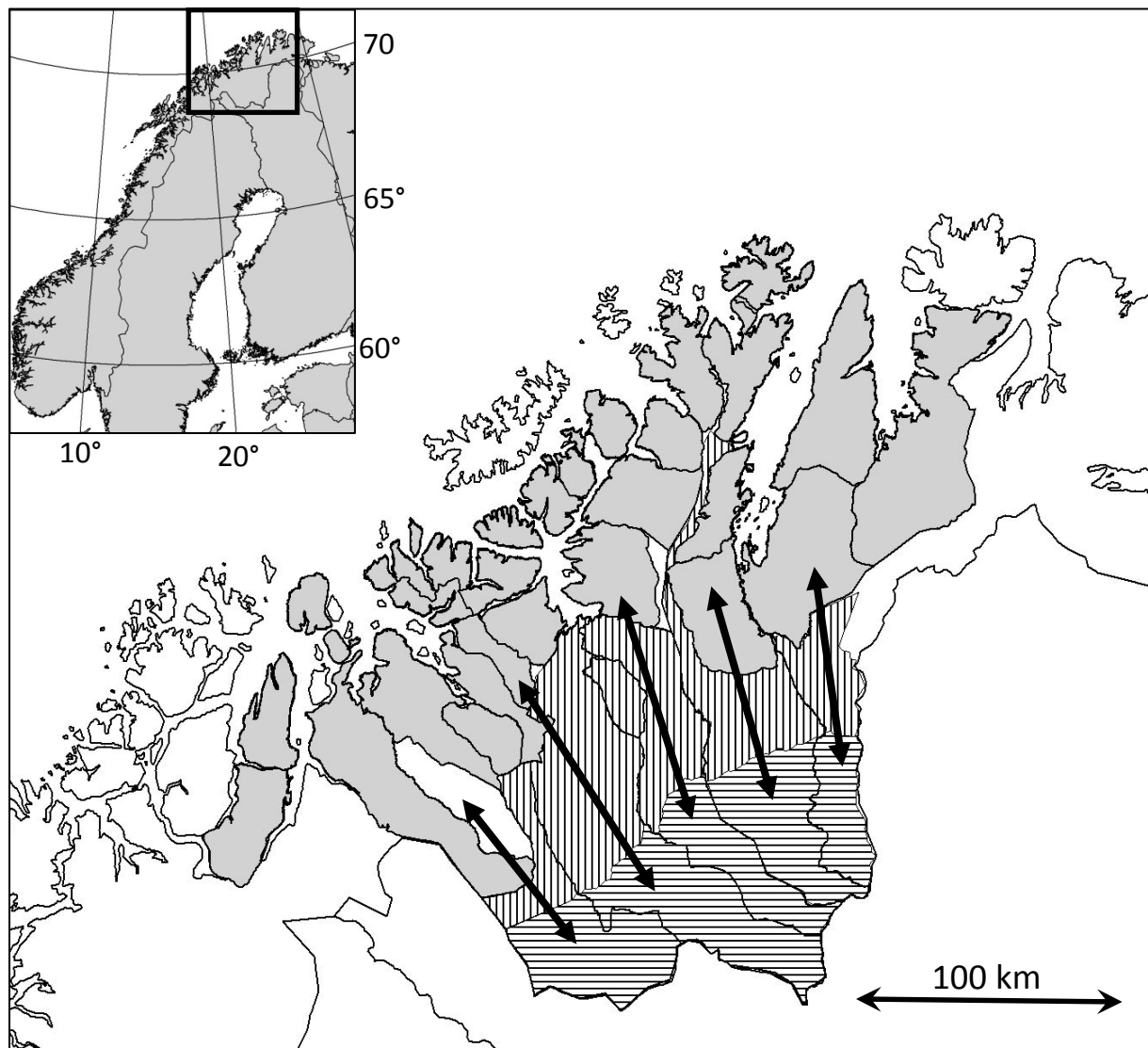
siidas (Riseth and Vatn 2009:96). The commonality of the winter pastures could be, however, questioned: Paine (1994:75) argues that while summer pastures are physically separated, winter pastures constitutes an overlapping quilt. Saami reindeer herders have, however, a clear understanding of the fact that different winter pasture areas belong to different siidas (Riseth 2000:132). Furthermore, Riseth (2000:132 italics in original, see also Paine 1994) argues that “The ethic of respecting another’s pastures seem to have been rather strong. This is; however, modified by the rule that *everybody had right of access to alternative pastures, when in need* [...]”. This siida delineation of winter pastures, however, have been informal, a situation that the Norwegian government is in the process of rectifying. Presently, the Norwegian government has initiated a redistribution of common inland winter pastures to the siida units as this is assumed to ease both governmental and regional management (Anonymous 2007c, Anonymous 2007a, Anonymous 2007d). In short, the distribution of pastures requires that Saami reindeer herders living in Finnmark migrate with their reindeer out to costal summer pastures during spring time from winter pastures in the interior (Figure II.3) with distances often being several hundred kilometres (Paine 2004:24).



**Figure II.1.** Map over the different Saami reindeer husbandry areas in Norway and their respective administrative centres (adopted from Ulvevadet 2008:54). Number of districts refers only to summer and whole-year districts per 31 March 2008 (Anonymous 2009a:50). ‘Siida shares’ is the same as what has been termed ‘husbandry units’ in **Paper 1, 5 & 6**. Numbers in relation to persons refers to number of persons in siida shares (Anonymous 2009a:50). Number of reindeer refers to the total number in area. All numbers refer to per 31 March 2008 (Anonymous 2009a:62).



**Figure II.2.** The current organisational and administrative levels in the Saami reindeer husbandry, Norway. Number of siida in black refers to summer siida, while grey refer to the number of winter siida. All numbers in relation to siida and husbandry units/siida shares is from Anonymous (2009a:62), while numbers pertaining to districts is from Anonymous (2009a:50).



**Figure II.3.** Map showing the spring, summer, autumn and winter grazing areas for reindeer husbandry districts in Finnmark, Norway. Grey shaded area designates the 27 reindeer husbandry districts used as a basis for analyses in **Paper 5** and also serves as their individual summer pastures. Vertically hatched area shows the area used for spring and autumn pastures while horizontally hatched area shows the area used for winter pastures. Arrow headed lines indicates general seasonal movement patterns between different grazing areas for all husbandry units and do not refer to the movement pattern of specific husbandry units within specific districts.

## **ERRATA**

### **ABSTRACT/KEYWORDS**

**P. i** – “Norway” has been inserted as keyword.

### **PAPERS INCLUDED IN THE THESIS**

**P. ii** – Status of papers have been updated.

### **ACKNOWLEDGMENT**

**P. iii** – Error in name spelling has been corrected.

### **APPENDIX II: SAAMI REINDEER HUSBANDRY**

**P. v, vii, viii** – minor language corrections have been undertaken.

### **MAIN TEXT**

**P. 20, 36, 40, 41, 42, 45, 46** – minor language corrections have been undertaken.