

Material, social, and moral institutional consequences in natural resource management in southern Namibia

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Abstract: In southern Namibia ineffective enforcement contributes to natural resource degradation. We analyse the root causes of ineffective enforcement applying diverse methods. In the first step we develop a conceptual framework distinguishing between moral, social, and material enforcement. In the second step we analyse water and rangeland management regulations through the filter of our conceptual framework. In the third step we conduct economic experiments in order to gain additional insights into the characteristics of selected elements of the framework. We observe that social enforcement has the strongest impact on encouraging cooperative behaviour. Water governance in our cases makes more direct use of social enforcement, which is one factor contributing to its relative success compared to rangeland governance. We draw the general conclusion that existing moral and social norms should be considered as starting points for the establishment of formal rules because norms are more costly to establish but cheaper to apply.

Keywords: Common Pool Resources, economic experiments, enforcement, institutional interactions, Namibia

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1. Introduction

Namibia is a biologically megadiverse country, but its biodiversity is one of the most threatened in the world (Tuxill 1999). Ecological research in southern Namibia provides evidence that past and current resource management is not sustainable (Dreber and Falk 2010). An interdisciplinary team conducted research in the region for nine years assessing this complex arid socio-ecological system (summarized in Appendix 1). Exploratory institutional analyses suggested that the effectiveness of different institutions related to natural resource management in the southern Namibian communal area Namaland varies. While the regulation of land access functions relatively well, the coordination of the intensity of pasture use is very ineffective. We observed that statutory, customary, and self-organization authorities claim to regulate natural resource management, but inconsequently enforce institutions in the realm of rangeland management (Falk 2008). Thus, there is a huge discrepancy between ‘de jure’ and ‘de facto’ rules. However, institutions will only effectively coordinate behaviour if enforcement arrangements are provided at different governance levels (Becker 1968; Crawford and Ostrom 1995; Cardenas et al. 2000). Gibson et al. (2005) give evidence for the importance of enforcement especially of local users for the sustainable management of resources. This might be an explanation why access regulations work well in our case. Local residents are motivated to take actions in order to avoid unauthorized grazing on their land. The observations from our study site and the literature on common-pool resources (both case studies and experiments) led to the following research question(s):

Which (dis-)incentives do exist in pasture management of the Namaland, how effective are they in changing people’s behaviour and how do interactions between institutional (dis)incentives influence the effectiveness?

Adhering to Ostrom’s (2007) calls, we applied complementary methods such as document analysis, surveys based on open and semi-structured interviews as well as economic experiments. The aim of this article is to synthesize some of our work using a coherent theoretical framework in order to derive policy relevant conclusions. For this purpose we set the results of field experiments into the context of a specific case study. In section 2 we will distinguish between different kinds of enforcement and integrate the underlying incentives into Crawford’s and Ostrom’s

(1995) Grammar of Institutions. Our research is inspired by the Institutional Analysis and Development (IAD) framework (Ostrom et al. 1994; Ostrom 2005).¹ Section 3 gives an overview of our data sources and clarifies how the presented materials are linked. The adapted Grammar of Institutions guides our survey on pasture governance in Tiervlei/Namaland (Section 4). We gain additional insights on the role of enforcement consequences and their interactions by complementing our survey with economic experiments (Section 5). The experiments help us to bridge the gap between abstract concepts and real life observations. We discuss the presented material and draw our conclusions in Section 6.

2. Consequences of (dis-)obeying institutions

Crawford and Ostrom (1995) developed the Grammar of Institutions as a tool to analyse the institutional statements that shape incentives in action situations. According to the syntax of the Grammar of Institutions, a rule is defined by the following characteristics (Crawford and Ostrom 1995; Ostrom 2005):

- 1) It specifies to whom it applies (ATTRIBUTES of the addressee of the institution),
- 2) It specifies the deontic operator (may, must, or must not do) (DEONTIC),
- 3) It describes which action is concerned by the institution (AIM),²
- 4) It specifies conditions under which the institution applies (CONDITION),
- 5) It specifies institutionally assigned consequences (OR ELSE).

Norms are distinguished from rules by not having institutionally assigned consequences (OR ELSE). Norms are based on consequences which are perceived costs and rewards of obeying or breaking a shared prescription (summarized as a delta parameter). The Grammar of Institutions therefore, distinguishes five types of implications for (dis-)obeying an institution that change the individual's payoff (Crawford and Ostrom 1995; Ostrom 2005):

- 1) institutionally assigned sanctions for breaking a rule (f),
- 2) changes in expected payoffs from obeying a prescription originating from external sources (δ^{oe}),
- 3) changes in expected payoffs from breaking a prescription originating from external sources (δ^{be}),
- 4) changes in expected payoffs from obeying a prescription originating from internal sources (δ^{oi}),

¹ In the language of the IAD framework we assess the net costs and benefits assigned to potential outcomes in the operational action situation of rangeland management in Namaland.

² We understand institutions in the broadest sense as any prescription which at least specifies the ATTRIBUTE, DEONTIC and AIM characteristics.

- 5) changes in expected payoffs from breaking a prescription originating from internal sources (δ^{bi}).

In the application of the Grammar of Institutions we struggled to draw the line between informal rules and norms (see also Ostrom 1998). Even though we followed its general logic, we decided to define alternative types of consequences for obeying or disobeying an institution. In this way we can better highlight the importance of different sources of enforcement and describe how interactions between institutional consequences influence how effective the set of institutions is. Using the concept of consequences further helps us to distinguish between the effects and means of sanctioning. In our understanding, sanctions refer more to activities which are externally applied to create consequences. One sanctioning activity can simultaneously have different consequences, which we understand in Maslow's (1987) sense as the impact on human need satisfaction. We will embed the new set of consequences (material, social, moral) into the IAD framework and apply it in our case study.

2.1. Material, social, and moral enforcement

Assuming that compliance with an institution leads to socially optimal outcomes, it is desirable that rules or norms are enforced so that the individual's expected total payoff from breaking a prescription is smaller than the expected total payoffs from obeying it (Coleman 1987).³ The typical association of institutional consequences is a punishment or reward. The prediction of human behaviour can, however, be improved if one considers alternative, more internalized consequences (Ostrom 2008) such as self-blame or self-praise. For our assessments, we will distinguish three types of institutional consequences based on the nature of incentives which they provide:

1. material consequences
2. social consequences
3. moral consequences.

Material consequences are based on incentives which influence material well-being (Cummins 1996), or, in other words, the satisfaction of physiological needs (Maslow 1987). Common forms include fines, monetary rewards, corporal punishment, or imprisonment (Becker 1968). Material (dis-)incentives can originate from various sources and are, in the logic of the Grammar of Institutions, often institutionally assigned (e.g. governance subsidies or fines assigned by self-organized groups). In contrast, non-institutionally assigned material consequences

³ From a social planner's perspective this is rational as long as the overall enforcement costs do not exceed the costs to society due to non-compliance (Becker 1968; see also Cardenas et al. 2000).

are, for instance, the corporal punishment one can expect when provoking a violent person or flagellatism.

Social consequences are based on incentives which affect the satisfaction of belongingness and status needs. It is based upon the human striving for praise and intimacy (Cummins 1996) and the avoidance of blame (Smith [1789] 2004). People comply with institutions because they fear anger, hostility, social isolation, loneliness, ostracism, or rejection in the case of non-compliance with expressed expectations (Coleman 1987; Maslow 1987; Smith [1789] 2004; Ostrom 2005; Andersson and Ostrom 2008). Social (dis-)incentives often have the strongest effect if they are based on lengthy processes of developing enduring and reliable social relationships with frequent contacts. The agents' utility must be affected by each other's praise or blame (Becker 1974; Fehr and Schmidt 1999). This requires networks to be of relatively small scale (Bowles and Gintis 2002). Social consequences are always of external origin as they require human interaction. Social consequences largely overlap with the changes in expected payoffs originating from external sources δ^{oe} and δ^{be} of Crawford and Ostrom (1995). They can, however, also be institutionally assigned. A group can clearly formulate the exclusion from the social network as a consequence of disobeying with one of its institutions. A court can prohibit a stalker from having any contact with her victim.

Moral consequences, in contrast, do not rely on external incentives to comply with an imperative. They are based on incentives influencing emotional well-being (Cummins 1996; Frey and Stutzer 2002), or, in Maslow's (1987) words, the satisfaction of needs for self-esteem and self-actualization. People assign positive or negative intrinsic values such as joy or regret to their actions (Ostrom 2005). Recent developments in economic theories introduce the wish to behave according to one's self-image and the internal costs of not keeping promises (Bénabou and Tirole 2006; Ellingsen and Johannesson 2008). Behaviour that is motivated by a sense of moral duty does not only rely on others but on the intrinsic belief in the rightness of an action (Smith [1789] 2004). Neuroeconomic research gives evidence that subjects experience positive hedonic responses when they cooperate independently on receiving external incentives (Rilling et al. 2004). In terms of the Grammar of Institutions, moral (dis-)incentives are equivalent to the changes in expected payoffs originating generally from internal sources δ^{oi} and δ^{bi} (Crawford and Ostrom 1995; Ostrom 2005). Sometimes the border between moral and social enforcement is fuzzy. Schlüter and Volland (2010) present a field study of an honour based payment system where people behaved more honestly when their actions could be observed by other customers even though no social or material consequences could be expected from them.

2.2. The origin of consequences and the costs of enforcement

Transaction costs have a strong impact on the probability of monitoring and sanctioning taking place. In natural resource management, these costs depend on various aspects of the social-ecological system, such as the accessibility of the

system or the population density. As a general feature, we argue that, independent from the resource system, the transaction costs of enforcement are lower the more internalised the enforcement becomes. We understand internality as how close the person who monitors the compliance and who provides a consequence for obeying or disobeying is to the addressee of the (dis-)incentive.

From a social planner's perspective, moral (dis-)incentives are the cheapest way of transmitting consequences to individuals. Every person is simultaneously monitor, incentive provider and addressee of moral consequences. No external monitoring is necessary as people know whether they are right or wrong in their actions (North 1990; Searle 2001). Morals steer behaviour very efficiently (North 1990; Ostrom 2000), because self-esteem and self-actualisation work immediately as an intrinsic mechanism. Even if no one learns about their actions, people suffer from self-blame and enjoy self-praise (Ostrom 1990, 2005; Smith [1789] 2004). No external costs arise from the provision of moral enforcement incentives. For effectively changing behaviour, the perceived moral consequence must be stronger than the expected pay-off from disobeying the institution. Moral consequences from stealing a colleague's pen are most likely weaker than the ones from stealing her car. Considering the value of the items, however, it is probably often more effective to enforce the private property of pens solely by moral consequences than the private property of cars.

By nature, social enforcement is of external origin. It requires the costly monitoring of compliance. As described earlier, social consequences are mainly applied within social networks and monitoring is often part of daily activities, which reduces transaction costs compared to e.g. control by specialised agents such as the police. Within the network, each member is simultaneously monitor, incentive provider and addressee (Bowles and Gintis 2002). Once the obeying or breaking of a prescription is detected, the provision of social consequences is associated with exposing themselves within the community by pointing out the mistakes of others. A provider of social (dis-)incentives may face psychological costs (Coleman 1987) or benefits. One reason why enforcement costs tend to be low is that the knowledge of underlying moral values is shared by group members and not entrusted to specialised experts such as judges (Benda-Beckmann 2002).

It is much more difficult to make a general statement about the transaction costs related to the provision of material consequences. They depend on who is monitoring and enforcing. In the uncommon case of flagellants, the enforcement costs for the society are zero. For a social network of limited size, which backs up its institutions with material consequences, the monitoring costs are comparable to the ones for social consequences. We may also expect the costs of providing consequences to be moderate as again the knowledge of the institution is shared by the group. The larger social networks grow, the more expensive enforcement becomes. In bigger organisations, whether markets, hybrids, or hierarchies, material consequences become more important as relationships become more impersonal. Even if one considers accomplishing economies of scale, the employment of

police, guards or watchmen for monitoring is costly (Becker 1968) as are trials at courts, imprisonment or the collection of fines (Williamson 1983).

The costs of compliance with institutions in large organisations strongly depend on the relation between different consequences. One important aspect is whether prescriptions of different origin are in line with or contradict each other. Ostrom (2005) emphasises that the costs of external enforcement become very high if they are perceived to be illegitimate according to moral values. Incentives and preferences may complement or substitute each other (Bowles and Polania-Reyes forthcoming). Bowles and Hwang (2008) argue that a sophisticated social planner would adapt her enforcement to such interactions. They discuss in particular how external enforcement can degrade the internalised moral kind. An external incentive can signal the incentive providers' distrust and reduce the self-determination of the addressee. Reinforcing morally enforced behaviour by external social or material consequences can lead to crowding out, which destroys the internalised motivations (Ostmann et al. 1997; Cardenas et al. 2000; Bowles 2008). External incentives can, however, also increase the confidence that everybody will comply with an institution. Crawford and Ostrom (1995) are concerned that moral values of previously compliant players may erode if violators are not externally punished (see also Henrich et al. 2006). Showing social approval or disapproval often also has the intention of initiating a change in a person's internal moral values. Equally, one purpose of laws and regulations is to influence moral values (Ostrom 2005).

A sophisticated social planner should not only have in mind incentive interactions, but also the transaction costs of specifying institutions. Institutions that are based on material incentives are more open to change than those based on social or moral ones. Even if one considers transaction-costly constitutionally-legitimate procedures of law-making in modern democracies, it is easier to formulate or change a law than to establish reliable friendships or internalise values (Coleman 1987; North 2000; Ostrom 2000). Both social and moral consequences are built on shared cultural values, traditions, convictions, and customs (Ostrom 2005) that determine which actions are socially rewarded and which are sanctioned in a group (Coleman 1990). Such values are socially transmitted and spread from one generation to the next via lengthy teaching, socialisation, imitation, and conditioning (Coleman 1987; North 1990; Smith [1789] 2004; Ostrom 2005).

If a group is sharing moral values the probability is high that they develop mutually accepted institutions that hardly require costly enforcement (Ostrom 2005). The fact that such values are slow to change, but have the potential to reduce the transaction costs of enforcement is one reason why institutional change is mainly an evolutionary process (Williamson 2000). North (1990) highlights that deeply rooted cultural values are preconditions for social relationships and formal institutions. Formal institutions survive due only to the legitimacy bestowed by the socio-cultural system (Cleaver 2000). Weber (1905) stressed that political change requires a change of norms.

It can, however, not be generalized that material consequences are always based on moral ones. In an authoritarian organization, the leaders can define institutions which are disconnected from moral values and enforce them with strong external power. This is costly. Existing institutions that are based on moral and social consequences form a capital, which can be applied by social planners to save enforcement costs. At the same time, public policies that impose new institutions without recognising moral values can erode this capital (Ostrom 2000, 2005).

It is a challenging task for a social planner to decide upon the right level of material incentive provision. On the one hand, she should capitalize on the existing moral capital in order to save transaction costs. On the other hand, she runs the risk of eroding moral consequences by applying external incentives such as in cases where powerful governments disrupt local institutional structures without the capacity to replace them with anything comparably functional (Stiglitz 2000).

Based on this discussion, we propose a few adaptations to the Grammar of Institutions. First, we argue that different kinds of consequences cannot be disconnected, and, due to their interactions, cannot be considered cumulative. Second, we were facing difficulties in distinguishing between when a consequence is institutionally assigned and when it is just based on institutions. We therefore propose to replace the institutionally assigned consequences as well as the delta parameters with moral, social and material consequences. All three consequences are covered by an alternative parameter Γ which comprises the total change in expected payoffs. The Γ parameter can thus be defined:

$\Gamma = f(\gamma^m, \gamma^s, \gamma^p)$, where

γ^m = the change of expected payoffs due to moral consequences,

γ^s = the change of expected payoffs due to social consequences,

γ^p = the change of expected payoffs due to material consequences.

The shape of the Γ function depends on the interactions between the different consequences. In this paper we understand the term enforcement as the Γ parameter and its components. It includes monitoring and provision of consequences.

3. Study area and data sources

The investigations were conducted by different researchers within the framework of the BIOTA Southern Africa research programme (see www.biota-africa.org). Within the BIOTA project, so-called Biodiversity Observatories were established in order to facilitate interdisciplinary research. All BIOTA research was supposed to be related to the observatories, which are demarcated plots of 100 ha in size. One of these plots was established in the Karas region in the southern Namibian communal area Namaland (Figure 1).

The paper presented here is drawing conclusions from linking the findings of different institutional analyses undertaken around the Tiervlei observatory in

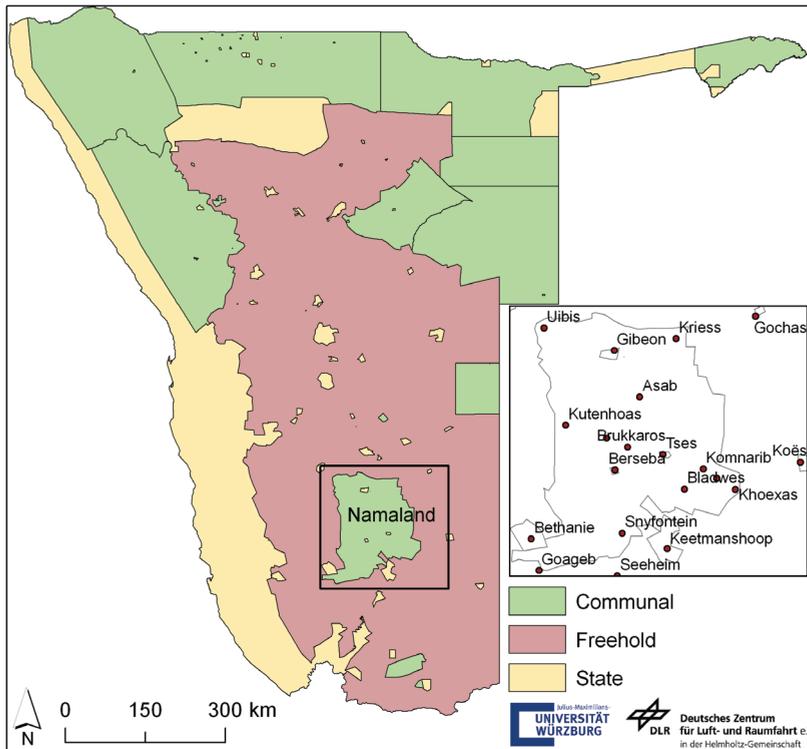


Figure 1: The research area Namaland in Namibia.

Namaland between 2003 and 2007 (see Table 1).⁴ All studies have in common that they included the users of the observatory. Falk (2008) conducted semi-structured interviews with all household heads ($n=27$) of the Tiervlei Water Point User Association (WPA), into which the territory of the BIOTA observatory falls. Bock (Bock and Kirk 2006; Falk et al. 2009) also interviewed all household heads of the Tiervlei WPA, but extended her sample to neighbouring farming units (covering the whole population of these units, $n=60$). We further present results of two independent experiments implemented by Vollan (2009) in 2006 and 2007. The experiments allow us to unravel stepwise the effects of different institutional consequences. Vollan's experiments were announced through written

⁴ There is no scientific evidence that the BIOTA Tiervlei observatory is a representative social-ecological system for the region or even the communal area. Combining the different perspectives of different studies around the same area provides insights into the pasture management and in particular enforcement challenges for one case. We use the case to demonstrate exemplarily the role and interaction of different institutional consequences. Our policy applications are not specific to the results of survey items or experiments, but are conceptual proposals for policy-making.

notices at the local shops and the municipality office as well as by word of mouth prior to conducting the experiments. In most cases a research assistant also went from door-to-door to inform and recruit people. Upon arrival, participants agreed to take part in a game and to fill out the survey forms. They were made aware that they could earn some money during the exercise. The experiment participants were partly Tiervlei residents.

4. Case study on the governance of pasture management

The total Namaland population consists of 5800 people with a population density of 0.2 people per square kilometre. Low and highly variable average rainfall of around 150 mm limits natural resource use opportunities. The main livelihood strategy is small stock farming for subsistence use.

Land ownership is vested with the state in trust of the community. Namaland farmers use their pastures as a common pool resource. As a consequence, they face the challenge of coordinating their rangeland management (Falk 2008;

Table 1: Description of different data sources and corresponding socio-demographic variables¹

	n	Year of research	Data collection method	Average age	Proportion of male ²	Proportion of farmers	Related publications
Analysis of natural resource management institutions	27	2003	Semi-structured interviews, document analysis, discussions with key stakeholders	56	78%	78%	Falk 2008
Analysis of natural resource management institutions	60	2004/2005	Semi-structured interviews	48	78%	97%	Bock and Kirk 2006; Falk et al. 2009
Social capital survey	64	2004/2005	Semi-structured interviews	47	76%	73%	Vollan 2009, 2012
Common-pool resource game	50	2006	Economic experiments	n.a.	8.5	78%	Vollan 2008, 2009; Hayo and Vollan 2012
Third party punishment game	70	2007	Economic experiments	27	60%	n.a.	Vollan 2009, 2011

¹The studies were part of larger research projects in different regions of Namibia and South Africa. For this research paper we only analyse the data for the Namaland in southern Namibia while many of the related publications analyse the whole sample or different aspects.

²The fact that mainly household heads have been interviewed in particular explains why in these two studies the proportion of male respondents is very high.

Vollan 2009). Practices which have a positive impact on productivity are, for instance, stocking rate control, resting, strategic trampling, and seed dispersal. Seventy-eight percent of Bock's respondents claimed to practice rotational grazing but only 12% acknowledged controlling their stocking rates.⁵ Figure 2 shows that the rangeland resources of Tiervlei are under stress. Independent from the precipitation, over a period of nine years the number of plant species was lower on our research site in communal Tiervlei (Nabaos) compared to a neighbouring government research farm (Gellap-Ost).⁶ We relate these signs of degradation to institutional weaknesses and in particular ineffective enforcement. In this section we will assess the governance system of communal pasture management focusing on the enforcement aspect.

The operational institutions-in-use of Tiervlei rangeland management are affected by a diverse set of interlinked collective choice arenas. The government's statutory collective choice arena provides laws and regulations for the management of Namibian communal land. The traditional authorities' customary collective choice arena provides customary laws for the specific Namaland community and the management of their resources. At the same time the community's self-organisation collective choice arena specifies new management institutions. The operational institutions are further affected by internalised moral values, which have been transmitted via teaching and imitating processes. In Appendix 2 we link certain institutions to specific collective choice arenas.

The Namibian government is obliged to administer communal land in trust for the benefit of traditional communities residing on it. The allocation of customary land rights for residential and subsistence farming purposes is delegated to traditional authorities (Republic of Namibia 2002). In Namaland, traditional authorities are not recognized by the government because there is a long-standing dispute over the chieftaincy between two families (Adams et al. 1990; Keulder 1997; Kössler 2001). This weakens their position.

Use rights of Tiervlei pastures are restricted to the residents of the area. In Falk's (2008) case study farmers stressed that there is no more space for newcomers and that they would only temporarily allow other people to use their territory in cases of emergency. They stated that the community's decision is more important than the decision of traditional authorities. Nonetheless, the respondents reported a case where traditional authorities allowed somebody to settle in a camp without

⁵ Do you practice grazing rotation? n=58, n=45 every season, median=every season. Do you control your stocking rate? n=58, n=3 every season, n=4 every year, n=51 never, median=never.

⁶ All differences between the Observatories are significant at $p < 0.01$ (Mann-Whitney-U) except for total species richness in 2004 ($p = 0.058$). The Gellap research station is a government owned farm, which is used for grazing and breeding experiments. On Gellap a sophisticated vegetation monitoring and range management system is implemented. Since the farm receives a fixed budget and is not dependent on the income from farming, there are few incentives to overuse the farm and the need to enforce grazing regulations is low. The farm can be considered a benchmark for how the vegetation in the area could look like under sophisticated management. The BIOTA observatories of Gellap and Nabaos are adjacent and separated only by a fence.

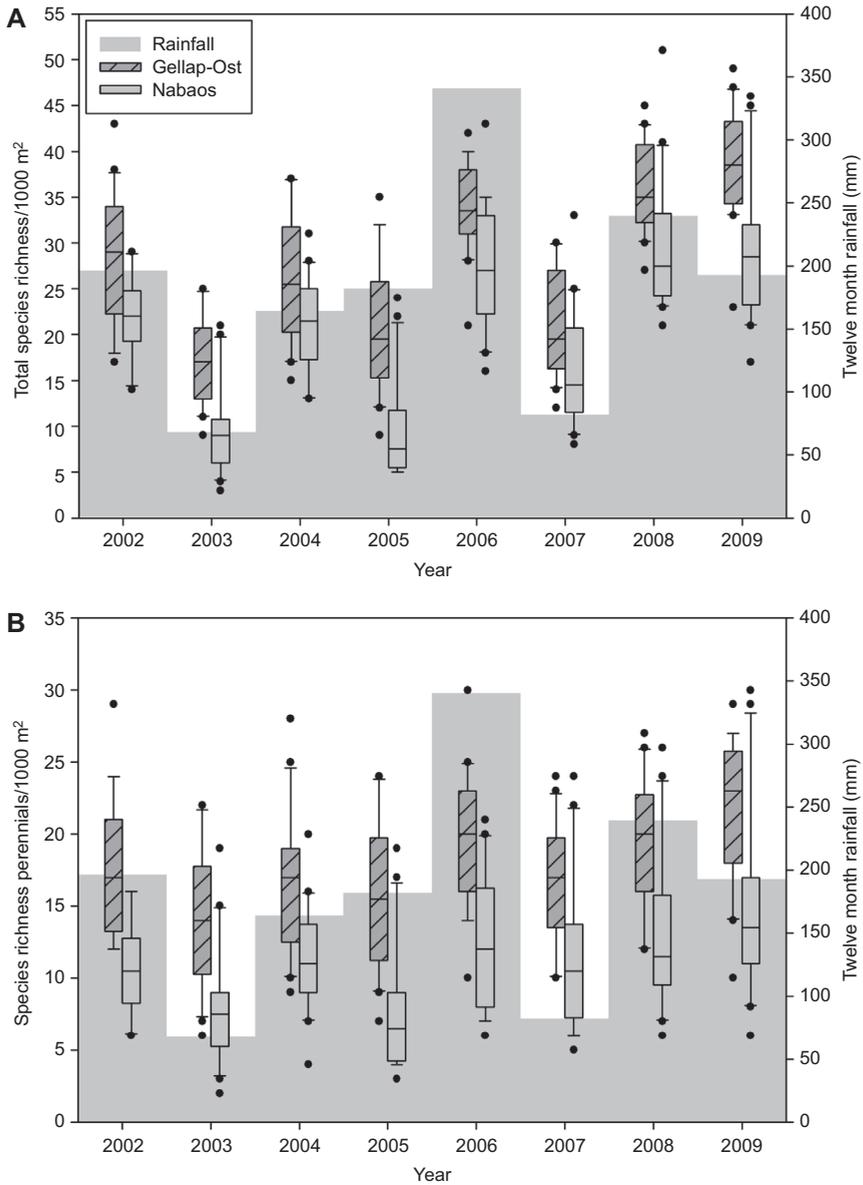


Figure 2: Annual and inter-annual variability of (A) total vascular plant species richness and (B) richness of perennial species for 20 biodiversity monitoring plots (each 0.1 ha) compared to total rainfall (July to June, bars) at the BIOTA Observatories Gellap-Ost and Nabaos (source: based on Haarmeyer et al. 2010).

knowledge of the grazing conditions and despite resistance from the current users. Simultaneously, some farmers undermine the regulations on land access by taking livestock from their friends or extended family and add it to their herd. Thus, a herd of livestock might belong to many people, although only one might have the right to use the land. Among other reasons, the Namibian government introduced Land Boards as part of Communal Land Reform in order to solve such conflicts (Republic of Namibia 2002). Nonetheless, the legally possible option to take intruders to the Land Board or court for violating the Communal Land Reform Act of 2002 was not mentioned in the interviews (Falk 2008). When asked how the residents can prevent unauthorised grazing, they stated that they would mainly talk to intruders and try to convince them to leave. This approach can be interpreted as the provision of social consequences. Should these incentives be insufficient, the traditional council and the water point committee are informed. These authorities would also mainly put social pressure on the intruder.

Land access regulations are the only institution limiting the intensity of rangeland use. Both farmers and traditional authorities agree that there are no limitations to the number of livestock residents may keep within the area (Falk 2008). The Regulations of the Communal Land Reform Act demand that communal land must be managed in accordance with accepted farming practices (Republic of Namibia 2003). Land boards may suspend customary land rights if practices contradict government recommendations (Republic of Namibia 2003). The Communal Land Reform Act (Republic of Namibia 2002) gives traditional authorities the power to determine the amount of livestock people can own. However, these laws are vague. In addition, the enforcement of pasture management regulations was and is not of high-priority for the statutory executive and judiciary organs. Monitoring rangeland management practices is prohibitively expensive for the police as it requires basically the permanent control of every farmer. Farmers have a long history of resisting external material consequences. In the past, attempts by the colonial administrations to enforce measures, such as the levying of livestock fees, largely failed (Kössler 2001). One reason is the large size of the area, making it very costly for an external agent to monitor livestock numbers. It can be seen in this context that government extension officers state that the laws are solely educational instruments, which are not meant to harass farmers with material consequences, but rather to create moral consequences by changing internalized values.

One challenge for the governance of natural resources in Tiervlei is the fact that neither traditional nor statutory authorities are permanently present at the local level. The physical distance increases their transaction costs of monitoring the developments in the area. Many Tiervlei residents lack appropriate means of transport to cover the large distances. Contacting traditional or statutory authorities is therefore expensive for them and consequently avoided. Increasingly used alternative organisations are local water user associations (WPA), which have been recently established in the framework of the Rural Water Supply Reform. They consist of community members who permanently use a common water point. Following subsidiarity principles, the associations have the right and

the duty to operate and maintain their water source in order to foster a sense of ownership (Republic of Namibia 2004). In a self-organized collective choice arena, they have to decide on their own locally adapted and respected water institutions. Among other functions, they also regulate the access to water. Since the land cannot be used without water, they consequently wield indirect control over access to the land. It was repeatedly reported that the water committees, as an operative organization of the association, also become involved in decisions on the management of resources other than water. The committees have, among other duties, the task of monitoring regulation compliance. Their constitutions give them rights to provide material consequences such as issuing fines. The probability that this happens is low as it is too expensive for the committees to employ sufficient guards to enforce material consequences. The statutory judiciary and executive organs are supposed to enforce the associations' legally recognized by-laws as a last resort. This is, however, improbable as the costs for the police to make inquiries into the case, for courts to come to a decision, and for the police to collect fines are very high considering the nature of the matter. Taking into account the limited capacities of the judicial and executive organs, they give more capital crimes higher priority.

The decentralized approach of the WPAs encourages a self-organized decision-making process where institutions are specified in a way that material consequences are in line with internalized moral consequences. This increases the probability that a majority of farmers will believe in the rightness of these institutions and are even willing to provide social consequences when observing non-compliance of fellow farmers. In this way, the need to make use of the more costly to apply material consequences is reduced.

Bock asked her respondents in her 2004 survey who is responsible for making the rules in their area. From the perception of the residents, no collective choice arena dominates the Tiervlei operational institution making. Most often mentioned with only 41% was the farmer herself. In Vollan's social capital survey, only 15% of the respondents confirmed that they can always influence decisions which affect their land. Two-thirds said that they can influence the decisions at least sometimes.⁷ Again two-thirds of the respondents believe that rules adapt to the needs of the people.⁸ Assuming that farmers would only make rules according to their moral values, we took a closer look at potential moral and social incentives related to natural resource management.

Eighty-four percent of Vollan's respondents stated that they would accept a limitation of stocking rates in order to prevent environmental degradation.⁹

⁷ Do you feel that you can influence decisions that affect your area? n=55, n=9 never, n=38 sometimes, n=8 always.

⁸ Do you think that the rules change according to the needs of the people? n=55, n=17 no, n=38 yes.

⁹ In favour of biodiversity, we should all accept to limit the amount of animals. n=64, n=3 no, n=54 yes, n=7 don't know.

Also, the majority of respondents in Bock's survey stressed that farmers should be stopped from an unlimited use of the pasture.¹⁰ Such expressions do not fit to the fact that only 12% of the respondents report controlling their stocking rate.¹¹ Three-fourths of the farmers do not even know the carrying capacity of their pastures.¹² Eighty-one percent of the respondents acknowledge serious environmental problems in their area, but many of them question the impact of land use on the ecology.¹³ Two-fifths believe that local organizations do enough to prevent the overuse of resources.¹⁴ The fact that many farmers do not see an urgent need to coordinate rangeland management is also supported by the statement of almost half of the interviewed that they do not react when observing the overgrazing of fellow farmers¹⁵. Nonetheless, at least 44% stressed that they would try to convince the other to cease, which can be interpreted as a willingness to apply social consequences. The respondents saw a need for external monitoring as almost all of them stated that when people in the community are not monitored they tend to be dishonest.¹⁶

The lack of self-organized regulation of management practices cannot alone be attributed to the lack of capacity of resource users. The prevention of unauthorized grazing by intruders shows that the farmers are able to provide relatively effective institutional consequences when they have a strong and shared interest.

Appendix 2 summarizes our analysis of Tiervlei pasture management institutions. The monitoring of compliance is de-facto only done by resident farmers. The detection of non-compliance only exceptionally leads to material consequences. Compliance, therefore, mainly depends on how strong moral consequences guide the farmers and how strong they are willing to provide social consequences to influence fellow farmers.

5. Experimental analysis of enforcement provision

The effectiveness of moral and social consequences is difficult to observe in surveys. We therefore complemented our research with economic experiments. In Section 5.1, the first 10 rounds of a repeated one-shot common pool resource

¹⁰ Livestock farmers should not be prevented to keep their animals on the rangelands for as long as they want. n=57, n=36 disagree, n=9 neutral, n=16 agree.

¹¹ Do you control your stocking rate? n=58, n=3 every season, n=4 every year, n=51 never.

¹² Do you know the carrying capacity for the grazing area in your community? n=64, n=50 no, n=14 yes.

¹³ Are there environmental problems in your area? n=58, n=7 no, n=4 uncertain, n=47 serious.

The problem of landuse with respect to environmental damage (overuse, collection of firewood) seems to me to be overestimated. n=64, n=15 no, n=40 yes, n=9 don't know.

¹⁴ Local decision-makers do enough to prevent the land from being overused. n=64, n=30 no, n=25 yes, n=9 don't know.

¹⁵ You observe, that your neighbour puts more animals than are good for the land on the same place where your animals are grazing. What do you do? n=61, n=29 nothing/no possibility, n=27 try to convince the other that we should reduce animals, n=5 unilateral reduction.

¹⁶ If people in this village are not observed, they tend to be dishonest. n=58, n=56 yes, n=2 no.

experiment are presented to show the impact of mainly moral consequences on pasture management. The experiment is framed according to the cooperation problem of real-life common pool rangeland management situations of Namaland farmers. In Section 5.2, the experiment is extended for another 10 rounds by adding social and material consequences to the game. It teaches us about the impact of different institutional consequences and their interactions. In Section 5.3, we discuss the potential of moral consequences in combination with social and material ones based on an unframed one-shot trust experiment. In both experiments, players made anonymous decisions and they earned real money dependent on their decisions and the decisions of the other players.

5.1. Common pool resource experiment without external consequences

Our common pool resource experiment¹⁷ simulates an everyday challenge in communal farming among five players in which individual harvests create negative externalities to the other four farmers through a reduction in available fodder. The design imitates the real-life farming situation of Namaland farmers and is linked to our rangeland governance studies. A framed common pool resource experiment was conducted as a 20 rounds repeated one-shot experiment and fixed partner matching. The experiment is framed as a task for farmers to decide on the number of sheep (number between one and nine) they want to possess on jointly owned grazing land. The theoretical economic assumptions imply that individuals dealing with collective grazing resources are presumably trapped in social dilemmas that can lead to overuse. The social optimum within the experiment is for each farmer to possess not more than 2 units of livestock while the Nash equilibrium prediction is 7 units. The first 10 rounds of the experiment were similar to an unmanaged situation where players were not monitored and or had to fear material or social consequences.

In the experiment without material or social consequences, participants stocked the virtual pasture with on average 5.4 sheep per person (see also Figure 3). This very moderate number indicates that the players restricted themselves in contradiction to the theoretical assumptions. The only incentives which could have driven their decision to put a relatively low stocking rate on the land are moral consequences. This result is in line with the findings of Prediger et al. (2011), who assessed the cooperation and coordination patterns in neighbouring Nama communities.

5.2. Common pool resource experiment with external consequences

After round 10 of the experiment 5.1, the participants could vote for three different rules (treatments):¹⁸ a) face-to-face communication allowing them to

¹⁷ The experiment design was adapted from Cardenas et al. (2000).

¹⁸ The participants could vote for one of the three treatments to be applied in their group after round 10. The treatment which was voted for by the majority of the group members was implemented. If the outcome of the vote was a tie a random choice was made.

send signals of approval or disapproval, b) material disincentives as a fine for putting too much livestock on the common pasture,¹⁹ and c) material incentives as a reward for putting fewer livestock on the common pasture.²⁰ The experiment was carried out in 10 sessions with a total of 50 participants. Material incentives were implemented in four sessions, and material disincentives and communication in three sessions each. In the experiment, the material (dis)incentives were implemented with a probability of 20%. This reflects the real-world problem of high enforcement costs. Communication was possible before every round. Communication can help to create trust as players can obtain information about each other's moral values (Ostrom 2005). Balliet (2010) stresses that face-to-face communication can improve cooperation as it allows the players to send signals, such as eye gaze, sound, and touch (see also Ostrom et al. 1994; Ostrom 2005). Such signals show approval or disapproval and can be interpreted as social consequences.

Figure 3 illustrates that material disincentives were the least effective of the three instruments to encourage socially optimal resource use. In this case, it fares equally well as the situation in the first 10 rounds without any external consequences while communication and material incentives improved cooperation. We used regression analyses to confirm these findings. Models one to three in Table 2 show that the players reduced their stocking rates with the introduction of the communication and material incentives rules. Model one further suggests that, including all experiment rounds in the analyses, material disincentives also have a positive effect. Models two and three imply, however, that this effect can be observed only due to an adaptation period during the first rounds after the introduction of the disincentive. Excluding the experiment rounds 11 and 12 (Model 2) and 11–14 (Model 3), respectively, gives evidence that the longer the experiment is played, the more similar the stocking rates are to the experiment rounds without external enforcement (Table 2, Vollaard 2008). The material disincentives are not only inefficient; they are also the least desired enforcement mechanism among the participants. In a vote after having played 10 rounds, 22% of them chose the material disincentives. At the end of the game in a hypothetical referendum, only 12% opted for them. Namaland farmers perceive negative material consequences as an inappropriate mechanism for encouraging cooperation while lawmakers and economists tend to focus on this solution.

At the same time, groups who choose the more widely accepted material positive incentive achieved the result closest to the social optimum (Figure 3, Table 2 Models 1 to 3). Positive material consequences seem to be likely complements of moral consequences while negative material consequences are

¹⁹ With a probability of 20% anybody playing more than two units of sheep per round will be sanctioned with 50 points per unit exceeding the recommendation of two units.

²⁰ With a probability of 20% anybody playing not more than two units of sheep per round will be rewarded with the total of 100 points.

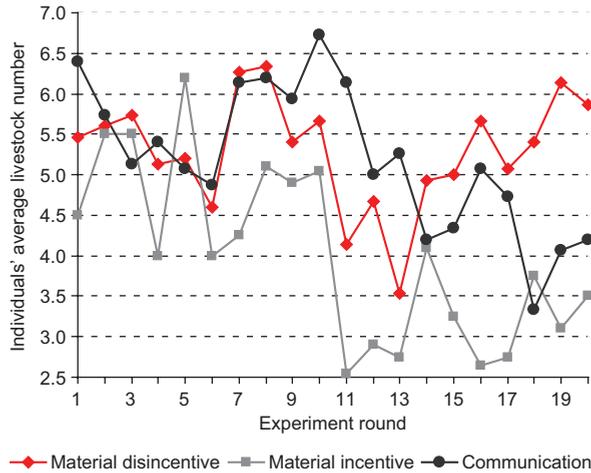


Figure 3: Results from the common-pool resource experiment in southern Namibia (based on Vollan 2008).

rather substitutes for moral ones. Also, communication significantly improves performance compared to the situation without any external consequences (Figure 3, Table 2 Models 1 to 3). The possibility to apply social consequences, therefore, seems to complement the moral ones.

Model 4 (Table 2) indicates that after adaptation took place, groups playing the material disincentive rule had significantly higher livestock numbers than the ones under the communication rule. It further shows that material incentives more strongly motivated players to reduce their stocking rates than communication. Despite this result, from a social planner's perspective, social consequences are cheaper than both material incentives and disincentives. However, its success crucially depends on the heterogeneity of group members' interests and pre-existing trust among members.

5.3. Third party punishment experiment

In order to test the impact of different institutional consequences, we further extended a simple one-shot trust experiment by a social dimension and a third party punishment option (Vollan 2011). The experiment was carried out in 3 sessions with a total of 70 participants ($n=23$ in role A, $n=22$ in role B, $n=25$ in role C). The experiment is played among three anonymous players. Player A first has the opportunity to give both himself and Player B N\$10²¹ in which case the game is over. Alternatively, Player A can present Player B with two choices: a) either Player B can take N\$30 out of N\$35 leaving Player A N\$5, or b) she

²¹ Average exchange rate 2006: N\$1=€0.12 (<http://www.oanda.com>).

Table 2: Regression analysis of Common Pool Resource experiments; the models explain how many heads of sheep a player decided to graze on the common pasture (average=4.7)

Model type	Model 1	Model 2	Model 3	Model 4
Experiment rounds included in model	Fixed effects 1–20	Fixed effects 1–10 and 13–20	Fixed effects 1–10 and 15–20	Random effects 15–20
Dummy material disincentives	–0.801* (0.466)	–0.715 (0.540)	–0.380 (0.688)	1.233** (0.527)
Dummy material incentives	–2.071*** (0.484)	–2.043*** (0.495)	–2.096*** (0.532)	–1.122** (0.483)
Dummy communication	–1.427** (0.605)	–1.735*** (0.637)	–1.834*** (0.665)	Reference category
Experiment round	0.0301 (0.0268)	0.0341 (0.0283)	0.0302 (0.0330)	0.0497 (0.0696)
Constant term	5.185*** (0.178)	5.163*** (0.177)	5.184*** (0.189)	3.419** (1.340)
Observations	1000	900	800	300
R ²	0.0773	0.0756	0.0767	0.00192
R ² within	0.0773	0.0756	0.0767	
R ² between	0.249	0.180	0.186	0.328
R ² overall	0.0975	0.0877	0.0905	0.144

Robust standard errors in parentheses; *p<0.1, **p<0.05, ***p<0.01.

can split N\$40 evenly between Players A and B. The unique sub-game perfect equilibrium is the (10, 10) outcome since Player B will always prefer N\$30 over N\$20. In addition, a Player C plays the role of an external material enforcer. We used the strategy method and asked player B what he would do in case Player A did not take the N\$10. This was done in order to have observations for all B players. The enforcer receives N\$20, which she can keep or invest in the enforcement of cooperation simulating the costs of monitoring and providing material consequences. Every dollar invested in enforcement by Player C is multiplied by five and subtracted from the punished player. Thus, if Player C wishes to punish Player B with N\$4, Player B receives N\$30–N\$4×5=N\$10 at the end of the game and Player C receives N\$20–N\$4=N\$16. In this way Player C can materially reinforce the potentially existent moral norm of fair sharing. In order to test the impact of social consequences, we further asked the participants to state how they make their decisions if the other player is an unrelated villager, a friend or a family member. However, the three choices (villager, friend, family) were not hypothetical but real experimental decisions with a certain probability of being implemented if the participant had stated to have more than two friends or two family members in the session (90% had at least two friends and 65% at least two family members). Their decision was also anonymous as participants did not know with which friend or family member they were paired. These features of the experiment were known to the

participants.²² In order to analyze the interaction between material and social consequences, Player C was asked how she would sanction an unfair transaction between two unrelated villagers, two friends, or two family members (Vollan 2011). The framing does not fully cover social consequences as the players could not directly interact and show their approval or disapproval. One could argue that the internalized moral consequences for cooperation differ between people with varying social relations. We still believe that the players anticipated the social consequences that they would expect from villagers, friends and family members.

The results are presented in Figure 4 by differentiating for the degree of social relations. If anonymous Players A and B are threatened with an external enforcer, 27% of Players B choose a strategy of sharing equally. Thus, combining moral with material consequences leads to a moderate social outcome. In the context of natural resource management in Namaland, this means that farmers would probably comply with an institution even if moral consequences were complemented by material consequences such as a fine.

When a social dimension was introduced and the game was played among two friends, 52% of Players B shared fairly, and when the game was played among two family members the share increased to 60% (see Figure 4).²³ The combination of material (fine from Player C), social (fear of experiencing anger or disapproval) and moral (one does not cheat a friend) incentives increases the level of cooperation significantly.

In order to test for the significance of differences we used regression models as reported in Table 3. Model 5 shows that Players A made significantly more offers to Players B if B was a family member and not a stranger. Model 6 implies that Players B shared the offer of A more fairly if A was a friend or family

²² Upon arrival, participants received a sheet asking them to identify their friends and family members within the session. Then the experimental instructions were read aloud to all participants and visualized on a (white) board by the same native speaker in all villages. Participants also received written instructions and had to answer a set of test questions on the experiment. Thereafter, one by one, the participants were asked into a separate room. In the room, the researcher first checked the answers to the quiz and made sure the participant understood all possible outcomes of the game. Then the participant was asked to make her decision according to her role (A, B or C) and for villager, friend, family member (if available). We always used the same ordering (villager, friend, family) and thus cannot test for order effect. At the end of the game each participant was randomly matched with another participant. This matching determined which of the three decisions was implemented (villager, friend, family). Since matching of players was random, participants were informed that they could be paired with either one of their family members, friends or an unrelated villager. However, they could not know for sure with whom they were paired as people had to name at least two people for each category. Thus, the decision-regarding kinship was not hypothetical and the experiment was anonymous as no one knew exactly with whom she/he was paired with.

²³ There are, however, cases where players played less cooperative with more closely related experiment partners. In 13% of the cases player B cooperated with a stranger but not with a family member; in 14% of the cases player B cooperated with a friend but not with a family member.

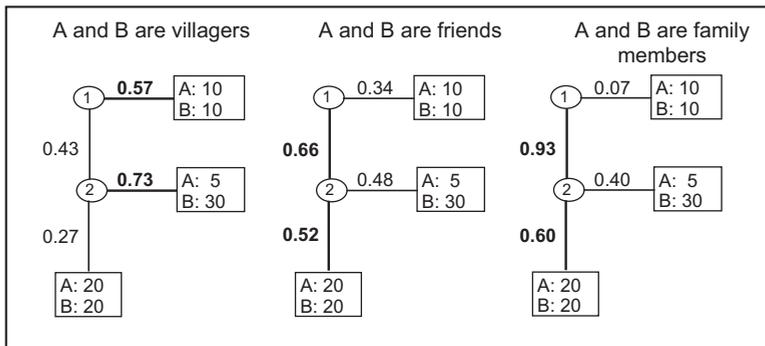


Figure 4: Trust game with third party punishment option and differing social relations (relative frequencies of strategies). (Note: Bold lines and numbers indicate majority choices of participants. Based on the Namibian sample in Vollan 2009, 2011).

member instead of a stranger. These results provide evidence that the experiment participants played more cooperatively the closer the social relations with the opponent.

In the same experiment we further assessed to which extent the actor’s decision regarding whether or not to adhere to an institution is influenced by her perceived probability of the other player externally enforcing non-compliance. In addition, the actor might experience different degrees of self-blame as a moral consequence depending on the expectation they have regarding the fairness norms of the other player. In order to predict an actor’s behaviour, it is consequently as important to know her own and other-regarding preferences as it is to know her expectations of other actors.

Table 3: Regression analysis of the third party punishment experiments explaining how different experiment decisions were influenced by the social relation of the players

Model type	Model 5 Player A makes offer (yes/no) Probit	Model 6 Player B shares fairly (yes/no) Probit	Model 7 Player C punishes Player A for not making an offer (1–20) Fixed-effects	Model 8 Player C punishes Player B for not sharing fairly (1–20) Fixed-effects
Players A and B are family members	1.629*** (0.574)	0.858* (0.438)	0.400*** (0.131)	0.440* (0.256)
Players A and B are friends	0.595 (0.407)	0.664* (0.399)	0.440*** (0.132)	0.880*** (0.270)
Constant term	-0.164 (0.265)	-0.605** (0.288)	-0 (0.0797)	0.760*** (0.161)
Observations	55	58	75	75
R ²	0.15	0.06	0.247	0.214

Robust standard errors in parentheses; *p<0.1, **p<0.05, ***p<0.01.

Table 4: Behaviour of Player B and her expectation of being punished

Relation with Player A	n	Did not share equally with Player A (n)	Expected punishment by Player C (n)
Villager	22	16	7
Friend	21	10	4
Relative	16	6	1

Table 4 shows that amongst the Players B who did not share equally with Players A, the largest proportion expected to be punished by Player C if an unrelated villager was treated unfairly. One interpretation of this result is that in a context where social and moral consequences are weak, participants are more likely to expect external material interventions. Depending on the context, Namaland farmers see different institutional consequences as substitutes.

To our surprise, however, Players C did not use material punishment as a substitute, but rather as a complement. On average Player B was punished with N\$1.20 if she was unfair to a family member (22%²⁴) and with N\$1.64 (26%²⁴) if unfair with a friend but only with N\$0.76 if Player A was a villager (14%²⁴). Model 7 (Table 3) indicates that Player C more often punished Players A if A did not make an offer to a friend of family member than to a stranger. Likewise, Player C punished B more often if B did not share fairly with a friend or family member compared to a stranger (Model 8, Table 3). The applied punishment is therefore greater the closer the relation between the two players. This is not as much a contradiction as it first appears to be. Player C, as the external monitor and enforcer, is most enraged about other players violating, in her perception, fundamental moral norms. Therefore, Player C increases her utility in terms of moral consequences if she punishes such violators for what she believes is wrong. Player A and B seemingly did not consider the moral values and the utility function of the monitor. The policy implication of these results is that Namaland farmers are willing to make costly investments in providing material consequences if their moral values are violated. They further expect material consequences to be applied as substitutes in cases when social consequences are ineffective²⁵.

6. Discussion and conclusion

Our research of Namaland pasture governance revealed that different collective choice arenas are involved in specifying operational rangeland management institutions. The different origins of institutions are not disconnected. For instance, the government formalizes the customary land access regulations

²⁴ Share of all cases where Player B was playing unfair.

²⁵ It is, however, possible as well that Namaland farmers have little experience with external enforcement and thus no congruent expectations.

and self-organization rules of water associations. As a result, it also takes over responsibility for the enforcement of such institutions. Customary institutions enter the newly established self-organized collective choice arena of the associations. Long-lasting but also changing moral values influence the decisions especially of self-organized and customary collective choice arenas. None of the arenas seem to play a leading role in Namaland pasture governance. One reason is that all involved organizations lack sufficient capacity to effectively monitor and enforce operational institutions. As a result, customary and self-organized operational rules are monitored and enforced mainly by the residents, and in the de-facto absence of material consequences only social and moral ones can encourage compliance with institutions. Farmers will therefore only follow operational management institutions if they believe in their rightness. They will equally be willing to provide monitoring services and social consequences if they believe in their rightness. In this context, ambiguous and partly contradicting moral values related to pasture management constitute a considerable challenge for Namaland rangeland governance. Remarkable is also the strategy of the government, which specifies vague and non-enforced management prescriptions believing that they are going to be internalized into the moral values of farmers. This is a very optimistic hope as farmers do not even know these laws.

Our research gave evidence of complex interactions between material, social and moral institutional consequences, and more specifically the risk of substitution (crowding out morality) and the potential of synergies (crowding in morality). Such interactions are difficult to assess in interviews and observations. We therefore complemented our surveys with economic experiments.

We observe in a Common Pool Resource experiment setting that farmers restrict their stocking rates in a situation when mainly moral consequences are at work. Combining moral consequences with social ones improves performance and stocking rates are further reduced. The interaction between moral and material consequences depends on their direction. The more widely accepted positive material consequences improve cooperation close to the social optimum while the less frequently chosen negative ones rather worsen the situation. The effect of communication lies in between the two. From a social planner's perspective, this instrument is still attractive as it implies the lowest costs for her.

In a one-shot trust experiment setting, we further observe that some players are willing to provide costly enforcement services. In playing the role of the monitor, the farmers are most willing to invest in enforcement when their own moral values are violated. At the same time the players expected external material consequences to be provided particularly in situations when moral and social ones were perceived to be weak, such as when dealing with people outside family or friendship-networks (see also Bowles and Hwang 2008).

For policy-makers a confusing picture of incentive interactions emerges. It is important to be aware that material consequences are not the only motivations that encourage compliance with an institution. Acknowledging the power of moral and social (dis-)incentives, the policy-maker should be conscious of the

enforcement costs related to the provision of different consequences. She should further be aware of potential substitutions (e.g. material and moral disincentives) and synergies (e.g. social and moral disincentives) of consequences, which are very location and context specific. In the process of policy-making, questions should be answered such as:

Which moral values are attached to the specific matter at a specific place?

Which enforcement services are the addressees of an institution willing to provide and under which circumstances?

Under which conditions do people expect the external provision of material consequences?

Adapting policies to the answers to these questions can help actors of various collective choice arenas improve compliance with institutions while at the same time saving on costs of enforcement. Formulating institutions by external agents can have signalling and educative effects even without enforcement mechanisms. But there is always the risk that such institutions crowd out moral and social enforcement. Enforcement is not more important than the proper formulation of institutions, but in the formulation of institutions their enforcement must be taken into account. If no enforcement is planned this should also be communicated to the people in order to emphasize that the rule has only educative purposes.

Which realistic measures can be proposed to Namibian policy-makers trying to improve the Namaland rangeland management? Without a doubt it is important to increase the awareness of links between resource use and resource change. This link is not trivial and uncertainty in environmental responses is high. Rangeland ecologists argue that in semi-arid regions, positive changes in resource condition take a long time while negative ones happen immediately (Popp et al. 2009). The focus should therefore be on improving the governance and management of still less or non-degraded areas. Training courses and field visits to model farms and irreversibly degraded areas can help to create a shared understanding of which kind of management might improve the group's welfare. This could be a starting point for changing the situation. Our study showed that farmers are willing to specify, monitor and enforce institutions if they believe in their rightness. Existing structures, such as the water associations, could be used to initiate a discussion on possible rangeland management regulations, their monitoring and the provision of institutional consequences. As a result of such discussions, the group hopefully decides on management rules, specifies how the farmers monitor compliance and which material and social (dis-)incentives are provided to encourage compliance. It is also crucial to formulate clearly in which situations the group requests support from statutory enforcement authorities. There must be a reliable commitment from the government to provide material enforcement services on request. Clear rules and the group providing unambiguous evidence of violations could reduce the

transaction costs for statutory judiciary and executive organs, which increases the probability that they may react. Often the group does not have the power to really apply material consequences. Group members who refuse to follow the group's management regulations on the basis of internalized moral values and who are not impressed by social consequences must be aware that there is a realistic chance that they will face painful material consequences.

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Appendix

Appendix 1: Summary of second-tier variables of Namaland rangeland management system according to the framework for analyzing a social-ecological system (Ostrom 2009)

<i>Resource system (RS)</i>	
RS1 – Sector	Rangelands
RS2 – Clarity of system boundaries	Fuzzy but core area clear
RS3 – Size of resource system	Small to moderate
RS4 – Human-constructed facilities	Poorly maintained fences
RS5 – Productivity of system	Low carrying capacity (can only be evaluated in combination with water supply)
RS6 – Equilibrium properties	State and transition system – currently at relatively poor state
RS7 – Predictability of system dynamics	High spatial and temporal variability of biomass production
RS8 – Storage characteristics	No
RS9 – Location	Arid rural Namibia
<i>Governance system (GS)</i>	
<i>Matter of this paper</i>	
GS1 – Government organizations	Formally Ministry of Agriculture, Water and Forestry, local government, land boards
GS2 – Non-government organizations	Hardly any NGOs are active in the area
GS3 – Network structure	Water point user associations, clubs of churches, elderly etc.
GS4 – Property-rights systems	State ownership, communal use rights, and unclear decision-making rights
GS5 – Operational rules	Specific for access regulation, unspecific for regulation of management practices
GS6 – Collective-choice rules	Depend on the collective choice arenas (statutory, customary, self-organized)
GS7 – Constitutional rules	General framework is given by the government
GS8 – Monitoring and sanctioning	Monitoring mainly done by residents, material enforcement is weak but social and moral partially work
<i>Resource units (RU)</i>	
RU1 – Resource unit mobility	Livestock, mainly goats, sheep, and cattle
RU2 – Growth or replacement rate	Livestock moves up to app. 8 km away from the water point
RU3 – Interaction among resource units	Highly variable dependent on annual rainfall and management practices
RU4 – Economic value	Through the resource system
RU5 – Size	Saving, insurance, status and income generation function of livestock
RU6 – Distinctive markings	Small stock
RU7 – Spatial and temporal distribution	Mainly ear clips
	Stronger use pressure around water points

Appendix 2: Summary of rangeland management institutions relevant in Namaland

Origin of institution	ATTRIBUTES		DEONTIC	AIM	CONDITION	OR ELSE	Provider of monitoring	Probability of detection	Provider of incentive	Nature of incentive	Strength of incentive	Probability of incentive being provided
	Anybody approved by residents and traditional authorities	Anybody not approved by residents and traditional authorities	May	Use the land	If not violating group norms	Individual farmer	Very high	Individual farmer	Moral	Strong	Very high	
Internalised by farmers	Anybody approved by residents and traditional authorities	Anybody not approved by residents and traditional authorities	May	Use the land	If not violating group norms	Individual farmer	Very high	Individual farmer	Moral	Strong	Very high	
Internalised by farmers	Anybody not approved by residents and traditional authorities	Anybody not approved by residents and traditional authorities	Must not	Use the land	Unconditional	Residing farmers	High	Residing farmers	Social	Moderate	High	
Customary collective choice arena	Anybody not approved by traditional authorities	Anybody not approved by traditional authorities	Must not	Use the land	Unconditional	Residing farmers	High	Traditional authority	Material	Moderate	Low	
Statutory collective choice arena	Anybody not approved by traditional authorities and land board	Anybody not approved by residents and water committee	Must not	Use the land	Unconditional	Residing farmers, police	Moderate	Government executive	Material	Strong	Low	
Internalised by farmers	Anybody not approved by residents and water committee	Anybody not approved by water committee	Must not	Use the water	Unconditional	Residing farmers	High	Residing farmers	Social	Moderate	High	
Community self-organisation collective choice arena	Anybody not approved by water committee	Anybody not approved by water committee	Must not	Use the water	Unconditional	Residing farmers	High	Water committee	Material	Moderate	Low	

Appendix 2: (Continued)

Origin of institution	ATTRIBUTES		DEONTIC	AIM	CONDITION	OR ELSE		Probability of detection	Provider of incentive	Nature of incentive	Strength of incentive	Probability of incentive being provided
	Individual farmer	Individual farmer	Must	Control stocking rate	If carrying capacity is exceeded	Individual farmer	Very high					
Internalised by farmers	Individual farmer	Individual farmer	Must	Control stocking rate	If carrying capacity is exceeded	Individual farmer	Very high	Individual farmer	Moral	Low	Low	Very high
Internalised by farmers	Individual farmer	Individual farmer	Must	Control stocking rate	If carrying capacity is exceeded	Residing farmers	High	Residing farmers	Social	Low	Low	High
Statutory collective choice arena	Any communal farmer of Namibia	Any communal farmer of Namibia	Must	Control stocking rate	Specification of traditional authorities	Unclear	Very low	Traditional authority	Material	Unclear	Unclear	Very low
Statutory collective choice arena	Any communal farmer of Namibia	Any communal farmer of Namibia	Must	Apply accepted farming practices	Unconditional	Police	Very low	Government executive	Material	Unclear	Unclear	Very low