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Sustainable use of ecosystem services under multiple risks – a survey of commercial cattle farmers in semi-arid rangelands in Namibia

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Abstract

Studying the sustainable use of ecosystem services under uncertainty requires the consideration of the stochastic dynamics of the system under study, risk and time preferences, risk management strategies and normative views pertaining to sustainability. To gather this information for an important ecological-economic system, we conducted a survey of commercial cattle farmers in semi-arid rangelands of Namibia, a system that features risks on various space and time scales. Here we present a description of the research aims, design and conduction of the survey, and analyze and discuss the homogeneity and representativeness of our survey population. The survey consisted of a mail-in questionnaire and in-field experiments. We combined two existing farm-address databases, reaching 77% of the estimated 2,500 cattle farmers. The return rate of questionnaires exceeded 20%, and response rate to individual questions surpassed 95% and 90% for the majority of non-sensitive and sensitive questions, respectively. Distinct sub-sample groups within the survey population did not differ in the analyzed characteristics with the exception of ethnicity, regional location of farmland and an intentionally induced bias for residency on farm. It has turned out that we have undersampled distinct population segments of farmers, such as indigenous farmers or farmers not belonging to the main interest group of commercial cattle farming. Notwithstanding, we consider the survey to be highly successful, yielding a rich dataset which allows diverse analyses.

Keywords: survey, cattle farming, semi-arid, rangeland management, sustainability, risk
JEL-classification: Q12, Q15, Q24, Q56, Q57

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I. Introduction

Ecosystem users depend upon the specific spatio-temporal provision of ecosystem services. The provision of many of these services is influenced by risks acting on various space and time scales. To what extent users are affected by these risks depends on the risks' characteristics, users' risk and time preferences and their endowment (Gollier 2001, Machina and Rothschild 2008). Many of these risks are endogenous, i.e. users may employ strategies to lessen risk (Shogren and Crocker 1999, Perrings 2004). These risk management strategies have a long history in human civilization (Covello and Mumpower 1985) and are ubiquitous in the everyday life (Shogren and Crocker 1999).

In a coupled ecological-economic system, different ecological and socio-economic management strategies may be substitutes in regards to risk reduction, but may differ profoundly in regards to their sustainability (Quaas and Baumgärtner 2008). Generally speaking, users may employ ecological risk management strategies to alter the probability distribution of ecosystem service provision. For example, conservative pasture management may be employed as a form of natural insurance to reduce the variance in forage provision and thus dampen income risk from livestock production (Quaas et al. 2007). Alternatively, users may resort to socio-economic management strategies to hedge risk arising from uncertain provision of ecosystem services. For example, a (hypothetical) financial insurance may indemnify users when income from livestock production falls below a certain threshold. Depending on the properties of the ecological-economic system as well as on the specific design of insurance contracts, financial insurance indeed provides the same risk reduction as natural insurance but leads to a degradation of the ecosystem (Quaas and Baumgärtner 2008, Müller et al. 2009). Thus, one approach to promote sustainable use of ecosystem services under uncertainty may be to design policies and institutions to encourage the employment of sustainable risk management strategies.

Furthermore, any meaningful assessment of sustainability of risk management strategies faces issues on a fundamental level: the necessity to address uncertainty about the system dynamics in the criterion used for the assessment. Services may cease to exist due to stochastic events that are beyond human control. For grazing in semi-arid rangelands, for example, the system might be irreversibly degraded through a long-term drought despite the best human efforts at conservation.

A novel operational criterion for strong sustainability under uncertainty that captures uncertainty about the system dynamics is ecological-economic viability (Baumgärtner and

Quaas 2009). Viability, in short, specifies that components and functions of a dynamic, stochastic system remain at any time in a domain where their future existence is guaranteed with a sufficiently high probability. To this end, the criterion requires normative judgments that have to be made by society pertaining to object and scope of sustainability, to appraisal of risk and to the relevant time horizon.

Against this background, our research is aimed firstly at characterizing what risks affect individual ecosystem users in a coupled ecological-economic system with stochastic dynamics. Secondly, we explore ecosystem users' risk and time preferences and the relationship of preferences with personal, economic and environmental characteristics. Thirdly, we study what views of sustainability in the sense of viability are present among ecosystem users. And lastly, we characterize what risk management strategies are employed and how the choice and extent of strategies relate to individual risk and time preferences and views of sustainability. Results of this research should be useful for assessing ecological and socio-economic risk management strategies in general, and natural and financial insurance in specific, in regards to risk reduction and sustainability. Ultimately, we aim at contributing to an understanding of how economic policies and institutions have to be designed to effectively and efficiently promote sustainable use of ecosystem services.

We focus on ecosystem users that derive their income predominantly from ecosystem services. As a case study we have chosen commercial cattle farming in semi-arid rangelands of Namibia. This tightly coupled ecological-economic system is of high economic importance, contributing one-third of the agricultural output in Namibia (Directorate of Planning 2005), is subject to a variety of environmental, economic, political and social risks (Olbrich et al., in prep.) and is therefore a prime object of study for ecological economics (e.g. Janssen et al. 2004, Perrings and Walker 2004, Quaas et al. 2007, Baumgärtner and Quaas 2009). Approximately 2,500 commercial farmers conduct cattle farming in Namibia. Predominant among the risks farmers face is uncertain precipitation and the resulting uncertain production of forage. Namibia has a mean annual rainfall of approximately 270 mm, and precipitation is highly variable across the country with the coefficient of variation of annual precipitation ranging from below 30% to over 100% (Sweet 1998).

In addition to these scientific reasons, commercial cattle farming in Namibia also lends itself as an empirical case study for practical reasons. Infrastructure is comparatively well developed, allowing a relatively easy data collection. Furthermore, information systems are likewise well developed, permitting extended analyses by combining collected data with existing databases on various economic and environmental aspects.

In August 2008 we conducted a survey of 2,119 commercial cattle farmers. In line with the research aims described above, we collected information about (i) risks faced by farmers, (ii) individual risk and time preferences and their determinants, (iii) risk management strategies and (iv) normative views towards sustainability in the sense of viability.

This paper explains the design and conduction of the survey. Since our survey population was a subset of all Namibian commercial cattle farmers and was comprised of two distinct groups, we also analyze this population for homogeneity and discuss its representativeness for the overall group of Namibian commercial cattle farmers. Section II describes the survey's design and Section III its conduction. Analyses of participation and population homogeneity are presented in Section IV. Finally, we discuss the results in Section V and draw conclusions.

II. Survey design

The survey consisted of two parts: a mail-in questionnaire was sent to farmers and in-field experiments were conducted with a subset of those farmers who received a questionnaire (see Appendix B and C for questionnaire and experimental documentation). In these experiments we elicited risk and time preferences involving payments of real money which were designed to complement corresponding hypothetical experiments in the questionnaire.

II.1 Qualitative interviews and pre-testing

In order to acquire a sound understanding of system dynamics, decision making, management strategies and issues of sustainability in commercial cattle farming, we conducted a series of qualitative interviews with farmers, experts and decision makers of the agricultural, political and financial sector (Appendix A lists interview partners; see also Olbrich et al., in prep.). These interviews were held in person in March and October 2007 in Namibia. Following the March interviews we designed a first version of the questionnaire. In October, we discussed this version in a second set of interviews and also during a workshop with 14 farmers which we organized with our cooperating organization *Namibia Agricultural Union* (NAU), the main interest group for commercial farmers. Based on the feedback gained, we revised the questionnaire. We distributed the questionnaire for pre-testing to a group of ten farmers and experts in June 2008. Subsequently, we made last modifications to the questionnaire based on the group's comments and produced the final version which was sent-out to the entire survey population in August 2008.

From the qualitative interviews it became clear that a considerable challenge would be the general skepticism of farmers towards surveys and distrust regarding promises of feedback

and confidentiality. Farmers were confronted with a number of surveys in the previous years, but hardly ever were findings made accessible to them. Even worse, there was a serious breach of confidentiality in at least one survey which was advertised as anonymous but contained a hidden identification code. In addition, almost all white farmers – who constitute the majority of commercial farmers – are worried about the political situation and especially about possible expropriation, which contributes to their unwillingness to take part and reveal sensitive data in surveys. As a consequence, the return rate to surveys in previous years was frequently lower than 5%. We paid tribute to this in the elicitation format for sensitive questions, as described below in Sections II.6 and II.7, and in the conduction of the survey, as discussed in Section III.2[1].

We complemented the questionnaire with a cover letter and more detailed descriptions of our research aims (Appendix D). Farmers usually converse in Afrikaans among themselves but are by and large fluent in English. We therefore formulated the questionnaire in English with only selected terms and section headings also supplied in Afrikaans, and we supplied the accompanying documents both in English and in Afrikaans[2].

II.2 Elicitation of perception and characteristics of risks

In the survey, we elicited farmers' perception of a number of risks. To this end we identified the 13 most important environmental, economic, political and social risks during our qualitative interviews (Olbrich et al., in prep.). We then listed these risks in the questionnaire and asked farmers to rate their importance on a six-item Likert-scale, ranging from "no risk" to "very high risk" (Part II of the questionnaire, Appendix B). Since precipitation risk was identified as the dominant environmental risk we specifically collected additional information on on-farm monthly precipitation for the previous two rainy seasons and assessments of the previous five rainy season (Part V).

II.3 Elicitation of risk and time preferences

Both risk and time preferences were elicited for each farmer. We view risk preferences in the sense of von-Neumann-Morgenstern expected utility theory (von Neumann and Morgenstern 1944) and time preferences in the sense of the discounted utility model, i.e. as pure preference for utility in the present versus utility at some future point in time (Samuelson 1937).

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[1] In addition, we will hold a series of workshops in Namibia in February/March 2010 to inform farmers about our results as well as supply NAU with our research papers stemming from this survey.

[2] Translation from English into Afrkiaans was curtesy of Marietjie van Staden of AgriForum, the monthly newsletter published by NAU.

We elicited preferences by an adapted multiple price list format both in a hypothetical scenario within the questionnaire (Part IV) and through in-field experiments involving payments of real money (Appendix C). This method was pioneered in the elicitation of preferences for risk and time by Binswanger (1980) and Coller and Williams (1999), respectively, and has since been regularly employed (e.g. Holt and Laury 2002, Harrison et al. 2005, Andersen et al. 2008). Subjects choose for a number of scenarios between taking part in a lottery or receiving a certain payment instead ("risk experiments"), or between receiving a payment at a certain point in time or a higher payment later ("time experiments"). Scenarios differ with regard to the certain amount and the amount of the later payment, respectively, which increases from the first to the last scenario. Subjects in these experiments typically prefer the lottery when the certain amount is low and the earlier payment when the later payment is likewise low. They switch once the certain amount or the later payment are deemed high enough. From the switch point, interval measures of risk aversion such as the constant relative risk aversion (CRRA) and of the discount-rate, respectively, can be inferred.

In the elicitation of risk preferences we aimed at analyzing how different farmers value the same lotteries, thus income from and probabilities of occurrence of each lottery were objectively defined and communicated to the participants. In the hypothetical risk experiments we presented farmers with six scenarios, where we framed the lottery in the context of selling cattle at an auction. The auction had two possible outcomes, N$90,000[3] and N$130,000, each occurring with equal probability of 1/2. The expected value of the auction (N$110,000) corresponds to about 1/3 of the annual net income of the average farmer. Instead of taking part in the uncertain auction, farmers could chose to sell to a trader for a certain amount which started at N$100,000 in the first scenario and increased in steps of N$2,500 to N$112,500 in the sixth scenario. The six scenarios corresponded to intervals of the coefficient of CRRA the lowest of which was [-∞;-1.40] in the sixth and the highest of which was [6.32; ∞] in the first scenario.

In the in-field experiments the lottery was context-free with an expected value of N$1,500, which corresponds to the value of a calf. The certain amount started at N$550 and increased to N$1,900. For a higher resolution of risk aversion measures 16 scenarios were presented corresponding to intervals of the coefficient of CRRA from [-∞; -1.46] in the last to [8.27; ∞] in the first scenario. After the subject had made their choices for all scenarios one scenario was chosen at random and played out, i.e. the subject either received the certain amount or the lottery in turn was played out. Payments were made in cash instantly.

[3] On the 1st of August 2008, N$1,000 equalled €88.14 or US$137.50.

In the elicitation of time preferences we focused on the long-term behavior of farmers and consequently eliminated the possibility of short-term considerations to influence the farmers' decision making. We considered this approach appropriate as 1) the relevant outcomes of farming decisions rarely manifest immediately, but rather months or even longer into the future, and 2) we are especially interested in analyzing the relationship between long-term behavior and sustainable use of ecosystem services. Subjects in the time experiments had to choose between receiving a payment in one month or a higher payment in seven months. Both hypothetical and in-field experiments were framed context-free and values were in a similar range as in the risk experiments. In the hypothetical experiments we elicited discount rates in five scenarios, with a payment in one month of N$100,000 and a payment in seven months which increased from N$104,881 in the first to N$122,474 in the last scenario. The scenarios corresponded to discount rate intervals from [-∞; 10%] to [50%; ∞]. In the in-field experiments 20 scenarios were presented with a payment in one month of N$2,000 and a payment in seven months which increased from N$2,025 in the first to N$2,449 in the last scenario. Corresponding discount-rate intervals ranged form [-∞; 2.5%] to [50%; ∞]. Scenario selection for payout corresponded to that in the risk experiments. Payments in the in-field experiment were guaranteed by the NAU which would transfer the money to the farmer's account with the respective delay chosen by the farmer. Due to monetary constraints we could pay only 10% of farmers in the in-field risk and time experiments which were randomly selected by letting farmers draw lots.

Through the conceptual separation of risk and time preferences and the corresponding experimental set-up we implicitly assumed that farmers were not influenced by time preferences in the elicitation of risk preferences since lotteries had a time scale of effectively zero (i.e. they were resolved immediately after the farmers had made their decisions). Conversely, we assumed that risk preferences were irrelevant in the elicitation of time preferences since later payments were guaranteed by the NAU and thus deemed certain.

Risk and time preferences were also elicited in the questionnaire in an alternative format involving self-assessment through nine-item Likert-scales (Part IV), ranging from "completely avoid taking risks" to "very willing to take risk" for risk and from "not at all willing to wait" to "very willing to wait" for time preferences. We calibrated answers to these questions through the in-field experiments involving real monetary payments, a strategy which has been successfully applied in a survey of the German Socio-Economic Panel (Dohmen et al. 2006).

II.4 Elicitation of risk management strategies

Farmers employ a range of different risk management strategies, which can be distinguished into ecological strategies which alter the production process (termed "on-farm risk management" in the questionnaire) and socio-economic strategies which make use of financial instruments ("financial risk management") or group membership ("collective risk management") (Olbrich et al., in prep.).

Again, we selected the 16 most relevant strategies based on the information gained in the qualitative interviews, and asked farmers to rate the importance of each strategy on a six-item Likert-scales ranging from "not at all important" to "very important" (Part II). Given the dominance of precipitation risk, we framed the elicitation of on-farm and financial – but not collective – strategies in the context of that risk. In addition, we elicited quantitative information on the following risk management strategies: legal organization for the farm (Part I), spatial diversification of farmland (Part I), structural organization of the farm (Part V), diversification of cattle production system (Part V), and diversification of income (Part V).

II.5 Elicitation of normative views of sustainability

We consider normative views of sustainability in the context of a specific operational criterion for strong sustainability under uncertainty, namely ecological-economic viability (Baumgärtner and Quaas 2009). The viability-criterion enables an *ex-ante* assessment of the ecological-economic sustainability of a given action within a system under study. To this end, the criterion requires a number of normative judgments in order to adequately assess such an action. More specifically, it requires judgments on the object and scope of sustainability. In this regard, viability reflects the properties of traditional notions of strong sustainability, including that various stocks or services have to be conserved separately. However, owing to the explicit consideration of uncertainty the criterion also requires judgments on the appraisal of risk and the relevant time horizon. This appraisal is conceptually separate of any valuation of risks and their time scales due to preferences.

Hence, the following questions have to be answered prior to a sustainability assessment under uncertainty using the viability-criterion:

(i) What should be preserved, i.e. what ecological or economic stocks or services should be maintained?

(ii) How much of it should be preserved, i.e. at what level should the selected stocks and service be maintained?

(iii) For how long should it be preserved, i.e. over what time horizon should the stocks and service be maintained?

(iv) To what extent of uncertainty, i.e. what are the minimum probabilities that the stocks and services are above their respective threshold levels at each point in time?

We based the elicitation of normative views of sustainability on these questions. We pre-selected the main ecological stock (grass biomass) and economic service (income) within the system and asked farmers about their views of threshold levels, time horizon and extent of uncertainty (Part III). In addition, we inquired in an open question which other stocks and services farmers considered important for preservation, but without inquiring for threshold levels, time horizon or extent of uncertainty.

II.6 Elicitation of farm business and personal characteristics

Finally, we recorded information on a variety of variables which possibly impact on farmers' behavior under uncertainty. We enquired about additional farm business characteristics such as quantity of farmland (Part I), degradation status and carrying capacity of farmland (Part V), size of cattle herd (Part V) and household income. Because of the sensitivity of income information and farmers' skepticism, we elicited income only in categories. We also collected information on personal characteristics such as gender, age, ethnicity, education and experience with farming (Part VI). As we suspect a connection between some of the aforementioned behavioral determinants and one's outlook into the future, we asked farmers for their expectations regarding the future development of their farm business (Part VI).

II.7 Linkage with other databases

In general, data collection is extensive in Namibia, and a number of organizations maintain comprehensive databases on various aspects of cattle farming, such as precipitation recordings, price data for live cattle on auctions or beef exports. To allow spatial analyses of our survey data and linkage with the existing databases we concluded the questionnaire with a question for the farm number. The farm number is an official and unique label of each commercial farm in Namibia, the knowledge of which allows identification of the owner and farm location. Due to the sensitivity of this information we left this question optional. Since we expected a majority of farmers to not answer this question we also acquired at least a broad indication of the farm's location by eliciting the district location of the farm (Part V).

III. Conduction of the survey

III.1 Survey population

No up-to-date database containing all commercial cattle farmers in Namibia exists. As a consequence, the total number of farmers is unknown, though it is estimated at 2,500 by experts (H. Marggraff, W. Schutz, V. Tjimune; pers. communication). For this survey we compiled an address database that was as comprehensive as possible by requesting access to and combining databases of various Namibian organizations.

One source was the NAU database which contains about 2,500 members but no additional information on the kind of agricultural production. We therefore selected only those members who lived in the commercial cattle farming regions (the states Erongo, Khomas, Omaheke, Otjiozondjupa, and adjoining districts of neighboring states) which amounted to 1,324 members. We estimate that 1,121 (84.7%)[4] of these are actually producing cattle.

The other source was *MeatCo of Namibia* (MeatCo), Namibia's largest slaughterhouse. MeatCo has a database of all those farmers[5] who had delivered cattle to MeatCo in the period 2004–2008. This database contains 1,484 entries. After removing 689 entries which were already contained in the NAU-database, 795 remained. The survey populations thus comprised 2,119 farmers of which we estimate 1,916 to be producing cattle. The survey population thus makes up for 77% of the estimated total number of commercial cattle farmers in Namibia.

Based on the assessment of experts (H. Marggraff, W. Schutz, V. Tjimune), we suspected that NAU members and farmers delivering to MeatCo would differ from each other and from the whole population of commercial cattle farmers in the characteristics ethnicity and production system pursued. White commercial farmers are overrepresented among NAU-members for historical reason, while there was no previous indication that this should also hold for farmers delivering to MeatCo. These should be representative in ethnicity for the overall group of commercial cattle farmers. Conversely, NAU-members are thought to be representative for all commercial cattle farmers in regard to production system pursued – i.e. production for beef, production for sale of live animals or stud breeding – while farmers who concentrate on beef production are thought to be overrepresented among those delivering to MeatCo. To avoid a

[4] This estimation is based on our selection of experimental participants among NAU-members: 61 (84.7%) of the contacted 72 members produce cattle.

[5] Both farmers and legal entities deliver cattle to MeatCo. The latter numbered 67 (8.4%) in the MeatCo database. For simplicity reasons we will use the term 'farmer' throughout this paper to refer to both individual farmers and legal entities.

possible bias in production system pursued among the experimental participants, we selected these only among NAU-members.

The whole survey population was thus divided into two mutually exclusive subpopulations: NAU-members living in cattle producing regions (which we label *"NAU-members"* in the following) and MeatCo-customers who delivered cattle and were not simultaneously NAU-members (labeled *"MeatCo-customers"* in the following). Survey participants constituted three samples of these two subpopulations, labeled as follows (Figure 1):

- *Sample "NAU-respondents"* of the *subpopulation "NAU-members"*: NAU-members who returned a mail-in questionnaire,
- *Sample "experimental participants"* of the *subpopulation "NAU-members"*: NAU-members who participated in the experiments,
- *Sample "MeatCo-respondents"* of the *subpopulation "MeatCo-customers"*: MeatCo-customers who returned a mail-in questionnaire

We marked all those questionnaires that were sent to MeatCo-customers, in order to allow some identification of group membership of responding farmers.[6]

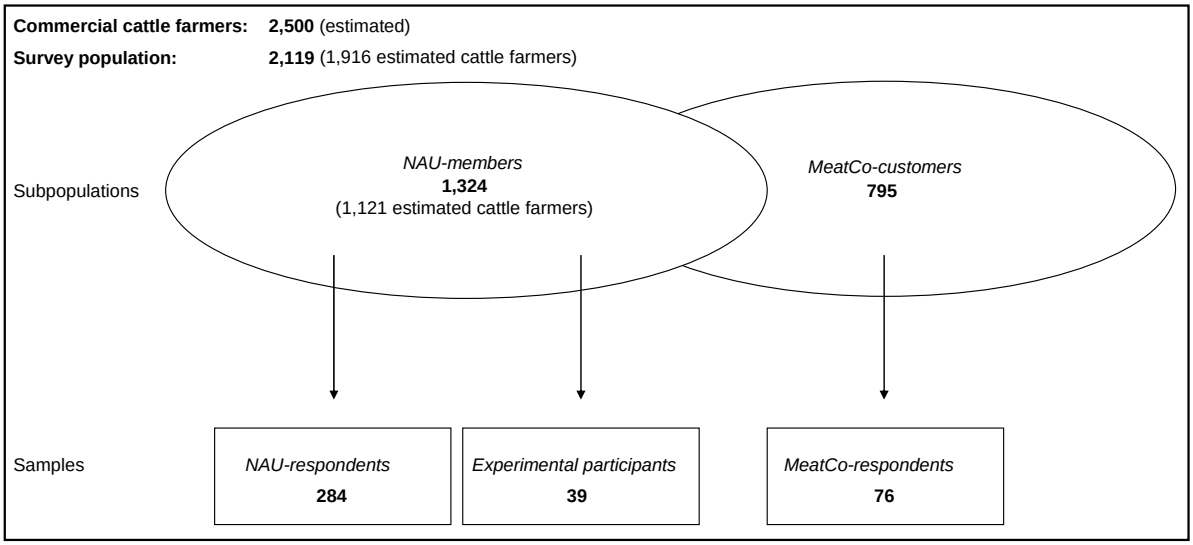

Figure 1: Survey population with subpopulations and samples as defined in section III.1. Overlap in subpopulations indicates 695 double entries in the two source databases which were assigned to the subpopulation *NAU-members.*

[6] We received the MeatCo database after the questionnaires destined for NAU-members had already been prepared. Thus, it was not possible for logistic reasons to also separately mark those questionnaires that were sent to MeatCo-farmers who were simultaneously NAU-members.

III.2 Promotion of survey

As noted in Section II, farmers are generally skeptic towards surveys, and the possibility of low participation was thus very high. Therefore, we put considerable effort into trust-building and into the promotion of the survey. One strategy was the utilization of NAU's organizational structure by contacting responsible decision makers (farm convention chairmen, regional chairmen and national board members) and asking for their support. A similar strategy was not feasible with regard to MeatCo-customers since they lack any specific coherent organization.

NAU is a hierarchically organized interest group. At the local level, individual farmers are organized in about 70 farm conventions, each headed by a local chairman. At the regional level, farm conventions are grouped into 10 regional divisions, each in turn headed by a regional chairman. A national board consisting of regional chairmen, deputies of various committees and the administrative directorate is representing the organization at the national level. We succeeded in personally reaching all national and regional representatives, as well as half of the local chairmen, and contacted the remaining local chairmen by email or phone.

We also aimed our promotion directly at farmers, and again made special use of NAU's organization. To this end we gave an interview about the survey in the NAU-affiliated monthly magazine "AgriForum" (AgriForum 21(7), August 2008), and placed advertisements in the weekly online NAU-newsletter for several weeks (22nd and 29th of August, 12th of September). Both NAU members and MeatCo-customers were addressed through a radio interview transmitted by the Namibian Broadcasting Corporation (23rd and 25th of August 2008) and through an advertisement in the "Ring" (The Ring, September 2008), the monthly newsletter of Agra Co-operative Ltd., Namibia's largest retailer for farm equipment. In addition, we extensively spoke with many farmers, assuming (correctly) that word about our survey would spread between individual farmers.

III.3 Send-out of questionnaires and conduction of experiments

We mailed out a first batch of questionnaires in the period 19th – 21st of August 2008, and a second batch as a follow-up on the 15th of September 2008. Return address for the questionnaires was the NAU which forwarded all incoming questionnaires to Leuphana University of Lüneburg. Owing to delays in the Namibian postal system, where delivery of mail can take weeks, we set the 28th of February 2009 as a cut-off date for questionnaires to be included in our analysis.

In-field experiments were conducted with 39 commercial cattle farmers.[7] To this end, 72 farmers were randomly selected, and a session was scheduled if the farmer produced cattle and worked on his farm full-time. This applied to 57 (79.1%) of the contacted farmers. 44 sessions were set of which 39 were actually conducted.[8] [9]

We visited the majority of participants (79.4%) on their respective farm, and the remaining ones at pubic locations in major cities. With one exception,[10] each session of experiments started with the participants filling in the questionnaire. We then conducted the experiments and subsequently determined whether the farmer had won money by letting him draw a lot. Duration of sessions varied between one and two-and-a-half hours.

IV. Data quality and homogeneity of samples

IV.1 Return rate of questionnaires and response rate of individual questions

We received 399 questionnaires, 360 of which were sent to us and 39 of which were filled out during experimental sessions. Of the 360 questionnaires sent in, 284 came from NAU members and 76 from MeatCo-customers (Figure 1). This makes a return rate of 20.8% in regard to the estimated number of cattle farmers within the survey population.[11] Return rate was much higher among NAU-members than MeatCo-customers, with 28.8%[12] and 9.6%, respectively.

In the returned questionnaires, response rate for non-sensitive questions exceeded 95% for most questions, the exception being cattle production system (91.9%), the risk management strategies 'purchase of extra rangeland for scale effects' and 'investment into agricultural

[7] The in-field experiments were conducted by one of us (Roland Olbrich).

[8] Three sessions were cancelled by farmers on short notice and no alternative session could be set, during one session filling in of the questionnaire lasted so long that no time remained for the conduction of experiments and one session had to be cancelled by the researcher due to a tire break.

[9] During one session it became obvious that the participant was a part-time farmer. Thus, of the 39 sessions conducted, only 38 were with full-time farmers. We have included data on the part-time farmer in our subsequent analysis in this paper as inclusion of these data does not change our results.

[10] Upon arrival at the meeting the farmer remarked that his time would not permit both filling-in of the questionnaire and conducting experiments. We thus chose to elicit only selected data in the questionnaire and directly proceeded to the experiments. After the experiments, we asked the farmer to mail or fax us a completed questionnaire, but unfortunately the farmer never sent a complete questionnaire.

[11] This rate is the fraction of returned questionnaires to the number of the 1,916 farmers that we have estimated to be cattle farming (see Section III.1). This rate drops to 18.8% if return rate is instead calculated as a fraction of the 2,119 farmers that had received a questionnaire.

[12] Again, the rate was calculated as a fraction to the number of the 1,121 NAU-members that we have estimated to be farming cattle and drops to 24.4% if calculated as a fraction of all of the 1,324 NAU-members that had received a questionnaire.

derivatives on the stock market' (both 90%) and on-farm monthly rainfall (83.5%). Response rate was also high among the sensitive questions regarding normative views of sustainability (94.7%), size of cattle herd (93.6%) and income (91.9%). The optional question for identification of the farm was answered by 75.1% of survey participants, while the more general question for district location of the farm was answered by 99%. Only a single questionnaire was discontinued after the initial questions.

IV.2 Population homogeneity

As discussed in Section III.1, NAU-members and MeatCo-customers were expected to differ in the characteristics ethnicity and production system pursued. We thus tested for homogeneity of samples in respect to the these characteristics, as well as for further basic farm business and personal characteristics which we deemed to be possibly distinct in both groups. We aimed at revealing evidence which would prohibit us from 1) generalizing results from the in-field experiments to either subpopulation and 2) pooling samples in future analyses. The descriptive statistics of personal and farm business characteristics are reported in Table 1.

Production system was recorded by five variables representing percentages of cattle herd allocated to live cattle production, cattle speculation, beef production, stud breeding and other production types. We examined differences by employing a one-way multivariate analysis of variance (MANOVA) using the Wilks' Lambda criterion. Comparisons for other farm business and personal characteristics were performed with Student's t-tests assuming unequal variances in case of continuous variables, with Mann-Whitney-tests in case of ordinal variables and with Fisher's exact tests in case of nominal variables. As a significance threshold for group difference we took the 5%-level.

Differences between experimental participants and respondent samples

Table 2 (third column) reports the comparison of experimental participants with NAU-respondents. Since both samples originated from the same subpopulation, any detected difference would have been an indication for a bias in sampling procedure, and generalization of in-field experimental evidence to the subpopulation would thus have to be restricted. We found no difference in production system pursued ($F(4, 254)=0.98$, $p=0.42$)), or most of the other farm business or personal characteristic. The only exception was residency on farm ($p=0.003$) where 97,4% of experimental participants but only 79.9% of NAU-respondents lived on the farm.

Table 1: Descriptive statistics for *experimental participants*, *NAU-respondents*, *all NAU-members* (pooled from experimental participants and NAU-respondents), *MeatCo-respondents* – all as classified in Section III.1 – and for *all farmers* who participated in the survey. For continuous variables, mean and standard deviation (in brackets) are noted, for ordinal and nominal variables proportions in each category. Cattle production system depicts the allocation to each branch of production for the average farm business in each group, irrespective of actual number of cattle.

Variable	**Experi-mental participants**	**NAU-respondents**	**All NAU-members**	**MeatCo-respondents**	**All farmers**
Personal characteristics					
age	52.5 y	55.5 y	55.2 y	56.5 y	55.4 y
	(12.1 y)	(11.5 y)	(11.6 y)	(13.3y)	(11.9 y)
male	94.9%	94.7%	94.7%	94.7%	94.7%
ethnicity					
Afrikaans	41.0%	46.5%	45.8%	51.3%	46.9%
German	59.0%	49.1%	50.3%	30.3%	46.4%
Herero	0%	0.4%	0.3%	15.8%	3.4%
Ovambo	0%	0.7%	0.6%	1.3%	0.8%
Nama/Damara	0%	0.4%	0.3%	1.3%	0.5%
English	0%	1.8%	1.6%	0%	1.3%
other indigenous	0%	1.1%	1.0%	0%	0.8%
education					
no high school graduation	7.7%	2.5%	3.1%	12.0%	4.8%
high school graduation	12.8%	23.4%	22.1%	29.3%	23.5%
trade / apprenticeship certificate	28.2%	14.5%	16.2%	8.0%	14.7%
diploma or bachelor	41.0%	45.7%	45.2%	37.3%	43.7%
master	10.3%	10.3%	10.3%	12.0%	10.6%
Ph.D	0%	3.6%	3.1%	1.3%	2.8%
farming experience	24.7 y	25.2 y	25.1 y	26.7 y	25.4 y
	(12.7 y)	(14.2 y)	(14.0 y)	(15.3 y)	(14.3 y)
annual net household income					
< N$ 50.000	7.7%	16.2%	15.1%	20.0%	16.0%
N$ 50,001 – 150,000	28.2%	26.3%	26.5%	31.4%	27.5%
N$ 150,001 – 250,000	25.6%	27.0%	26.9%	15.7%	24.7%
N$ 250,001 – 350,000	12.8%	12.0%	12.1%	11.4%	12.0%
> N$ 350,001	25.6%	18.5%	19.5%	21.4%	19.8%
income from cattle farming					
0%	0%	6.9%	6.1%	6.9%	6.2%
1-20%	10.8%	12.0%	11.8%	13.9%	12.2%
21-40%	2.7%	14.5%	13.1%	13.9%	13.3%
41-60%	24.3%	18.5%	19.2%	12.5%	17.9%
61-80%	32.4%	19.9%	21.4%	20.8%	21.3%
81-100%	29.7%	28.3%	28.4%	31.9%	29.1%
residency on farm	97.4%	79.9%	81.9%	72.4%	80.1%

Variable	Experi-mental participants	NAU-respondents	All NAU-members	MeatCo-respondents	All farmers
Farm business characteristics					
cattle production system					
weaner production	29.1%	26.4%	26.8%	29.0%	27.1%
beef production with weaner breeding	6.3%	11.2%	10.5%	16.7%	11.5%
beef production without weaner breeding	56.8%	48.4%	49.6%	39.6%	48.0%
stud breeding	6.7%	10.5%	9.9%	8.0%	9.6%
other	1.1%	3.6%	3.2%	6.6%	3.8%
ownership status					
owner	87.2%	93.2%	92.5%	86.7%	91.4%
hired manager	7.7%	1.8%	2.5%	4.0%	2.8%
tenant	2.6%	3.2%	3.1%	6.7%	3.8%
other	2.6%	1.8%	1.9%	2.7%	2.0%
legal organization of farm					
single owner	69.2%	72.7%	72.3%	58.9%	69.8%
partnership	2.6%	4.7%	4.5%	8.2%	5.2%
cooperative	2.6%	1.8%	1.9%	2.7%	2.1%
corporation	25.6%	19.6%	20.4%	26.0%	21.5%
other	0%	1.1%	1.0%	4.1%	1.6%
area for cattle farming	8,472 ha (4,324 ha)	8,000 ha (5,257 ha)	8,056 ha (5,151ha)	7,551 ha (6,896 ha)	7,962 ha (5,511ha)
number of own cattle in Nov '07	489 (307)	451 (354)	456 (349)	425 (448)	450 (369)
regional location of main farmland					
Erongo	0%	7.5%	6.6%	1.3%	5.6%
Hardap	2.6%	2.1%	2.2%	5.3%	2.8%
Karas	0%	0.4%	0.3%	2.6%	0.8%
Khomas	28.2%	20.6%	21.6%	15.8%	20.5%
Kunene	5.1%	9.6%	9.1%	13.2%	9.9%
Omaheke	18.0%	21.7%	21.3%	26.3%	22.2%
Oshikoto	2.6%	2.1%	2.2%	5.3%	2.8%
Otjozondjupa	43.6%	35.9%	36.9%	30.3%	35.6%

Table 2 (fourth column) reports the comparison between experimental participants and MeatCo-respondents. Again, we found no difference in production system pursued ($F(4, 83)=2.06$, $p=0.09$)), or in most of the other farm business or personal characteristic. We found differences in ethnicity ($p=0.003$). This was mainly due to 18.4% of indigenous farmers among MeatCo-respondents while no indigenous farmers were present among experimental participants. We also detected a difference in residency on farm ($p=0.001$) with only 72.4% of MeatCo-respondents living on the farm as opposed to 97.4% of experimental participants.

Table 2: Comparison of personal and farm business characteristics between *experimental participants* and both *NAU-respondents* and *MeatCo-respondents*. Analyses were performed with Student's t-tests assuming unequal variances for continuous, with Mann-Whitney tests for ordinal and with Fisher's exact tests for nominal variables. Production system was analyzed with a MANOVA using the Wilks' Lambda criterion. p-Values significant at the 5%-level are indicated by an asterisk (*).

Variable	**Statistical test**	**p-Value**	
		NAU-respondents	**MeatCo-respondents**
Personal characteristics			
age	t-test	0.15	0.11
gender	Fisher's exact test	0.66	0.67
ethnicity	Fisher's exact test	0.82	0.003*
education	Mann-Whitney test	0.47	0.46
farming experience	t-test	0.85	0.48
total household income	Mann-Whitney test	0.20	0.14
income from cattle farming	Mann-Whitney test	0.11	0.30
residency on farm	Fisher's exact test	0.003*	0.001*
Farm business characteristics			
cattle production system	MANOVA	0.42	0.09
ownership status	Fisher's exact test	0.13	0.77
legal organization of farm	Fisher's exact test	0.78	0.62
area for cattle farming	t-test	0.54	0.39
total number of own cattle	t-test	0.49	0.38
regional location of main farmland	Fisher's exact test	0.47	0.39

Differences between subpopulations

Given that experimental participants did not differ from NAU-respondents except for residency on farm we pooled both samples for a second comparison of subpopulations using the whole dataset for the subpopulation of NAU-members (Table 3). Excluded in this comparison was residency on farm since we detected a significant difference in this characteristic between both samples. In regard to this characteristic, we tested between subpopulations using only the sample NAU-respondents for the subpopulation NAU-members.

We detected no difference in production system pursued ($F(4, 304)=1.47$, $p=0.21$) and in the majority of farm business or personal characteristics. Again, we detected a difference in ethnicity ($p<0.001$) due to higher proportions of indigenous farmers among MeatCo-

respondents which amounted to only 2.2% in the pooled NAU-sample. A test for differences in regional location was significant (p=0.03), but no clear picture in distribution of the pooled sample versus MeatCo-respondents emerged. Educational difference was barely insignificant (p=0.054) with a lower proportion of MeatCo-respondents having a trade certificate or some form of university education (46.6% versus 75.1% in the pooled sample). Likewise, a test for legal organization of the farm business was barely insignificant (p=0.06), with a smaller percentage of MeatCo-respondents conducting the farm business as single owners (58.9% versus 72.3% in the pooled sample). A test for differences in farm residency using only the sample NAU-respondents for the subpopulation of NAU-members detected no difference.

Table 3: Comparison of personal and farm business characteristics between the subpopulations *NAU-members* and *MeatCo-customers*. Both samples of the subpopulation *NAU-members* were pooled for the analyses except for residency on farm which was performed only with the sample *NAU-respondents*. Analyses were performed with Student's t-tests assuming unequal variances for continuous, with Mann-Whitney tests for ordinal and with Fisher's exact tests for nominal variables. Production system was analyzed with a MANOVA using the Wilks' Lambda criterion. p-Values significant at the 5%-level are indicated by an asterisk (*).

Variable	**Statistical test**	**p-Value**
Personal characteristics		
age	t-test	0.43
gender	Fisher's exact test	0.63
ethnicity	Fisher's exact test	< 0.001*
education	Mann-Whitney test	0.054
year of farming experience	t-test	0.43
total household income	Mann-Whitney test	0.41
income from cattle farming	Mann-Whitney test	0.91
residency on farm	Fisher's exact test	0.08
Farm business characteristics		
cattle production system	MANOVA	0.21
ownership status	Fisher's exact test	0.28
legal organization of farm	Fisher's exact test	0.06
area for cattle farming	t-test	0.56
total number of own cattle in November	t-test	0.58
regional location of main farmland	Fisher's exact test	0.03*

V. Discussion and conclusion

In this paper we describe a survey that we conducted among commercial cattle farmers in Namibia. The survey was designed on the basis of a comprehensive conceptual framework reflecting the current state of knowledge in sustainability and risk economics. The survey's actual specification was adapted to the specific situation of commercial cattle farmers in Namibia through information gained in qualitative interviews and pre-tests. An analysis of participation and homogeneity of the survey population confirmed the existence of single biases while refuting the majority. In this concluding section we discuss our findings.

Farmer's skepticism towards surveys

A considerable challenge was to overcome farmers' skepticism towards surveys in general and to specific sensitive questions. We successfully addressed this challenge, resulting in an overall return rate of 20.8%, and 28.8% and 9.6% among NAU-members and MeatCo-customers, respectively.

We attribute the high return rate in part to our transparency in explaining our research aims by attaching detailed FAQ-pages to the questionnaire and by explaining these in interviews and advertisements in major Namibian magazines and radio broadcasts. Moreover, we assume that high participation principally reflects our effort in trust-building through prior discussions with individual farmers and with decision makers at all hierarchical levels in the well-connected NAU organization. This is indicated by a striking difference in return rates between NAU-members and MeatCo-customers. During our discussions, decision makers showed a keen interest in our study and were willing to motivate their constituencies to participate. In addition, word-of-mouth on our survey spread between individual farmers originating from discussions that followed the in-field experiments and that took place during our preceding research journeys. As anecdotic evidence we can cite that frequently farmers unknown to us had heard about our study from already visited farmers. Thus, given the general trust of NAU-members towards decision-makers and a well-connected network within the organization, we assume that our effort in trust-building produced a 'snowball effect' in ensuring participation.

In addition to high participation, farmers also proved to be less skeptic than expected towards specific sensitive questions. Response rates for the sensitive questions income, size of cattle herd (which is a proxy for wealth) and normative views of sustainability was high with values between 91% and 95%. Furthermore 75.1% of all survey participants identified their farm, which will allow us to conduct extended analyses for a significant portion of participants by including information from other databases.

For the majority of non-sensitive questions response rate was very high, exceeding 95%. Fewer farmers responded to the questions concerning the risk management strategies 'land increase for scale effects' and 'investment into agricultural derivative' (both 90% response rate). From question marks set in a few cases of non-response it seems that this was due to a lack of understanding of the terms 'scale effect' and 'agricultural derivatives'. Even fewer farmers indicated on-farm monthly rainfall. This is likely due to some farmers not keeping precipitation records, which was the case among the personally interviewed experimental participants where response rate to these questions was likewise low with only 77.5%. We cannot conclusively explain why response rate for cattle production system was only 91.9%; possible reasons are incomplete records or an unexpected sensitivity of the question.

Generalizing experimental results to subpopulations

A possible bias was introduced through the creation of the survey address databases from the two databases of NAU and of MeatCo. Participants in this survey thus belonged to two distinct subpopulations of commercial cattle farmers.

Generalizing results from the in-field experiments to either subpopulation requires the absence of sampling biases and suitably similar subpopulations. In our analysis of farm business and personal characteristics between both samples of the subpopulation NAU-members we found no indication for a sampling bias, except for residency on farm (a proxy for full-time farming). We intentionally had induced this bias as we wanted to specifically elicit risk preferences from farmer that are primarily dependent on the farm business for the provision of income.

Owing to our sampling design we could not test for sampling biases in the sampling of MeatCo-customers and simply assumed that random sampling was sufficient. With regard to similarity of subpopulations when comparing the samples experimental participants and MeatCo-respondents we found both to be similar in most characteristics. The only exceptions were ethnicity and the intentionally induced bias in residency on farm.

Thus, we will consider these restrictions when generalizing results from the in-field experiments and will certainly perform more detailed analyses when we approach the respective research questions, but at this point we find no general adverse indication for generalization of results. One future challenge which might arise is the comparatively low number of experimental participants owing to the logistic challenges in collecting these data. If and to what extent this will impose further restrictions is a matter that we will address in future analyses.

Differences between subpopulations

It will be desirable to pool questionnaire data and it was thus necessary to determine to what extent the subpopulations NAU-members and MeatCo-customers differ. In addition to the comparison between the samples experimental participants and MeatCo-respondents we therefore performed a further comparison between subpopulations by pooling the samples experimental participants and NAU-respondents for the subpopulation NAU-members.

One likely difference between subpopulations was the production system pursued, which we suspected to be biased towards beef production among MeatCo-customers. We detected no such difference between both groups in our data. Furthermore, a large share (30.6%) of MeatCo-respondents indicated that they exclusively pursue production systems other than beef production. Thus, farmers seem to deliver to MeatCo regardless of production system pursued, where even farmers that do not focus on beef production likely deliver the occasionally unproductive or old animals for slaughtering.

The difference in ethnicity that already manifested in the comparison using only the sample experimental participants was also detected when using the pooled sample. This difference in ethnicity is not unexpected since indigenous farmers were reported to be underrepresented among NAU-members. We also detected a difference in regional location of farmland, but no clear pattern emerged which would allow us to give a reasonable explanation at this point. We found no further significant difference in other characteristics. However, because of the small proportion of indigenous farmers and the lack of a pattern in regional location of farmland, respectively, we consider the significant difference in ethnicity and regional location no general reason for not pooling samples from both subpopulations. In future analyses we will evaluate differences in farm location more precisely by using the farm identifier – when provided by the respective survey participants – and we will taken care in any analysis that explicitly involves ethnicity.

Representativeness of survey population

Assuming the estimate of 2,500 commercial cattle farmers is accurate we will not have reached 23% of farmers. The question remains whether the survey population is representative for all commercial cattle farmers or if we have undersampled distinct subpopulations.

Since we had access to a complete database of NAU-members our sample will be biased with regard to membership in this interest group. The bias was probably amplified by our selective promotion among NAU-members. Furthermore, NAU-members are reported to be distinct

regarding ethnicity, which was also indicated in our comparison with the subpopulation MeatCo-customers. A likely secondary bias induced is thus undersampling of indigenous farmers. Less obviously, membership to an organization that lobbies for the continuance of cattle farming may indicate a certain predisposition in Weltanschauung, among which may also be specific normative views of sustainability. We will take this possible bias into account in future analyses.

A further possible bias could have been introduced through MeatCo-customers being distinct in production system pursued. We found no indication for this in our comparison with NAU-members. In addition, none of the other analyzed characteristics revealed any difference. We also found no further indication for any undersampling of distinct subpopulations, nor do we suspect any such bias.

Ultimately, however, due to lack of quantitative data on characteristics of the general commercial cattle farmer population we cannot conclusively answer the questions of representativeness. We will therefore be very careful in considering if and how we can generalize any of our future results to the whole population of commercial cattle farmers.

Conclusion

Notwithstanding the aforementioned limitations, the survey was very successful, and given the resulting extensive dataset we expect that future analyses advance our understanding of sustainability under uncertainty in coupled ecological-economic systems. Overall, we take the comparatively high return and response rate as a confirmation of what became already apparent during the qualitative interviews – that issues of sustainable use of ecosystem services under uncertainty are highly relevant for the agricultural sector in Namibia, and that our research can contribute to producing relevant solutions.

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APPENDIX A: Qualitative expert interviews conducted in preparation of the survey

Hermann Caspers, Audit Manager, *Grant Thornton Neuhaus*, Windhoek (Namibia), 03/28/2007

Marina Coetzee, Chief Agricultural Researcher, *Ministry of Agriculture, Water & Forestry*, Windhoek (Namibia), 10/19/2007

Flip de Bruyn, General Manager Finance, *Agra Co-operative Ltd.*, Windhoek (Namibia), 03/30 & 10/11/2007

Volker Dieckhoff, Chairman of *Water Management Group Okakarara, Farm La Paloma,* Okahandja (Namibia), 10/15/2007

Peter Eichhoff, *Farm Vergenoeg*, Summerdown (Namibia), 10/17/2007

Celeste Espach, Agricultural Researcher, Remote Sensing & GIS, *Ministry of Agriculture, Water & Forestry*, Windhoek (Namibia), 10/19/2007

Dr. Ben Fuller, Independent expert on Social and Economic Research and Policy Analysis, Windhoek (Namibia), 03/28/2007

Arne Gressmann, Chairman of Board of Directors, *MeatCo*, Chairman, *Study Group Karsfeld*, *Farm Klein-Huis*, Grootfontein (Namibia), 10/13–10/14/2007

Claus Hager, Manager Research and Development, *Namibia Agricultural Union*, Coordinator: Land Management Desk, *Desert Research Foundation of Namibia*, Windhoek (Namibia), 04/02/2007

Birgit Hoffmann, Senior Manager Marketing, *Agra Co-operative Ltd.*, Windhoek (Namibia), 10/08/2007

Jürgen Hoffmann, Senior Trade Advisor, *Namibian Agricultural Trade Forum*, Windhoek (Namibia), 04/01 & 10/09/2007

Oliver Horsthemke, Manager Agricultural Development, *First National Bank of Namibia*, Windhoek (Namibia), 03/29/2007

Peter H. Hugo, Senior Manager Livestock, *Agra Co-operative Ltd.*, Windhoek (Namibia), 10/11/2007

Arnold Klein, General Manager Retail and Wholesale, *Agra Co-operative Ltd.*, Windhoek (Namibia), 03/30 & 10/08/2007

Bertus Kruger, Head of Land Desk, *Desert Research Foundation of Namibia*, Windhoek (Namibia), 03/29/2007

Glenn-Marie Lange, Senior Researcher, Center on Globalization and Sustainable Development, The Earth Institute, *Columbia University,* New York (USA), 10/09 & 10/12/2007

Leon Lubbe, Agricultural Researcher, Pasture Science, *Ministry of Agriculture, Water & Forestry*, Windhoek (Namibia), 10/19/2007

Harald Marggraff, Manager Commodities, *Namibia Agricultural Union*, Windhoek (Namibia), 04/02 & 10/08/2007

Joseph Minnaar, Statistician, Agricultural Statistics, Central Bureau of Statistics, *National Planning Commission*, Windhoek (Namibia), 03/29/2007

Thomas Peltzer, Board Member, *Conservancy Association of Namibia*, *Farm Onjossa*, Okahandja (Namibia), 10/18–10/19/2007

Klaus Schade, Acting Director, *The Namibian Economic Policy Research Unit*, Windhoek (Namibia), 10/09/2007

Robert Schultz, Member of Energy Desk, *Desert Research Foundation of Namibia*, Windhoek (Namibia), 03/29/2007

Willie Schutz, Manager Information Systems, *Meat Board of Namibia*, Windhoek (Namibia), 03/29/2007

Elaine Smith, Manager Research & Development, *Namibia Agricultural Union*, Windhoek (Namibia), 10/19/2007

Hans-Günter Stier, Chairman of Board of Directors, *Agribank of Namibia*, Partner, *Stier Vente Associates*, Windhoek (Namibia), 10/12/2007

Paul Strydom, General Manager, *Meat Board of Namibia*, Windhoek (Namibia), 03/29/2007

Vehaka Tjimune, Chairman, *Namibian National Farmers' Union*, Senior Manager: Procurement, *MeatCo of Namibia*, Windhoek (Namibia), 03/29/2007

Justus Tjituka, Senior Manager Finance, *Agribank of Namibia*, Windhoek (Namibia), 10/11/2007

Wessel Visser, Manager Karakul, *Agra Co-operative Ltd.*, Windhoek (Namibia), 03/30/2007

Peter Zensi, Member, *Study Group Karsfeld*, *Farm Hamburg*, Grootfontein (Namibia), 10/14–10/15/2007

Ibo Zimmermann, Chair of Steering Committee, *BIOTA Namibia*, Deputy Director, Department of Agriculture, *Polytechnic of Namibia*, Windhoek (Namibia), 03/31/2007

APPENDIX B: Questionnaire

Leuphana University of Lüneburg

Sustainability of commercial cattle farms and the natural environment in Namibia

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Volhoubaarheid van kommersiële beesplase en die natuurlike omgewing in Namibië

A scientific study by the *Leuphana University of Lüneburg*, Germany,
in cooperation with the *Namibia Agricultural Union*.

Important

⇨ Questionnaire may be filled in in English, Afrikaans or German.

⇨ All information collected will remain **strictly confidential.**

⇨ Please return the questionnaire even if you cannot answer all questions.

Who should complete this questionnaire?

⇨ We kindly ask any commercial farm business that farms cattle to complete one questionnaire only.

⇨ We kindly ask the principal operator / *hoof* of each farm business to complete the questionnaire, i.e. the person that is responsible for the on-site, day-to-day operation of the farm business.

How to complete this questionnaire?

Please follow these guidelines when you complete this questionnaire:

- **check white boxes**

  Example: **Gender:** Male ..... ☒
  Female ..... ☐

- **enter numbers in the larger white fields**

  Example: Farm size ..... 5 000 ha

- **write text on the continuous lines**

  Example: Other: *Cattle* .. ☒

For some questions we provide you with additional explanations. This is indicated by the ➔ symbol.

How to contact us?

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Or visit our web site at http://www.uni-lueneburg.de/seg

➔ *Continue to STEP 1*

I. Business basics / Basiese boerdery-inligting

STEP 1

1. **What is your status as the principal operator / *hoof* of the farm business?**

   ➔ *Please check only one box.*

   I'm an owner ..... ☐

   I'm a hired manager ..... ☐

   Other: _____ ☐

2. **How would you characterize your farm business structure?**

   Sole proprietorship .... ☐ Partnership ..... ☐ Cooperative ..... ☐

   Family corporation ..... ☐ Non-family corporation . ☐ Other: _____ . ☐

STEP 2

3. **What area of land (in hectares) did your farm business own, lease, or use free of charge on April 30, 2008?**

   3.1 Owned by your farm business ..... ☐ ha

   3.2 Rented or leased <u>from</u> others for 1 year or less ..... ☐ ha

   3.3 Rented or leased <u>from</u> others for more than 1 year ..... ☐ ha

   3.4 Used free of charge <u>from</u> others ..... ☐ ha

   3.5 Total area of land owned, leased or used free of charge

   ➔ *Total of questions 3.1 to 3.4* ..... ☐ ha

4. **What area of land was owned by your farm business but used <u>by others</u> on April 30, 2008?**

   4.1 Rented or leased <u>to</u> others for 1 year or less ..... ☐ ha

   4.2 Rented or leased <u>to</u> others for more than 1 year ..... ☐ ha

   4.3 Entrusted <u>to</u> others free of charge ..... ☐ ha

   4.4 Total area of land used by others

   ➔ *Total of questions 4.1 to 4.3* ..... ☐ ha

5. **What total area of land was <u>operated</u> by your farm business on April 30, 2008?**

   ➔ *Question 3.5 minus 4.4* ..... ☐ ha

6. **What area of land operated by your farm business on April 30, 2008 was designated for cattle farming, hereafter in the questionnaire referred to as your RANGELAND?**

   ➔ *Include all land available for cattle farming even if it is used at the same time for other purposes such as game farming; include also areas with bush encroachment; exclude land used <u>solely</u> for other purposes* ..... ☐ ha

II. Risks and management strategies / Risiko en bestuurstrategieë

STEP 3

7. How would you rate the risk of low rainfall resulting in low grass production for your farm business?

➔ *Please check the box on the scale that best describes your rating.*

no risk ☐ ☐ ☐ ☐ ☐ ☐ **very high risk**

8. Considering only the risk of low rainfall resulting in low grass production, we would ask you to rate the importance of each of the following individual "On-Farm" and "Financial" management strategies.

➔ *For each strategy, please check the box on the scale that best describes the importance.*

ON-FARM management strategies …	**not at all important**					**very important**
- purchase of supplementary feed / *voer en lek*	☐	☐	☐	☐	☐	☐
- choice of cattle production system such as oxen production	☐	☐	☐	☐	☐	☐
- choice of breed adapted to high variability in grass production .	☐	☐	☐	☐	☐	☐
- resting part of your RANGELAND in good rainy seasons to build up buffers for bad seasons	☐	☐	☐	☐	☐	☐
- purchase/lease of extra RANGELAND in areas with different rainfall patterns	☐	☐	☐	☐	☐	☐
- purchase/lease of extra RANGELAND for scale effects	☐	☐	☐	☐	☐	☐
- other ON FARM management strategies:						

_____

FINANCIAL management strategies …	**not at all important**					**very important**
- forward contracts for fixing a good price	☐	☐	☐	☐	☐	☐
- advances on livestock sales	☐	☐	☐	☐	☐	☐
- savings/checking account as a financial buffer	☐	☐	☐	☐	☐	☐
- uptake of loans for covering operating losses	☐	☐	☐	☐	☐	☐
- income from off-farm employment and off-farm assets	☐	☐	☐	☐	☐	☐
- investment into agricultural derivatives on the stock market	☐	☐	☐	☐	☐	☐
- other FINANCIAL management strategies:						

_____

9. The following is a list of other risks that may impact on your cattle farming. How would you rate each risk?

➔ *For each risk, please check the box on the scale that best describes your rating.*

How would you rate the NATURAL RISK of …	**no risk**					**very high risk**
- low groundwater levels due to low rainfall ……	☐	☐	☐	☐	☐	☐
- unintentional bush fires striking your RANGELAND ……	☐	☐	☐	☐	☐	☐
- cattle contracting diseases or parasites ……	☐	☐	☐	☐	☐	☐
- cattle loss from predators ……	☐	☐	☐	☐	☐	☐

How would you rate the ECONOMIC RISK of …	**no risk**					**very high risk**
- unfavourable prices for live cattle/slaughter sales ……	☐	☐	☐	☐	☐	☐
- unfavourable prices for farming inputs such as feed or licks ……	☐	☐	☐	☐	☐	☐
- rising living expenses ……	☐	☐	☐	☐	☐	☐

How would you rate the POLITICAL RISK of …	**no risk**					**very high risk**
- unfavourable trade agreements on export of cattle meat ……	☐	☐	☐	☐	☐	☐
- changing labour market conditions ……	☐	☐	☐	☐	☐	☐
- expropriation ……	☐	☐	☐	☐	☐	☐

How would you rate OTHER RISKS such as …	**no risk**					**very high risk**
- cattle theft ……	☐	☐	☐	☐	☐	☐
- failure of machinery or other farm equipment ……	☐	☐	☐	☐	☐	☐

10. Apart from individual management strategies, there are also collective management strategies. How important in general (not just for the risk of low rainfall) are the following collective management strategies for your cattle farming?

➔ *For each strategy, please check the box on the scale that best describes the importance.*

	not at all important					**very important**
Cooperative ownership of farmland ……	☐	☐	☐	☐	☐	☐
Governmental support such as subsidies or drought relief ……	☐	☐	☐	☐	☐	☐
Interest groups on a local level such as conservancy groups ……	☐	☐	☐	☐	☐	☐
Interest groups on a national level such as NAU or parties ……	☐	☐	☐	☐	☐	☐

III. Sustainability / Volhoubaarheid

STEP 4

11. **Sustaining the livelihood of farmers by sustaining income: How much annual net income (gross revenues from farming minus operating expenses, taxes and interest on loans), expressed in today's N$, should you yourself and future generations at least derive from cattle farming?**

    ➔ *Please enter an amount in the box. Assume that there is no rise in prices or living expense over time.*

    [ ] N$

12. **Sustaining the natural environment by sustaining the grazing capacity of your RANGELAND: How high should the grazing capacity of your RANGELAND, expressed in hectares per large stock unit, be during your own and future generations?**

    [ ] hectares per large stock unit

13. **For how many generations should cattle farming be sustained, i.e. both net income and grazing capacity of your RANGELAND stay at or above the levels you have specified in *Questions 11* and *12*?**

    ➔ *Please enter a number into the box, where **'0'** denotes the current generation, **'1'** the following generation, **'2'** the generation thereafter etc.*

    [ ] generations

14. **Income from cattle farming is always risky to some degree. It may not be possible to obtain the net income at or above the level you have specified (*Question 11*) in every year .**

    In how many out of every 10 years is it manageable that income falls below the level specified?

    ➔ *Please enter the number of years between **'0'** and **'10'** into the box.*

    [ ] years out of 10 years

15. **Grazing capacity of your RANGELAND is always risky to some degree. It may not be possible to obtain the grazing capacity at or above the level you have specified *(Question 12)* in every year.**

    In how many out of every 10 years is it manageable that grazing capacity falls below the level specified?

    ➔ *Please enter the number of years between **'0'** and **'10'** into the box.*

    [ ] years out of 10 years

16. **We assumed that sustaining livelihood means sustaining income, and that sustaining the natural environment means sustaining the grazing capacity of RANGELAND.**

    In regard to livelihood or the natural environment, it may also be important to sustain things other than income or grazing capacity of RANGELAND. In your opinion, what else should be sustained?

    _____

    _____

IV. Attitude towards risk / Benadering tot risiko

STEP 5

17. In general, how would you rate your willingness to take risks?

➔ *Please check the box on the scale that best describes your willingness to take risks.*

completely avoid to take risks ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ **very willing to take risks**

18. In the following question, we would like you to respond to a hypothetical situation.

Let's assume you are forced to sell fifty weaners (due to financial or grazing reasons) and can do so at auction. However, you are uncertain about the amount of money they will fetch. You have a 50% chance that the fifty weaners combined will fetch N$ 90 000 and a 50% chance that they will fetch N$ 130 000.

Instead of selling at auction, you can sell the weaners to a reputable trader for a fixed amount of money. The trade procedures (i.e. driving to the venue, paperwork, etc.) are similar regardless of whether you sell at auction or to the trader.

For each of the following six scenarios, please choose whether you prefer to take part in the auction having a 50% chance of fetching either N$ 90 000 or N$ 130 000, or prefer to sell to the trader offering you increasing higher amounts of money.

➔ *Please check only one box for each of the six scenarios.*

Scenario	Auction		Trader
1: The trader offers you **N$ 100 000**. What would you prefer?	Sell at auction ☐	or	sell to trader ☐
2: The trader offers you **N$ 102 500**. What would you prefer?	Sell at auction ☐	or	sell to trader ☐
3: The trader offers you **N$ 105 000**. What would you prefer?	Sell at auction ☐	or	sell to trader ☐
4: The trader offers you **N$ 107 500**. What would you prefer?	Sell at auction ☐	or	sell to trader ☐
5: The trader offers you **N$ 110 000**. What would you prefer?	Sell at auction ☐	or	sell to trader ☐
6: The trader offers you **N$ 112 500**. What would you prefer?	Sell at auction ☐	or	sell to trader ☐

STEP 6

19. In your present situation, what would you prefer: a payment of N$ 100 000 in one month or a higher amount in seven months (therefore six months later)?

➔ *Please check only one box for each of the five scenarios. For your convenience, we have indicated for each scenario the corresponding effective annual interest rate with quarterly compounding.*

Scenario	Payment in one month		Payment in seven months	Annual interest rate
1: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 104 881** in seven months ☐	10%
2: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 109 545** in seven months ☐	20%
3: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 114 018** in seven months ☐	30%
4: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 118 322** in seven months ☐	40%
5: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 122 474** in seven months ☐	50%

20. How would you rate your willingness to wait for a larger payment?

➔ *Please check the box on the scale that best describes your willingness to wait.*

not at all willing to wait ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ **very willing to wait**

V. Your farm management / Jou plaasbestuur

STEP 7

21. How much rainfall did you receive at the farm house in the rainy seasons of 2006/07 and 2007/08?

➔ *Please enter the total amount of rainfall for the respective periods in **mm**.*

Oct ´06	Nov ´06	Dec ´06	Jan ´07	Feb ´07	Mar ´07	Apr ´07	May – Sept ´07
Oct ´07	Nov ´07	Dec ´07	Jan ´08	Feb ´08	Mar ´08	Apr ´08	May – July ‘08

22. How would you characterize each rainy season (November 1 to April 30) on your farm in the period 2003 to 2008?

➔ *Please check only one box for <u>each</u> season.*

	very poor					**very good**
2007/08 rainy season ……	☐	☐	☐	☐	☐	☐
2006/07 rainy season ……	☐	☐	☐	☐	☐	☐
2005/06 rainy season ……	☐	☐	☐	☐	☐	☐
2004/05 rainy season ……	☐	☐	☐	☐	☐	☐
2003/04 rainy season ……	☐	☐	☐	☐	☐	☐

STEP 8

23. How would you rate the quality of your RANGELAND (see *question 6*)?

➔ *Please check the box on the scale that best describes the quality.*

very poor quality ☐ ☐ ☐ ☐ ☐ ☐ **very good quality**

24. What percentage of your RANGELAND was covered by bushes on April 30, 2008 ?

0 % …… ☐	1 to 20 % …… ☐	21 to 40 % …… ☐
41 to 60 % …… ☐	61 to 80 % …… ☐	81 to 100 % …… ☐

25. What percentage would be the optimum level of bush cover for your RANGELAND?

[ ] %

26. What was the grazing capacity of your RANGELAND as measured as hectares per large stock unit on April 30, 2008?

[ ] hectares per large stock unit

27. How many camps is your RANGELAND divided into?

➔ *If you have not divided your RANGELAND, please enter **'0'** in the box.*

[ ] camps

STEP 9

28. How many of <u>your own</u> cattle did you have on your RANGELAND at the start (November 1, 2007) and the end (April 30, 2008) of the rainy season of 2007/08?

➔ *Please report the number for each cattle group. Only include cattle that you own.*

	Cows	Weaners	Heifers	Oxen	Bulls
November 1, 2007					
April 30, 2008					

29. In addition to your own cattle, how many cattle that did not belong to your farm business did you have on your RANGELAND on April 30, 2008?

	Cows	Weaners	Heifers	Oxen	Bulls
April 30, 2008					

30. For each of the following production systems of cattle farming, please indicate the percentage of <u>your own</u> cattle herd assigned to each production system.

➔ *Please enter the percentage in the box. If you don't pursue a specific production system, enter **'0'** in the box. Please bear in mind that the percentages should add up to **100**.*

Percentage of total herd

Weaner breeding for sale but not for slaughter..... [ ] %

Slaughter animal production from weaners that you have bought ..... [ ] %

Weaner breeding for slaughter ..... [ ] %

Stud breeding ..... [ ] %

Other: _____ ... [ ] %

STEP 10

31. Including yourself and your spouse (if married), how many people are in your household?

➔ *Include in 'household' anyone who is living on your farm and with whom you share at least one meal per day, but exclude anyone whom you pay a salary to and you are not related to (e.g. farm workers).*

Number of people in your household: ☐

32. Adding up the income from all sources and all household members, which best describes your annual household net income (gross revenues from farming minus operating expenses, taxes and interest on loans) in the period March 1, 2007 to February 29, 2008?

N$ 0 to N$ 50 000 ..... ☐ N$ 50 001 to N$ 150 000 ..... ☐ N$ 150 001 to N$ 250 000 . ☐

N$ 250 001 to N$ 350 000 ..... ☐ N$ 350 001 or more ..... ☐

33. What percentage of your annual household net income came from cattle farming in the period March 1, 2007 to February 29, 2008?

0 % ..... ☐ 01 to 20 % ..... ☐ 21 to 40 % ..... ☐

41 to 60 % ..... ☐ 61 to 80 % ..... ☐ 81 to 100 % ..... ☐

34. What other products do you farm, and what percentage of your annual household net income came from farming these products in the period March 1, 2007 to February 29, 2008?

➔ *For each product, please enter the percentage in the box. If you don't farm it, enter '**0**' in the box.*

Percentage of annual household net income

Small stock ..... ☐ %

Game (for meat production) ..... ☐ %

Tourism (e.g. accommodation, hunting) ..... ☐ %

Maize ..... ☐ %

Bioenergy ..... ☐ %

Other products: _____ ... ☐ %

35. What percentage of your annual household net income came from off-farm employment, off-farm business or other off-farm sources in the period March 1, 2007 to February 29, 2008?

0 % ..... ☐ 01 to 20 % ..... ☐ 21 to 40 % ..... ☐

41 to 60 % ..... ☐ 61 to 80 % ..... ☐ 81 to 100 % ..... ☐

STEP 11

36. Do you live on the farm during the week?

Yes ..... ☐ No ..... ☐

37. In which district is the majority of your RANGELAND located? _____

VI. Personal information / Persoonlike inligting

STEP 12

38. What is your year of birth and gender?

Year of birth: 19 ☐

Male ..... ☐

Female ..... ☐

39. Which of the following best describes your ethnic background?

Afrikaans .... ☐ German ..... ☐ Herero ..... ☐ Ovambo ..... ☐

Kavango ..... ☐ Nama/Damara ..... ☐ English ..... ☐ Other: _____ .. ☐

40. What is the highest level of education that you have completed?

No high school graduation ..... ☐

High school graduation ..... ☐

Trade or apprenticeship certificate ..... ☐

University/Polytech Diploma or Bachelor .. ☐

University/Polytech Master ..... ☐

University Doctoral ..... ☐

Other: _____ ... ☐

41. What is the main field of study for your highest certificate, diploma or degree?

_____

STEP 13

42. How many years of experience do you have with operating a farm business?

As farm owner: ☐ years As manager: ☐ years Other: _____ ☐ years

43. Since what calendar year have you been operating this particular farm business? ..... ☐

44. How many years do you plan to continue cattle farming? ..... ☐

45. If you retire from cattle farming, what do you expect would be the reason?

_____

46. What do you think is most likely going to happen with your farm business if you would retire?

_____

STEP 14

47. Are you an Emerging Commercial Farmer?

Yes ..... ☐ No ..... ☐

STEP 15

48. And finally, could we ask you to give us your farm number?

Please consider carefully if you are willing to disclose this information. By giving us your farm number your responses to these questions will no longer be anonymous to us!

Knowing the farm number will enable us to perform additional scientific analysis because we can link the information you provide to information on local environmental conditions such as rainfall or soil quality.

Your information will remain strictly confidential, we will not share this information with others, and nobody will be able to identify you or your farm from any information we include in our reports.

Your farm number: ☐

Do you have any suggestions or comments to add to this questionnaire? Are there important aspects of management or sustainability of cattle farming that we have not considered? We are grateful for any comment or suggestion.

_____

_____

_____

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_____

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_____

➔ ***Please put the completed questionnaire in the enclosed postage-paid envelope and mail it to the NAU who will forward the envelope unopened to the Leuphana University of Lüneburg.***

➔ ***If you have any questions, feel free to contact us at the addresses provided on the second page.***

Thank you for your cooperation.

Dankie vir u samewerking.

APPENDIX C: Experimental documentation

Leuphana University of Lüneburg

Sustainability of commercial cattle farms and the natural environment in Namibia

Volhoubaarheid van kommersiële beesplase en die natuurlike omgewing in Namibië

Experiment of attitude towards risk and time, conducted by the *Leuphana University of Lüneburg* in cooperation with the *Namibia Agricultural Union*.

What is this about?

In the following, we would like to conduct with you an scientific experiment about your attitude towards risk (Section I) and time (Section II). Each section consists of one question where we would like to ask you to rate your respective attitude and one question where we would like to ask you to respond to a hypothetical situation. Each section concludes with a task that involves real money.

When you have completed all questions and tasks we would ask you to draw a lot for both tasks having each a 10% change to win whatever you have chosen in the respective task.

We wish you good luck!

I. Risk

I.1 In general, how would you rate your willingness to take risks?

➔ *Please check the box on the scale that best describes your willingness to take risks.*

completely avoid to take risks ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ **very willing to take risks**

I.2 In the following question, we would like you to respond to a hypothetical situation.

Let's assume you are forced to sell fifty weaners (due to financial or grazing reasons) and can do so at auction. However, you are uncertain about the amount of money they will fetch. You have a 50% chance that the fifty weaners combined will fetch N$ 90 000 and a 50% chance that they will fetch N$ 130 000.

Instead of selling at auction, you can sell the weaners to a reputable trader for a fixed amount of money. The trade procedures (i.e. driving to the venue, paperwork, etc.) are similar regardless of whether you sell at auction or to the trader.

For each of the following six scenarios, please choose whether you prefer to take part in the auction having a 50% chance of fetching either N$ 90 000 or N$ 130 000, or prefer to sell to the trader offering you increasing higher amounts of money.

➔ *Please check only one box for each of the six scenarios.*

Scenario	Auction	Trader
1: The trader offers you **N$ 100 000**. What would you prefer?	Sell at auction ☐	or sell to trader ☐
2: The trader offers you **N$ 102 500**. What would you prefer?	Sell at auction ☐	or sell to trader ☐
3: The trader offers you **N$ 105 000**. What would you prefer?	Sell at auction ☐	or sell to trader ☐
4: The trader offers you **N$ 107 500**. What would you prefer?	Sell at auction ☐	or sell to trader ☐
5: The trader offers you **N$ 110 000**. What would you prefer?	Sell at auction ☐	or sell to trader ☐
6: The trader offers you **N$ 112 500**. What would you prefer?	Sell at auction ☐	or sell to trader ☐

I.3 In the following we would like to present you with a task that involves real money.

Below is list of sixteen scenarios. Each scenario gives you the choice between taking part in a lottery or accepting a certain amount instead. The lottery is same throughout the scenarios offering a 50% chance to win N$ 2 500 and a 50% chance to win N$ 500, but the certain amount increases from one scenario to the next.

We would like to ask you to consider every scenario and indicate whether you would prefer to take part in the lottery or accept the certain amount. After you have made your choices for all scenarios we will randomly select one scenario for which your choice becomes relevant, i.e. either taking part in the lottery or receiving the certain amount. Finally, will make a second random selection where you have a 10% chance of being the lucky winner of whatever you have chosen in the selected scenario. If you win you will receive the money straight away.

Scenario	Lottery				Certain amount	Your choice	
	Probability of N$ 2.500		*Probability of N$ 500*			*Lottery*	*Certain amount*
1	50%	N$ 2.500	50%	N$ 500	N$ 550	☐	☐
2	50%	N$ 2.500	50%	N$ 500	N$ 600	☐	☐
3	50%	N$ 2.500	50%	N$ 500	N$ 650	☐	☐
4	50%	N$ 2.500	50%	N$ 500	N$ 700	☐	☐
5	50%	N$ 2.500	50%	N$ 500	N$ 800	☐	☐
6	50%	N$ 2.500	50%	N$ 500	N$ 900	☐	☐
7	50%	N$ 2.500	50%	N$ 500	N$ 1.000	☐	☐
8	50%	N$ 2.500	50%	N$ 500	N$ 1.100	☐	☐
9	50%	N$ 2.500	50%	N$ 500	N$ 1.200	☐	☐
10	50%	N$ 2.500	50%	N$ 500	N$ 1.300	☐	☐
11	50%	N$ 2.500	50%	N$ 500	N$ 1.400	☐	☐
12	50%	N$ 2.500	50%	N$ 500	N$ 1.500	☐	☐
13	50%	N$ 2.500	50%	N$ 500	N$ 1.600	☐	☐
14	50%	N$ 2.500	50%	N$ 500	N$ 1.700	☐	☐
15	50%	N$ 2.500	50%	N$ 500	N$ 1.800	☐	☐
16	50%	N$ 2.500	50%	N$ 500	N$ 1.900	☐	☐

II. Time

II.1 In your present situation, what would you prefer: a payment of N$ 100 000 in one month or a higher amount in seven months (therefore six months later)?

➔ *Please check only one box for each of the five scenarios. For your convenience, we have indicated for each scenario the corresponding effective annual interest rate with quarterly compounding.*

Scenario	Payment in one month		Payment in seven months		Annual interest rate
1: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 104 881** in seven months ☐		10%
2: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 109 545** in seven months ☐		20%
3: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 114 018** in seven months ☐		30%
4: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 118 322** in seven months ☐		40%
5: What would you prefer?	**N$ 100 000** in one month ☐	or	**N$ 122 474** in seven months ☐		50%

II.2 How would you rate your willingness to wait for a larger payment?

➔ *Please check the box on the scale that best describes your willingness to wait.*

not at all willing to wait ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ **very willing to wait**

II.3 In the following we would like to present you with a task that involves real money.

Below is list of twenty scenarios. Each scenario gives you the choice between a payment of N$ 2 000 in one month and larger payment in seven months (therefore six months later). The payment in one month is the same for all scenarios, but the payment in seven months increases from one scenario to the next.

We would like to ask you to consider every scenario and indicate whether you would prefer the payment in one month or in seven months. After you have made your choices for all scenarios we will randomly select one scenario for which your choice becomes relevant, i.e. receiving the payment in one month or in seven months. Finally, will make a second random selection where you have a 10% chance of being the lucky winner of whatever you have chosen in the selected scenario. If you win you will receive a guarantee backed by the Namibia Agricultural Union over the time and amount you have chose in the selected scenario.

Scenario	Payment in one month	Payment in seven months	Effective annual interest rate	Your choice	
				One month	*Seven months*
1	N$ 2 000	N$ 2 025	2,5%	☐	☐
2	N$ 2 000	N$ 2 049	5,0%	☐	☐
3	N$ 2 000	N$ 2 074	7,5%	☐	☐
4	N$ 2 000	N$ 2 098	10,0%	☐	☐
5	N$ 2 000	N$ 2 121	12,5%	☐	☐
6	N$ 2 000	N$ 2 145	15,0%	☐	☐
7	N$ 2 000	N$ 2 168	17,5%	☐	☐
8	N$ 2 000	N$ 2 191	20,0%	☐	☐
9	N$ 2 000	N$ 2 214	22,5%	☐	☐
10	N$ 2 000	N$ 2 236	25,0%	☐	☐
11	N$ 2 000	N$ 2 258	27,5%	☐	☐
12	N$ 2 000	N$ 2 280	30,0%	☐	☐
13	N$ 2 000	N$ 2 302	32,5%	☐	☐
14	N$ 2 000	N$ 2 324	35,0%	☐	☐
15	N$ 2 000	N$ 2 345	37,5%	☐	☐
16	N$ 2 000	N$ 2 366	40,0%	☐	☐
17	N$ 2 000	N$ 2 387	42,5%	☐	☐
18	N$ 2 000	N$ 2 408	45,0%	☐	☐
19	N$ 2 000	N$ 2 429	47,5%	☐	☐
20	N$ 2 000	N$ 2 449	50,0%	☐	☐

APPENDIX D: Cover letters and FAQ-pages

Leuphana University of Lüneburg

Prof. Dr. Stefan Baumgärtner
Sustainability Economics Group

July 31st, 2008

Dear *Cattle Farmer*:

You have chosen a tough job! Variable rainfall and fluctuating cattle prices cause commercial cattle farming to be a risky enterprise. Moreover, the natural environment is degrading in many areas of Namibia making farming even more challenging. Nonetheless, commercial cattle farmers have been employing well-suited management strategies to make cattle farming successful.

Who are we?

The *Sustainability Economics Group* at the *Leuphana University of Lüneburg*, Germany, along with the *Namibia Agricultural Union* (NAU), is conducting a study of commercial cattle farming in Namibia. We want to know how under risky conditions both the livelihood of farmers and the natural environment can be sustained for present and future generations. Your perspective on this issue will be unique and extremely valuable to us.

We are asking just a few minutes of your time.

The enclosed questionnaire has been sent to more than two thousand commercial cattle farmers in Namibia. It includes questions about the risks you face as a commercial cattle farmer, your management strategies and your views on sustainability. We kindly ask you to answer these questions and return the questionnaire in the postage-paid envelope. **The questionnaire may be filled in in Afrikaans, English or German.** *'N70'* on this envelope is the business reply license for all envelopes of this study; it is not unique to your envelope. Of course, your answers will be strictly confidential. We will use the information only anonymously and only for scientific purposes.

We know you are busy. So why should you participate?

Findings from this study may help to achieve long-term economic success of cattle farming in Namibia and contribute to sustaining the natural environment that enables farming. To this end we will invite you to workshops throughout Namibia in the summer of 2009/10. The findings will also be available from the NAU as a written report, and we will gladly send you an electronic version upon request.

If you have any questions or concerns about completing the questionnaire, please contact us at the *Sustainability Economics Group*. The contact address is provided below. You may also contact Harald Marggraff at the *NAU* (phone: 061.237838, email: meat@agrinamibia.com.na).

We are looking forward to your participation!

Yours sincerely,

Prof. Dr. Stefan Baumgärtner

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Leuphana Universiteit van Lüneburg

Prof. Dr. Stefan Baumgärtner
Volhoubaarheid Ekonomie Groep

31 Julie 2008

Geagte *Beesboer*:

U het dit nie maklik nie! Wisselende reënval en beespryse bring mee dat kommersiële beesboerdery ondernemings met risiko's geword het. Intussen gaan die natuurlike omgewing in baie gebiede agteruit, wat boerdery in Namibië nog meer uitdagend maak. Tog span kommersiële beesboere geskikte bestuurstrategieë in om suksesvol met bees te boer.

Wie is ons?
Die *Volhoubaarheid Ekonomie Groep* aan die *Leuphana Universiteit van Lüneburg*, Duitsland, onderneem in samewerking met die *Namibia Landbou Unie* (NLU) 'n studie na kommersiële beesboerdery in Namibië. Ons probeer vasstel hoe volhoubaar boere hul bestaan op plase en die natuurlike omgewing bestuur ten einde 'n goeie lewe te maak – vir huidige en toekomstige geslagte. U siening oor hierdie aspek sal uniek en van groot waarde vir ons wees.

Ons vra net 'n paar minute van u tyd
Die ingeslote vraelys is aan meer as tweeduisend kommersiële beesboere in Namibië gestuur. Dit sluit in vrae oor risiko's, bestuurstrategieë en u standpunt oor volhoubaarheid. Ons versoek u vriendelik om hierdie vrae te beantwoord en dit terug te stuur in die ingeslote koevert. **Vraelyste kan ook in Afrikaans en Duits ingevul word.** Die posgeld daarvoor is reeds betaal. Die kode *"N70"* op die koevert is 'n identfikasie-kenmerk en vir die uitsluitlike doel van die studie. Alle antwoorde is streng vertroulik. Inligting word anoniem vir 'n suiwer wetenskaplike doel gebruik.

Ons weet u is besig. So waarom moet u deelneem?
Bevindinge van die studie kan help om die langtermyn ekonomiese sukses van beesboerdery in Namibië te bepaal en kan bydra om die omgewing volhoubaar te onderhou ten einde te kan boer. Aan die einde van die navorsing in die somer van 2009/10 sal ons die bevindinge by werkwinkels regoor Namibië waarheen u genooi sal word, bekend maak. Teen daardie tyd sal bevindinge van die studie in verslagvorm (ook elektroniese formaat) by die NLU beskikbaar wees.

Indien u enige vrae rondom die invul van die vraelys het, kontak die *Volhoubaarheid Ekonomie Groep* deur middel van Harald Marggraff by die NLU (tel: 061-237838 of e-pos: meat@agrinamibia.com.na).

Ons sien uit na u deelname.

Groete,

Prof. Dr. Stefan Baumgärtner

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NAU NLU

Leuphana University of Lüneburg

Sustainability of commercial cattle farms and the natural environment in Namibia

Additional information

Who are we?

The *Sustainability Economics Group* at the *Leuphana University of Lüneburg*, Germany, carries out research on how human economic actions depend upon and affect the natural environment. Research about sustainability of the Namibian agriculture is conducted since 2004. For this study, the group cooperates with the *Namibian Agricultural Union* (NAU).

Why management of risk and sustainability?

Sustainability is generally understood as sustaining both the livelihood of humans and the natural environment – for present and for future generations. Due to risks such as variable rainfall or fluctuating cattle prices, livelihood and the natural environment are always risky to some degree. When considering sustainability, those involved have to specify how much of both they wish to sustain for how long and how much risk is acceptable. Once specified, actions for achieving sustainability can be devised which may include management strategies aimed at reducing risk.

What is the purpose of this questionnaire?

We conduct a scientific study on how sustainability of commercial cattle farming in Namibia may be achieved under risky condition. Farmers know best how to deal with these conditions, and we want to find out how risk, management strategies, and the assessment of what sustainability is differ across farmers. We aim at identifying economic and institutional obstacles that prevent farmers from applying sustainable management strategies. We also aim at deriving potential solutions of how to overcome these obstacles – so that the livelihood of farmers and Namibia's natural environment can be sustained for present and future generations.

What is your benefit from participating and how will you be informed about the results?

Findings from the analyses of your answers may help to achieve long-term economic success of commercial cattle farming. Moreover, with your answers you will contribute to the conservation of the natural environment that enables farming. At the end of our study in summer 2009/10 we will present our findings in workshops throughout Namibia that you will be invited to attend. In addition, the findings will be available as a free report from the NAU, and we will gladly send you an electronic version upon request.

Sensitive information is asked in the questionnaire. What will happen with these data?

We ask you to return the questionnaires in the enclosed business-reply envelope to the NAU who will forward the envelopes to us unopened. *'N70'* on this envelope is the business-reply license for all envelopes of this study; it is <u>not</u> unique to your envelope. Your data stays <u>anonymous</u> and we will treat it as <u>strictly confidential</u>. Under no circumstances will we pass personal data to any governmental institution.

Leuphana Universiteit
van Lüneburg

Volhoubaarheid van kommersiële plase en die natuur in Namibië

Addisionele inligting

Wie is ons?

Die *Volhoubaarheid Ekonomie Groep* van die *Leuphana Universiteit van Lüneburg*, Duitsland, doen navorsing oor hoe menslike ekonomiese optrede bepaal en beïnvloed word deur die natuur. Navorsing oor die volhoubaarheid van Namibiese landbou word sedert 2004 gedoen. Vir hierdie studie werk die groep saam met die *Namibia Landbou Unie* (NLU).

Hoekom moet risiko en volhoubaarheid bestuur word?

Volhoubaarheid word algemeen verstaan as die volhou van die lewensbestaan van die mens en die natuur vir die huidige en toekomstige generasies. Weens risiko's soos wisselende reënval en beespryse is lewensbestaan en die natuurlike omgewing altyd tot 'n mate riskant. Wanneer volhoubaarheid in aanmerking geneem word, moet diegene wat daarby betrokke is, spesifiseer hoeveel van beide hulle wil volhou, vir hoe lank en hoeveel risiko's aanvaarbaar is. Wanneer dit gespesifiseer is, kan aksies vir die bereik van volhoubaarheid opgestel word wat bestuurstrategieë kan insluit en daarop gemik is om die risiko te verminder.

Wat is die doel van hierdie vraelys?

Ons doen wetenskaplike navorsing oor hoe volhoubaarheid van kommersiële beesboerdery in Namibië onder riskante toestande onder riskante toestande bereik kan word. Boere weet die beste hoe om hierdie toestande te hanteer en ons wil vasstel hoe risiko, bestuurstrategieë en die begrip van volhoubaarheid tussen boere verskil. Ons poog om ekonomiese en institusionele struikelblokke te identifiseer wat boere verhinder om volhoubare bestuurstrategieë toe te pas. Ons poog ook om moontlike oplossings te vind om hierdie hindernisse te oorkom sodat die lewensbesaan van boere en Namibië se natuurlike omgewing vir die huidige en toekomstige generasies behoue kan bly.

Watter voordeel hou deelname aan hierdie studie vir u in en hoe gaan u ingelig word oor die bevindinge?

Die bevindinge van die ontledings van u antwoorde kan help om langtermyn ekonomiese sukses vir kommersiële beesboere te bereik. Soveel te meer sal u antwoorde bydra tot die bewaring van die natuur wat boerdery moontlik maak. Aan die einde van die navorsing in die somer van 2009/10 sal ons die bevindinge by werkwinkels regoor Namibië waarheen u genooi sal word, bekend maak. Bykomend hiertoe sal die bevindinge gratis by die NLU verkry kan word. Ons sal ook graag vir u by navraag 'n elektroniese weergawe aanstuur.

Sensitiewe inligting word in die vraelys gevra. Wat gaan met hierdie inligting gedoen word?

Ons vra u om die vraelys in die ingeslote koevert aan die NLU terug te besorg wat dit dan onoopgemaak na ons sal aanstuur. Die kode N70 op hierdie koeverte is 'n kode wat die inligting vir hierdie studie identifiseer en is <u>nie</u> uniek aan die koevert wat u ontvang het nie. U inligting bly <u>anoniem</u> en ons sal dit <u>streng vertroulik</u> hanteer. Onder geen omstandighede sal u persoonlike inligting aan enige regeringsinstelling gegee word nie.

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