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Learning from each other: participatory research with landusers on management applications

Ibo Zimmermann*, Ute Schmiedel & Clement Cupido

Summary: BIOTA undertook several approaches towards learning partnerships between academic researchers and farmers in order to develop and evaluate management measures. This chapter describes several examples of how researchers and landusers identified the challenges, discussed the possible measures, decided what and how to test them and conducted and evaluated experiments together. The examples show that farmers are innovative, experimental and eager to learn about new ways of how to improve their land management. The partnership approach revealed new perspectives for farmers, farm workers and researchers: The joint research resulted in more biodiversity-friendly land management, tested strategies for restoration of degraded rangeland based on better insight into ecological processes for farmers and researchers.

Introduction

The ultimate aim of applied research is to improve people's lives. In the case of biodiversity research, the expected improvement should come about through enhanced ecosystem services that biodiversity provides, through improved management by landusers. To reach this goal, decisions on land management need to be based on better understanding of biodiversity's functions and how these are influenced by different management strategies. In order to empower landusers to apply effective management, the focus of agricultural extension has shifted from prescriptive to participatory. Before solutions can be found it is necessary to understand why farmers use the land unsustainably (Düvel & Lategan 1997). Participatory methodologies, such as those of Participatory Learning and Action (Pretty et al. 1995), provide useful learning tools for both farmers and researchers, if adapted to local conditions and capable of overcoming accustomed expectations (Treurnicht et al. 2001). Participatory action research can be usefully applied to landuse management (Shah 1997) and lead to participatory trials (Mapfumo et al. 2008) that enable farmers to find ways to improve their farming practices.

Despite the mainstreaming of unsustainable farming practices over the past decades, some farmers have maintained or developed biodiversity-friendly approaches to farming. The effectiveness of these approaches can be scientifically tested in partnerships between farmers and scientists and publicised among farmers through farmer organisations and extension services, to encourage others to experiment with them. Some of the participatory projects applied in BIOTA research are presented below, divided into those that: (i) introduced innovative practices that were new to farmers, (ii) learnt from practices already being applied by innovative farmers, and (iii) jointly developed and applied practices that addressed the farmers' needs.

Projects that suggested new practices

Biodiversity-friendly control of internal parasites

The increasing use of toxic chemicals by farmers poses a threat not only through worms developing resistance to the chemicals (van Wyk et al. 1998) but also to essential ecological services provided by dung beetles, such as cycling mineral nutrients through the soil and burying dung that would otherwise breed flies and spread diseases (Walters 2008).

During a workshop held with farmers in Rehoboth in 2007, the analytical tool of a problem tree (Fussel 1995) was used to analyse the sequence of events that eventually lead to roundworm infestations. Diagnosis through drawing a problem tree is useful in allowing the consequences of different interventions to be better visualised and understood, thereby guiding decisions on management of the problem. Management that addresses causes higher up a problem tree, closer to the root causes, is likely to be more effective in the long run than management that addresses the proximate causes or symptoms at the bottom of a tree. The root causes as perceived by farmers included the increased human population, easier access to loans and the El Niño weather phenomenon. Root causes from a more ecological point of view included the provision of permanent water from boreholes, the control of large predators, the use of poisons to control parasites, premature weaning, aggressiveness in the handling of livestock and the kraaling of livestock (Zimmermann et al. 2009). This allowed farmers to view roundworm infestations as a symptom caused by imbalances in regulatory processes. Treating the imbalances will be far more effective for long-term sustainability than will treating the symptoms with quick fix toxic chemicals. Although the overall problem tree appears complicated at first glance (e.g. Fig. 1), it becomes clearer when interpreted one step at a time, as in the presentation inserted as Electronic Appendix or available at www.biota-africa.org/PublPDF/Abstracts/Problem_tree_step_by_step.ppt

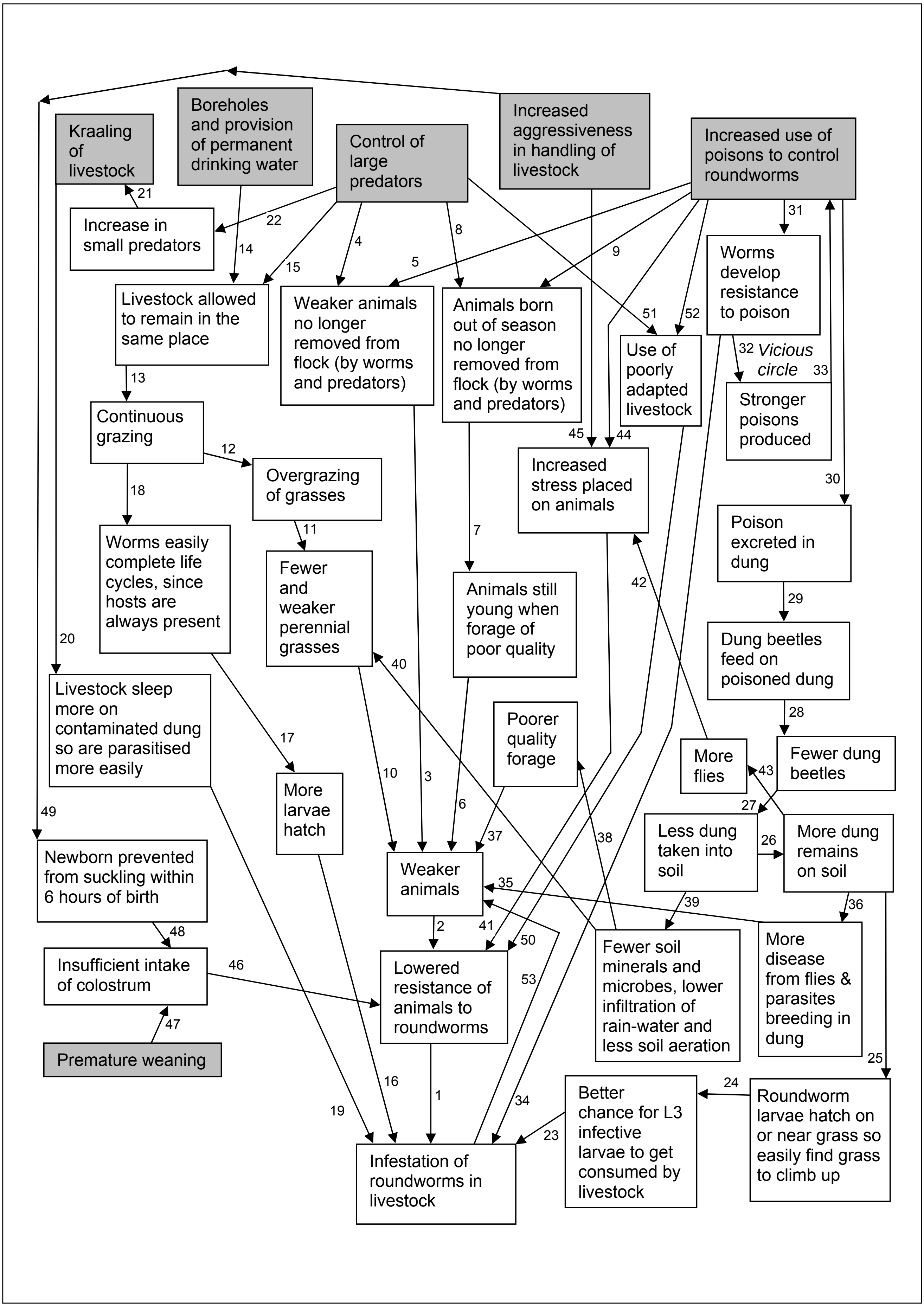

Fig. 1: Diagnostic problem tree for the infestation of intestinal roundworms in livestock, with root causes shaded.

The project also learnt from farmers who successfully raise sheep and goats without the need for any remedies, whether toxic chemicals or environmentally friendly ones. Treating the symptoms with environmentally friendly remedies could be viewed as a temporary measure until the wider imbalances have been corrected. While constructing the problem tree, the farmers learnt about another Namibian farmer who stopped his use of toxic chemicals to treat sheep and goats against intestinal worms, after observing the death of dung beetles that fed on the dung of recently treated animals (Zimmermann & Smit 2008). He was able to avoid treating his animals because the rotational grazing disrupted the worm life cycles and provided nutritious forage that maintained animal resistance to parasites, while the overnighting of animals on the rangeland avoided close contact with worm larvae in kraals. However, many other farmers are not yet able to apply management closer to the root causes, as they lack the means to rest rangeland sufficiently and to control predators, so are forced to kraal their livestock. Therefore, as a temporary measure the use of biodiversity-friendly treatments against parasites was investigated. This would at least allow dung beetles to continue to perform ecological services, while farmers jointly plan how to manage their animals in a way that raises their resistance to parasites.

A participatory trial was initiated with five farmers in the Rehoboth District of Namibia and jointly analysed by farmers and researchers to evaluate alternatives. Groups of sheep received the following different treatments: conventional treatments with chemicals, two different environmentally-friendly treatments based upon Effective Microorganisms (EM, i.e., a consortium of naturally-occurring lactic acid bacteria, yeasts and phototrophic bacteria) and no treatment as the control. The sheep were weighed every two months, when dung samples were also collected for determination of parasite loads. No significant differences in weight gains and parasite loads were found among groups (Muheua & Zimmermann 2009). Nevertheless, the farmers noticed other improvements in the groups receiving the EM treatments, such as better meat quality and cleaner carcasses, while a herder observed that the EM sheep grazed more voraciously early in the morning and subsequently stopped grazing before the other sheep did.

Photo 1: A farm worker receives his certificate from the Polytechnic of Namibia for participating in a research trial. Photo: Justus Kauatjirue.

The experiments and workshops inspired several farmers to initiate further activities in this field: The farmers also experimented on their own with other uses for the EM, such as successfully treating sheep that had consumed poisonous plants and applying it on external wounds to speed up the healing process. One of the farmers even bought EM to provide to his other sheep and goats that were not included in the trial. He continued to do so after cessation of the trials. Another farmer offered financial support for a former student to establish a business of producing a herbal vermicompost (i.e. compost made from earth worms that ate herbs) that boosts immunity. Following the suggestion from one of the farmers involved, farm workers who had learnt how to produce and administer the EM derivatives used in the trials, received certificates at the final workshop (Photo 1).

Biodiversity-friendly tick control

In another project, farmers became aware that it sometimes takes the extermination of a species to gain appreciation of its value. This was the case with oxpeckers (*Buphagus erythrorhynchus* and *B. africanus*), which are now valued for their role in helping to control ticks in parts of South Africa where the previous use of acaricides resulted in their local extermination. Bird capture teams have come to Caprivi Region of Namibia to translocate oxpeckers to South Africa (Stutterheim & Panagis 1987). However, the increasing use chemical acaricides in Caprivi Region now threatens its oxpeckers.

During workshops, the construction of problem trees by farmers (Photo 2) revealed their perceptions of the root causes of tick infestations as the suspension of free dipping services by government and the prohibition on burning grass. Root causes from a more ecological point of view were similar to those mentioned above for the problem tree of roundworm infestations, as indeed dung beetles are also threatened by acaricides (Chihiya et al. 2006), especially the systemic products that get poured onto animals' backs.

The project learnt from farmers in areas prone to tick infestations who manage to raise cattle without the use of chemical acaricides. They tend to treat the root causes, by resting rangeland and applying breeding seasons to ensure that calves are born with maximum immunity, thus

Photo 2: A problem tree shows the causes of tick infestation as perceived by farmers in Kwandu Conservancy. Photo: Ibo Zimmermann.

preventing the conditions that favour ticks. They also welcome low levels of ticks to maintain immunity against ticks amongst their cattle (Rechav et al. 1991). Communal farmers are not yet in a position to apply such management. This project therefore tried EM derivatives for treating the symptoms of tick control on cattle in partnership with farmers in the Kwandu and Salambala Conservancies of Caprivi Region. The process of the project experienced some challenges as treatments that were to be applied weekly were often neglected, such as when the farmers were too busy working in their crop fields. The effectiveness of the EM treatments only became apparent on the cattle of some of the farmers during some of the months of tick counting (Liyemo & Zimmermann 2009). When tick numbers became very high, most of the farmers applied chemicals to all their cattle, including those that were supposed to receive only the EM treatments. Most farmers were unaware that small numbers of ticks are helpful to maintain immunity amongst their cattle. They rather viewed ticks as enemies that must be exterminated. The majority also viewed oxpeckers as pests that cause wounds on their cattle and donkeys. The threat of toxicity from chemicals seemed to be of little concern to most farmers. It was rather the high cost of the chemicals which prevented their more frequent use, while even the students assigned to this project seemed to perceive chemical treatment as the superior method of tick control. Thus, the process helped to gain insight into the perceptions of farmers towards tick infestations but basically failed to dissuade the farmers from wanting to use toxic chemicals.

Research projects on management strategies of innovative farmers

Patch burning in Namibia's Thornbush Savanna

More Namibian farmers are coming to realise that their success at controlling lightning induced fires over the past decades has been a major contributor to bush encroachment and a less diverse rangeland. A few farmers have addressed this by applying prescribed fire to patches on their farms and this project made use of this opportunity by taking measurements on three such farms.

At two of the farms, the reason for burning patches of approximately 130 ha each was to control bushes. The fires reduced the height of established bushes, but they virtually all re-grew. The mortality of the encroaching *Acacia mellifera* saplings was higher on the burnt patches than on unburnt control plots on only one of the farms, while seedlings virtually all died, both in the burnt and control plots (Tjilumbu & Zimmermann 2009). At the other farm, the burning of patches of approximately 10 ha was for the purpose of improving biodiversity. Here the soil was more fertile where a patch had been burnt two years earlier, compared to the unburnt control (Zimmermann et al. 2008b).

This project indicated that fires increased the mortality rates of smaller plants, many of which seem to have died from the exceptionally long dry period before the burning in 2007. The main lessons learnt from this project are that the use of fire after such a premature end to the rainy season may be inappropriate for most rangeland management objectives. The application of fire should rather await appropriate conditions, such as those appearing after season of exceptionally high rainfall. The farmers provided not only the opportunity for the measurements to be taken, but also assistance with transporting of students. One of the farmers requested that markers of transects and measured plants be left in place after completion of the project, so that further monitoring may continue.

The farmers appreciated having quantified results in the form of charts that showed the consequences of their patch burning, while other farmers may use the information to decide whether they too should apply patch burning.

Trampling in Namibia's Thornbush Savanna

An innovative farmer gained useful experience with trampling, through his adaptive management (Zimmermann & Smit 2008). His observations suggested that brief trampling after good rain, on soil with the right texture and organic matter content, conserved soil moisture, possibly by breaking the capillary connections that suck moisture from lower layers in untrampled soil. This project therefore undertook to investigate the influence of trampling on soil moisture and vegetation, in partnership with three farmers.

The three farms in eastern Namibia were selected due to their grazing management comprising fast rotation of large herds through many paddocks. The high stocking density provided short trampling followed by a long period of absence during which the grazed and trampled plants could recover whenever moisture was available. Gypsum blocks were buried at four depths, both in and outside exclosures replicated five times per farm (Zimmermann et al. 2008a). An electronic meter for reading the blocks was left with each of the three farmers, for them to take measurements whenever they had an opportunity to do so. The farmers submitted the collected data and were later provided with charts that provided a visual impression of the changes in soil moisture profile. The farmers were able to observe the fence-line contrasts at the exclosures, while data from vegetation measurements

Photo 3: Participants of the Namibian Rangeland Forum view a gully treated with branches of *Acacia mellifera*. Photo: Ibo Zimmermann.

Photo 4: Members of the Griqua Community install the developed restoration treatments on the farm Ratelgat in the Succulent Karoo in September 2004. Photo: Ute Schmiedel.

were converted to charts that the farmers were provided with.

Initial results from the gypsum blocks were inconsistent among replicates. However, a few examples with greater consistency hinted that trampled sites experienced greater infiltration and less evaporation. The density index of plants, mostly annual grasses, was significantly higher outside most of the exclosures. This increase of annual grasses on trampled sites may be responsible for subsequently transpiring more water out of the soil, resulting in higher grass productivity from trampling (if followed by sufficient rest), but not in moister soil by the end of the growing season.

As a consequence of the mutual learning experience, one of the farmers added a fenced plot alongside three of the exclosures on his farm at his own expense, to investigate the effect of applying a large flock of sheep for a short time. Another farmer constructed five additional exclosures along a landscape gradient, to learn more after completion of this project.

The farmers appreciated having quantified results in the form of charts that showed the consequences of their short-duration grazing, while other farmers may use the information to decide whether they too should apply occasional trampling on any part of their farm.

Projects that jointly addressed farmers' needs

Restoration of a gully system in Namibia's Highland Savanna

In 2003, the participatory process of Ecosystem Management Understanding (EMU) (Pringle & Tinley 2001) was introduced to Namibia by three EMU facilitators during a workshop with members of the Auas-Oanob Conservancy. EMU approach aims to help landusers to understand and adapt to natural processes rather than fighting against them. This approach and the pilot restoration project of eroded gully systems that emanated from it are described in detail in Article III.6.3. The conservancy members often visit the site and are impressed with the results. The treated and untreated gully systems also serve as a demonstration site for visits by interested groups (Photo 3).

Participatory experiments in the Succulent Karoo

Locally degraded rangelands which are caused by farming management measures (stock posts, water points, gathering places for livestock near gates but also installations of infrastructure etc.), typically show poor recovery even many years or decades after the land management changed (Walker 1993). Due to poor vegetation cover, they provide poorer grazing resources (Milton & Hoffman 1994, Todd & Hoffman 1999) and are often the starting point of soil erosion. Many farmers have a negative perception of these degraded areas and feel compelled to improve them by changing management measures or actively restoring degraded sites. BIOTA researchers have often been approached about options for restoration of such sites. In the Succulent Karoo, concrete questions and discussions resulted in participatory projects where BIOTA researchers together with the landusers developed and tested restoration measures for particular situations (near Observatory S22; see also Chapter IV.4). On the newly established communal land of Soebatsfontein (Chapter IV.4) farmers felt very proud of their sustainable management practices and thus would like to restore the bad patches in the landscape inherited from the previous landowner. In the Knersvlakte on the farm Ratelgat (near Observatory S27), owned by the Griqua Ratelgat Development Trust since the year 2000, more than 10 km of trenches that had been dug for the installation of water pipes left poorly recovering scars in the landscape. In the newly implemented Richtersveld Community Conservancy, a new World Heritage Site, the wish had been expressed to restore the vegetation around the settlement Eksteenfontein that had been degraded due to many years of overgrazing. In all cases, BIOTA researchers and landusers held workshops and discussed the ecological processes that might be

Photo 5: Members of the Tweerivier Community identifying indicators for assessing and monitoring of rangelands. Photo: Melvin Swarts.

Photo 6: Livestock keepers from the Leliefontein community rank the most common perennial plant species according to palatability to livestock. Photo: Melvin Swarts.

the reason for the degradation and poor recovery. During these workshops, farmers and researchers together developed restoration treatments, taking into account the local availability of material and resources. The restoration treatments were applied as trials at selected sites, employing scientifically suitable design of replications and controls. The farmers supported the work by providing material, transport and manpower (Photo 4).

The subsequent regular monitoring of the trials was conducted by the BIOTA botanical researchers and the BIOTA para-ecologists (see Article III.8.3). The vegetation and soil data from the trials were finally analysed (Meyer 2009, Hanke et al., submitted), the results shared with the farmer communities during feedback workshops and visits. Based on the findings the environmental impact of overutilisation and mechanical disturbance as well as ideas for adjusted trials and future implementation on larger scale were discussed. Beyond the sharing of the results with the farmers, the results were also presented at a local conference (Meyer et al., oral presentation at the at the Arid Zone Ecology Forum, Graff Reinet, South Africa, 2009) as well as prepared for scientific publication.

Indicators for assessing and monitoring rangeland condition in the Succulent Karoo

For centuries before colonisation the Nama people have freely utilised the semi-arid Namaqualand rangeland as grazing land. Under the Apartheid government the transhumance movements of the Kamiesberg herders were limited with the establishment of the 192,000 ha "Coloured Reserve" of Leliefontein. Today, livestock mobility is still very much part of these livestock keepers as they continue to seasonally move with their flocks of goats up and down the Kamiesberg in search of grazing opportunities and water. The ephemeral wetlands of the Kamiesberg Upland, which provide water in the dry season, are unique features in this semi-arid ecosystem. Many rangeland scientist and agricultural extension officers have deemed the grazing land as being degraded. Despite these claims the Leliefontein Communal Area continues to be productive without significant subsidies or additional fodder being fed to livestock during the dry season. The Agricultural Research Council (ARC), which has worked in this area for more than more than 15 years, uses a participatory research approach to collect social and environmental data. In studies by the ARC, which formed part of the BIOTA project, two questions were raised at these workshops:

(1) what indicators do livestock owners perceive to be most important in monitoring rangeland condition?, and
(2) what plant species should be considered for rehabilitation of rangeland in order to improve the grazing capacity?

Two workshops were held respectively in the Upland village of Leliefontein and in the Midland village of Tweerivier. The objective was to obtain some insight on the perception of livestock keepers in terms of what they regard as the most important indicators in qualifying rangeland condition. Firstly, possible environmental and livestock indicators were brainstormed within smaller groups (Photos 5 & 6) and each group came up with its own set of indicators. These keywords were, through consensus of the larger group, formalised into what was termed key indicators for rangeland condition assessment and monitoring. These indicators were as follows: soil erosion, palatable plants, livestock deaths / health, presence of *Galenia africana* (unpalatable plant harmful to small stock), plant moisture, soil, moisture, animals and insects and ephemeral plants. Indicators were then ranked by the participants as a group exercise, using a pair wise ranking system. The result is summarised in Table 1.

This result shows that livestock owners consider the condition of their livestock as the most important indicator to assess and monitor rangeland condition. Unnatural livestock deaths cause great economic losses and are mainly caused by livestock accidentally, or under stressful conditions, consuming poisonous plants. Livestock keepers generally perceive rangeland condition as poor when poisonous plants tend to increase. Poor animal health is an indication of the absence of nutritious plants on the rangelands. Livestock condition has also been identified as an indicator for local level rangeland monitoring the semi-arid areas of Botswana (Reed et al. 2006a, b) and Namibia (Desert Margins Programme 2005). The presence of palatable species was ranked second, followed by plant moisture. Surprisingly vegetation cover, also identified by Esler et al. (2006) as one of the key indicators for assessing semi-arid and arid rangeland condition, was not identified by participants. This would suggest that livestock keepers do not perceive that bare areas are a major concern in the Kamiesberg. Samuels (I. Samuels, pers. comm.) has indicated piospheres are relatively small and that the sacrifice zones radii are seldom longer then 50 m. Allsopp (1999) recorded that a diverse shrubland community can easily be replaced by a single unpalatable species, such as *Galenia africana*, when overgrazed. The acknowledgement of unpalatable plants, such as *Galenia africana*, indicates that livestock owners are aware of the fact that the ratio between palatable and unpalatable should continuously be monitored.

During the course of the workshop participants realised that even though they do not formally assess and monitor rangeland condition, they actually do take a lot of variables into consideration. They also realised what indicators they tend to consider as more important when assessing or monitoring rangeland condition. This workshop opened the door for further discussion on the need and development of a local level monitoring (LLM) system best suited for their conditions. ARC researchers learned in the process that it would be fruitless to introduce a LLM system, developed in a different biome with different livestock management practices, to the communities of Namaqualand. This is underlined by the fact that the indicator 'vegetation cover', which is considered important in various LLM systems in semi-arid southern Africa, was not considered by the Namaqualand livestock owners.

Table 1: Important indicators in qualifying rangeland condition, identified and ranked by farmers during workshops at Leliefontein and Tweerivier in the Kamiesberg area of the Succulent Karoo

Key Indicators	Ranked
Livestock deaths/health	1
Palatable plants	2
Plant moisture	3
Unpalatable plants harmful to livestock	4
Ephemeral plants	5
Soil erosion	6
Wild animals and insects	7
Soil moisture	8

Conclusions

The different steps used in each of the seven participatory projects are summarised in Table 2, indicating the division into projects that: (i) introduced innovative practices that were new to farmers, (ii) learnt from practices already being applied by innovative farmers, and (iii) jointly developed and applied practices that addressed the farmers' needs.

The joint learning approaches were most successful where farmers felt the urgency for taking action, as was the case for restoration of obviously degraded environment (see also Article III.6.3).

Table 2: Summary of different approaches used in each of the seven participatory projects

Type of project →	Projects that suggested new management practices		Research projects on management strategies of innovative farmers		Projects that jointly addressed farmers' needs		
Project → / Project steps applied ↓	Internal parasite control	Tick control	Patch burning	Trampling	Restoring gully system	Restoring pipe trench scars	Rangeland condition indicators
Scientists suggested the project	✓	✓					
Farmers already applied innovative approaches			✓	✓			
Farmers identified priority problem					✓	✓	✓
Workshops with farmers	✓	✓			✓	✓	✓
Problem tree used	✓	✓					
Farmers were exposed to management practices of innovative farmers elsewhere	✓	✓			✓		
Experiments conducted	✓	✓	✓	✓	✓	✓	
Results fed back to farmers	✓	✓	✓	✓	✓	✓	✓

Interactions

Interactions

When farmers are unaware that their actions are leading to degradation, they tend to respond less favourably to actions that emerged from the participatory process. The tick control project, for instance, failed to achieve its objective of encouraging biodiversity friendly methods of tick control. The farmers were preoccupied with chasing symptoms of different problems they faced, some of which had resulted from the inadvertent harm caused to biodiversity's services. Such farmers are in need of assistance to transform to proactive management. The use of the analytical tool of a problem tree helped farmers of the roundworm control project to differentiate between symptoms and different levels of causes. Although the treatment of causes is better for long-term sustainability, sometimes it is necessary to treat symptoms too, in order to speed up recovery or as a stepping stone to proactive management. Innovative farmers who already apply preventative, biodiversity-friendly management are useful research partners for joint learning, as they are eager to learn and to improve their management as well as being in better control of their situations. This was the case for the farming communities in the Succulent Karoo that had perceived the disturbed areas on their farm as being problematic and searched for means to reverse the situation. Participatory action research depends on innovative farmers who are curious to learn and prepared to continuously adjust their management. As lead farmers they may later convince the larger community by showing that agricultural production can be both economically and ecologically viable.

The main lessons learnt from these participatory projects are: Farmers are more motivated to participate if their priority need is addressed, than when scientists suggest a project for them.

Innovative sustainable farmers are important research partners for other farmers and researchers to learn from and set as their benchmark.

Problem trees are useful in situations where farmers tend to treat the symptoms of a problem rather than the causes.

When provided with the opportunity, farmers experiment and find solutions beyond those recommended by scientists.

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