Enclosures for Rehabilitating Pond Catchments and Implications for Grazing Management on the Borana Plateau

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Research Brief

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Abstract

Boran pastoralists say they have one over-riding problem: Limited drinking water for both people and livestock. Ponds are therefore a critical resource. However, lack of livestock control in pond catchments subjects them to heavy grazing and trampling that creates landscapes vulnerable to erosion. Ponds collect sediment after rainfall events and water holding capacity is reduced. We wanted to test a system to improve the management of pond catchments. In March 2014 we erected bush fences to enclose catchments surrounding one demonstration pond in each of four Pastoral Associations. The purpose was to prevent unregulated livestock access and allow recovery of vegetation to trap sediment before it could reach the ponds. In June 2014 a sampling program was introduced to quantify ecological improvements evident after the first rainy season. Permanent 1-m² plots were established inside and outside the enclosures. They were sampled for plant cover (%) and species presence in June 2014, November 2014, and June 2015. Protection from livestock grazing for only one year led to a 400% increase in plant cover overall. Increases in cover tended to be greater on sites that had less cover to begin with. The pastoralists report that the increased cover has reduced pond sedimentation and improved water quality. In addition, protection from grazing improved plant biodiversity. Altogether, 64 plant species were recorded, half of which appeared for the first time in November, 2014. Perennial grasses responded dramatically to protection, which is important given that the Boran highly value their cattle, and cattle prefer to eat grass forage. The implications of these results go far beyond a program of pond rehabilitation. Short-term protection from livestock should be incorporated into a grazing management strategy planned and implemented by the pastoral community at the landscape level.

Pond sedimentation threatens the sustainability of Borana pastoral communities

Ponds capture run-off water for both livestock and human populations on the Borana Plateau. Pond water is a critical resource here, especially during rainy periods and the cool dry season. However, most ponds rapidly fill with sediment from eroding catchments that suffer from uncontrolled grazing and trampling by livestock. Much work is then required each year for the Boran to remove sediment manually.

Our project adopted a three-pronged approach to alleviating the pond siltation problem: excavation of sediment to restore pond capacity; capturing sediment in gullies before it can enter the pond; and reducing erosion in the immediate vicinity of the pond. This report only provides highlights for the third component. Results concerning the repair of gullies and costs of excavating sediment are covered in another Research Brief.

Figure 1. The catchment of a demonstration pond at Dikale PA exhibits dramatic recovery of vegetation after only 8 months of excluding livestock in this photo taken in October, 2014. (Photo credit: Layne Coppock)

Thorn-bush fenced enclosures offer protection from livestock

Four ponds were nominated by the pastoralists for treatment, with one in each of four targeted Pastoral Associations (PA). The PAs were: Harweyu, Dikale, Denbala Bedana, and Medecho.

Enclosures made from thorn-bush fencing were erected in March 2014. This was just before the long rainy season. The original enclosed areas ranged from 2 to 10 hectares (ha), but three of the enclosures (Dikale, Denbala Bedana, and Medecho) were extended with additional fencing in August-September 2014 at the start of the short rainy season; this extension was done by the pastoralists themselves. Dikale has the largest pond enclosure, at least 15 ha with the extension.

The intent of the enclosures was to protect the catchments from livestock. Livestock could still access the water, however, via a corridor leading to the pond edge. This controlled livestock movement and would allow for vegetation recovery elsewhere in the catchment. An increase in the vegetative cover would intercept the overland flow of rainwater and trap suspended sediment before it could reach the ponds.

In effect, the pond enclosures would resemble *kalo* (traditional fodder banks) that have been created by the Boran in recent decades to conserve forage elsewhere in the system. *Kalo* also are known to improve the forage base after one or two years of protection from grazing. The effects of protection from grazing in pond catchments should be much greater than those observed in *kalo*, however, simply because pond catchments are landscape sinks where water and nutrients accumulate.

Our studies on the effects of protection from grazing were focused on changes in plant cover and the number of plant species in the catchments over time. On visiting the enclosures in May 2014, just two months after they were fenced, the ecological improvement inside the fences was already evident after one rainy season. A sampling program was developed to quantify the changes.

Establishment of sampling plots

In June 2014, after the long rains, permanent 1-m^2 quadrat plots were established at the four pond enclosures, including some control plots located outside the fencing for comparison. The plots were grouped into two zones based on distance from the pond edge, which corresponded to decreasing density of vegetation. These plots were sampled for plant cover and species presence at the time of establishment, in November 2014 after the short rains, and again after the next long rains in June 2015.

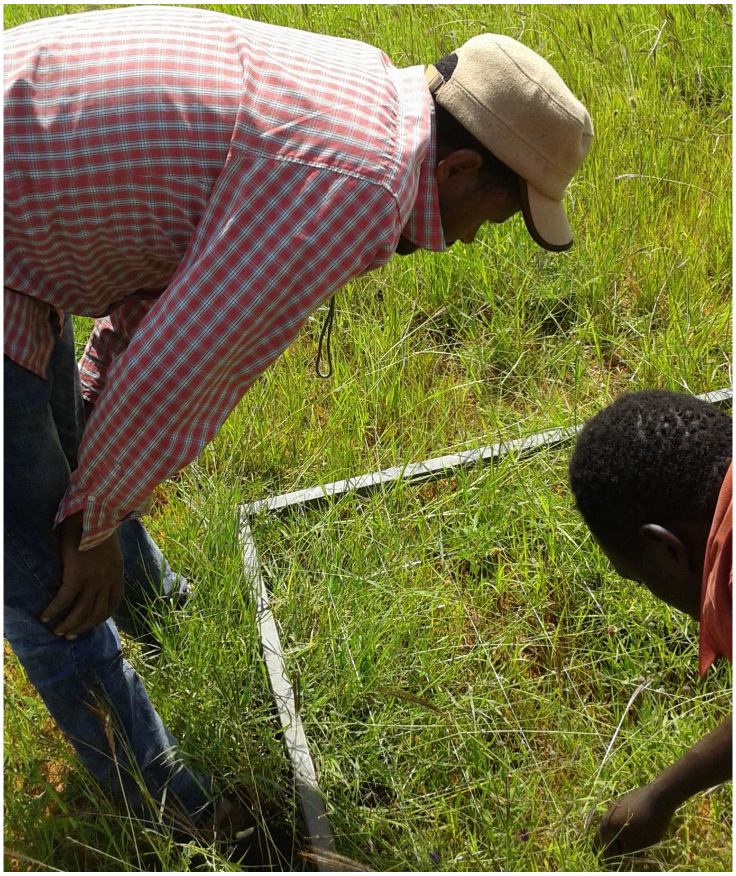

Figure 2. Researchers record vegetation data using the square-meter sampling frame at within a protected pond catchment at the Delbana Bedana PA. (Photo credit: Bedasa Eba)

Altogether 72 quadrats were installed and marked by GPS coordinates, pegs, and flat-head nails driven into the plot corners. A metal detector facilitated plot re-location for consecutive readings. Recording of information on plot cover and species was facilitated by nylon strands stretched every 10 cm from both sides of a 1-m^2 quadrat frame, creating a grid of 100 squares 10x10 cm. The quadrat data record provided a list of species present with the dominant species identified.

Plots were placed subjectively in locations representative of major vegetation cover types observed within a zone: A minimum of 3 plots in each zone up to a maximum of 12 plots at Dikale Zone 2 where cover was more variable.

Name of PA	Number of plots, data collection dates and % increase since previous record						
	N	Jun '14	Nov '14	% incr. Jun-Nov	Jun '15	% incr. Nov-Jun	% incr. Jun-Jun
		% cover			% cover		
Harweyu	15	3.8	7.7	103	26.6	245	600
Dikale	18	10.6	25.7	142	37.3	45	252
Denbala Bedana	12	15.3	36.4	138	50.5	39	230
Medecho	7	6.4	17.6	175	36.1	105	464
column means		9.0	21.9	140	37.6	109	387

Table 1. Plant cover (%) for plots initially within the four enclosures at three sampling dates and % increase over the three periods.

Figure 3(a). Degraded landscape outside of the pond-catchment enclosure at Dikale PA during the warm dry season (February) of 2015; the lack of plant cover can lead to soil erosion. (Photo credit: Brien E. Norton)

Figure 3(b). Abundant forage inside of the pond-catchment enclosure at Dikale PA during the dry season (February) of 2015; note that trespassing livestock have invaded the site. (Photo credit: Brien E. Norton)

Four to six plots were located outside the enclosure boundary as a set of "controls." In three cases (Dikale, Denbala Bedana, and Medecho) these control plots became protected from livestock after the enclosures were extended.

Protection from grazing greatly increases plant cover

Protection from livestock grazing led to substantial increases in plant cover (Table 1). Within the four pond enclosures, plant cover steadily increased at each sampling period. Mean plant cover was 9% in June 2014, 21.9% in November 2014, and 37.6% in June 2015. On average, cover increased nearly four-fold (400%) over 12 months between June 2014 and June 2015.

When data are broken down according to zones within the enclosures (Table 2), the zone closest to the pond, Zone 1, recorded a percent plant-cover trend of 15.6, 34.7, and 59.9% over the three sampling periods. In Zone 2 furthest from the pond where vegetation was initially less dense, the percent cover changed from 5.2 to 14.2 and 22.4% over 12 months.

The enclosures of Dikale, Denbala Bedana and Medecho were extended outwards during August and September 2014 by the pastoralists themselves. These extensions then annexed many of our original (unprotected) control plot locations! While this disrupted our research design, it provided evidence that the people appreciated the effects of the intervention.

By the November 2014 sample, the cover on the annexed "control" plots at Dikale had jumped from 0.7% to 4.3%, and up to 14.4% by June 2015. Similarly, the "control" plots at Denbala Bedana initially had mean cover of 6.3% before being annexed, and after receiving protection the mean cover for these increased to 29.3% by November 2014 after the preceding short rainy season. They finally achieved 35% cover by June 2015.

Bare ground greatly dominated the control plots with only 3.1% mean plant cover at the June 2014 sample. Of the 72 quadrats, 15 were completely bare of vegetation at the first sample. Four remained completely bare a year later, while 8 quadrats recovered some vegetation by the second sample. Three more initially bare quadrats exhibited some plant growth by the third sample in June 2015. General observations from these data overall include that:

- Protection from livestock grazing can cause dramatic increases in vegetation cover within a relatively short period of time;
- The trend of increasing plant cover under protection had not reached its potential after 12 months; and
- Areas that initially had very low plant cover can experience substantial increases in cover once protected.

Protection from grazing greatly increases the number of plant species

Name of PA	% cover in Zone 1			% cover in Zone 2			% cover in Control area		
	Jun '14	Nov '14	Jun '15	Jun '14	Nov '14	Jun '15	Jun '14	Nov '14	Jun '15
Harweyu	3.4	8.2	37.2	4.1	7.3	19.6	2.4	5.8	14.3
Dikale	25.8	52.8	59.7	3.0	12.2	23.8	0.7	4.3	14.4
Denbala Bedana	31.0	69.0	96.0	4.1	13.1	18.0	6.3	29.3	35.0
Medecho	2.0	8.8	46.7	9.8	24.1	28.3	no data	12.0	20.0
column means	15.6	34.7	59.9	5.2	14.2	22.4	3.1	12.9	20.9

Table 2. Plant cover (%) for plots according to pond and zone, and for control plots that were initially established outside the enclosure fences. The Dikale, Denbala Bedana and some Medecho control plots were later contained within enclosure extensions erected in August-September before the short rains of 2014.

The data record for each of the three sampling dates included a list of species present in each plot. The frequency of the dominant species in the 100, 10x10cm cells of the 1m^2 quadrat was also noted.

Altogether, 64 species were recorded in the quadrats. Biodiversity, expressed as the average number of species per PA site, increased steadily through time: 13 species in the first sample, 20 species in November 2014, and 23 species in June 2015. Even the control quadrats showed an increase in species: 5.5, 11.5, and 13 species averaged over the four sites on the 3 sampling dates. The increase in the species diversity of control plots, however, is partly attributable to the enclosure extensions in August-September 2014 that brought many control quadrats inside the protective fencing.

The most widespread species in all 4 enclosures were the perennial grasses *Eragrostis heteromera, Sporobolus pellucidus,* and *Cynodon dactylon*. The most common non-grass species were *Berleria spinisepala* and *Indigofera* sp. There is great floristic variation across the 4 enclosures; some species appeared in only 1 or 2 enclosures while some species occurred more frequently in one zone rather than the other.

Cattle are prized by the Boran above camels and small ruminants. Grasses are the preferred forage for cattle, and therefore the response of grasses to the enclosure treatment is of particular interest here. Twenty grass species were recorded across the four enclosures, of which 18 were perennials. As noted above, three of these were common species, and altogether they gave the vegetation a characteristic "grassy appearance." At the first sample, only 8 perennial grasses were found in the quadrats. By the second sample that number had risen to 15 species, and another 3 perennial grasses were observed in June 2015.

In general, there was a surprising amount of dynamism in plot floristics over the three sampling times. Thirty-two species were recorded for the first time in November 2014. Another 7 species were observed for the first time in June 2015. In contrast, only 6 of 25 species recorded in June 2014 were not evident in the following November sample.

Plant community resilience exceeds our evidence

The sampling program described in this report began after the first season of protection from grazing during the long rains in March to May 2014. It was not possible to measure changes that took place over those first 10 weeks of protection. But we have documented the substantial improvement in ecological conditions over the next 12 months that embraced two more rainy seasons. We can be reasonably certain, therefore, that our data underestimate the beneficial effects of protection from livestock extending from the initial conditions in March 2014 to the final sampling period in June 2015.

Implications for grazing management

The current grazing practices on the Borana Plateau allow livestock to have continuous access to any areas that are not demarcated by either cultivated fields or bush-fenced fodder banks (*kalo*). *Kalo* are a distinctive feature of land and livestock management in the Borana region, and similar practices have been observed in other pastoral societies. *Kalo* tend to be modest in size (12 ha or less) and they cover only a small percentage of the landscape here. *Kalo* protect forage that is generally reserved for old, sick, or young animals that are unable to travel to find grazing during dry periods. If *kalo* are large enough, however, they can also provide some emergency forage during the warm dry season. Traditionally *kalo* have been community grazing resources—shared by local groups of herd owners. Recently, however, it has been reported that some wealthy herd owners in Borana have established private *kalo*. This is a controversial issue that is currently under review by various stakeholder groups.

The importance of protection for increasing forage available in the long dry season was evident from observations in February 2015 of several breaches of the enclosure fence surrounding the Dikale pond. Dozens of sheep, goats and cattle were being herded inside the enclosure. By daring to trespass inside the enclosure—contrary to community agreements to protect the site—the livestock owner inadvertently demonstrated the value of short-term protection from grazing to enhance forage resources, particularly in the dry season. This is the principle underlying a grazing management strategy to achieve three goals: recovery of vegetation across the landscape, reduction of soil erosion, and increased livestock carrying capacity. The project has shown that these outcomes are technically feasible. All that is lacking is implementation of a grazing plan by collaborative community action.

Residents of the four PAs held focus group discussions during August 2014 and prepared sustainable grazing management plans on a map of each PA's community rangeland resources. They know that their rangelands are degraded—and getting worse—and they have observed the greater forage production in their *kalo* as well as the pond enclosures. They accept that there is a need for temporary rest from livestock as the foundation of sustainable grazing management.

The rotational grazing plans developed by members of the PA focus groups began with a map of wet season and dry season areas in management zones. These were further divided into "paddocks" that would be grazed sequentially. Paddock boundaries followed roads, tracks and natural features in the landscape. Herds would be restricted to paddock areas by herders, not fences. The essence of a sustainable rotational grazing plan is to provide each area with rest from livestock during at least one rainy season, preferably two or three. While one area is being rested, other parts of the landscape are being grazed until their turn for a rest period arrives.

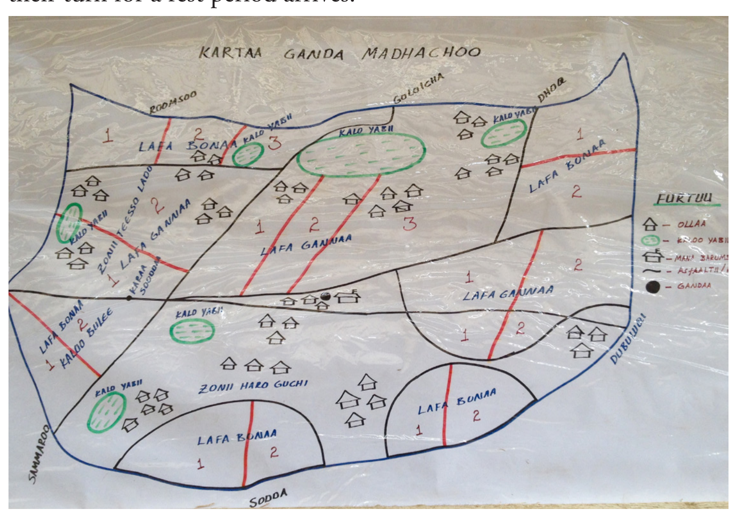

Figure 4. Hand-drawn map of the Medecho PA based on input from focus groups. The map shows sections of the PA divided into "paddock" areas for a proposed rotational grazing plan. (Photo credit: Layne Coppock)

This initiation of a grazing system is “rotational rest” rather than “just rotational” grazing. The goal is to work towards a situation where only one paddock is being grazed while the remaining paddocks are rested; this becomes rotational grazing that ensures a combination of short but intense grazing followed by long rest intervals for every part of the PA. It will achieve sustainable improvements in available forage, livestock productivity, community water quantity and quality, human welfare, and household viability.

Conclusions

The simple act of fencing an area to exclude livestock here for about one year caused both plant cover and plant species diversity to more than double. This is a conservative conclusion based on a data record that was initiated well after the improvement process had begun. The data collected so far show that the positive ecological changes are relatively greater on sites that are in a poorer condition to begin with. These results offer promise to those who dream of restoring the degraded rangelands of Borana to their former productivity, reduce landscape erosion, and reverse degradation. But to reach these goals will require wise management of land and livestock. A carefully designed rotational grazing plan, and acceptable mechanisms for regulated implementation, are essential for sustainable improvements in environmental condition, water supply, and forage production.

Further Reading

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Prjoect: Sustainable Pastoralism on the Borana Plateau: An Innovation Systems Approach

Principal Investigator: D. Layne Coppock, Utah State University

This project is focused on the study and testing of best-bet land and livestock interventions that can move the Borana pastoral system back towards sustainability. These efforts will consider livestock herd diversification, improvements for forage production, changes in common-property management, as well as pastoral livelihood diversification. A partnership including Utah State University, the Oromia Agricultural Research Institute (OARI), Managing Risk for Improved Livelihoods (MARIL PLC), and other stakeholders will be forged to help meet project objectives.

Feed the Future Innovation Lab for Collaborative Research on Adapting Livestock Systems to Climate Change is dedicated to catalyzing and coordinating research that improves the livelihoods of livestock producers affected by climate change by reducing vulnerability and increasing adaptive capacity.

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