

Planned comparison protocol:

Short-duration resting of wet season grazing areas

Jason Sircely, International Livestock Research Institute (ILRI)

j.sircely@cgiar.org

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1. Research summary

Question or objectives	How can grass production and composition be cost-effectively improved in wet season grazing areas in poor range condition?
Hypothesis	Short-duration resting improves grass production and composition in wet season grazing areas, and improves environmental condition, especially when combined with re-seeding.
Options to compare	Resting of wet season grazing areas for 1 month vs. 2 months per rainy season (precise treatments may differ by site according to stakeholder interest, e.g., 2 weeks vs. 1 month rest per rainy season)
	Resting of wet season grazing areas for 1 month, with vs. without re-seeding
	Resting of wet season grazing areas 2 months, with vs. without re-seeding
Contexts to compare	Topographic position and pasture use type (if applicable)
	Dominant soil types x Slope classes
	Distance from water, settlements, and markets
	Productivity and condition of surrounding grazing lands
Study units	15 resting sites, each with 8 1.1-ha research plots: 3 1-month (or 2-week) plots with nested re-seeding plots, 3 2-month (or 1-month) plots with nested re-seeding plots, 2 control plots
Responses to measure	Grass basal area, vegetation and bare soil cover, biomass of 'good' and 'bad' herbaceous and woody species, grass density (as indicator of grass regeneration), woody plant density, soil stability, lost grazing cost, labor cost, input cost (seeds and labor), pastoralist preference for each option
Roles of pastoralists	<ul style="list-style-type: none">• Comment on the treatments of the Planned Comparisons (PCs) so as to decide what is relevant for the area• Decide the precise locations where PCs will be implemented• Implement the PCs according to the agreed treatment combination• Keeping records ('Pastoralist Researchers', PRs) and experience sharing• Participate in the evaluation of options at middle and end of the research cycle or agreed time periods
Roles of others	<p>ILRI:</p> <ul style="list-style-type: none">• Lead in the preparation of the planned comparison protocol and roll out• Provide technical backstopping in the delivery of the training of relevant program staff and pastoralists• Lead the preparation of the data capture format, analysis and reporting <p>Project partners:</p> <ul style="list-style-type: none">• Contribute to the design of the PCs• Assist identification of pastoralists who would like to engage in PCs• Assist identification of general locations where PCs can be implemented• Provide budget for labor and propagation materials as required

	<ul style="list-style-type: none"> • Lead the organization and delivery of training of program staff and Pastoralist Researchers on the planned comparison • Lead the identification of Pastoralist Researchers • Organize exchange visits • Participate in the evaluation of the options <p>Pastoralist Researchers (and possibly also DAs):</p> <ul style="list-style-type: none"> • Participate in training of pastoralists • Oversee and maintain the research plots and treatments • Assist research implementation and data collection
Study/experimental design	Among/within (nested) rangeland site trial
Suggested timing (start and end)	Study initiation, plot establishment and baseline, re-seeding: Before the main rainy season, March/April 2018. First outcome assessment: End of main rainy season, June 2018. Second outcome assessment: End of short rainy season, January 2019.

2. Research process

Location criteria

First, NGO partner staff request that community members locate portions of wet season grazing areas where pastoralists are able and willing to reserve an area of 7 ha for resting from grazing for 1–2 months per rainy season (2–4 months per year), and to conduct re-seeding. Pastoralists (not project or ILRI staff) identify the precise locations for resting, to ensure its location is useful. Resting plots must be located within wet season grazing areas (or all-year grazing areas), usually in the most degraded places. Research plots may not be located inside gullies or in wetland areas that flood for part of the year (extremely rocky areas are also excluded, unless typical of the area), and the plot layout can be adjusted accordingly.

Community members must be clearly informed that to participate in the research, a 7–ha plot will be rested for 2 months at the beginning of each rainy season of the year, for 4 months total per year. Inside the 7–ha plot is a smaller, 3.5–ha plot rested for 1 month at the beginning of each rainy season of the year, for 2 months total per year (Note: if necessary, the 4–month resting area may be reduced to 5 ha at minimum; similarly, the resting time may be reduced to 2 weeks–1 month per year at minimum). Re-seeding sub-plots will be created in all resting plots. For more details, see *Plot design and layout*, below.

Project staff provide a list of locations (name of the area, latitude/longitude from GPS) to the ILRI team. The ILRI team selects the study locations from the list provided by project staff.

Setting up community research oversight and liaison

In addition to project and ILRI staff, representatives from the local level are involved in initiating and overseeing the research. The stakeholder groups that should be consulted and linked to the research include pastoralists residing in the area, especially elders and other representatives of the rangeland management institutions and relevant NGO staff. If possible, monitoring teams may be recruited locally on a part-time basis to assist with research oversight and data collection.

In every area where research plots are created, a Pastoralist Researcher (PR) will be recruited to act as the primary liaison between ILRI, NGO, and local stakeholders. The PR will also assist ILRI and project staff with data collection.

Measuring outcomes and impacts

Surveys will be created to monitor changes in livelihoods indicators and pastoralist preference for different rangeland restoration approaches, including possible costs of the approaches tested, and potentially higher costs with progressive up-scaling. These ideal surveys will be used to establish social outcomes and impacts, including the indicators in Appendix 2. Survey participants should be among those pastoralists who normally use the resting area extensively.

Beginning the research

Once the precise research locations have been identified and agreed upon by pastoralists, NGO staff, and ILRI staff, it will take time, between 3 and 9 months, to implement all treatments and assess their effects. The steps to conduct the treatments are provided below in chronological order.

Establishment and baseline. ILRI team goes to the agreed research locations, locates the resting area, and locates the research plots to be sampled. ILRI team samples the baseline research plots and takes photos (see *Field measurement details* and *Plot design and layout*, below), and conducts Focus Group Discussions (FGDs) (or interviews if only a few pastoralists are available). The FGDs include determining the reasons pastoralists give for selecting the location of the resting area. Together, ILRI staff, project staff, and pastoralists mark the resting plot. The resting plots can be marked with moveable markers such as large painted rocks, or other methods, depending on the preferences of pastoralists. The baseline is sampled in the dry season before re-seeding, so that the treatments can begin to take effect during the next wet season.

Re-seeding treatment. Seeds are planted after plot establishment, but before the next rains are expected to begin. Seeds are planted into small holes, 5-10 cm in depth, to avoid seed loss in runoff. All re-seeding plots (*ab* in both the R1 and R2 resting plots; see *Plot design and layout*) are planted at the same time. There is no re-seeding plot in the control plots, since seedlings of high-quality grasses disappear quickly under open grazing.

Completing the research

The steps described here provide a schedule for roughly one year of research, after which observation will lead to refinement and can lead to additional, adaptive experimentation. Since the effects of resting and re-seeding mostly occur during the rainy season, outcomes are assessed at the end of the rainy season. However, poor rainfall could necessitate delaying outcome assessment sampling until after the second resting period (at the end of the second rainy season after the treatments are applied). The steps as outlined here may be delayed by an additional season to provide sufficient resting time.

Resting treatments. After plots are established and re-seeding is complete, the larger 1-month resting area is closed to grazing for the first month of the next rainy season. The 1-month resting area is closed to grazing before the first substantial rains begin. After 1 month, the 1-month resting area is opened to grazing, and the smaller 2-month resting area remains closed to grazing. After the 2nd month of rest, the entire resting site is opened to grazing.

Outcome assessment—Round 1. After the resting and re-seeding treatments are complete, the first round of outcome assessment is at the end of the first rainy season post-baseline and post-treatment. Therefore the first outcome assessment is 3–6 months after the baseline is conducted and treatments are applied. The ILRI team re-samples the plots, including the full set of indicators, and takes photos (see *Field measurement details* and *Plot design and layout*, below), and conducts an FGD (or interviews) for participatory assessment of outcomes for the resting and re-seeding treatments.

Outcome assessment— Round 2. Once two successive resting periods have

been completed, the second round of outcome assessment is at the end of the second rainy season, or 9–12 months after the baseline and re-seeding treatment. The ILRI team re-samples the plots and takes photos (see *Field measurement details* and *Plot design and layout*, below), and conducts an FGD (or interview) for participatory assessment of outcomes for all treatments.

Survey. At or around the time of the second round of outcome assessment (before or after), 9–12 months after research initiation, a survey is conducted among a sample of users of the rested and re-seeded areas from which to estimate outcomes and impacts. Survey participants should be among those pastoralists who normally use the resting area extensively.

3. Field measurement details

Equipment

1. Camera
2. GPS
3. Wooden pole marked at 1 and 2 m
4. Plastic bags for soil samples
5. Bulk density cores
6. Data collection sheets (provided in appendices)

Measurements

1. Site description and photos (baseline)
2. Sample soils (baseline)
3. Area and height (baseline, outcome)
4. Trees and shrubs (baseline, outcome)
5. Grass density (outcome)

1. Site description and photos. Place 2 m pole in the plot center point, stand 30 m downhill (from the center point), center the camera on the middle of the 2m pole (1 m high), and take 2 photos. Use a GPS to record the position of the plot center. Complete the site description datasheet.

2. Sample soils. Soil bulk density cores are taken, and soil stability is measured, at the center of each plot.

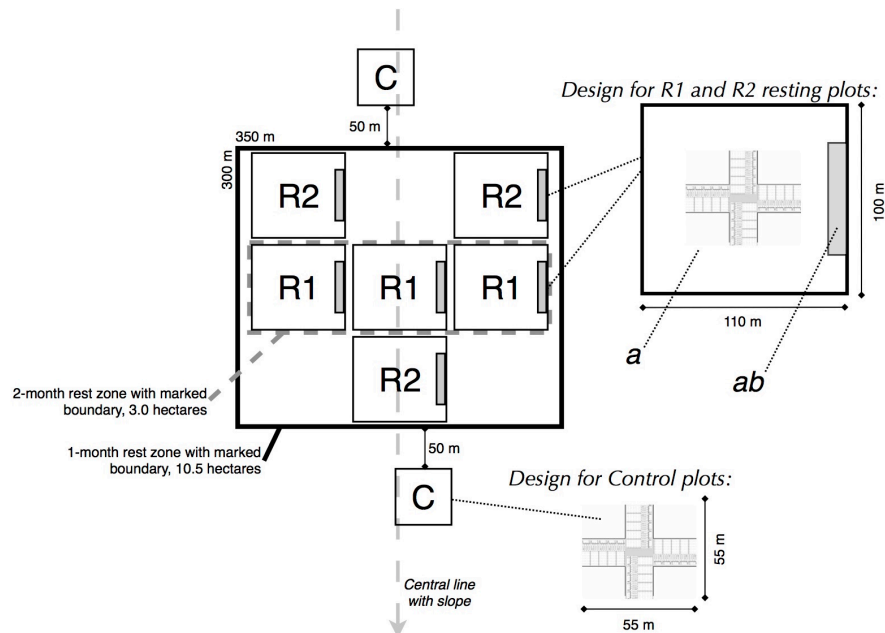
3. Area and height. The cover and height of herbaceous (separated by 'good' and 'bad' species, i.e., preferred vs. non-preferred) and woody vegetation (also by 'good'/'bad'), grass basal area, bare soil, gaps > 1 m, are recorded at the 20 sample points along the 4 transects in each plot.

4. Trees and shrubs. The density of trees and shrubs is measured at two scales: (i) for all trees and shrubs inside the 1 m² plots at transect positions 2 and 5, for a total of 8 1 m² measures per plot; and (ii) at the scale of the entire plot, for shrubs and trees > 1 m in height only.

5. Grass density. The density of 'good' or preferred grasses is recorded at transect positions 2 and 5, in 1 m² plots, for a total of 8 1 m² grass density plots within each plot. The re-seeding plot has an additional 8 1 m² grass density plots arranged at the same vertical interval, in 2 rows separated by 4 m (re-seeding plots are 57 x 10 m in size). The variable collected is grass density, as an indicator of the survival and recruitment of seedlings of preferred grass species. As the baseline is sampled in the

dry season, grass density is not part of the baseline. It is collected only during outcome assessment.

Plot design and layout



Plot and treatment definitions:

R1 = 1-month resting plot (alternatively, 2 weeks)
 Treatment **a** = 1-month rest only
 Treatment **ab** = 1-month rest + re-seeding

R2 = 2-month resting plot (alternatively, 1 month)
 Treatment **a** = 2-month rest only
 Treatment **ab** = 2-month rest + re-seeding

C = Control (located a random distance from central line; plots not subjected to resting or other management beyond grazing)



= LandPKS monitoring plot (Riginos and Herrick 2010, Riginos et al. 2011); see datasheet in Appendix 1.

4. Focus group discussions and key informant interviews

After the plots have been established and the baseline sampled, hold a focus group discussion with those pastoralists who joined the field work, and any pastoralists from the introductory meeting who wish to join the discussion.










Make a list of the herbaceous species present in the resting area (dominants only, >30% of herbaceous biomass), and score preference, primary and secondary uses, and primary and secondary seasons of use.

Record how the resting sites will be managed after they are opened to grazing, and whether and how will the treatments be maintained. Inquire as to whether additional rules for regulating use of the resting sites after the resting period may be beneficial, and their likely feasibility. For example, grazing could be restricted to cows and calves only, or perhaps the number of grazing livestock could be limited somehow.

Before closing the meeting, identify possible key informants willing to conduct more extensive semi-structured interviews. Promote the appointment of Pastoralist Researchers (PRs) who will assist study implementation and data collection.

Appendix 1. LandPKS rangeland monitoring datasheets (Riginos and Herrick 2010, Riginos et al. 2011).

i. Site description datasheet

Mapping Quick Plot / Site Condition																																															
<p>Site Name: _____</p> <p>Site ID: _____</p> <p>GPS</p> <p>Datum: _____</p> <p>Latitude: _____</p> <p>Longitude: _____</p> <p>Accuracy: _____</p>	<p>Date: _____</p> <p>Observer(s): _____</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">For Mapping Quick Plots:</p> <p style="text-align: center;">Slope</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>< 5%</p> </div> <div style="text-align: center;">  <p>5-30%</p> </div> <div style="text-align: center;">  <p>>30%</p> </div> </div> </div> <p>Slope Aspect: _____</p> <p>Shape: (walking down the longest slope)</p> <div style="display: flex; justify-content: space-around;">    </div> <p>Shape: (walking across the longest slope)</p> <div style="display: flex; justify-content: space-around;">    </div>																																														
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Appendix 2. Summary of relevant aspects of survey instrument: indicators for outcomes and impacts.

	Indicator	Measure	Frequency
<i>Outcomes</i>	Forage production and consumption	Grazing supported by the rested area (animal–days in the past 12 mo.)	Annual
	Grazing restriction	Restriction of grazing during the resting period (animal–days in the past 12 mo.)	Annual
	Milk production and economic value	Milk produced (average L/day) in the past 6 months; Value of 1 L (KES)	Annual
<i>Impacts</i>	Milk-based income	Income from sale of milk in the past 6 months (KES)	Annual
	Animal sale-based income	Income from sale of animals in the past 6 months (KES)	Annual
	Nutrition	Milk consumption (average L/day) in the past 6 months	Annual
<i>Feed use pattern</i>	Type, source, and amount of feeds used	% of main feed sources used	Annual
	Utilization of feeds	% of main feed sources used by animal type	Annual
	Changes in feed use	Increasing, decreasing, or constant over the past 3 years	Annual
	Reasons for change in feed use	List of drivers for change in feed use	Once