

Planned comparison protocol:

Augmented bush-thinning

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1. Research summary

Question or objectives	How can the process of creating new communal <i>kallo</i> enclosures be improved?
Hypothesis	Enclosure and bush-thinning result in more productive enclosures, in better environmental condition, when combined with re-seeding and prescribed fire.
Options to compare	Communal <i>kallo</i> enclosure created by bush-thinning and bush-fencing with vs. without re-seeding
	Communal <i>kallo</i> enclosure created by bush-thinning and bush-fencing with vs. without prescribed fire
	Communal <i>kallo</i> enclosure created by bush-thinning and bush-fencing with vs. without re-seeding and prescribed fire
Contexts to compare	Topography and pasture use type
	Dominant soil types x Slope classes
	Market access (distance as proxy)
	Productivity and condition of surrounding grazing lands
Study units	20 communal <i>kallo</i> enclosures, each with 5 plots: 2 bush-thinning plots with nested re-seeding plots, 1 prescribed fire plot with nested re-seeding plot, and 2 control plots
Responses to measure	Grass basal area, bare soil and vegetation gaps, biomass of 'good' and 'bad' herbaceous and woody species, grass density (as indicator of grass regeneration), woody density, soil stability, 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 PCs so as to decide what is relevant for the area• Implementing 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 period
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 extension program staff, workers and farmers• Lead the preparation of the data capture format, analysis and reporting <p>Project partners:</p> <ul style="list-style-type: none">• Identify locations and pastoralists who would like to engage in planned comparisons• Provide budget for labor and propagation materials as required• Contribute to the design of the planned comparisons• 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

	Pastoralist Researchers (and possibly also DAs): <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) exclosure trial
Suggested timing (start and end)	Study initiation, bush-thinning, plot establishment, re-seeding: July–September 2017. First outcome assessment: November 2017. Prescribed fire: location dependent, at earliest February–March 2018. Second outcome assessment: June 2018.

2. Research process

Location criteria

When project staff are organizing bush-thinning with communities, they locate pastoralists able and willing to reserve an area of ~1.3 ha for fire management within the bush-thinned area for 6–12 months. Pastoralists (not project or ILRI staff) identify the location where fire can be applied, to ensure its location is most useful. Fire plots must be located within the bush-thinned area, probably in the most degraded (denuded) area inside the new communal *kallo*. 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, because these areas are generally not used for communal *kallo*), and the plot layout can be adjusted accordingly.

Community members must be clearly informed that to participate in the research, a 1.3-ha fire plot inside the new *kallo* must be bush-fenced and rested until the fuel load can support prescribed fire, between one and two rainy seasons (6 months at minimum, 12 months at maximum) after the bush-thinning is completed.

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. Most of the bush-thinned area will be opened for communal *kallo* use after the standard one rainy season's rest (3–6 months after bush-thinning and baseline sampling).

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 *ola* elders and other local representatives of the larger rangeland council, including government officers at *kebele* level, who are well-placed to oversee the effective and organized implementation of treatments. If appropriate, DAs for the *kebele* may be recruited on a part-time basis to assist with research oversight and data collection.

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

Measuring outcomes and impacts

Surveys will soon be conducted to create a baseline for phase II of the RESET project. These ideal surveys will be used to establish social outcomes and impacts, including the indicators in Appendix 2.

Beginning the research

Once the precise research locations are determined by project staff and pastoralists, it will take time, between 3 and 12 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 communities who have agreed to use fire, locates the bush-thinned area, identifies the precise locations of the research plots to be sampled. ILRI team samples the baseline in the research plots and takes photos (see Field measurement details and Plot design and layout, below), and conducts an FGD (or interviews if only a few pastoralists are available). The FGD includes determining when the fire plot will be burned, and the reasons pastoralists give for selecting the location of the fire plot. Together, ILRI staff, project staff, and pastoralists mark and bush-fence the fire plot (fence completely outside the 100 x 110 m fire plot, 1.1 ha), and scatter a thin layer of branches across the entire fire plot. The density of branches in the fire plot should be enough to increase the fuel load for burning and to reduce soil erosion, covering approximately 5–10% of the soil surface. The baseline is conducted in the dry season, when bush-thinning is conducted, so that the treatments can begin to take effect during the next wet season.

Re-seeding treatment. Seeds are planted after bush-thinning and 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 3 re-seeding plots (*ab* in both the BT and fire 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

During establishment of communal *kallo* in Borana the new *kallo* is typically rested for 1–2 rainy seasons (6–12 months). Re-sampling of plots for outcome assessment proceeds after this resting period. However, poor rainfall would necessitate delaying plot sampling. More importantly, the sampling must be completed before the *kallo* is opened for grazing to calves and other selected animals. Since the effects of exclosure resting, re-seeding, and prescribed fire mostly occur during the rainy season, outcomes are assessed at the end of the rainy season.

The research steps as described here provide a schedule for the first year of research, after which adaptive observation will lead to refinement and perhaps additional experimentation. In some areas, one rainy season will not be sufficient to regenerate enough grass to support fire, and the fire plot will require a second rainy season of rest before burning. As regards fire, the steps as outlined here may be delayed by an additional season to provide sufficient resting time.

Outcome assessment—bush-thinning and re-seeding. After the bush-thinning 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 assessment is 3–6 months after the baseline and treatments are conducted. Until this sampling occurs, the area is closed to all grazing, including calves. 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 the bush-thinning and re-seeding treatments. For this sampling, the fire plot acts as a third bush-thinning plot, since the plot cannot yet be burned.

Fire management treatment. As noted under plot establishment, the fire plot is marked and bush-fenced, with the fence completely outside the 100 x 110 m fire plot (1.1 ha). Assuming the bush-fence has a maximum width of 5 m, when the bush-fence is included the entire fire plot is 110 x 120 m (1.32 ha) at maximum. In addition to the bush-fencing, a thin layer of branches cut from the trees is scattered across

the entire fire plot, including the re-seeding plot. The layer of branches should cover approximately 5–10% of the soil surface in the fire plot, enough to increase the fuel load for burning and to reduce soil erosion (but without covering the area excessively with thorny branches that will pose a problem for grazing animals after the area is burned). The fire plot can potentially be burned as soon as the fuel load can support a low-intensity fire evenly throughout the entire fire plot area.

At the time previously designated by pastoralists, one or two rainy seasons (6 months at minimum, 12 months at maximum) after bush-thinning, and according to the burn prescription for the site, the fire plot is burned. The precise timing of the burn is determined by pastoralists from the area. Before burning is conducted, approval must be obtained from the woreda, especially the Land Use office and Pastoral Development office.

Outcome assessment—bush-thinning, re-seeding, and fire. Once all treatments are complete, including prescribed fire, the second round of outcome assessment is at the end of the first rainy season post-fire treatment. Therefore the second assessment is 3–6 months after the fire treatment is conducted (9–12 months after the baseline, thinning, and re-seeding). Until this sampling occurs, the area is closed to all grazing, including calves. 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 initiation of the research, a survey is conducted among a sample of users of the bush-thinned area from which to estimate outcomes and impacts.

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.

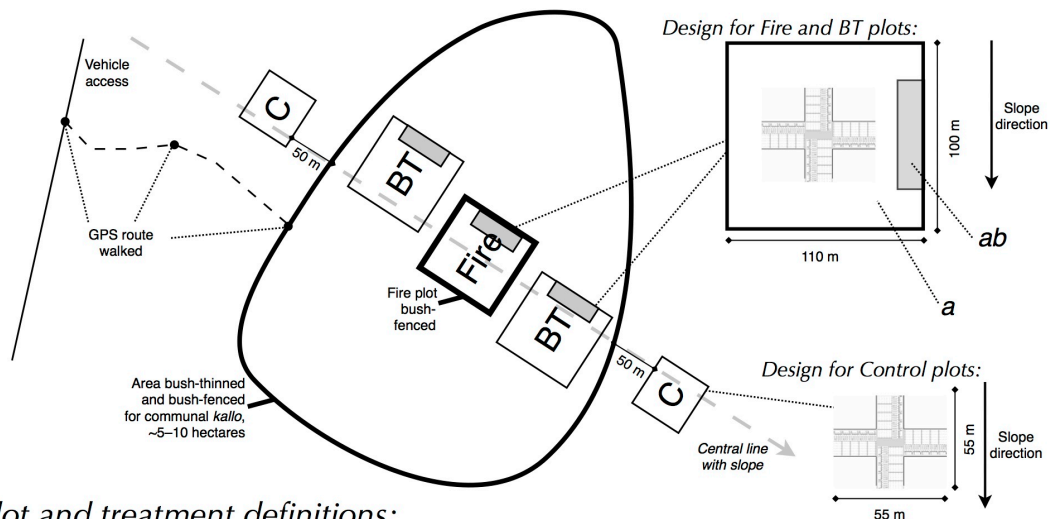
3. Area and height. The cover and height of herbaceous (separated by ‘good’ and ‘bad’ species, i.e., preferred vs. non-preferred) and woody vegetation (also by

'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 in 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' 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, with the main goal of estimating the contribution of treatments to the survival and recruitment of preferred grass species seedlings. As the baseline is sampled in the dry season, grass density is not part of the baseline. It is only collected during outcome assessment.

Plot design and layout



Plot and treatment definitions:

Fire = Fire plot (location selected by pastoralists and sets the central line; plot is bush-fenced, to be rested for up to 1 year)

Treatment **a** = bush-thinning + fire

Treatment **ab** = bush-thinning + fire + re-seeding

BT = Bush-thinning plot (located a random distance from central line; plot is not bush-fenced, to be rested for 6 months or as project protocol)

Treatment **a** = bush-thinning

Treatment **ab** = bush-thinning + re-seeding

C = Control (located a random distance from central line; plots not subjected to bush-thinning 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 baseline sampled in all plots, 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 *kallo* (dominants only, >30% of herbaceous biomass), and score preference, primary and secondary uses, and primary and secondary seasons of use.




Make 2 lists for the woody species in the *kallo*: one list for species retained after bush-thinning (dominants only, >30% of woody biomass), and the primary species removed (>30% of woody biomass removed) during bush-thinning. For species retained after treatment application, score preference, primary and secondary uses, and primary and secondary seasons of use, and the reason(s) for their retention. For species removed during treatment, record preference, and the reason(s) for removal.

Record how the communal *kallo* will be managed after it is opened to selective grazing, and whether and how will the treatments be maintained. Inquire as to whether additional rules for regulating use of the communal *kallo* may be beneficial, and their likely feasibility. For example, grazing could be restricted to cows and calves only, and the number of grazing livestock could be limited.

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																																																
Site Name: _____		Date: _____																																														
Site ID: _____		Observer(s): _____																																														
<div style="display: flex; justify-content: space-between;"> <div style="width: 40%;"> <p>GPS</p> <p>Datum: _____</p> <p>Latitude: _____</p> <p>Longitude: _____</p> <p>Accuracy: _____</p> </div> <div style="width: 30%; text-align: center;"> <p>For Mapping Quick Plots:</p> <p>Slope</p>  <p>< 5% 5-30% > 30%</p> </div> <div style="width: 25%;"> <p>Slope Aspect: _____</p> <p>Shape: (walking down the longest slope)</p>  <p>Shape: (walking across the longest slope)</p>  </div> </div>																																																
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Vegetation Type:</p> <p>Trees:</p> <ul style="list-style-type: none"> <input type="radio"/> None <input type="radio"/> <10% <input type="radio"/> 10-40% <input type="radio"/> >40% <p>Characteristic Species:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Shrubs:</p> <ul style="list-style-type: none"> <input type="radio"/> None <input type="radio"/> <10% <input type="radio"/> 10-40% <input type="radio"/> >40% <p>Characteristic Species:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Grasses/Forbs:</p> <ul style="list-style-type: none"> <input type="radio"/> None <input type="radio"/> <10% <input type="radio"/> 10-40% <input type="radio"/> >40% <p>Characteristic Species:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Species of Concern:</p> <p>Species Names:</p> <ul style="list-style-type: none"> <input type="radio"/> None <input type="radio"/> <10% <input type="radio"/> 10-40% <input type="radio"/> >40% <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> </div> <div style="width: 50%;"> <p>- Indicators of Site Use -</p> <p>Grass (not protected by shrubs/trees) has been grazed:</p> <ul style="list-style-type: none"> <input type="radio"/> Not at all <input type="radio"/> Lightly <input type="radio"/> Moderately <input type="radio"/> Heavily <p>Species that have done most of the grazing:</p> <p>_____</p> <p>Trees/shrubs have been browsed:</p> <ul style="list-style-type: none"> <input type="radio"/> Not at all <input type="radio"/> Lightly <input type="radio"/> Moderately <input type="radio"/> Heavily <p>Species that have done most of the browsing:</p> <p>_____</p> <p>- Indicators of Change -</p> <p>Signs of Erosion:</p> <table border="0" style="width: 100%;"> <thead> <tr> <th></th> <th>None:</th> <th>Few:</th> <th>Some:</th> <th>A lot:</th> </tr> </thead> <tbody> <tr> <td>Rills</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Gullies</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Litter Dams</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Pedestals</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Soil Deposition</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Water Flow Patterns</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Sheet Erosion</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Other: _____</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> </tbody> </table> </div> </div>					None:	Few:	Some:	A lot:	Rills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Gullies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Litter Dams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Pedestals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Soil Deposition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Water Flow Patterns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Sheet Erosion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Other: _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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ii. Main datasheet

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Appendix 2. Summary of relevant aspects of RESET-II survey instrument: indicators for outcomes and impacts.

	Indicator	Measure	Frequency
<i>Outcomes</i>	Forage production	Grazing supported by the new <i>kallo</i> (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 (ETB)	Annual
<i>Impacts</i>	Milk-based income	Income from sale of milk in the past 6 months (ETB)	Annual
	Animal sale-based income	Income from sale of animals in the past 6 months (ETB)	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, including inside vs. outside exclosures	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