Introduction to multi-stakeholder action research for restoration of communal grazing lands

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RESEARCH PROGRAM ON
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ILRI RESEARCH REPORT
63

Introduction to multi-stakeholder action research for restoration of communal grazing lands

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August 2020

ILRI thanks all donors and organizations which globally supports its work through their contributions to the CGIAR Trust Fund

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover photo—ILRI/Apollo Habtamu

ISBN: 92–9146–627–1

Citation: Sircely, J., Nganga, I., Temesgen, T. and Zerfu, E. 2020. *Introduction to multi-stakeholder action research for restoration of communal grazing lands*. ILRI Research Report 63. Nairobi, Kenya: International Livestock Research Institute (ILRI).

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Executive summary

Restoring degraded communal grazing lands involves applying specific, time- and space-bound restoration options under the guidance of local institutions tasked with planning for and managing these lands. To better understand the scaling potential of restoration options for communal grazing lands, action research trials were used to generate evidence on what restoration options are useful for whom, where and when. A conceptual model is presented to summarise the approach used by International Livestock Research Institute (ILRI) researchers to conduct action research trials for restoration of communal grazing lands, and practical steps are outlined to depict the action research process—steps conceptualised by ILRI researchers and acted on by larger communities of practice (producers, local institutions, regional institutions and international researchers). These steps give general guidance on the structure of the action research process and the decisions made throughout the process, including identifying questions, designing trials, integrating knowledge of producers and scientisits, assessing outcomes, and identifying institutional pathways for up-scaling. To demonstrate how these steps were put into practice, we provide examples of action research trials from three research sites where action research trials were conducted—range resting and reseeding in pastoral Kajiado and Wajir counties in Kenya, and exclosure productivity improvement in mixed farming areas in Amhara region of Ethiopia. The results from these trials are valuable for their immediate purpose of informing ongoing and potential up-scaling; further applications also exist. These results are currently able to provide general advice on restoration measures likely to succeed in pastoral herding systems that cover large areas of East Africa, and in cut-and-carry exclosures found throughout the rainfall-sufficient highlands of Ethiopia. Scaling pathways and actors differ between these systems, but in both cases will likely rely on a combination of local institutions (formal and/or informal community systems), and wider networks of government agencies and nongovernmental organisations. The purpose of this guideline is to describe our process for engaging these local institutions and other stakeholders, conducting action research through this ‘community of practice’ to test restoration options, determine restoration options that are potentially scalable in particular agro-ecological and social contexts, and how these action research results and institutional networks can lead to scaling of promising restoration options. Attributes of the research process that appear to have contributed to the success of the research include putting end users first; working with local institutions to fit technical restoration options to institutions and management systems and to access potential scaling networks; and a multi-stakeholder approach enabling mixing of local knowledge, science and practitioner experience to generate results that are both accurate and widely applicable.

Introduction

Land restoration is a key pathway to achieving food security and poverty reduction for vulnerable people living in the African drylands. In line with United Nations Sustainable Development Goals, it is required that successful restoration efforts reach larger numbers of farmers and hectares over the coming decade. The challenge with scaling is that the ecological, economic, sociological and institutional context varies from household to household. To reduce poor adoption rates, participatory technological adaptation is useful to provide locally relevant restoration options that will work for different people in different places.

This land restoration work was done as part of a project *Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel: taking successes in land restoration to scale*. The overall goal of this project is to reduce food insecurity and improve livelihoods of poor people living in African drylands by restoring degraded land and returning it to effective and sustainable tree, crop and livestock production, thereby increasing land profitability and landscape and livelihood resilience.

This 'research-in-development' approach (Coe et al. 2014) takes as its starting point research priorities broadly identified from the initial reviews of literature and development experience. A process of iteratively narrowing the field of potential research concepts and details of research implementation is used to fit research to the needs of communities and partners. A conceptual model for using restoration action research trials to generate scalable evidence for restoration of communal grazing lands is provided in Figure 1. Producer communities, research partners in government agencies or nongovernmental organisations, and ILRI researchers from communities of practice (CoPs) involved in the research, bringing the experience and needs of end users of the research results into the research process. Through the CoPs, research protocols for planned comparisons (PCs) are developed and implemented to conduct experimental action research trials across ranges of contextual variables. The PCs are producer-managed field trials able to distinguish what restoration options are most effective, where, when, why and for whom, to the greatest extent possible, or in other words, evidence of the success of 'options by context' (OxC) (Sinclair and Coe 2019). Where options can be improved further, additional trials can be conducted to obtain clearer answers; in our case further research trial iterations were largely unnecessary though preferential, given rainfall variability. We propose this OxC evidence is useful in improving the applicability of the research to eventual scaling conducted by CoPs from local to international levels.

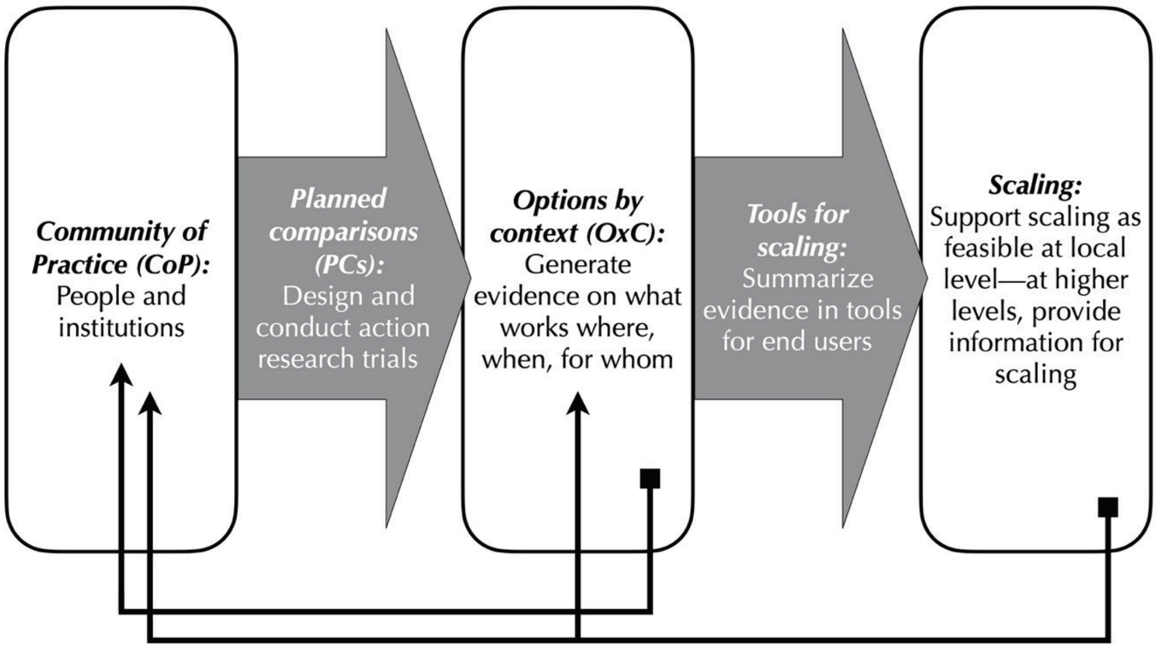

Figure 1. Conceptual model of action research for scaling. Wide gray arrows show flows of information from communities of practice to scaling; thin black arrows show flows of information from research evidence and scaling experience back to communities of practice and to update the evidence base. Information flow in multiple directions enables iterative and adaptive revision of knowledge and practice.

Action research process in communal grazing lands

The process of conducting site-level, on the ground research on specific 'technical' restoration options is divided into phases. In pastoral sites, the process links upward to institutional arrangements, their scales and boundaries. Site-level research is guided by activities falling into several phases comprising the action research in development approach. The timeline for progress through these phases in the three case studies provided here is summarised in Table 1, and in graphical form in Appendix 1.

Phases of action research for scaling

1. Prioritization of research for local assessment
2. Research needs assessment
3. Research agreements with development partners
4. Draft planned comparison protocol development
5. Research adaptation and initiation
6. Planned comparison protocol finalization
7. Planned comparison implementation
8. Site-level scaling strategy development
9. Planned comparison refinement and local up-scaling

Table 1. Steps in conducting action research trials to provide scalable evidence in restoration, and overview of timelines for each site

Steps in action research for scaling							
					Timing by site		
Step	Description	Scale	Primary function	Secondary functions(s)	Kajiado	Wajir	Amhara
1	Prioritization of research for local assessment	National: Kenya and Ethiopia	Constrain possible restoration options for research	Begin identifying potential primary research partners in government and civil society.			
2	Research needs assessment	Local/ individual settlements	Qualitatively prioritize restoration options based on producer priorities and policy/programmatic applications	Start building local ownership over the research; identify local institutional partners.	April 2017	April 2017	April 2016
3	Research agreements with development partners	Local	Agree to terms for the research with government and NGO partners		2017	NA	2017
4	Draft planned comparison protocol development	Local	Provide restoration action research trial protocols for partner comment	Modify research protocols based on partner feedback.	2017	2017	2016
5	Research adaptation and initiation	Individual settlements	Adapt research protocols to local conditions, and begin the trial	Document local livelihoods and management; identify field supervisors.	March 2018	March 2018	March 2017
6	Planned comparison protocol finalization	Local	Provide final restoration research protocols	Document local adaptation of research protocols.	April 2018	April 2018	April 2017
7	Planned comparison implementation	Individual settlements	Conduct the restoration research trials		March 2018–January 2019	March 2018–February 2019	March 2017–November 2018
8	Site-level scaling strategy development	Local	Compile stakeholder views into a draft restoration scaling plan for wider comment		NA*	NA*	November 2017
9	Planned comparison refinement and local up-scaling	Local	Seek further changes to research protocols; up-scale successful restoration options as feasible	Document possible local scaling pathways and approaches.	December 2019	January 2020	March 2018 onward

* In Kajiado and Wajir, no site-specific scaling strategy was developed as the local institutions operating over large scales were directly involved in the research, enabling direct provision of information to the institutional leadership.

Description of action research phases

1. Prioritization of research for local assessment. The starting point is broadly identifying research priorities from initial reviews of literature and development experience. Prioritization of restoration options for research is guided by formal literature review (Sircely 2016), here conducted specifically for Ethiopia, as supplemented from elsewhere in the literature for consideration of issues specific to Kenyan versus Ethiopian pastoral rangelands (which are similar ecologically). Restoration experiences of development partners are assessed primarily through interviews (in addition to those reports available online used in the literature review), here at national level for Ethiopia and Kenya and including primarily government agencies and international nongovernmental organisations. The literature and experience assessments largely validated one another, providing a set of prioritized restoration options potentially applicable over large areas.

2. Research needs assessment. An assessment of research needs is conducted, the primary goal of which is to ensure a thorough engagement of relevant stakeholders from community to site scales. At this stage, expert and local knowledge on restoration options and contextual factors affecting their success generally within each study site are collected as a first-pass check on the feasibility of restoration options; likely constraints upon their success and disagreements or variation in perspectives among farmers (highlands), herders (pastoral areas) and between experts (government, NGO staff and researchers); and farmers or herders. Novel local innovations and site-specific drivers and challenges are recorded. Research assessment guides were developed to assess previously identified priority research areas through focus group discussions with members of community institutions, community members more broadly and experts operating at local and larger scales. In Ethiopia, the community institutions consulted here included exclosure user groups, youth groups, participatory forest management committees, watershed committees and rangeland councils, and in Kenya, group ranch committees and community-based natural resource management committees. Customary or traditional rangeland management bodies are embedded in community rangeland management institutions in both Ethiopia and Kenya (rangeland councils, group ranch committees, and community-based natural resource management committees).

3. Research agreements with development partners. Once the partner(s) for each site and several communities within each site have been thoroughly consulted, it becomes possible to provide robust research plans. Where appropriate, an agreement (a joint coordination agreement or memorandum of understanding) may be signed to establish a formal research relationship. For this research work in 2016, ILRI signed a joint coordination agreement with the primary research partner the Community-Based Natural Resource Management Project (CBINReMP), implemented by Amhara Bureau of Agriculture (Amhara BoA) of the Amhara National Regional State government under the framework of the federal Sustainable Land Management Programme (SLMP). The agreement aimed for collaborative identification of research needs and adaptation to local contexts. In 2017, ILRI signed an MoU with the primary research partner in Kajiado South Rift Association of Land Owners (SORALO), a nongovernmental organisation with Shompole and Olkiramatian Group Ranches as the local institutional partners, to have collaborative technical assessment of resting and reseeding approaches. In Wajir, no partnership was required as ILRI had an ongong project on Accelerated Value Chain Development (AVCD) and the primary research partner was the Livestock Production Office of the Wajir County Department of Agriculture, Livestock, and Fisheries (DALF), under the auspices of the Wajir County government.

4. Draft planned comparison protocol development. Detailed protocols for planned comparisons in the field are developed and formally proposed to the partner, and via the partner to project beneficiaries for review and approval. By this point, a general research focus and generalities of implementation are established, although significant community-level adaptation may be required to ensure that the precise treatments tested in planned comparisons represent useful and feasible options in each community, and that research plans are fully actionable.

5. Research adaptation and initiation. Before roll-out of the planned comparison research protocols, adaptation of the research to local needs is conducted alongside research initiation to tailor pre-targeted options to specific needs of grazing land users. As the research is discussed with farmers or herders to build trust and to ensure the applicability (and ultimate scalability) of the research, the precise locations of research plots and treatments are agreed and demarcated. The adaptation process is accomplished through facilitated community workshops targeted to members of community institutions responsible for the management of grazing lands (exclosure user groups, watershed committees, rangeland council sub-unit leaders, etc.), with participation of partner project representatives (e.g., project experts, woreda or county staff). The workshops are structured by research adaptation guides for gathering key information on community perceptions of the proposed planned comparisons; local knowledge on feed utilization and feed shortages; contextual variation in livelihood systems and resource use (e.g., reliance on grass vs. crop residues for feed, off-farm opportunities); costs, risks and constraints involved in implementation; and opportunities for innovation.

Key issues to resolve before action research trials begin:

a Decisions on generality vs. specificity of experimental controls, that is, what factors will be standardized vs. factors that will not (see also Box 1). These decisions include minute details of research implementation, including treatment application and measurement of response variables. The implied trade-off between research consistency and the relevance of research to local conditions, which will differ from place to place, is resolved before a planned comparison is implemented. Deciding experimental controls carefully helps to balance among internal and external validity (Box 1), which are both necessary ingredients of robust research providing scalable results. Internal validity provided by researchers helps to establish causality, while external validity provided by the influence of producers bolsters confidence in the practical applicability of the results. In short, the goal is to conduct a fairly realistic 'simulation' of restoration implementation over a limited time frame (1–3 years), in contrast with less realistic approaches such as on-station trials or other heavily controlled experiments.

b Establishment of permanent community oversight through existing institutions to result in a thoroughly vetted research design for every community, aligned with community institutional management and ready for implementation at the appropriate time according to seasonal agronomic or ecological cues.

c Appointment of field supervisors to conduct community sensitisation and provide community research oversight, both key ingredients of conducting formal planned comparisons of restoration options across wide ranges of context with significant buy-in from the communities participating in the reseach.

Box 1. Multi-stakeholder influences on the design and implementation of site-level planned comparisons in three ILRI research sites.

In each site, the process through which research decisions are made is a multi-stakeholder collaborative effort, in which farmers and herders, ILRI and ILRI partners each hold some kind of influence over the design and implementation of research protocols. Some elements of a collaborative action research design come from stakeholders other than researchers or development agents—the farmers or herders themselves—bringing local knowledge and experience alongside technical expertise. The goal of this interaction is to ensure that the research balances among ‘internal validity’ (the research is rigorous) and ‘external validity’ (directly applicable in actual existing agricultural contexts).

		ILRI and ILRI partner influences on research design	Farmer/herder influences on research design	
Site (primary partner)	**Action research trial conducted**	**Systematized variables**	**Systematized variables**	**Non-systematized variables**
Kajiado and Wajir Counties, Kenya (SORALO; Wajir County)	Short duration resting and re-seeding	• Resting and re-seeding treatments • Species selection, re-seeding method in re-seeding treatments • Plot and assessment design	• Treatment area • Resting and re-seeding dates • Preferred vs. non-preferred species	• Location of research plots (degraded areas) • Fencing of research plots • Grazing intensity after re-opening • Wildlife utilization intensity
Amhara region, Ethiopia (Amhara BoA)	Exclosure productivity improvement	• Weeding, re-planting, and plowing/planting treatments • Species selection and method of propagation in plowing/planting treatments • Weeding frequency • Location of research plots (random) • Plot and assessment design	• Plowing/planting treatments • Species selection and method of propagation in plowing/planting treatments • Treatment area • Plowing, weeding and planting dates • Major weed species to remove • Preferred vs. non-preferred species	• Plowing and weeding methods • Weed species to remove

The role of researchers in a collaborative approach is to provide materials and approaches for documentation, and to guarantee that certain variables are highly controlled: those variables to which outcomes are most sensitive, that are easiest to control, or that require some level of ‘expert’ knowledge. Such controls (column 3) enable identification of causal research outcomes, providing internal validity.

The roles of farmers and herders are specific to the system, site and research question at hand, and can range from major influences on the treatments to be conducted, to more minor influences such as delineating the precise locations of measurements according to the priorities of community members. Documented views of farmers and herders are used to systematically control another set of variables (column 4), those to which expert knowledge is not well suited yet and experimental controls are both feasible and useful. These variables provide both internal and external validity. A final set of variables remains uncontrolled (column 5) either because they are unimportant (outcome-insensitive), or simply uncontrollable in a practical sense for development projects implementing across large areas over limited time periods. Options that do not succeed consistently without strict experimental controls will likely have higher uncertainty in eventual development implementation.

A final set of variables remains uncontrolled (column 5) either because they are unimportant (outcome-insensitive), or simply uncontrollable in a practical sense for development projects implementing across large areas over limited time periods. Options that do not succeed consistently without strict experimental controls will likely have higher uncertainty in eventual development implementation.

6. Planned comparison protocol finalization. After research protocols have been reviewed and critiqued by the partner project or organization and local farmers or herders, and research adaptation discussions have been conducted in all research-hosting communities, the final planned comparison protocol is prepared. The degree of modification made to the original protocol is generally more extensive in smaller grazing lands such as those in the highlands of Amhara, or wherever there exists intense interest of farmers in the management of the area, and requires more precise calibration of research scope and scale. Modifications may include the details of treatments to be tested, quantification of response variables and steps for treatment application. These modifications can be essential for reasons varying from pure practicality, to mitigating disruptive effects of local conflicts and competition for resources on the research. For example, the number of sub-sample plots was reduced in Amhara to minimize the probability of disruption through premature cutting of grass, while in Wajir a major change was made to multiple, smaller resting areas that could be feasibly managed in dense, thorny, shrubby vegetation (Table 2).

Table 2. Changes to research area size and sub-sampling frequency.

Site (primary partner)	Action research trial	Original research area size (proposed by ILRI)	Final research area size (agreed and implemented)
Kajiado County, Kenya (SORALO)	Short duration resting and re-seeding	10.5 ha, 1 per location	5.3 ha, 1 per location
Wajir County, Kenya (Wajir County)	Short duration resting and re-seeding	10.5 ha, 1 per location	0.25 ha, 3 per location
Amhara region, Ethiopia (Amhara BoA)	Exclosure productivity improvement	0.013 ha, approximately 7 per exclosure	0.084 ha, 1–2 per exclosure

7. Planned comparison implementation. Implementation of first round planned comparisons (PCs), from context and baseline to outcome assessment, begins when the season is right and logistical research arrangements are in place. In pastoral sites, institutional characterization of community-based rangeland management insitutions is conducted as a prelude to PCs. This phasing allows the institutional characterization to inform the specifics of the ‘technical’ options to be tested and the research locations where they will be compared.

8. Scaling strategy development. Upon formation of nested communities of practice from the community level to agro-regional or national levels, this complement of stakeholders enables development of a strategy for up-scaling. Wherever relevant, inputs from ILRI, our development partner(s) and farmers engaged in PCs inform the scaling strategy based on evidence and experience generated from PCs.

9. Planned comparison refinement and local up-scaling. Biophysical outcomes and producer preferences from the first round of PCs is used to inform the design of second round PCs in subsequent growing seasons. These outcomes and preferences similarly support participatory up-scaling to larger areas as supported by available partnerships and finances. In the case of the present research, refinements to PC protocols were requested from the research partners and community beneficiaries. However, no significant modifications were requested; the only change requested was in Amhara, where farmers recommended compacting soils while planting grass from seed to prevent seed loss in runoff. Additional dry season rest post-reseeding might improve outcomes for reseeding in pastoral areas, but this is far from certain. In Amhara, local up-scaling proceeded to the maximum area feasible by local institutions without significant outside support. Local up-scaling in pastoral areas would be taken by the rangeland management institutions with which we partnered, although the introduction of resting and acceptance by the community cannot be rushed and must follow from the information provided in the natural course of events.

Action research examples: summary of research process by sites

Amhara region, Ethiopia

Community of practice (CoP)

Amhara region is located in the Ethiopian highlands, where mixed farming (a combination of crops and livestock) is the predominant livelihood. The primary research partner in Amhara was the Community-Based Natural Resource Management Project (CBINReMP), implemented by Amhara Bureau of Agriculture (Amhara BoA) of the Amhara National Regional State government under the framework of the federal Sustainable Land Management Programme (SLMP). The local institutional partners were government-assigned groups engaged in natural resource management, primarily exclosure user groups who use and manage government-mandated grazing exclosures created to rehabilitate degraded communal grazing lands, or to protect grassy wetlands. In a few sites, partners include participatory forest management groups or youth groups (here, referred to for simplicity as 'exclosure user groups'). The exclosures managed by these institutions were located in eight woredas (districts) in Amhara region where CBINReMP was operating—Bahir Dar Zuria (Gombat and Yinessa kebeles), Dangila Zuria (Afesa and Wubri kebeles), Dangila town (Zubura-Zagri kebele), North Mecha (Amarit, Dilbetigil and Dagi kebeles), South Mecha (Addis Alem kebele), North Achefer (Ambashen Jana, Legdia and Liben Dankura kebeles), Sekela (Ambisi kebele) and South Achefer (Korench, Kurba and Lalibela kebeles). These woredas extend from 1800 m in elevation in Bahir Dar Zuria to 2600 m in Sekela woreda, with average annual rainfall between 1200–1600 mm/yr. The membership of these local institutions (the direct beneficiaries of the research) comprise 3,948 individuals with an average of 165 individuals per exclosure. Action research trials were supervised at exclosure level by a 'field supervisor' appointed by the exclosure user group, as supported by the respective watershed technical committees, the kebele (sub-district) watershed committees and the woreda focal person for CBINReMP employed by Amhara BoA.

Planned comparisons (PCs)

The research needs assessment identified improving the productivity of exclosures as an important management goal for exclosure user groups with policy relevance nationwide throughout the Ethiopian highlands. Improving the productivity of exclosures is an effective strategy for increasing forage supplies, especially in areas where few grazing lands remain.

A draft PC protocol was developed by ILRI researchers and sent to Amhara BoA for comment and improvement. Before roll-out of the trial, adaptation workshops were held in each exclosure with representatives of the user group with the goal of conducting a final check on the suitability of the research. During the adaptation workshops, Rhodes grass (*Chloris gayana*) was suggested by several user groups as a priority improved forage for testing, which was added to the protocol. Community livelihood information collected during the adaptation workshops showed that the average household in the user group membership had 1.73 total livestock units and a cropping area of 0.81 ha, with crop residues–the dominant livestock feed–accounting for 87.8% of the total livestock feed basket. The top preferred species for cut-and-carry fodder from the research exclosures were *Cynodon dactylon* (*sardo*), *Pennisetum glabrum* (*tucha*) and *Digitaria adscendens* (*warate*). These data on livelihoods supported a description of the area as 'mixed farming' relying on both crops and animals. The area is in transition between extensive and intensive production systems with diminishing farm sizes and increasing use of external inputs such as commercial fertiliser, and where former communal grazing lands have been privatised or converted to crops or short-rotation forestry, or are now being converted at a significant rate. These trends may increase the importance of exclosures for both livelihoods and environmental rationales.

The final protocol included two weeding treatments, one with, and one without transplanting of local forages into the holes created by weeding, and two improved forage treatments that involved plowing the exclosure and planting two improved forages—Rhodes grass (*Chloris gayana*) and Desho grass (*Pennisetum pedicellatum*). Across the eight woredas, an exhaustive list of government mandated exclosures within these woredas was compiled, and all but four of the 28 exclosures identified formed the research sample of exclosures (the four 'drop-outs' declined to participate in the research for unstated reasons). Each of the 24 research exclosures received 1–2 research plots, each 840 m^2 in area, including control portions. The effects of the treatments were measured by comparing biomass production and forage quality, which was largely similar among the treatments in terms of crude protein content and *in vitro* digestibility.

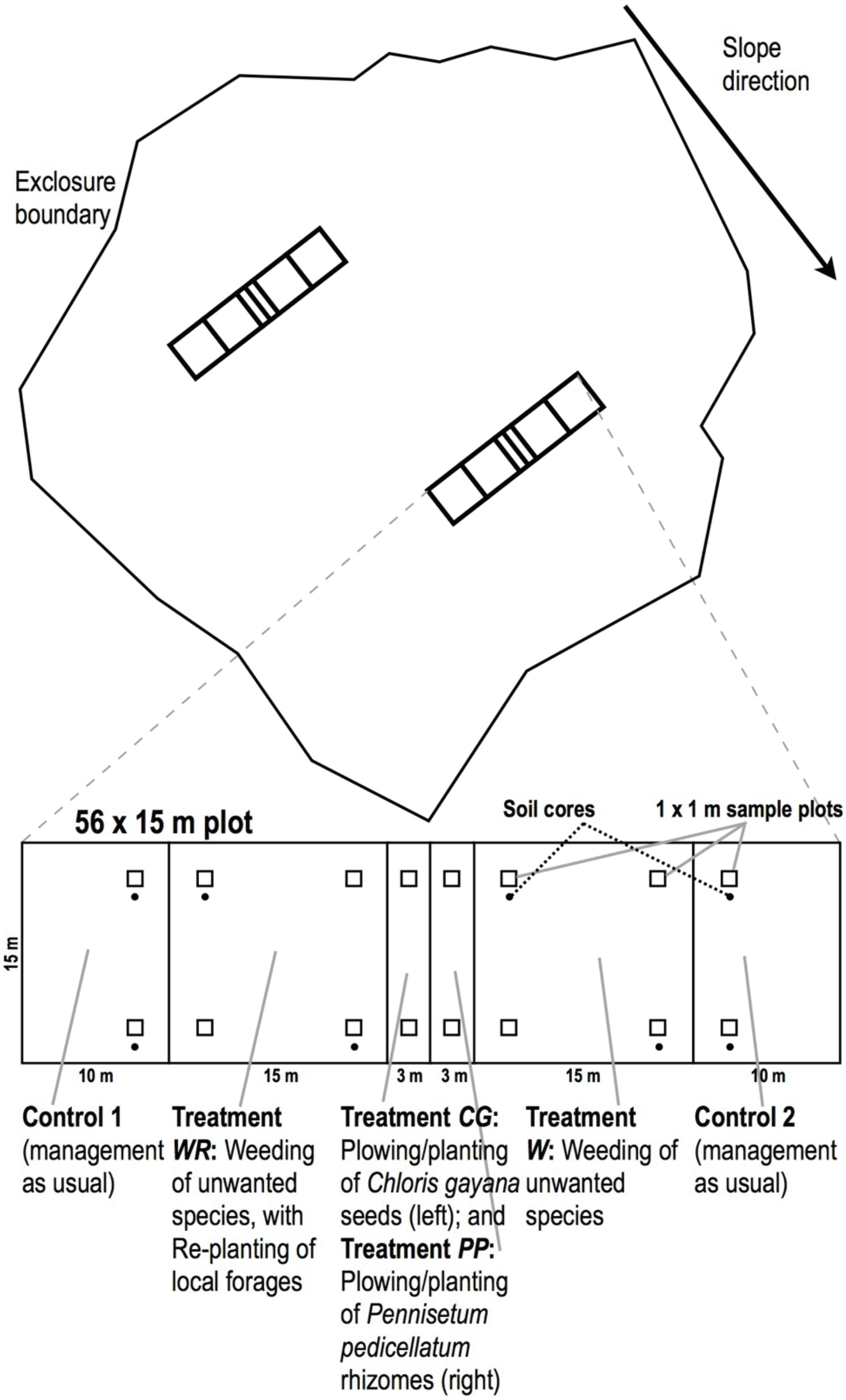

Figure 2. Plot design for exclosure productivity improvement in Amhara, Ethiopia

Research plots were placed randomly inside each exclosure. Some research plots were fenced as necessary to prevent disturbance, but most were not fenced. Exclosures larger than the mean exclosure size of 7.78 ha received two research plots (rather than one), to measure variability in response due to natural variation in soils, vegetation and hydrology within larger exclosures (except for one exclosure where severe swampy conditions limited the relevant research area). On average, the research areas comprised 3.84% of the total area of the research exclosures.

Baseline measurements were taken early in the 2017 rainy season, and outcome measurements were taken during the early dry season in 2017 and 2018. Biomass wet and dry weights were taken from a subset of 1 m^2 quadrats (25% of quadrats) during the 2017 outcome measurements to create site-specific conversion factors linking biovolume to wet weight, and linking wet weight to dry weight, enabling calculation of biomass dry weight from rapid estimation of biovolume. Biovolume and biomass measurements were separated for (i) forage species used by farmers for cut-and-carry feeding to their animals, and (ii) species not used by farmers locally for cut-and-carry feeding, including weeds and other plants not useful as cut-and-carry fodders.

Options by context (OxC)

The key results of the Amhara exclosure productivity improvement action research trial are summarized in Table 3. The steps along the top of the table show how, depending on soil characteristics readily observed by farmers and practitioners, these end users can select exclosure productivity improvement treatments that suit a specific location. Biomass reported here is only for species used by farmers locally as cut-and-carry fodders.

Table 3. Performance and best options for up-scaling exclosure restoration (results are for Year-2 of implementation; one highly productive outlier excluded). Biomass includes only species used locally as cut-and-carry fodders. These results exclude one highly productive outlier on black soil (vertisol).

			Step 4. Expected Results by Year-2			
Step 1. Select soil color	*Step 2. Select soil constraint, if any*	*Step 3. Select grassland treatment*	***Biomass (t / ha)***	***Success rate (%)***	***Best option(s)***	Number of sites
Red soil	Poor soil (rocky and/or shallow)	No treatment	2.5	—		4
		Desho grass	5.6	86	**1. Desho grass**	
		Rhodes grass	2.3	38		
		Weeding	2.8	—		
	Good soil (no major problems)	No treatment	3.9	—		8
		Desho grass	10.4	100	**1. Desho grass**	
		Rhodes grass	3.7	100	2. Rhodes grass	
		Weeding	4.6	—		
Black soil	Good soil (no major problems)	No treatment	7.1	—		6
		Desho grass	12.4	83	**1. Desho grass**	
		Rhodes grass	5.8	100	2. Rhodes grass	
		Weeding	6.8	—		
	Swamp (floods every year)	No treatment	10.1	—		3
		Desho grass	—	33		
		Rhodes grass	—	0		
		Weeding	11.4	—	**1. Weeding***	
Brown soil (highlands in Sekela)	Swamp (floods every year)	No treatment	7.3	—		3
		Desho grass	6.4	100		
		Rhodes grass	—	0		
		Weeding	7.4	—	**1. Weeding***	

** Since swamps usually have productive grass, it is best to weed the existing grasses. In swamps, desho grass is generally NOT recommended, as desho may require frequent cutting to prevent invasion of the existing grasses.*

For example, a community that has an exclosure on red soils (Eutric Histosols) on a rocky hillside would likely prefer Desho grass as it is more likely to succeed than Rhodes grass and gives more biomass than the existing grasses (which are usually poor in such locations), and since weeding will accomplish little. On the other hand, a community with an exclosure on black soils (Pellic Vertisols) that flood annually for weeks to months would likely prefer to weed the existing local grasses (which are usually of good quality in swampy areas), since Rhodes grass is virtually guaranteed to fail due to flooding, and Desho may present a potential invasion threat to these wetlands. A government or NGO practitioner can easily follow this simple guide to identify practical, low-cost options for improving the productivity of community exclosures.

There are clear indications that new communities are likely to accept similar recommendations given the spontaneous, exclosure-level up-scaling in 2018, the second year of the action research trial (Table 4). Here, 'spontaneous' means that exclosure user groups up-scaled their preferred treatments with virtually zero material support or incentives from outside their user group. These up-scaling results from the second year of the trial demonstrate the ability of local institutions to engage in collective action to improve collective resources, resulting in rapid progress.

Table 4. Revealed preferences of farmers from spontaneous* up-scaling of exclosure productivity improvement by planting improved forages (*spontaneous = conducted by the community exclosure user group. The only incentives provided were seeds and cuttings, and transport for the seeds and cuttings — no incentives were provided for plowing, fencing, weeding, manuring, or any other costs).

Soil color	*Soil constraint, if any*	*Number of upscaling sites*	*Restoration option(s) up-scaled*	*Total up-scaling area (ha)*
Red soil	Poor soil (rocky and/or shallow)	1	Desho	1.0
	Good soil (no major problems)	6	Desho (5), Rhodes (6)	1.4
Black soil	Good soil (no major problems)	3	Desho (2), Rhodes (1)	1.2
	Swamp (floods every year)	0	—	—
Brown soil (highlands in Sekela)	Swamp (floods every year)	1	Desho	0.1
			Total improved forage up-scaling area (ha):	3.7

The main limitation of these results is that they are conservative estimates, and that the amount of replication (number of sites/communities/user groups) across gradients in soil conditions and other ecological characteristics, which would allow more precise targeting. These limitations are the result of the limited number of exclosures available for research, and the limited amount of exclosure area that farmers were willing to sacrifice for the research. The effect of these limitations on the use of the results in up-scaling should be minimal, since simple, robust targeting guidelines may be more appropriate and practically applicable than detailed targeting rubrics more difficult to apply, and since conservative 'promises' on the payoffs from investment in exclosure improvement will help keep the expectations of practitioners and farmers within realistic bounds.

The probable biophysical scaling potential of these results extends throughout the entire 'rainfall-sufficient' highlands of Ethiopia and similar contexts elsewhere from approximately 1000–1600 mm/yr, 1700–2300 m in elevation (up to 2600 m with greater uncertainty) within the Weyna Dega and Dega zones in the traditional classification system. After excluding drier highlands in eastern Amhara and Tigray, applicable areas are mostly in highland areas of Amhara and three other national regional states with rainfall-sufficient areas; in other words, most of the large highlands of Ethiopia. The institutional potential for up-scaling exclosure productivity improvement is great since grazing exclosure is an essential element of integrated watershed management, the approach employed by the Sustainable Land Management Programme (SLMP) across the Ethiopian highlands, which is also used by several other large development projects and programs that include natural resource management goals at federal and regional levels.

Kajiado County, Kenya

Community of practice (CoP)

Kajiado is in the semi-arid southern rangelands of Kenya, where pastoralism (semi-nomadic herding) is the predominant livelihood. The primary research partner in Kajiado was the South Rift Association of Land Owners (SORALO), a nongovernmental organisation. The local institutional partners were Shompole Group Ranch and Olkiramatian Group Ranch, where land is collectively owned and managed by the membership of the two group ranches. The two neighboring group ranches near Lake Magadi in Kajiado West sub-county manage their land together, including joint planning and decision-making. Research locations were identified with the guidance of SORALO staff near 14 settlements throughout the two group ranches. These research locations surround the eastern side of one of the lowest points of the South Rift Valley in Kenya, Lake Magadi. Elevation in this area ranges from 600–700 m, with average annual rainfall of approximately 550 mm/yr (the same trial was conducted in Burder Ward in Wajir, elevation 150–190 m with 300 mm/yr rainfall. See below). The direct beneficiaries of the research in the two group ranches comprise 2,700 individuals. Action research trials were supervised at each research location by a 'field supervisor' residing nearby, who was appointed on the agreement of nearby residents and group ranch committee representatives. The supervisor was trained and coordinated by SORALO staff. Field supervisors were compensated with a modest stipend for their efforts in sensitising the community about the research, organising labor required (for which payments were received by participating community members), and providing a some protection for the research plots from being grazed prematurely.

Planned comparisons (PCs)

The research needs assessment identified only one option (of many proposed) likely to be feasible: improving the quantity and composition of rangeland vegetation biomass (grasses, shrubs and trees alike) through resting for the minimum period required to substantially improve vegetation regeneration from the soil seed bank, existing rootstock and woody stems, and range re-seeding. Secondary benefits include greater pasture cover at the end of the rainy season and at the onset of the dry season (of more mature, lower quality grass), and ecological functions such as improved infiltration of rain, improved micro-climate and reduced erosion. Resting for short periods at the beginning of the rains, or 'spelling', is an effective, low-cost strategy for modestly improving rangeland grass production and regeneration over large areas (100–1,000's of hectares). Shorter resting times are likely to be more beneficial where symptoms of degradation include loss of high-quality grasses but not massive soil erosion, and where heavy grazing precludes resting for an entire season or longer.

A draft PC protocol was developed by ILRI researchers and sent to SORALO for comment and improvement. Before roll-out of the trial, adaptation workshops were held in each research location with residents of the area with the goal of conducting a final check on the suitability of the research. During the adaptation workshops, no major changes to the protocol were recommended. Community livelihood information collected during the adaptation workshops showed that the average household livestock holding was 11.54 total livestock units (though group ranch members can grow irrigated crops in certain areas, not all residents grow crops), with the main source of feed grazing and browsing at

85% of total feed. The top preferred grass species for rangeland grazing in the research locations were *Cenchrus ciliaris* (*entiamonyua*), *Sporobolus* spp. (*enkapururu*), *Cynodon dactylon* (*emurua*) and *Pennisetum mezianum* (*osangash*), and for browsing *Cordia sinensis* (*oldorko*), a shrub or small tree. These data on livelihoods describe the pastoral lifestyle of the residents with the main focus on milk production from cattle and small ruminants almost entirely dependent for grazing on communal rangelands. The area is significantly affected by intermittent droughts, in combination with high stocking rates in some areas, where loss of high-quality grass species is the main concern. These trends increase the value of cost-effective measures for halting and reversing ongoing degradation and preventing further degradation.

The final design for the action research trial involved short duration resting of moderately to heavily degraded rangelands for one and two months at the beginning of the 'long rains' of 2018 and the 'short rains' of 2018–2019, with nested plots re-seeded with a mix of drought-tolerant rangeland grass species—*Cenchrus ciliaris, Cymbopogon pospischilii, Enteropogon macrostachyus, Eragrostis superba* and *Sehima nervosum*. Research locations were targeted by the two group ranches to the most degraded portion of the area (i.e., the most bare ground), their rainy season grazing area which also hosts most of their permanent settlements. Around the 14 research locations, residents of each settlement targeted the specific plot locations to the most degraded areas nearby.

Resting and re-seeding were implemented by closing off the 1-month resting areas and then opening them up for grazing after a period of one month. The 2-month resting areas remained closed for another month and opened for grazing after the 2-month period had elapsed. Both the 1- and 2-month resting areas contained nested re-seeding plots. In doing so, both low-cost (short resting) and higher-cost (re-seeding) restoration options were tested to identify the success of each option.

Each of the 14 research locations had a single resting area 5.3 ha in size, with 2-month resting at the centre, and 1-month resting portions up- and down-slope from the centre (Figure 3). The outside boundary of the resting area was bush-fenced, as were boundaries demarcating the 1- and 2-month resting areas. Bush fencing was done mostly to mark the resting areas, while large-scale resting would not use fences, rather relying on community organisation, communication of resting locations and timing. Spatial vegetation cover measurements used the LandPKS approach (www.landpotential.org). Control plots (no resting, grazing as usual) were established 50 m outside the research areas, up- and down-slope from the resting areas.

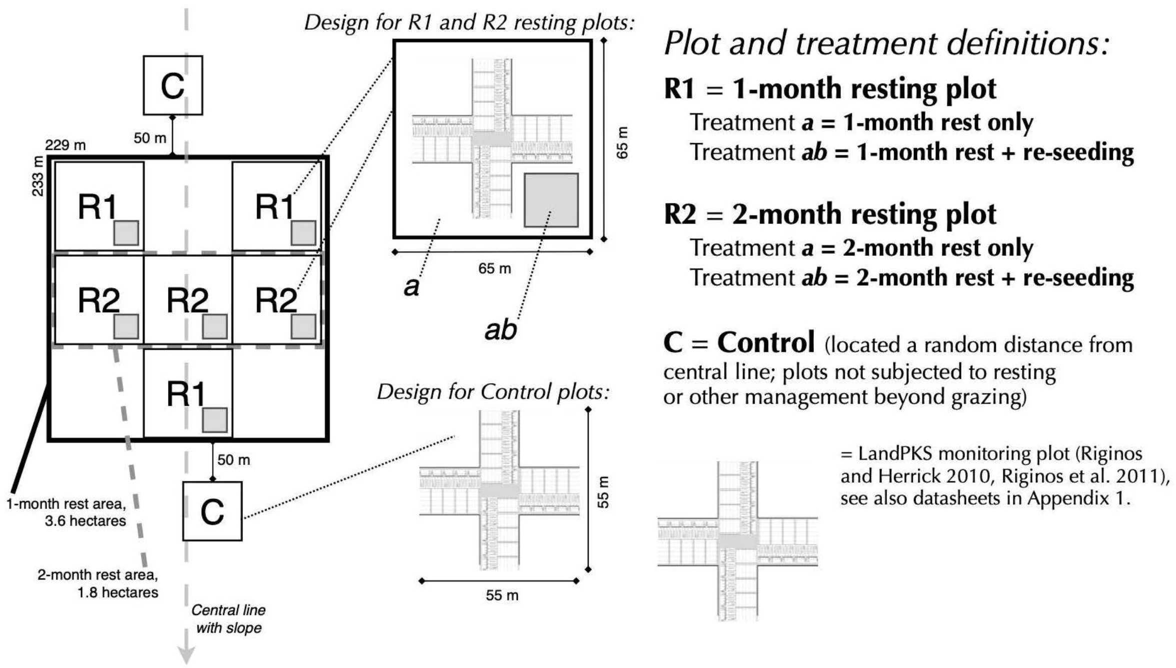

Figure 3. Plot design for resting and re-seeding plots in Kajiado, Kenya

Baseline measurements were taken in the late dry season at the onset of the 2018 long rains, and outcome measurements were taken after the rains in the 2018 'long dry' season, and again after the 2018–2019 'short dry' season. Outcome measurements were taken one month after the 2-month resting areas were re-opened to grazing, that is two months after the 1-month resting areas were re-opened. The benefits from one month of rest are probably relatively underestimated, since grazing started earlier than in the two month resting areas. The outcome measurements were taken after 1–2 months of grazing to test whether the benefits of resting could withstand the rapid initial grazing down of the most preferred forages upon re-opening, and whether those benefits included any improvement in forage availability during the early dry season. Another advantage of this study design is its conservative estimation of resting benefits (underestimation), especially for the 1-month resting treatment.

Options by context (OxC)

The key results of the Kajiado resting trial are summarized in Table 5. The table reports how much plant cover increases through the rainy seasons under normal grazing (and remains into the early dry season after grazing exposure), how much benefit resting for one or two months gives over and above this natural increase, and the total estimated increase in plant cover with resting. Plant cover reported here includes vegetation of all plant species, since virtually all plant species and biomass in the area are useful for grazing or browsing livestock (and does not include plant litter on the ground).

The large difference observed between 'good' and 'poor' rainy seasons helps in planning the use of resting, and the results from Wajir provide a useful comparison from a more arid area. In Kajiado, the long rains of 2018 were heavy and the short rains of 2018–2019 were poor, and the benefits of resting were much greater under the high rainfall in the 2018 long rains. Resting during a poor rainy season, as in the short rains of 2018–2019 in Kajiado, requires longer rest and would likely come at a higher cost to the community due to lost grazing. Resting during a drought accomplishes little to nothing (see the short rains 2018–2019 results from Wajir for an example). Good rainy seasons are clearly the best time to rest, when forage is in surplus. The decision to rest can be taken based on seasonal cues suggesting that a good rainy season is coming or appears to have already begun.

Table 5. Increase in plant cover from before the rains to after the rains (m^2/ha). Plant cover includes only standing biomass and does not include litter.

Season	Rainfall	Resting treatment	Increase under normal grazing (no resting)	Benefit of resting	Total increase with resting
Long rains 2018	Good rains	1 month rest	3,510	670	4,180
		2 months rest	3,510	980	4,490
Short rains 2018–2019	Poor rains	1 month rest	1,950	–	1,950
		2 months rest	1,950	570	2,520

Note: 1-month benefits may be underestimated since grazing started earlier than in the 2-month resting areas.

The main limitation of these results is the limited number of sites (two sites—Kajiado and Wajir), seasons (two seasons) and years (one year), over which the research was conducted. Rainfall varies greatly in the arid and semi-arid rangelands of Kenya; meaning each season is different from the last, and each location is different from the next. Replication of research locations inside each of the two sites was constrained by financial resources and logistics, and the limited number of sites reduced the ability to use detailed statistical targeting at site level.

To implement resting over large scales in pastoral rangelands, decisions must be made in advance by those local institutions responsible for grazing management. In pastoral areas of Kenya, such institutions are varied and include group ranch committees as in the area in Kajiado. Resting plans can be implemented rapidly based on seasonal indicators that a good rainy season is expected or has arrived. If the rains turn out to be poor later, the decision to rest can be rescinded at any time. Fencing is not required when community buy-in is strong, and in good rainy seasons the cost of lost grazing from resting is low or near zero. The main costs of resting during a good rainy season are the transaction costs involved in taking the decision, communicating it widely and for any vigilance required to maintain the resting period.

The eventual intended application of the results is to inform an approach termed 'rotational resting,' in which degraded rangelands are rested for short or long periods of time in large or small portions of a rangeland, in a shifting pattern over time that encourages ecological regeneration of priority rangeland resources. The general approach involves resting degraded areas during seasons with higher rainfall when forage is in surplus allowing the ecosystem to do the 'work' with minimum assistance. The management goals guiding resting plans can vary, but usually the goal is to maintain or improve the biomass production and quality of grass forage species through natural ecological regeneration, as well as by providing safer locations for re-seeding of range forages.

In the resting action research trial, such an approach to range re-seeding was attempted. Of the five drought-tolerant rangeland grass species—*Cenchrus ciliaris, Cymbopogon pospischilii, Enteropogon macrostachyus, Eragrostis superba* and *Sehima nervosum*—sown together in mixture. Most or all five species grew during the heavy long rains of 2018 in most research locations. However, all grasses except for *Cenchrus ciliaris* had disappeared by the short rains of 2018–2019. These results indicate that successful range re-seeding of *Cenchrus ciliaris* may need to involve protection during the dry season following the initial re-seeding (after the re-seeded grasses are fully grazed down in the early dry season), and possibly for more than one dry season with the goal of preventing repeated re-grazing of *Cenchrus* as it re-sprouts again and again. If that also fails, rest longer than two months is likely required for effective range re-seeding. An additional benefit of choosing *Cenchrus* is that it has a second function as a fodder (fresh or hay) that is productive under irrigation, from which the seeds can be produced at relatively low cost for range re-seeding at large scale.

Taking the results from Kajiado and Wajir (below) together, these estimates of resting benefits are applicable in pastoral areas in East Africa with annual rainfall levels of 250–600 mm, slightly above and below the interval between our research sites in Burder, Wajir and Magadi, Kajiado (300–550 mm/yr). For these areas, the resting benefits from the good and poor seasons in Kajiado can be compared with the lower resting benefits in Wajir (see below) during two consecutive seasons of poor rains, enabling coarse bracketing between the maximum benefit that can be expected (Kajiado 2018 long rains), and the minimum (the 2018–2019 short rains in Wajir). These modest benefits are significant compared to the minimal cost of resting; meaning such benefits are realistic to achieve.

The potential for up-scaling short-duration resting is significant. The resting approach we tested is relevant in most pastoral rangelands in East Africa, especially in areas where heavy stocking can only be avoided temporarily (such as pastures in reach of permanent settlements and water points), and where symptoms of degradation include loss of high-quality grasses but not massive soil erosion. For example, the total applicable area for the results from Kajiado and Wajir taken together (areas with 250–600 mm/yr rainfall), covers nearly 50% of the entire land area of Kenya. Areas with similar rainfall and management systems cover large areas of other countries in East Africa and other sub-regions of the African continent. In pastoral areas of Kenya, resting and re-seeding would be implemented by local institutions that are responsible for rangeland management, which include wards (administrative boundaries), traditional or customary rangeland units, conservancies, environmental management committees, water resource user associations, grazing committees, natural resource management committees, and group ranch committees. These institutions provide essential channels through which information on resting and re-seeding can be directly applied for community rangeland management. In Kajiado, residents in 13 of the 14 settlements where the research was conducted indicated that they would recommend this resting approach to their group ranch committees, demonstrating strong community buy-in for short duration resting. The resting approach also provides practical options for government and NGO natural resource management programs to implement as a sustainable alternative to existing options such as exclosure and zero grazing, which are valuable yet limited solutions in pastoral areas as they are not feasible over large areas.

Wajir County, Kenya

Community of practice (CoP)

Wajir is in the arid northern rangelands of Kenya, where, as in Kajiado, the main livelihood is pastoralism. The primary research partner in Wajir was the Livestock Production Office of the Wajir County Department of Agriculture, Livestock, and Fisheries (DALF), under the auspices of the Wajir county government. The local institutional partner was Burder Ward Community-Based Natural Resource Management Committee (Burder CBNRM), in Wajir South Sub-County. Burder CBNRM has informal influence over rangeland management in Burder Ward, although Wajir County is moving quickly towards formalisation of land management by ward-level committees. The area is primarily national trust land, where ownership and administration is conducted by the national government or a locally delegated government body. Research locations identified by Wajir livestock production staff included most of the road-accessible settlements within Burder ward. The research locations are in a dry season grazing area surrounding low areas often flooded temporarily by the Upper Ewaso Ng'iro River and distributed around Burder town. Elevation in this area ranges from 150–190 m, with average annual rainfall of approximately 300 mm/yr (the same trial was conducted in the Magadi area in Kajiado, elevation 600–700 m with 550 mm/yr rainfall. See above). The direct beneficiaries of the research in Burder Ward comprise 2,347 individuals. Action research trials were supervised at each research location by a 'field supervisor' residing nearby, who was appointed on the agreement of nearby residents and Burder CBNRM committee representatives. The supervisor was trained and coordinated by Wajir livestock production staff. Field supervisors were compensated with a modest stipend for their efforts in sensitising the community about the research, organising required labor and providing some protection for the research plots from being grazed prematurely. No payments were made to participating community members for labor involved, as the World Food Programme (WFP) Food for Assets (FFA) programme was active in the area in providing food aid for public works. WFP recruited community members receiving food aid were willing to perform the labor required as their contribution under the FFA programme.

Planned comparisons (PCs)

The land restoration action trials in Wajir were identical to those in Kajiado, involving resting and re-seeding. As in Kajiado, this option was the only one out of many likely to be feasible for improving the quantity and composition of rangeland vegetation biomass (grasses, shrubs and trees alike) through resting for the minimum period required to substantially improve vegetation regeneration from the soil seed bank, existing rootstock and woody stems, and range re-seeding. Secondary benefits include greater pasture cover at the end of the rainy season and at the onset of the dry season (of more mature, lower quality grass), and ecological functions such as improved infiltration of rain, improved micro-climate and reduced erosion. Resting for short periods at the beginning of the rains, or 'spelling', is an effective, low-cost strategy for modestly improving rangeland grass production and regeneration over large areas (100–1,000's of hectares). Shorter resting times are likely to be more beneficial where symptoms of degradation include loss of high-quality grasses but not massive soil erosion, and where heavy grazing precludes resting for an entire season or longer.

A draft PC protocol was developed by ILRI researchers and sent to Wajir County Livestock Production office for comment and improvement. Before roll-out of the trial, adaptation workshops were held in each research location with residents of the area with the goal of conducting a final check on the suitability of the research. During the adaptation workshops, no major changes to the protocol were recommended. Community livelihood information collected during the adaptation workshops showed that the average household livestock holding—excluding camels, which residents were unwilling to report—was 11.85 total livestock units (and some grow crops, though not all), with the main source of feed grazing and browsing at 84.2% of total feed. The top preferred grass species for rangeland grazing in the research locations were *Aristida adoensis* (*biila*), *Sporobolus* spp. (*jarbi*), *Chrysopogon* spp. (*darema*), and *Pennisetum* spp. (*coows modul*). Good browse is plentiful. These data on livelihoods describe the pastoral lifestyle of the residents with the main focus on milk production from camels, cattle and small ruminants, all of which are almost entirely dependent on communal rangelands for grazing. The area is significantly affected by intermittent droughts in combination with high stocking rates of livestock from near and sometimes far away, where loss of high-quality grass species is the main concern. Even more so than in Kanjiado, these trends increase the value of cost-effective measures for halting and reversing ongoing degradation, and preventing further degradation.

The final design for the action research trial involved short-duration resting of moderately to heavily degraded rangelands for one and two months at the beginning of the 'long rains' of 2018 and the 'short rains' of 2018–2019, with nested plots re-seeded with a mix of drought-tolerant rangeland grass species—*Cenchrus ciliaris, Cymbopogon pospischilii, Enteropogon macrostachyus, Eragrostis superba* and *Sehima nervosum*. In Wajir, resting research locations were targeted at the most degraded areas (i.e., the most bare ground) by Burder CBNRM committee, in the moisture retaining dry season grazing area surrounding permanent settlements. Around the seven research locations, residents of each settlement targeted the specific plot locations at the most degraded areas nearby.

Resting and re-seeding were implemented by closing off the 1-month resting areas, and then opening them up for grazing after a period of one month. The 2-month resting areas remained closed for another month and opened for grazing thereafter, after the 2-month period had elapsed. Both the 1- and 2-month resting areas contained nested re-seeding plots. In doing so, both low-cost (short resting) and higher cost (re-seeding) restoration options were tested to identify the success of each option.

Each of the seven research locations had 0.74 ha total resting area, divided into three resting areas each 0.25 ha in size, with 2-month resting at the centre, and 1-month resting portions sideways along the slope from the centre (Figure 4), for a total of 21 resting areas. Unlike in Kajiado, the resting areas needed to be smaller (65 x 35 m) because thick, thorny vegetation made managing larger plots impossible. The outside boundary of the resting area was bush-fenced, as were boundaries demarcating the 1- and 2-month resting areas (bush fencing was done mostly to mark the resting areas, while large-scale resting would not use fences, rather relying on community organisation, communication of resting locations and timing). Spatial vegetation cover measurements used the LandPKS approach (www.landpotential.org) as modified to fit the plot design, with 10 25-metre transects per resting area (30 transects per research location). Control transects (no resting, grazing as usual) were established 10 m outside the research areas.

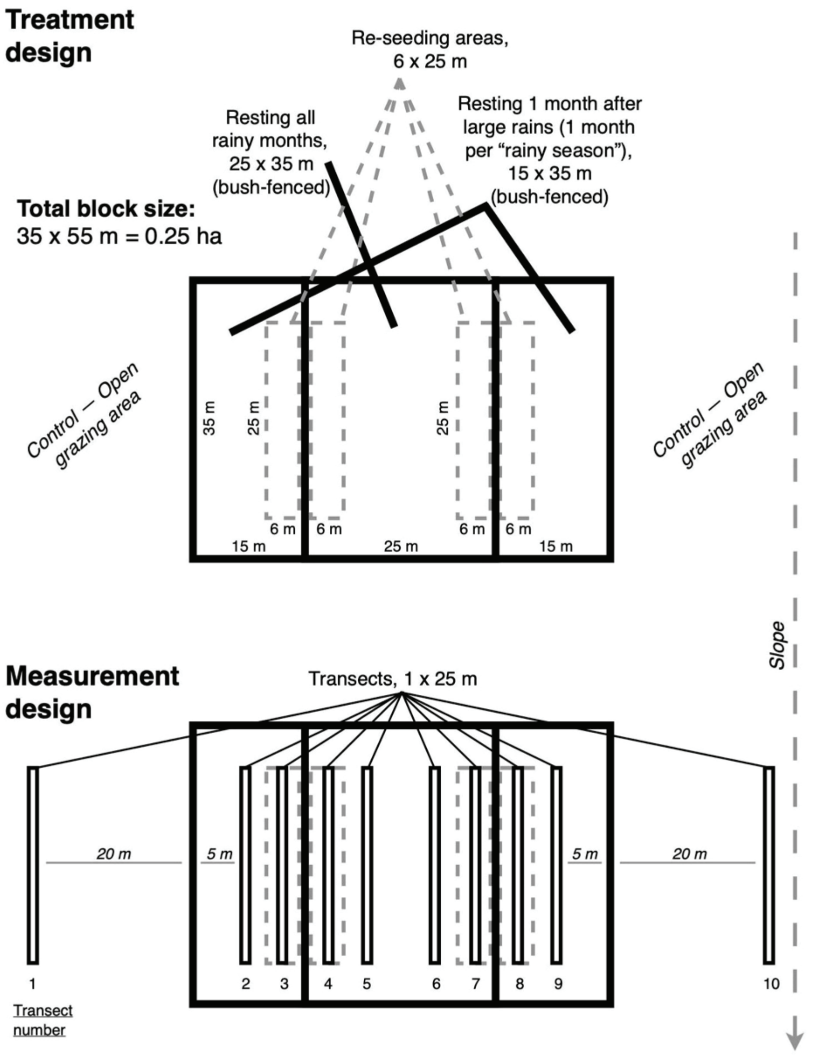

Figure 4. Plot design for resting and re-seeding plots in Wajir, Kenya

Baseline measurements were taken in the late dry season at the onset of the 2018 long rains, and outcome measurements were taken after the rains in the 2018 'long dry' season, and again after the 2018–2019 'short dry' season. Outcome measurements were taken one month after the 2-month resting areas were re-opened to grazing, that is two months after the 1-month resting areas were re-opened. The benefits from one month of rest are probably relatively underestimated, since grazing started earlier than in the two month resting areas. The outcome measurements were taken after 1–2 months of grazing test to see whether the benefits of resting could withstand the rapid initial grazing down of the most preferred forages upon re-opening, and whether those benefits included any improvement in forage availability during the early dry season. Another advantage of this study design is its conservative estimation of resting benefits (underestimation), especially for the 1-month resting treatment.

Options by context (OxC)

The key results of the Wajir resting trial are summarized in Table 6. The table reports how much plant cover increases through the rainy seasons under normal grazing (and remains into the early dry season after grazing exposure), how much benefit resting for one or two months gives over and above this natural increase, and the total estimated increase in plant cover with resting. Plant cover reported here includes vegetation of all plant species since virtually all plant species and biomass in the area are useful for grazing or browsing livestock (but does not include plant litter on the ground).

Although the 2018 long rains were poor (unlike most of Kenya that year), flooding from the Upper Ewaso Ngiro River inundated large areas for 1–2 weeks, including several research plots (flooding also depresses rangeland biomass production), making rangeland production conditions poor due to the flooding and poor rain afterwards. In spite of these problems, a substantial increase in plant cover was achieved by two months of resting. Both the 1- and 2-month resting produced a proportionally massive amount of pasture cover in comparison with the barren controls under normal, heavy grazing. The 2018–2019 short rains were again poor for the second consecutive season. Since by this point forage scarcity was already critical, and there was virtually no rain to support plant growth, no resting effects were achieved, nor should they be expected during such a drought. The results from Kajiado provide a useful comparison from a dry semi-arid site during good and poor rainy seasons.

Table 6. Increase in plant cover from before the rains to after the rains (m^2/ha). Plant cover includes only standing biomass, and does not include litter. These results exclude an outlier where animals were kept inside fences as opposed to outside, and which was not rested.

Season	Rainfall	Resting treatment	Increase under normal grazing (no resting)	Benefit of resting	Increase with resting
Long rains 2018	Flooding + poor rains	1 month rest	110	450	560
		2 months rest	110	830	940
Short rains 2018–2019	Poor rains*	1 month rest	-1,090	410	-680
		2 months rest	-1,090	430	-660

Note: one month benefits may be underestimated since grazing started earlier than in the two month resting areas

* As the short rains of 2018–2019 were the 2nd consecutive season of poor rain in Burder ward, resting effects were reduced due to persistent drought.

As discussed for Kajiado, the research covered a limited number of sites (two sites, Kajiado and Wajir), seasons (two seasons), and years (one year), which is the main limitation on how useful the results are. Rainfall varies greatly in the arid and semi-arid rangelands of Kenya, and that variation is greatest in more arid rangelands, such as Wajir, often resulting in drought (which, as observed here, removes any benefit of resting). Although the 2018 long rains were heavy in most areas, the rains were poor in Burder and the research was not able to measure a 'good' rainy season in Burder. This is unfortunate as resting benefits might be relatively massive. Replication of research locations inside each of the two sites was constrained by financial resources and logistics, and the limited number of sites reduced the ability to use detailed statistical targeting at site level.

In Wajir, decisions on resting would likely be made in advance by currently informal local institutions responsible for grazing management, in consultation with government, and traditional and religious leaders. Resting plans can be implemented rapidly based on seasonal indicators that a good rainy season is expected or has arrived. If a drought comes or the rains are poor, the decision to rest can be rescinded at any time. Fencing is not required when community buy-in is strong, and in good rainy seasons, the cost of lost grazing from resting is low or near zero. The main costs of resting during a good rainy season are the transaction costs involved in taking the decision, communicating it widely and for any vigilance required to maintain the resting period. In Burder, the successful resting trial indicates some community buy-in for conserving pasture for dry season use. However, short spells of rest are not the greatest need. Keeping dry season pastures for dry season use is a better and realistic goal, but that will require a fair degree of discussion and organisation.

The eventual intended application of the results, along with those from Kajiado, is to inform an approach termed 'rotational resting,' in which degraded rangelands are rested for short or long periods of time in large or small portions of a rangeland, in a shifting pattern over time that encourages ecological regeneration of priority rangeland resources. The general approach involves resting degraded areas during seasons with higher rainfall when forage is in surplus, allowing the ecosystem to do the 'work' with minimum assistance. The management goals guiding resting plans can vary, but usually the goal is to maintain or improve the biomass production and quality of grass forage species through natural ecological regeneration, as well as providing safer locations for re-seeding of range forages.

In the resting action research trial in Wajir, range re-seeding using the same five drought-tolerant rangeland grass species as in Kajiado (*Cenchrus ciliaris, Cymbopogon pospischilii, Enteropogon macrostachyus, Eragrostis superba* and *Sehima nervosum*) were sown together in mixture. A few individuals grew three species (*Cenchrus* and *Enteropogon*) during the long rains of 2018 in several research locations in areas flooded by the river. However, all re-seeded grasses appeared to have disappeared by the end of the short rains of 2018–2019. These results indicate that successful range re-seeding would need to take place during a productive rainy season without major flooding and *Cenchrus ciliaris would be the most probable species to sow*. As observed in Kajiado, resting may need to involve protection during the dry season following the initial re-seeding (after the re-seeded grasses are fully grazed down in the early dry season), and possibly for more than one dry season. An additional benefit of the choice of *Cenchrus* is that it has a second function as a fodder (fresh or hay) that is productive under irrigation, from which the seeds can be produced at relatively low cost for range re-seeding at large scale.

Combining the results from Wajir and Kajiado (above), these estimates of resting benefits are applicable in pastoral areas in East Africa with annual rainfall levels of 250–600 mm, slightly above and below the interval between our research sites in Burder, Wajir and Magadi, Kajiado (300–550 mm/yr). For these areas, the lower resting benefits in Wajir during two consecutive seasons of poor rains can be compared with a good and poor season each in Kajiado, enabling coarse bracketing between the maximum benefit that can be expected (Kajiado 2018 long rains), and the minimum (the 2018–2019 short rains in Wajir), effectively zero. Except during droughts, the modest benefits of well-timed resting are significant compared to its minimal cost, meaning such benefits are realistic to achieve even in the most challenging, arid rangelands.

As noted for Kajiado, the potential for up-scaling short duration resting is significant, with the total applicable area in Kenya for the results from Kajiado and Wajir taken together (areas with 250–600 mm/yr rainfall) covering nearly 50% of its land area. The resting approach we tested is relevant in most pastoral rangelands in East Africa, especially in areas where heavy stocking can only be avoided temporarily (such as pastures in reach of permanent settlements and water points), and where symptoms of degradation include loss of high-quality grasses but not massive soil erosion. Areas with similar rainfall and management systems cover large areas of other countries in East Africa, and other sub-regions of the African continent. In pastoral areas of Kenya, resting and re-seeding would be implemented by local institutions that are responsible for rangeland management, which include wards (administrative boundaries), traditional or customary rangeland units, conservancies, environmental management committees, water resource user associations, grazing committees, natural resource management committees and group ranch committees. These institutions can directly apply resting and re-seeding information for community rangeland management, although as the case of Burder demonstrates, community buy-in to rangeland management plans is both feasible and critical. In Burder, the approach of grazing flood-fed pastures closer to permanent settlements and water during the dry season means there is a significant challenge for the community to preserve these pastures into the dry season. In the meantime, short resting is somewhat useful in this context but will not make up for lack of effective seasonal grazing restrictions through community by-laws. The resting approach tested here provides practical options for government and NGO natural resource management programs to implement as a sustainable alternative to existing options such as exclosure and zero-grazing, which are valuable yet limited solutions in pastoral areas as they are not feasible over large areas.

Summary and conclusion

This work provides guidelines to governments and NGO practitioners on the processes involved in actual research implemented at field level and the phases to be followed in successfully conducting a multistakeholder action research trial for restoration of communal grazing lands. A conceptual model for how action research can lead to scaling of restoration in communal grazing lands, and practical steps are described for each stage in the research process. Three examples of the action research process are provided: range resting and reseeding in pastoral Kajiado and Wajir Counties in Kenya, and exclosure productivity improvement in mixed farming areas in Amhara region of Ethiopia. The apparent success of this work appears to have been enabled by several factors. In all cases, the eventual end users of the information produced—herders, farmers and their institutions, and government and NGO practitioners—came first in designing the trials. Multi-stakeholder engagement in design and implementation of research protocols allowed for balancing among the internal and external validity of the research work, blending accuracy with broad applicability, likely improving scalability of the results. Given the limitations that arise from the realities of field implementation, researchers need to be prepared to adjust research components such as research area size, sub-sampling frequency and experimental controls, among others. Identifying and working with development partners and local institutions provides for better research planning that aims for long-term sustainability through larger scaling pathways involving complex institutional networks. Through existing local institutions, community oversight can be established and the community can become more aware of and their interest aligned with project goals. Research that meets the needs of local producers by engaging local stakeholders and institutions creates a better understanding of local preference around the research, and in this way promotes the ability of local institutions to engage in collective action which results in rapid research progress. This is more likely to produce restoration in the long term. Finally, while adapting research to an area and to local context, researchers should also identify institutional potential and cost considerations for upscaling and plan for feasible tools and documentation of scaling pathways during the final stages of the project. These scaling pathways and the institutitions through which they will operate should come first if the research is to be applied by these end users.

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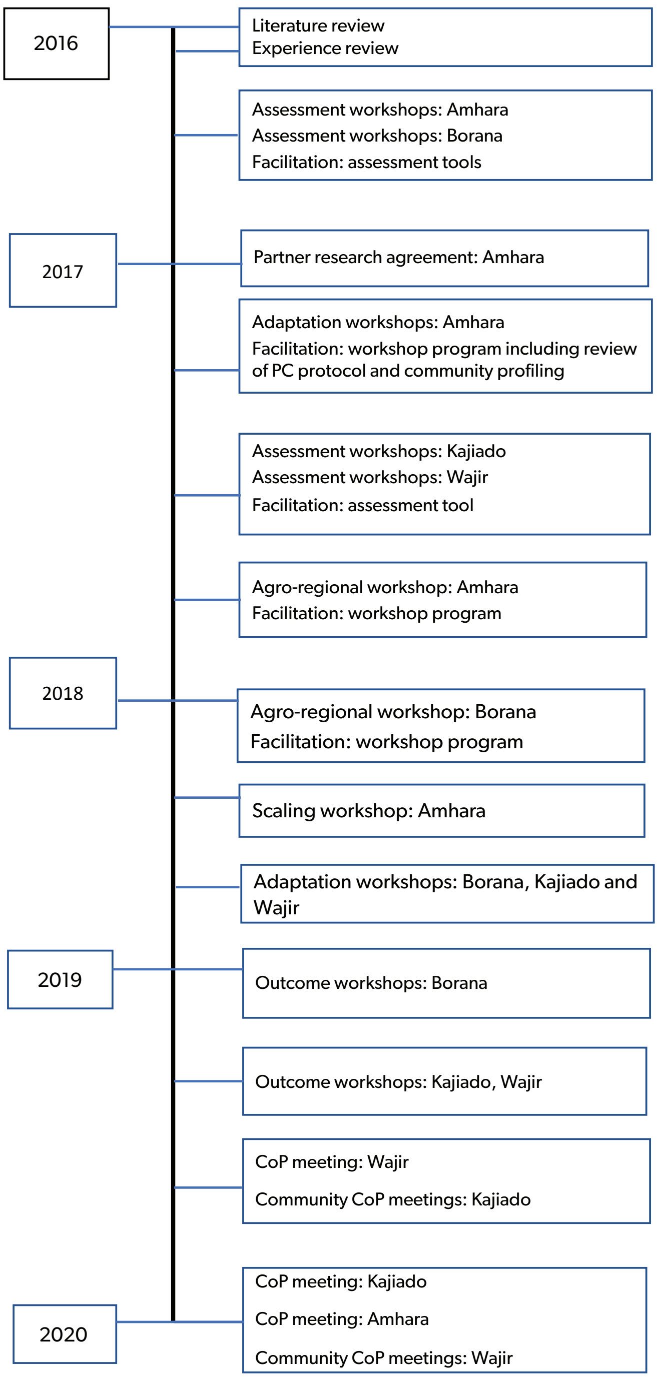
Appendix: Timeline for community of practice activities in the case study sites



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