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TECHNICAL REPORT

SUPPORTING PASTORALISTS THROUGH AFRISCOUT STEWARD AND REGEN: IMPACT EVALUATION

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About SPARC

Climate change, armed conflict, environmental fragility and weak governance and the impact these have on natural resource-based livelihoods are among the key drivers of both crisis and poverty for communities in some of the world's most vulnerable and conflict-affected countries.

Supporting Pastoralism and Agriculture in Recurrent and Protracted Crises (SPARC) aims to generate evidence and address knowledge gaps to build the resilience of millions of pastoralists, agro-pastoralists and farmers in these communities in sub-Saharan Africa and the Middle East.

We strive to create impact by using research and evidence to develop knowledge that improves how the UK Foreign, Commonwealth and Development Office (FCDO), donors, non-governmental organisations, local and national governments and civil society can empower these communities in the context of climate change.

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ACRONYMS

AMP	adaptive multi-paddock
AS	AfriScout
cRCT	cluster randomised control trial
ETB	Ethiopian Birr
FCS	food consumption score
FGD	focus group discussion
IE	impact evaluation
KES	Kenyan Shilling
KII	key informant interview
NDVI	Normalised Difference Vegetation Index
RCT	randomised control trial
RGU	regenerative grazing units
SPARC	Supporting Pastoralism and Agriculture in Recurrent and Protracted Crises
TLU	tropical livestock units

EXECUTIVE SUMMARY

Introduction

Pastoralism is an increasingly precarious livelihood in East Africa's arid and semi-arid regions due to climate-related disasters, armed conflict, livestock diseases, macroeconomic shocks and growing populations. Consequently, there is a critical need for innovations that enhance pastoralists' resilience and adaptability.

The AfriScout (AS) programme – devised and implemented by Global Communities – supports pastoralists through two intervention models: **AfriScout Steward**, a digital app implemented in Kenya that provides satellite and crowd-sourced information on rangeland conditions to inform grazing and migration decisions; and **AfriScout Regen**, which provides more intensive and localised grazing support at a community level in Ethiopia using a unique version of the adaptive multi-paddock (AMP) approach within defined regenerative grazing units (RGU).

Causal Design conducted an impact evaluation (IE) to understand the causal impacts of the two AS models (Causal Design, 2025). Primarily, the evaluation sought to identify the **attributable outcomes of AS on pastoralist decision-making** and **subsequent impacts on rangeland conditions and herd conditions**. This SPARC Technical Report summarises key findings and evidence-based recommendations for AS implementers and policy-makers.

Research methodology

This two-year IE used a rigorous mixed-methods approach. The quantitative component comprised a cluster-level randomised control trial (cRCT). A standard RCT was used for AS Regen in Ethiopia, with clusters randomly assigned to treatment or control groups. High compliance ensured that the intent-to-treat (ITT) analysis has closely measured the true impact of the intervention.

For AS Steward in Kenya, extensive information spillovers created methodological challenges, as control groups were indirectly affected. To address this, a quasi-experimental approach compared self-reported trained households with untrained ones. Advanced statistical methods (augmented inverse probability weighting and causal forests) were used to improve comparability, but the spillovers mean the results cannot be considered definitive causal effects.

The qualitative component comprised semi-structured key informant interviews (KIIs) and focus group discussions (FGDs) with a range of stakeholders. These provide nuanced insights into the 'how' and 'why' behind the observed outcomes, complementing the quantitative findings.

Literature review

As a livelihood, pastoralism in the Horn of Africa is increasingly vulnerable due to climate change and compounding challenges like land fragmentation and unreliable traditional knowledge. This study contributes to the literature on interventions that improve pastoralist well-being and rangeland management. The research focus on the AS mobile app highlights the critical role of timely, accurate information for migration decisions. Past climate forecasts were limited by coarse scales and real-time data was scarce. Digital tools are now gaining

traction, with mobile phones 'entrenched in customary practices of information gathering' (Boas, 2022: 3440). These tools, though often simple, are seen as a 'key pillar of agricultural and livestock development' (Daum et al., 2022: 12), with improved forage conditions shown to reduce food insecurity and enhance productivity. This study is the first to evaluate the digital AS app in real-world settings, building on previous paper map versions (Machado et al., 2020) by exploring wider outcomes and qualitative insights.

The second intervention, AS Regen, focuses on an adapted approach to AMP regenerative grazing. AMP is a practice known to improve soil health, productivity and resilience. While most AMP evidence comes from high- and middle-income countries, this impact evaluation is one of the first to examine the impact of this approach on pastoralist well-being and livestock health in a low-income-country context like Ethiopia. It complements studies such as Coppock et al. (2022: 5), which reports mixed results for similar interventions in Namibia, highlighting the 'fragility of the causal pathway' from programme to outcomes. Our mixed-methods design, which includes quantitative evidence and qualitative descriptions of success mechanisms, aims to bridge existing knowledge gaps in this crucial area.

Key findings and analysis

AfriScout Steward

AS Steward has significantly increased pastoralists' reliance on this digital tool for migration information. Qualitative data shows high user trust in the digital app, which has boosted confidence in migration decisions and reduced uncertainty. The training has also had a positive, though limited, quantitative effect on migration outcomes, helping households find better pasture. Qualitatively, pastoralists reported using the app to avoid unnecessary migrations, which has reduced stress and improved herd health. However, quantitative impacts on food security and financial well-being are small and impacts on overall herd condition are inconclusive. This is likely due to information spillovers, where benefits have diffused from trained to untrained households, making it difficult to measure the true causal effect. The sharing of information and practices means that the control group was not a true comparison, leading to an underestimation of the intervention's actual impact. App users also cited challenges like information lags, technical language, poor functionality in low-network areas and a lack of market features.

AfriScout Regen

AS Regen has had large and significant positive impacts across all primary indicators. The intervention has improved rangeland management capacities and behaviours, with a high percentage of households adopting shared grazing plans and taking action to improve grass quality. This has led to increased community confidence and substantial improvements in pasture quality. These enhancements have translated into significantly better herd conditions, with treatment households reporting improved herd health and a higher proportion of animals in good condition. This positive impact has contributed directly to significant improvements in financial well-being (increased herd value, improved milk production, reduced costs) and non-financial well-being (enhanced food security, greater resilience, reduced reliance on negative coping strategies and increased cooperation). The causal pathway – where collective management leads to improved pasture, healthier herds and enhanced well-being – is strongly supported by both quantitative and qualitative evidence. Success has been driven by effective shared grazing plans, strong community leadership and inclusive participation, though rule enforcement has been challenged by the attraction of neighbouring pastoralists to improved pastures.

Conclusions

This study confirms the increasing vulnerability of pastoral livelihoods in the Horn of Africa and the critical need for effective interventions. It contributes uniquely to the evidence base by evaluating both a digital information platform (AS Steward) and a community-led regenerative grazing model (AS Regen) in real-world pastoralist contexts. AS Steward in Kenya has shown promise in guiding migration decisions and is highly valued by users, but there is limited evidence of its impacts on migration outcomes and no evidence of its impacts on herd conditions. Extensive information spillovers in Kenya complicated the quantitative assessment of its full impact, which is one possible explanation for these inconclusive findings. Conversely, AS Regen in Ethiopia has shown clear and significant positive impacts across rangeland management, rangeland conditions, herd health and value, and pastoralist well-being. The success of AS Regen highlights the transformative potential of collective action and adaptive grazing in enhancing both ecological and human well-being. These findings underscore the importance of tailored interventions that consider local context, technological feasibility and community governance structures.

Recommendations

AfriScout Regen: Efforts are needed to raise awareness and expand the intervention to other areas. This is needed to share AS Regen's positive effects with other communities and to safeguard existing RGU-controlled areas. Particular gaps and barriers should be addressed (i.e., access to water and veterinary services), while emergent or inconclusive findings warrant further investigation (i.e., AS Regen's effects on gendered outcomes and livestock disease).

AfriScout Steward: Additional app features or functionality should be explored, such as incorporating market information and offline access. In-person and in-app training and troubleshooting support could also be improved.

Policy-makers: Policy-makers must consider local context, tailoring interventions to ensure their success. They should also consider trade-offs between impact, scalability and budget when designing interventions that target pastoralists. Both AS Steward and AS Regen were designed to take into account the specific needs of the pastoralist population, and they have been adapted in ways that ensure higher participation of the community in use and spread of the tools, and also in learnings. Models that deliver a benefit to pastoralists, that are tailored to community needs and that are codeveloped with them are more likely to increase the resiliency of pastoralist livelihoods.

1. INTRODUCTION

Pastoralism is a critical livelihood and economic activity in Africa's arid and semi-arid areas. It also represents one of the most viable production systems in such drylands (Mokku, 2023). However, the context in which pastoralists in Eastern Africa operate has changed rapidly due to climate change, making pastoralism an increasingly vulnerable livelihood. Under such conditions, the need for timely, accurate and accessible information to guide pastoralists' decision-making on migration and rangeland management becomes particularly relevant.

Global Communities' AfriScout (AS) initiative seeks to improve the way pastoralists make decisions around migrations and rangeland management. AS, which is implemented under two intervention models, provides pastoralists with information designed to improve decision-making and preserve pastoralists' livelihoods, herds and rangelands. **AS Steward** and **AS Regen** are successors to the initial AS prototype (Machado et al., 2020). They are based on two mechanisms: 1) the ability of AS information (and, in the case of AS Regen, targeted advice) to affect pastoralists' decision-making; and 2) the ability of new decision-making practices to bring about positive outcomes for rangelands, herd conditions and pastoralist well-being.

Box 1 summarises the main features of AS Steward and AS Regen. Appendix A provides greater detail.

BOX 1. FEATURES OF AS Steward AND AS Regen

AS Steward	AS Regen
Mobile app-based intervention that provides pastoralists with **information** relevant to their grazing decisions. The app's main features include: ▪ Grazing map of communities' customary rangelands. ▪ Current vegetation conditions, updated every 10 days. ▪ User-shared alerts, including predators, restricted grazing, and conflicts. ▪ Surface water is detected and represented in the maps.	▪ **Intensive community-based intervention** that provides **training and advice** to pastoralist communities on regenerative grazing principles. ▪ The intervention aims to increase the **adoption of community grazing plans** that allow rangelands to regenerate when executed. ▪ Communities, with the leadership and support of a designated committee and an AS Field Agent, **divide large, communal areas of land into smaller 'paddocks'** and **jointly rotate through paddocks when grazing** their herds. This **rotational grazing** is meant to allow 'resting paddocks' to regenerate and prevent overgrazing.

Source: Authors' own

To understand the causal impacts of the two models, Causal Design conducted a two-year, mixed-methods impact evaluation (IE) funded by the UK's Foreign, Commonwealth and Development Office (FCDO)'s Supporting Pastoralism and Agriculture in Recurrent and Protracted Crises (SPARC) research initiative. The baseline survey was conducted in January–February 2023 (Causal Design, 2023), while endline data was collected in February–March 2025.[1] Initially, the evaluation was designed to understand the causal impacts of AS Steward, the app-based model, in both Ethiopia and Kenya. However, the research design was adjusted in March 2024 due to a change in Global Communities' implementation, whereby Field Agents in Ethiopia were primarily assigned to support AS Regen. Consequently, the IE studied the causal effects of AS Steward in Kenya and AS Regen in Ethiopia separately (Causal Design, 2024).

The IE used a cRCT, whereby clusters in each country were randomly assigned to either the treatment or the control group. Due to some spillover issues in Kenya, we deviated from the traditional way of analysing RCT studies and employed a quasi-experimental method.[2] At the endline, the quantitative survey was complemented by a qualitative inquiry to assess programme implementation, to examine key mechanisms and to investigate causal pathways.

The study took place at an unusual time: the two years prior to implementation coincided with an intense drought in Ethiopia and Kenya, while the implementation years saw high levels of rainfall in study areas. Therefore, the results apply to a very specific context (namely, drought years immediately followed by high rainfall). While this does not threaten the validity of the results – these specific conditions affected treatment and control areas similarly – it does limit the contexts to which the results can be applied. For example, areas with intense droughts during implementation of similar initiatives might have different impacts. See Appendix E for further results on how the average vegetation quality in study areas changed in recent years (using the Normalised Difference Vegetation Index (NDVI) and monitoring and evaluation data).

AS Steward can be downloaded as a free app and is thus accessible to both the treatment and control groups in both countries. Given this, the treatment intervention in Kenya is defined as the promotion of the app, along with the active engagement and training provided by Field Agents in the treatment clusters. AS Steward provides satellite data on vegetation conditions, as well as ground-sourced alerts within a given community-defined grazing area. Individuals and groups determine how best to use that information to make better decisions for their herd and the grasslands they rely on.

AS Regen does not utilise an associated app, thus only households located in AS Regen treatment areas benefit from the intervention. As such, the evaluation of AS Regen examines the causal impacts of the AS Regen model, as well as the provision of training and additional support. AS Regen is a more intensive and localised grazing module providing hands-on grazing planning support. Smaller RGUs are defined within communities with direct stewardship responsibilities. Each RGU is led by a management committee that, with the help of Field Agents, is responsible for creating community grazing maps, developing seasonal grazing plans and implementing these plans. Plans follow the AMP grazing approach, which divides a rangeland into 'virtual paddocks'[3] for rotational grazing. AS Regen adapted the traditional AMP

1 See Appendix B for more details on the data collection activities.

2 See Research methodology section, and Appendices C and D for more details on the methodology and the contamination and spillover issues.

3 Appendix A presents a more detailed description of the AS Steward app, and the two treatment interventions.

to a much larger, landscape-level application, with no physical fencing around paddocks and the necessity for many hundreds of people and thousands of animals to work in unison.

The overall goal of the IE was to **identify the attributable outcomes of the AS interventions on pastoralist decision-making and their impact on rangeland conditions and herd conditions**. See Table 1 for the primary and secondary research questions. These were designed to elucidate the impact of AS, primarily on rangeland and herd conditions and also on the impact of AS on pastoralists' well-being.[4]

For each country, all research questions focused on either AS Steward (in Kenya) or AS Regen (in Ethiopia). In other words, in Kenya, all research questions focused on *the information services provided through AS Steward*, while all research questions in Ethiopia focused on *the grazing planning support provided through AS Regen*. Furthermore, though all research questions were relevant for both models, some questions were more pertinent to either AS Regen or AS Steward, or they manifested differently under the two models. Table 1 notes some of these intervention-specific nuances.

TABLE 1. RESEARCH QUESTIONS

Primary research questions
1. Does AfriScout influence pastoralists' decision-making and behaviours around migration, grazing patterns and rangeland management? *AS Steward focuses on behaviours and decision-making; AS Regen focuses more on grazing plans and adherence to the plan.*
2. What are the impacts of AfriScout on rangeland conditions? *The impact on rangeland conditions is more of a direct outcome for AS Regen than for AS Steward.*
3. What are the impacts of AfriScout on herd conditions?
Secondary research questions
4. What are the impacts of AfriScout on pastoralist well-being?
5. Does AfriScout impact pastoralists' perceptions of their own well-being?

Source: Authors' own

The endline survey included a large set of questions that provide a broad picture of pastoralist households' outcomes after two years of AS implementation. For this IE, a smaller set of primary outcomes was selected for each intervention (see Table 2). These were identified as key outcomes because they relate directly to the interventions' theory of change. The primary indicators were selected in consultation with Global Communities and SPARC. This report mainly focuses on a smaller set of the most relevant indicators because it would be difficult to analyse and draw conclusions from the full set.

Section 2 describes the methodologies used to answer the research questions; section 3 presents our literature review, highlighting this study's contribution to existing knowledge. The main results of the study, by country, are presented in sections 4 and 5. Each begins with the primary indicators, followed by detailed analysis of the quantitative and qualitative data that substantiates these outcomes. We give our conclusions in section 6 and recommendations in section 7, which are relevant for the implementers of each model plus policy-makers.

4 The IE also considered additional secondary research questions on auxiliary outcomes (e.g., conflict) and investigated additional causal pathways. See Appendix G.

TABLE 2. PRIMARY INDICATORS

AS Steward	AS Regen
Number of unsuccessful migrations (RQ 1)	Percentage of households living in a community with a shared grazing plan (RQ 1)
Percentage of households that migrated to areas with a water source available (RQ 1)	Actions taken to improve the quality of the grass in the area (RQ 1)
NDVI conditions in migration areas (RQ 1)	Confidence in the ability of the community to effectively manage rangelands and rangeland conditions (RQ 1, 2)
Proportion of herd lost during the last migration (RQ 1)	Average NDVI conditions in the area (RQ 2)
State of the pasture in migration areas (RQ 1)	Overall degree of satisfaction with the quality of the grass in the area (RQ 2)
Share of households for whom AS is an important source of migration information (RQ 1)	
Percentage of animals in good, moderate and poor condition (RQ 3)	
Overall changes in the condition of the herd over the past year (RQ 3)	

Note: The associated primary research question (RQ) is given in parentheses for each primary outcome.

Source: Authors' own

2. RESEARCH METHODOLOGY

The mixed-methods IE was designed to understand the causal impacts of AS Steward (Kenya) and AS Regen (Ethiopia) on pastoralist decision-making and the impact of the models on rangeland and herd conditions. The quantitative component generated evidence on the causal impact of AS. The qualitative inquiry provided additional evidence to triangulate the quantitative findings. More importantly, it provided insights into the drivers of the results, by building directly on the experiences of pastoralists in treatment areas.[5]

IE quantitative design and analysis[6]

The quantitative component was based on a cRCT. For AS Regen in Ethiopia, a standard RCT design was used: we randomly assigned half of the communities to a treatment group and half to a control group. Because of this random assignment, we could be confident that the two groups were, on average, similar at the start of the study. This meant any differences observed at the end of the evaluation could be directly attributed to the intervention and not to other external factors. The impact measured in this way is called the intent-to-treat (ITT) effect – this represents the impact of being in an area where the intervention was available. With the high level of participation in Ethiopia, the ITT effect is a strong measure of the programme's true impact.

A key challenge arose for AS Steward in Kenya: extensive information spillover. We found that households in the control group were indirectly benefiting from the intervention because of information sharing with their neighbours in the treatment group. This made a standard RCT analysis difficult, as the control group was no longer a pure comparison. To address this, we used a quasi-experimental approach to compare households with similar characteristics who reported using the app (named hereafter the treatment group) with those who did not (the control group).

In the analysis sections we discuss the effects of AS (e.g., improved rangeland conditions, enhanced food security). These effects are the measurable outcomes that directly link to the interventions. For AS Regen in Ethiopia, these findings represent the estimated causal impact attributed to the programme. However, the findings for AS Steward in Kenya – which are supported by advanced statistical methods – should be viewed as providing a robust, but not definitive, picture of the intervention's effects. This is given the methodological challenges we faced.

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5 In some cases, the mechanisms uncovered through qualitative analysis can be used to design new RCTs to evaluate the causal relevance of a given mechanism.

6 See Appendix C for a more detailed methodology. Readers can reach out to the authors for a copy of the qualitative and quantitative data collection tools used in this study: Miguel Uribe, Sophie Turnbull and Javier Madrazo.

Qualitative inquiry[7]

The cRCT was complemented by a qualitative inquiry to provide further insights into factors driving results. This enquiry examined key mechanisms and causal pathways to change from the perspectives of implementers and pastoralists. The qualitative inquiry also provides additional evidence to triangulate the quantitative findings.

Qualitative data was collected through semi-structured KIIs and FGDs, with a purposively selected range of stakeholders for each intervention to ensure a comprehensive evaluation of AS implementation. Study sites in Ethiopia and Kenya were selected purposively based on gender balance, implementation progress and intensity, and accessibility/security. In all, 70 qualitative interviews were conducted across 12 study sites (seven in Ethiopia, five in Kenya).

Qualitative data was analysed using ATLAS.ti computer-assisted qualitative data analysis software, following a content analysis approach. This allowed in-depth, systematic exploration of the data to identify and triangulate findings.

7 See Appendices B and C on sampling, data collection and the qualitative methodology.

3. LITERATURE REVIEW

Rangelands in the Horn of Africa are crucial ecosystems that support pastoralist livelihoods. Yet this traditional production system is increasingly vulnerable due to climate change and compounding historical and contemporary challenges. Among other obstacles, this includes changes in the seasonal distribution of water and forage (Tierney et al., 2015), shifting land tenure systems, land fragmentation (Tsegaye et al., 2013), intensified competition over scarce water and pasture, and the loss of reliability of traditional knowledge (Jiri et al., 2016). In response, a growing body of literature evaluates interventions aimed at improving pastoralist well-being, rangeland management and broader socio-environmental resilience. This report contributes to the evidence base by examining two interconnected interventions in Kenya and Ethiopia designed to address these complex issues.

This study's focus on the AS mobile app highlights the critical role of timely, accurate information for pastoralist migration decisions. Past research has found that climate forecasts have been limited by coarse spatial/temporal scales (Rasmussen et al., 2015; Luseno et al., 2003). Mertz et al. (2016: 974) note a lack of real-time satellite data and suitable distribution methods, further warning that more information could 'lead to increased conflict in some cases if it is not managed or communicated in a way that will avoid too many herds descending on areas that are too limited in size'.

Digital livestock tools are gaining traction, with mobile phones 'entrenched in customary practices of information gathering' and diversified herding (Boas, 2022: 3440). While most digital tools are 'simple' or 'smart', relying on manual data, they are seen as a 'key pillar of agricultural and livestock development' (Daum et al., 2022: 12). A few target pastoralists specifically. Alulu et al. (2024: 1265) show improved forage conditions measured by NDVI, significantly reduced food insecurity, boosted livestock productivity, lower food prices and improved coping strategies, suggesting 'high frequency data has the potential for providing early warning and informing anticipatory action'. Pastoralists prioritise information on pasture, water, markets and disease outbreaks, increasingly supplementing traditional methods with radio and phone (Banerjee et al., 2018).

This impact evaluation is the first in-depth examination of the AS Steward mobile app in real-world pastoralist settings. It builds on Machado et al. (2020), who assessed an earlier paper-map version of AS. The authors show mixed success and 'no causal evidence that map usage affected herd size' due to challenges with the distribution of physical maps. Machado et al. (2020) emphasise the need for real-time, spatially explicit forage information. Our study advances understanding of this need by evaluating the more advanced digital app and the accompanying structured training and support provided by Field Agents, designed to address prior distribution issues and potential problems in understanding. In addition, the quantitative survey included a wider array of outcomes than the previous assessment (e.g., food insecurity, coping mechanisms, conflict), thus allowing us to understand the impacts of the app on households' well-being and other variables like conflict.[8] We also conducted an in-depth qualitative inquiry in treatment areas, which provides additional evidence on the mechanisms through which the intervention has affected households' decisions and

8 This report focuses on primary indicators and related secondary indicators. Interested readers can consult the Impact Evaluation Report prepared for Global Communities (Causal Design, 2025), where we present evidence on all indicators collected.

outcomes. We found evidence of extensive sharing of information from treatment to control areas, which posed unique challenges to the analysis of the results (see section 2). Machado et al. (2020) experienced similar issues.

The second interconnected intervention in our study, AS Regen (providing localised grazing support), focuses on rangeland management practices rooted in the AMP regenerative approach. This aligns with a growing body of literature on regenerative grazing, which advocates for practices that prioritise soil health and adaptive livestock management to improve both human and ecosystem health. These approaches typically involve 'maintaining short periods of intense grazing followed by long rest periods to support the paddock's recovery and build on the relationship between livestock and grassland' (Vivas and Hodbod, 2024: 1).

Proponents of AMP argue that the approach can lead to increased pasture forage production, improved soil organic carbon, reduced soil respiration rates and enhanced climate resilience. A recent review by Khangura et al. (2023) highlights that, while individual regenerative practices show potential for improving soil health, a lack of comprehensive, regionally specific empirical evidence remains a major barrier to widespread adoption – which this study aims to address. Teague and Kreuter (2020: 1) assert that 'farmers and ranchers who apply regenerative management practices to restore ecosystem functionality create sustainable, resilient agroecosystems cost-effectively'. Studies have also linked AMP to improved physical and chemical properties in soil and to positive impacts on biodiversity. Mosier et al. (2022: 2593) find that 'chemical soil properties were improved where AMP grazing management was implemented' and that 'AMP grazing management could be implemented to regenerate several grassland soil properties across land currently under conventional grazing management'. Johnson et al. (2022) further support this, showing that AMP systems promote significant increases in standing crop biomass and soil organic carbon, and that soil carbon dioxide respiration is reduced.

However, much of the existing empirical evidence on AMP grazing focuses on ranching systems in high- and middle-income countries (e.g., US, Canada, Australia). Coppock et al. (2022) conducted a randomised evaluation of a community-based rangeland and cattle management programme in Namibia that is very similar to the present study. The results are mixed: the authors find 'persistent and large improvements for eight of thirteen indices of social and behavioral outcomes' (ibid: 1) related to community resource governance, but they find negative or nil effects on rangeland health, cattle productivity and household economics. They attribute this to factors like communities' inability to control grazing by non-participating herds and an unresponsive rangeland sub-system. This highlights the 'fragility of the causal pathway from program implementation to intended socioeconomic and environmental outcomes' (ibid: 5).

Our study significantly advances this literature, as it is one of the few that examines the impact of regenerative grazing and AMP-style interventions on pastoralists' well-being, livestock health and conflict in the context of a low-income country, namely Ethiopia. Additionally, while AS Regen shares some elements with traditional AMP grazing, it has some unique particularities. Traditionally, AMP is used primarily on small, privately held lands and uses physical fencing to separate the paddocks; AS Regen has adapted that approach for a much larger landscape with no physical fencing around paddocks and a necessity for many hundreds of people and thousands of animals to work in unison (for example, an entire ranch using AMP in the US might be smaller than one of the AS Regen paddocks).

Furthermore, AS Regen was built to support communities to participate within the voluntary carbon market based on the Core Carbon Principles.[9]

Similarly to the Kenyan component, for AS Regen in Ethiopia, our study employs an experimental methodology to generate quantitative evidence on a wide range of variables, including livestock condition measures and well-being indicators, plus conflict and perceptions around agency and resilience. Vivas and Hodbod (2024: 1) specifically highlight that while the 'ecological benefits of [regenerative grazing] have been extensively studied, their impact on farmers' wellbeing remains relatively unexplored but are as critical'. Our qualitative inquiry, integrated within a robust mixed-methods design, describes in detail how AS Regen has led to its observed success, offering rich contextual understanding that complements the quantitative findings. This direct investigation into the socioeconomic and environmental impacts of AMP adapted to a pastoralist setting, coupled with a broad set of outcome variables, contributes significantly to bridging existing knowledge gaps in this crucial area.

9 For more information on those principles see https://icvcm.org/core-carbon-principles/

4. AS Steward IN KENYA: KEY FINDINGS AND ANALYSIS

Quantitative findings are presented in a standardised table for ease of interpretation, including raw means for control and treatment groups, number of observations, treatment effect and p-value (here and in section 5). To summarise:

- Observations (N): The number of data points used for each group's mean and treatment effect, varying by question and respondent eligibility.
- Raw means (not-training/training): The average value for each group. For binary variables (0 or 1), this represents the proportion of households reporting '1', shown as a percentage.
- Treatment effect: The estimated impact of the intervention on a given indicator. Due to the cluster IE design, this may differ from a simple mean difference, especially with fewer observations.

  As discussed above, the treatment effect is a proxy for the difference between households who stated they received training against those who stated they didn't receive training.[10]
- P-value: Indicates the likelihood that the observed effect occurred by chance if the intervention had no real impact. A smaller p-value suggests greater confidence in a real effect. Thresholds for statistical significance are typically: * (10% level), ** (5% level) and *** (1% level).

Key findings

We summarise the findings of the endline study for the primary indicators. These indicators are grouped into: (i) use of AS Steward, (ii) migration outcomes and (iii) herd conditions.

Table 3 presents the treatment effects of the AS Steward training intervention on the primary indicators. As mentioned above, and discussed in more detail in Appendix D, the spillover problems in Kenya mean that the estimated effects cannot be considered definitive causal effects, despite the additional strategies employed to mitigate potential biases.

Overall, we find that pastoralist households who received AS Steward training were significantly more likely to report AS as an important source of migration information. We find some limited evidence that households who received the training migrated to areas where pasture conditions were more favourable. We find no evidence that these results have led to improvements in the conditions of herds belonging to households that received AS Steward training.

10 As alluded to in section 2, due to the spillover issues, comparing households assigned to treatment areas against households assigned to control areas will provide biased results. While not a perfect strategy, comparing households who self-reported that they received AS training (the intervention) against households who did not, provides a better measure of the impact of the intervention (i.e., of AS training).

It is important to preface our discussion of these results with certain caveats:

- **We cannot rule out the possibility that our estimated effects were diluted by the spread of the app's information via word of mouth**. Word of mouth is an important source of migration information among pastoralist households – in our sample, more than 40% of non-trained households reported this. If trained households who use the app share app information with their non-training group peers, this means our estimation methodology underestimates the true impact of AS Steward. We do find (see Appendix D) some suggestive evidence that control households living closer to treatment households were more likely to have used the app and to answer that they received training on how to use the app.

- **It is possible that the app has stronger impacts during periods of poor land quality and drought, which does not characterise the study period**. As presented in Appendix E and mentioned in the Introduction, the two intervention years (2023 and 2024) were periods of particularly good vegetation in the Kenyan study areas, compared to the preceding two dry years. It is possible that AS is most impactful during years with less favourable conditions, when fast and accurate information on grazing conditions is likely to be most valuable. This would limit the external validity of the results.

We briefly describe the results for each category below, before complementing this discussion with some secondary indicators and additional qualitative evidence.[11]

TABLE 3. PRIMARY INDICATORS (AS Steward)

Outcome	Non-trained		Trained			
	Mean	N	Mean	N	Treat. effect	P-value
Use of AS Steward and migration-related indicators						
Percent of pastoralist households for whom AS is an important source of migration information	13.02%	589	64.97%	593	52.07***	0.000
Number of times a household migrated to an area and found insufficient pasture	1.22	550	0.98	557	-0.25	0.127
Percent of households who migrated to areas with a water source available	79.86%	549	83.97%	557	3.83	0.212
Percent of households who migrated to areas where the state of the pasture was transition or graze	77.09%	550	83.57%	557	5.89*	0.055
Average NDVI (standardised deviation) in migration areas	1.00	530	1.03	547	-0.02	0.779
Percent of sheep/goat herd lost during migration	20.87	461	19.83	447	-0.86	0.736
Percent of camel herd lost during migration	18.27	89	14.52	81	-3.17	0.478
Percent of cattle herd lost during migration	23.50	142	16.45	201	-7.06	0.259

11 The IE considered more variables than those presented here. This report focuses on the primary indicators and related secondary indicators. Interested readers can consult the Impact Evaluation Report prepared for Global Communities (Causal Design, 2025), where we present evidence on all indicators.

Outcome	Non-trained		Trained			
	Mean	N	Mean	N	Treat. effect	P-value
Herd conditions						
Percent of pastoralist households for whom the average herd condition improved	67.45%	589	68.53%	593	1.86	0.438
Percent of sheep/goats in good condition	58.00	498	56.95	475	-1.10	0.697
Percent of camels in good condition	67.07	124	62.04	99	-5.46	0.457
Percent of cattle in good condition	59.74	179	60.83	228	1.56	0.632

Source: Authors' own – from study data.

Use of AS: AS Steward training had a large impact on use of the app in migration decisions. Trained households were 52.1 percentage points more likely than non-trained households to identify AS as an important source of migration information.[12] Qualitative data shows that pastoralists hold positive views regarding modern technology tools like AS Steward, feeling that they enhance rather than replace their traditional herding practices. Respondents also expressed high levels of trust in the app's accuracy, which improved their confidence and certainty around their migration decisions.

Migration outcomes: The indicators in this category were intended to capture the outcomes of herd migrations, in terms of the quality of pasture and water access within pastoralists' migration destinations, and the loss of animals during these migrations. Trained pastoralist households were 5.9 percentage points more likely to report migrating to areas with 'transition' or 'graze' state pasture (10% statistical significance). Specifically, the percentage reporting 'graze' pasture (the best type) increased by 15.42 percentage points (5% statistical significance), while those reporting 'transition' pasture (the second best) decreased by 9.24 percentage points (5% statistical significance). Contrary to these results, there is no quantitative evidence of effects on other migration primary indicators, including vegetation quality (as measured by standardised average NDVI), self-reported water source availability in households' migration destinations or the proportion of herds lost during migration.[13] Qualitative data indicates that use of the app leads to migration success by guiding pastoralists to areas with good-quality pasture. This is not entirely at odds with the quantitative findings, given that 83.6% of trained households reported having migrated to areas where the state of the pasture was 'transition' or 'graze'.

Herd condition: Similarly to migration-related outcomes, there is limited quantitative evidence that the AS Steward training has led to substantive impacts on the condition of pastoralists' herds. Among the trained and non-trained groups, similar percentages of households reported that the overall condition of their herd had improved in the last year. Similar average percentages were reported for sheep/goat, camel and cattle herds being in good condition. However, control households were more likely to report that the average condition of their herd deteriorated, by a difference of 3.8 percentage points. Overall, we also find that herd condition was favourable among both groups, which could be attributed to the

12 As mentioned in section 2, these treatment effects are estimated by comparing households that claimed to receive AS training against those that claimed to not receive AS training, with the use of observation re-weighting to make the two groups more comparable and the effects more robust to selection bias.

13 See Appendix E for a detailed explanation of how NDVI-related indicators were constructed, including sample maps depicting NDVI in the same area of Ethiopia for the month of December over 2021–2024.

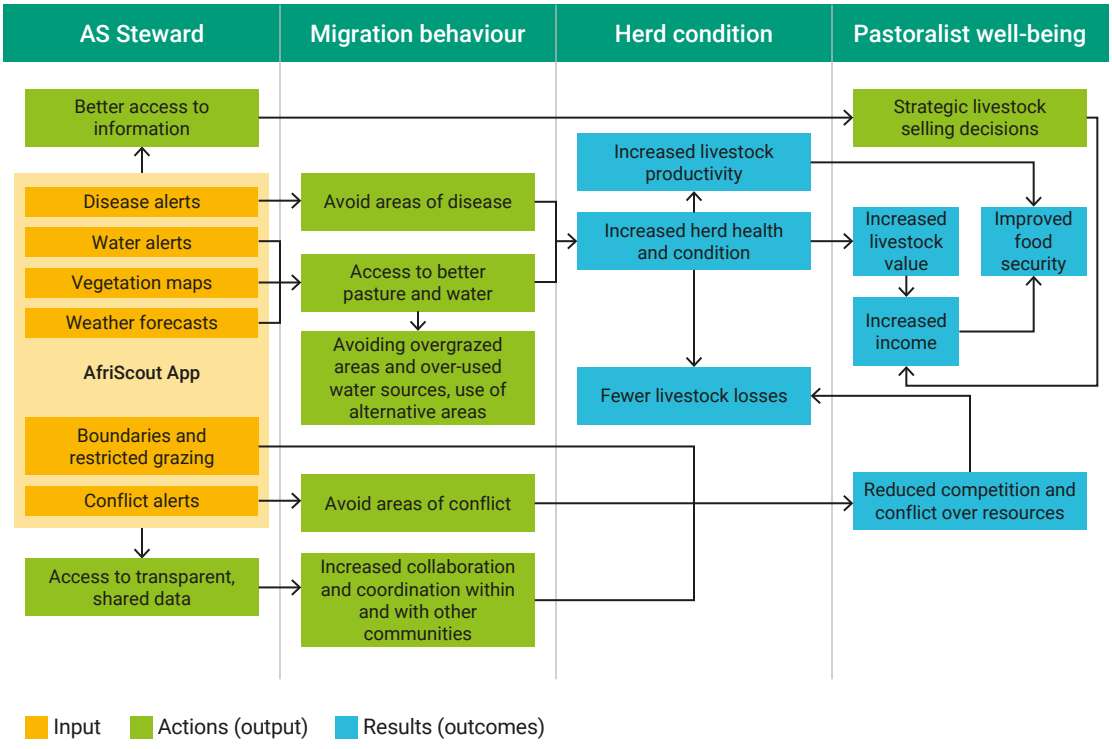
fact that the intervention years were characterised by particularly good rains and vegetation quality. Around 68% of all households reported that the average condition of their herds had improved in the last year, and the average percentage of herds in good condition ranged from 57% to 67% for all three herd types.

Respondents in qualitative interviews frequently cited improvements to the condition of herds since the introduction of AS Steward, brought on by the collective use of the app. These results are consistent with the quantitative finding that 68.5% of trained households reported improvements to their overall herd condition in the last year. However, the lack of a treatment effect when trained households are compared to non-trained ones prevents us from confidently attributing those improvements to the intervention itself.

Analysis of data

Here, we provide detailed analysis of the quantitative and qualitative data that substantiates the key findings. Figure 1 shows a simplified causal chain and the observed impacts of AS Steward on these outcomes. This is based largely on qualitative data, given that the survey findings show few significant results (possibly due to issues of contamination, as explained above). This section explores the evidence in depth, demonstrating the linkages between the intervention's mechanisms and the observed impacts. Our analysis is divided into the three primary indicators presented above, with an additional section discussing the impacts on well-being measures.

FIGURE 1. CAUSAL MECHANISMS OF AS Steward



Source: Authors' own

Use of AS

This subsection focuses on understanding how households who received AS Steward training use the app, rather than comparing households who received training with those who did not.[14] Since the theory of change relies on the training successfully promoting adoption of the app and its different features, we provide key initial insights into the intervention's impacts. We present quantitative and qualitative evidence on app use, organised around four topics: sources of migration information, views on AS, AS features and their benefits, and challenges experienced with using AS.

Sources of migration information: AS Steward was reported to be a very important source of migration information among the training group. Of all households trained in AS Steward use, 65% identified AS as one of their most important sources of migration information. This figure is significantly higher than those for other popular sources of migration information, such as indigenous knowledge (identified by 28% of trained households), scouts (25%) and word of mouth (24%). Section 5.2.2.1 in the full Impact Evaluation Report (Causal Design, 2025) presents further quantitative and qualitative evidence about the impact of AS Steward on pastoralists' sources of migration information.

Qualitative interview respondents echoed this reliance on AS's features to make migration decisions, often in combination with other information sources. Elders and traditional knowledge are valued in particular, due to the elders' experience. One female app user from Wajir explained, '*We use a combination of the AS Steward app, local community meetings, and advice from elders. The app provides up-to-date data, while the elders have experience and traditional knowledge*'. Similarly, some respondents noted that they use AS to verify information from other sources, reducing their reliance on limited or unverified information. In qualitative interviews, respondents frequently felt that decisions made with AS were more informed and data-driven, and they appreciated being able to move away from guesswork or a single source of information. One male app user from Garissa noted, '*Decisions have become more informed and data-driven. We no longer move blindly or depend only on rumours; we use AfriScout to validate information before making big decisions.*'

Views on AS: AS users shared overwhelmingly positive views about the app, citing its reliability and accuracy. Users reported high levels of trust in the accuracy of information from AS, with reliability and time savings being the most commonly cited reasons why a large share of pastoralist households consider AS Steward an important source of migration information. Our quantitative analysis shows an overwhelming majority of trained app users reported that their migration decisions are significantly affected by the app (99.9%), that AS is very accurate or accurate in reflecting conditions on the ground (99.5%), and that AS had become more reliable over the previous 12 months (97.0%). These positive findings are corroborated by qualitative data, where respondents expressed that the information available on the app is accurate, leading to trust in the app as an information source, as well as increased confidence and reduced uncertainty in grazing decisions. A female household decision-maker from Moyale expressed, '*Before, I relied on word of mouth and uncertain advice, which made decision-making stressful. Now, I have accurate information from AfriScout, so I feel more confident. There is less anxiety and better planning for the future.*'

14 The number is relatively low for households who did not receive training (the control group) who answered the questions analysed in this section, since most of them did not use the app.

AS features and their benefits: Vegetation maps, conflict and water alerts, and weather reports were noted to be the most important features of AS Steward that pastoralist households use to guide their migration decisions.[15] Among trained household app users, slightly under 90% identified the ability to observe vegetation conditions among the app features they use the most, followed by the ability to monitor alerts and post alerts. Less than 50% of app users identified the ability to estimate travel distance, to view topographical maps and to look at historical maps among the features they use the most. A large majority of trained household app users (close to 90%) identified disease alerts among the most useful types of alerts, followed by conflict and lack-of-water alerts (over 60% of trained households), and predator alerts (slightly under 60% of trained households). Qualitative data echoes these findings, with most respondents noting the usefulness of vegetation maps, followed by disease and water alerts, and then weather information. Qualitative respondents also mentioned the usefulness of conflict alerts, forbidden grazing alerts and wildlife alerts, though to a lesser degree.

Qualitative data also indicates that these app features are particularly useful for guiding both the location and timing of migration, to ensure livestock have continuous access to sufficient pasture and water. Using these features has been particularly helpful during dry seasons. A female app user from Moyale recalled, '*The weather forecast feature is the most useful for me. It helps me decide when to migrate by giving me information about upcoming rainfall or dry periods. For instance, when AfriScout shows that there will be heavy rains in a particular area, I know it's time to move my herd there. This feature helps me avoid being caught by surprise by harsh weather conditions, which could harm my animals.*'

Weather information has also helped respondents avoid other weather-related hazards. Although the quantitative survey did not ask respondents about their use of weather information, a few qualitative interview respondents commented that weather information is useful to avoid heavy rains or flooding, which could lead to herd losses. A female household decision-maker from Garissa South recalled, '*The weather updates helped me avoid a bad situation. A few months ago, the app showed incoming heavy rains. I delayed my movement, and later, I heard that herders who travelled during that time lost some animals due to flooding.*'

Challenges experienced with using AS: Respondents in the qualitative interviews mentioned some challenges they have experienced when using the app:

- **Information lags:** Some users have experienced delays with real-time information, expressing a desire for more immediate, crowd-sourced updates, especially for rapidly changing vegetation and water conditions. One male app user from Wajir suggested, '*The surface water information is useful, but sometimes it changes quickly due to weather conditions. If there were a way to get real-time updates from other users, it could make the information even more reliable.*' These delays in real-time information updating could be linked to the fact that some alerts must be vetted by Field Agents before being posted, such as those for conflict. Challenges with real-time information lags also link to the fact that users are required to update the app manually every ten days. Field Agents noted that this is a common topic in need of additional training, and a few respondents specifically noted a need for more support on app updates, such as notifications on when to update the app.

15 Towards the end of 2024 AS Steward rolled out a weather forecast feature, which shows temperatures and climatological conditions for several days (this occurred a few months before the endline survey and qualitative interviews).

- **Language challenges:** A few respondents found the app's language too technical and requested simplification. In Moyale, some asked for the app to be available in the Oromo language, which respondents noted was different from Kiborana.

- **Poor functionality in low-network areas:** Across regions, respondents reflected that they sometimes struggle to use the app or load its features in areas with low or no network, such as while migrating in remote grazing areas. As such, several respondents requested increased offline capabilities, or the ability to download vegetation maps in advance. One male app user from Wajir suggested, *'An offline mode would be very helpful, especially for those of us who travel to remote areas with limited network coverage. Being able to access maps and alerts without internet would make the app even more reliable.'*

- **Lack of a structured market feature:** Many users requested the addition of market information, including locations, hours and livestock prices to support their selling decisions. While some ad-hoc market information is posted by users under the 'Other' alerts feature, users felt it should be incorporated in a more structured way.

- **Difficulty navigating the app:** Respondents also identified a need for more training and support to navigate the app's interface and interpret its symbols, which can be especially challenging for older or less tech-savvy users. They suggested solutions like a search bar and in-app video tutorials, and they noted a need for more comprehensive and refresher training. One female app user from Wajir commented, *'Some new users struggle to understand the app, and they need additional follow-ups after the initial training to ensure they can use it properly.'*

Migration outcomes

An important objective of AS Steward is to provide pastoralists with reliable and accurate information on vegetation conditions and hazards. This is so they can make more informed decisions when deciding when and where to migrate and graze their herds. This subsection details the intervention's effects on migration outcomes, drawing from both quantitative survey data and qualitative insights.

Consistent with the overall points highlighted in the Key findings section, we find mixed evidence on the intervention's impact on migration outcomes, with the qualitative analysis providing some insights into how AS Steward might lead to improvements. Trained households were more likely to report migrating to areas with more desirable pasture. This result is driven by a large 15.4 percentage point effect on migration to graze-state pasture (the best kind), with a smaller 9.2 percentage point reduction on migration to transition-state pasture (the second-best kind). We also find suggestive evidence that trained households migrate on average 0.42 fewer times per year than non-trained households (a 13% reduction); and we find no evidence that the AS Steward training has impacted the length of these migrations, in terms of distance or nights away from home.

While we observe no differences in migration length, we do find that trained households have encountered more hazards along the way during their last migration. A higher number of treated households reported encountering instances of disease (a 14.3 percentage point increase from the control group's 32%), conflict (a 4.9 percentage point increase from the control's 12.3%) and areas of forbidden grazing (an 8.5 percentage point increase from the control's 3.0%). Additionally, the two groups were equally likely not to have encountered any hazards, which is the case for approximately 30% of households in both groups. These results are puzzling, since one of the main functionalities of AS Steward is the ability of users and Field Agents to post hazard alerts, which notify other users who might then choose to

avoid those areas. It is important to keep in mind that pastoralists migrate multiple times a year, however, and so evidence for the last migration might not be representative of what they experienced over the past year.

Qualitative data indicates that use of the AS Steward app leads to more successful migrations by guiding pastoralists to areas with good-quality pasture. This finding is partially corroborated by the positive effect we find on migration to graze-state pasture. Many respondents in the qualitative interviews recounted success stories from using the app to migrate to safe, high-quality areas, with subsequent positive effects on herd condition and reduced losses. For example, a male app user in Wajir gave a typical account, *'AfriScout guided my migration decision. I saw on the app that pasture was better in a different area than where I had planned to go. By following the app's information, my animals remained well-fed and healthy.'* Similarly, another male app user, this time from Garissa South, noted using AS to select a migration location based on water availability, finding success: *'We avoided a major herd loss thanks to AfriScout. The app showed us an area with water, while other herders moved to a place that later dried up. Those who didn't use the app struggled, but we had enough water for our cattle.'* The quantitative results show that trained households were indeed more likely to report migrating to areas with a better pasture state, although results on other pasture quality and migration indicators (such as average NDVI and water availability in migration areas) are inconclusive.

AS users also reported that the app has increased migration success by informing their decisions around migration timing. In particular, respondents noted that the app provides them with information to migrate before the pasture is depleted in the dry season, reducing the likelihood of encountering sudden pasture shortages. A female household decision-maker from Wajir recalled, *'One time, I moved earlier than usual because AfriScout showed worsening pasture conditions ahead. Because of that, my herd remained strong while others struggled.'* Similarly, a male app user from Garissa South recounted, *'I've noticed fewer cases of malnutrition, especially during the dry season. Before, we used to move too late when pasture was already depleted, but now we migrate early to avoid starvation.'*

Herd conditions

As an overall pattern, there is a somewhat puzzling mismatch between the quantitative and qualitative evidence on herd condition outcomes. While there is little quantitative evidence of the impacts of the AS Steward training, respondents in the qualitative interviews often mentioned improvements to their livestock's condition due to the app enabling better access to pasture. We offer two explanations for this. One possible reason is that the quantitative results reflect an underestimate of AS Steward's true impact, due to the likely presence of spillovers and control group contamination we have discussed above and discuss in more detail in Appendix D. A second possible explanation is that in the qualitative analysis it is difficult to separate impacts brought on by AS Steward from impacts brought on by better rains and vegetation conditions during the intervention period. This is especially true since we only interviewed respondents in treatment areas and not in control areas. These two points are important to keep in mind when interpreting the results.

Reasons for herd condition improvement: The quantitative and qualitative evidence both point to improved access to better pasture as an important reason for the improvements in livestock condition observed during the study period. Respondents in qualitative interviews frequently commented that their animals are stronger, healthier and fatter. They attributed these changes to use of the app, which allows them to make informed decisions about where to access nutritious grazing and water. Vegetation maps, water information and weather information are considered particularly useful. Two respondents reflected:

'Yes, my cattle are in better condition now. Since using AfriScout, I have been able to move them to areas with better pasture and water, which has improved their strength and milk production.' (Male app user, Garissa South)

'AfriScout guided my migration decision. I saw on the app that pasture was better in a different area than where I had planned to go. By following the app's information, my animals remained well-fed and healthy.' (Male app user, Wajir)

Among households reporting that herd condition had improved over the last year, more than 90% identified better pasture as a primary reason for this improvement. Improvements in water source availability were cited by over 60% of those households that reported herd condition improvements. Additionally, non-trained households were more likely than trained ones to identify reductions in animal disease as a primary reason for herd condition improvement (by 4 percentage points), while trained households were 7.1 percentage points more likely to identify more accurate maps as a primary reason.

Qualitative interview respondents also noted that herd conditions have been positively influenced by reducing unnecessary migrations, informed by app data. Reductions in excess migration reduces stress, exhaustion and injuries for animals, such as foot infections. A male app user from Garissa South expressed, *'The condition of my herd improved because I no longer move them unnecessarily. Over-migration used to make them weak, but now I move only when it's necessary and to the right areas.'* This finding is consistent with suggestive evidence (significant at the 10% statistical significance level) that trained households migrated on average 0.42 times fewer than control households, which represents a reduction of 13% compared to the control group average of 3.23 migrations per year.

Effects on herd size and value: The quantitative findings show no evidence of significant impacts on overall herd size and herd value from the AS Steward training. Average herd sizes, measured in tropical livestock units (TLU), and the average total monetary value of the herd are similar for trained households and non-trained households. Treatment effects are not statistically significant. When broken down by animal, lower percentages of trained households own camels and sheep/goats, which is counteracted by a higher (yet not statistically significant) percentage of trained households owning cattle. Relatedly, trained households have camel and sheep/goat herds of lower monetary value on average than control households, but they also have cattle herds of higher value on average.

In contrast, qualitative respondents credited the app with reducing losses and preserving herd condition by facilitating migration success during the dry season. Many respondents reported that the information on areas with available pasture and water is critical for making migration decisions during this period. Respondents cited vegetation information on the app as valuable for maintaining herd health and preventing losses from hunger and thirst during the dry season. Some respondents noted:

'I rely on vegetation maps, especially during dry seasons. They help me find green areas where my animals can graze, reducing the risk of losing livestock due to hunger.' (Male app user, Wajir)

'I first started using AfriScout two years ago when my brother recommended it. At first, I was unsure, but now I can't imagine managing my livestock without it. It has really helped in reducing losses during dry seasons.' (Female app user, Garissa South)

Effects on livestock disease and prevention: The quantitative analysis shows no evidence of differences in the mortality rates of herds owned by trained and non-trained households, across all animal types. However, the most common causes of death do differ by animal type and whether households received AS training: among cattle and camel owners who had a death in their herd, trained pastoralist households were, respectively, 12.6 and 19.9 percentage points more likely than control households to identify disease as a cause of death. Trained camel-owning households were also 24.9 percentage points more likely to identify predators as a cause of death among their herds.

Nonetheless, qualitative data indicates that the app's disease alerts allow respondents to be informed about outbreaks and take preventative measures to avoid exposure. Many respondents reported frequently checking disease alerts on the app to remain updated on outbreaks. While respondents acknowledged that the app may not directly prevent incidents of disease, it is effective in reducing the spread of disease by allowing pastoralists to take proactive, preventative measures to avoid disease outbreaks in their own herds. The most common preventive measure is to avoid areas where diseases have been reported. As one male app user from Wajir recalled, *'The app helped me avoid a disease outbreak. I saw an alert about livestock disease in a nearby region and decided to keep my herd away. Later, I heard that many animals in that area became sick, so I was grateful for the warning.'*

Some users reported using disease alerts to plan vaccinations and other preventative veterinary care measures to prevent outbreaks. Respondents explained:

> *'The app helps me plan vaccinations. If I know in advance that I will be moving to a certain area, I ensure my animals are vaccinated against common diseases in that region.'* (Male app user, Garissa South)

> *'Whenever I get a disease alert, I take precautionary measures like purchasing drugs for the said disease so that if the disease reaches our region by bad luck, I vaccinate my livestock.'* (Male household decision-maker, Isiolo)

A few qualitative respondents indicated that access to veterinary services could remain a challenge due to cost, although the quantitative analysis shows high uptake of vaccinations overall. Though qualitative respondents did not elaborate on access challenges in detail, a few noted that poor access to veterinary services could limit pastoralists' ability to take preventative measures in response to disease alerts. One male household decision-maker from Moyale stated, *'AfriScout is a great tool for tracking grazing conditions, but it needs to be combined with veterinary programmes to have a real impact on disease prevention.'* Despite this finding, results from the quantitative survey show that vaccination is still one of the most widely used preventative care measures implemented by pastoralist households. Around 90% of pastoralists use vaccinations for all animal types, including sheep/goats, cattle and camels. We also find no evidence that vaccination use rates differ between trained and non-trained households. Use of dipping is significantly lower among trained households, however, by 19.5 percentage points among sheep/goat owners, 9.8 percentage points among cattle owners and 36 percentage points among camel owners. A possible explanation is that trained households might rely more on avoiding areas with parasite outbreaks rather than dipping, although we cannot corroborate this with quantitative or qualitative data.

In addition to disease alerts, AS might also prevent disease through other measures, according to qualitative interview respondents. For example, some users noted that AS helps them prevent disease in their herd through avoiding contaminated water points. One female household decision-maker from Wajir recalled, *'I used AfriScout to guide my herd away from a water source that had been contaminated. A few weeks later, I heard that other herders who used that source had lost some animals due to illness.'* AS has also allowed users to find alternative grazing areas and avoid congestion or overcrowding, which could lead to disease. A male household decision-maker from Garissa South explained, *'When we see too many herders moving to one area, we avoid it to prevent diseases that spread easily when livestock are crowded.'* Finally, respondents also attributed reduced disease to better conditions and nutrition overall, which improves resistance to diseases.

Effects on livestock productivity: Milk productivity was higher for the sheep and goat herds of households who received AS training versus those who had not. The value of milk produced by sheep/goats per day was greater in trained households than non-trained ones – 149 Kenyan shillings (KES) per day higher during the dry season and 257 KES per day higher during the rainy season.

Echoing the quantitative data, the qualitative data indicates that AS use leads to increased livestock productivity due to access to better pasture and improved herd health. Some respondents noted that milk production had increased, leading to knock-on effects on household income and food security (discussed further in the next subsection on Well-being). A few respondents also observed positive impacts on breeding and reproduction, which they attributed to livestock being in better condition due to accessing better pasture. For example, one female household decision-maker from Wajir recalled, *'I've noticed that my goats and sheep produce more offspring. I think this is because they're healthier and less stressed, thanks to better grazing management.'* Similarly, a male app user from Garissa South noted, *'My animals are stronger and more productive. With AfriScout, I can make better decisions about grazing locations, which has reduced weight loss and increased calving rates.'* One male household decision-maker from Wajir reported using AS information to time his breeding decisions: *'If pasture conditions are poor, I delay breeding to ensure our animals have enough nutrition to stay healthy.'*

Well-being

AS Steward's theory of change hypothesises that improvements in migration outcomes and herd conditions will lead to enhanced pastoralist well-being overall. In prior sections, we have presented mixed and inconclusive results on the impact of AS Steward training on migration outcomes and herd conditions. This section focuses on the impacts of training across financial, non-financial and subjective dimensions of well-being.

Financial well-being: Qualitative data indicates that AS can lead to increases in household income in multiple ways, although this finding is not corroborated by our quantitative analysis. Households' ability to sell livestock at higher prices due to improvements in their physical condition was one of the most cited explanations given by respondents. A male app user from Wajir expressed, *'With healthier livestock, I have more bargaining power when selling animals, helping me afford school fees and other family expenses'.* A male household decision-maker from Isiolo noted he was able to sell fewer animals, as a result of getting better prices for them: *'Changes on my herd was a good one. I can sell my herds at good market price that I can even pay school fees for my kid, not like before where I had to sell more goats.'* However, these findings are not borne out in the quantitative analysis. In previous sections we have presented quantitative results that show no evidence of significant

differences between trained and non-trained households in terms of the proportion of herds in good condition, average herd size or average total herd value.

Increased milk and meat production from improved herd condition has also contributed to higher income for some households, for which we find some supporting evidence in our quantitative analysis. This finding was voiced by proportionally more women than men, likely reflecting the fact that women are responsible for selling milk in households. A female app user from Moyale stated, *'The app has had a positive impact on my income. By improving the health of my herd, I've been able to produce more milk and meat, which I sell for extra income. This has helped with financial security, and I'm able to cover household needs more easily.'* This is partially corroborated by results presented above, which show that average daily milk production values were higher for the sheep and goat herds of households who received AS Steward training.

Respondents reported that app information is useful for making strategic livestock-selling decisions, thereby maximising profits on livestock sales. They use information on vegetation, weather and market information in particular to inform the timing of livestock-selling decisions. This has allowed pastoralists to sell more strategically to maximise profits. For example, a male household decision-maker from Moyale explained, *'[the app] doesn't directly tell me when to sell, but it gives me information that influences my decisions. If I know there will be good grazing in a certain area, I can wait to sell until my livestock are in better condition and prices are higher.'*

Non-financial well-being: The qualitative and quantitative analyses show moderate and positive impacts of AS Steward training on household resilience and the ability to plan ahead. We find a small and statistically significant improvement in resilience (a 0.04 point increase from a non-trained mean of 0.59). Qualitative respondents also noted reduced stress from being able to plan better and from lower uncertainty due to the app's functionality. These respondents felt increased confidence and a greater sense of control regarding decisions around livestock and migration, which they attributed to having reliable, accurate data provided by AS. A female app user from Garissa South expressed, *'AfriScout has given us confidence in decision-making. Before, we relied on guesswork, but now we make informed choices, which has reduced anxiety and uncertainty.'* The app also reduced stress by enabling users to avoid last-minute decisions and uncertainty about finding resources. A male household decision-maker, also from Garissa South, explained, *'The stress of not knowing where to find food for my livestock has reduced. I feel more in control of my life.'*

Qualitative data suggests that the app has led to some improvements in food security, though this finding is not reflected to a strong degree in our quantitative findings. Respondents in qualitative interviews commented that using AS has led to increased milk and meat production for household consumption, as well as increased income to spend on food needs. This sentiment was raised by a female app user from Moyale, who noted, *'The app has helped me increase the productivity of my herd. With healthier animals, I've been able to get more milk and meat, which helps feed my family and sell for income. This has made it easier to meet other household expenses as well.'* Similarly, a male app user from Garissa South reflected, *'My family's diet has improved. Since my livestock are healthier, we have more milk and even some extra to sell, which gives us money to buy other foods.'*

These findings on improved milk consumption are to some degree corroborated by the quantitative evidence, such as the findings that sheep and goat milk production increased as a result of AS Steward training and that more trained households consume dairy products (by 7.3 percentage points, although this result is not statistically significant). Although it is

possible that the intervention has led to improvements in dairy consumption, we find limited evidence that it has improved overall food consumption. In the quantitative analysis, we find quite a small and statistically insignificant treatment effect on food consumption scores, and no significant differences in the types of food groups eaten during the past seven days by trained households and non-trained ones.

Views on pastoralism: While many qualitative respondents reported that their views on pastoralism as a livelihood have changed positively as a result of AS, this finding is not entirely corroborated by the quantitative data. Our analysis shows that 70% of study households reported having optimistic views on pastoralism, but there is no evidence of significantly greater optimism among trained households than non-trained ones. Nonetheless, we do find a large impact – of 16 percentage points – on the share of households who felt they have significant influence over their own well-being.

Qualitative data indicates that the app has significantly influenced and reshaped pastoralists' views of pastoral livelihoods. Before using the app, pastoralism was often seen as a traditional practice heavily reliant on unpredictable environmental factors and with limited economic prospects. However, the introduction of AS has brought about a transformative shift in this perception, according to these FGD participants.

A key reason mentioned by qualitative respondents for their greater optimism is pastoralists' increased confidence in making decisions related to livestock. By having access to robust information through the app, respondents felt they rely less on guesswork and make more informed choices, which leads to positive outcomes for herds and household well-being. For example, a male app user from Wajir expressed, '*The app gives me confidence in decision-making. Instead of guessing where there might be grass, I can look at the vegetation maps and take my cattle to the best available grazing land.*' Similarly, respondents were optimistic about the outcomes of managing their herds using AS. A female app user from Moyale stated, '*It's still early, but I believe AfriScout will help me save money. The better health management has led to fewer sicknesses in my herd, which has reduced vet bills. It also makes me feel more confident in managing my finances by preventing costly mistakes.*'

Respondents were also positive about their ability to adapt to future challenges and enhanced resilience as a result of the app. Respondents reflected that AS has shown them how pastoralism could be enhanced and modernised through technology. Respondents acknowledged the difficulties posed by climate change and competition over resources, but they felt that the app could help them overcome such challenges and turn pastoralism into a more sustainable, efficient and even profitable livelihood. A female app user from Garissa South expressed, *'My views have changed. Before, I thought pastoralism was becoming too risky due to climate change and resource conflicts. But with AfriScout, I see that technology can help us adapt and make better decisions, making pastoralism more sustainable.'*

5. AS Regen IN ETHIOPIA: KEY FINDINGS AND ANALYSIS

Key findings

Here, we present the findings of the endline study for the primary indicators. These indicators are grouped into: (i) rangeland management capacities and behaviour changes, (ii) rangeland conditions and (iii) herd conditions.[16]

Table 4 presents the treatment effect of the AS Regen intervention on the primary indicators. **Overall, AS Regen has had a large and statistically significant impact on all three categories of primary indicator. Our findings demonstrate that AS Regen has a high potential to improve how pastoralists manage and derive livelihood benefits from their rangelands**. We briefly describe the results for each category below, before complementing this discussion with secondary indicators and additional qualitative evidence.

TABLE 4. PRIMARY INDICATORS (AS Regen)

Outcome	Control		Treatment			
	Mean	N	Mean	N	Treat. effect	P-value
Rangeland management capacities and behaviour changes						
				650	90.62***	0.00 †
Percent of households that do something to improve the quality of the grass in their area	14.03%	670	96.46%	650	83.45***	0.00 †
Percent of households that feel very confident or confident that their community is able to manage rangelands and rangeland conditions	11.79%	670	89.69%	650	79.70***	0.00 †
Rangeland conditions						
Percent of households that are very satisfied or satisfied with the quality of the pasture and grass in the areas they have access to for their livestock	15.82%	670	96.77%	650	82.68***	0.00 †
Average NDVI in a radius of 10 km around the household's home (rainy season, June–August 2024)	1.45	670	1.46	650	0.06	0.36
Average NDVI in a radius of 10 km around the household's home (dry season, December 2024–February 2025)	0.10	670	0.04	650	-0.01	0.79
Herd conditions						

16 This report focuses on the primary indicators and related secondary indicators. Interested readers can consult the Impact Evaluation Report prepared for Global Communities (Causal Design, 2025), where we present evidence on all the indicators collected.

Outcome	Control		Treatment			
	Mean	N	Mean	N	Treat. effect	P-value
Percent of pastoralist households for whom the average herd condition improved over the last year	22.24%	670	92.00%	650	70.94***	0.00 †
Percent of sheep/goats in good condition	28.25%	558	60.67%	584	33.90***	0.00 †
Percent of camels in good condition	33.51%	102	68.16%	168	38.43***	0.00 †
Percent of cattle in good condition	21.40%	394	65.97%	491	44.30***	0.00 †

Note: † Baseline value of the outcome variable available.

Source: Authors' own

Rangeland management capacities and behaviour changes: AS Regen has had a very large impact on the indicators in this category. Households in treatment areas were 90.6 percentage points more likely to have a shared grazing plan[17] and 83.5 percentage points more likely to have implemented any actions to improve the quality of the grass in their area. The large and significant impact on these indicators shows the success of AS Regen in inducing specific changes in household and community behaviour. As a result of the actions undertaken by pastoralists and the greater emphasis on community behaviour, treatment households were almost 80 percentage points more likely than control households to feel very confident or confident that their community can manage rangeland and rangeland conditions.

The qualitative data also shows significant change in rangeland management and grazing practices, illustrating a high uptake of AS Regen's hands-on grazing planning advice. Awareness of RGU plans is high, as is adherence to grazing plans. Respondents attributed adherence to both leadership and enforcement by the RGU committee, as well as positive outcomes seen from the plans, which motivates adherence.

Rangeland conditions: Two indicators were used to capture impacts on rangeland conditions: (i) household satisfaction with the quality of the pasture and grass they access for their livestock, and (ii) average vegetation quality (NDVI) in a 10 km radius around the home.[18] The results for the first indicator are very positive: households in treatment areas were 82.7 percentage points more likely to be very satisfied or satisfied with the quality of the pasture compared to households in control areas.

For the second indicator,[19] we do not observe any meaningful differences between treatment and control households. This is puzzling, given the positive results in the level of satisfaction of treatment households with the quality of the pasture, the positive results on the herd condition (discussed in the next category) and qualitative field evidence. An important caveat of using average NDVI around a household's home is that this does not necessarily capture the areas

17 Respondents described shared grazing plans as a plan developed jointly by all community members (or their representatives) that is implemented together and enforced by some person/people. This is similar to traditional grazing approaches some 50 years ago. This is not to be confused with the general practice of grazing in a given area during the wet season and in another area during the dry season.

18 Causal Design selected this radius in consultation with AS. It was considered large enough to capture a significant proportion of the areas pastoralists move their animals to and small enough to not lead to significant overlap with other study communities. Robustness checks with a radius of 5 km and 20 km showed similar results as those for 10 km.

19 We used measures during the rainy season and the dry season to capture the average conditions of the pasture around the area where households live. In additional exercises (not presented in this report) we considered smaller and larger radiuses, arriving at similar results. Appendix E details how NDVI-related indicators were constructed.

where households move their herd for pasture. In the case of treatment areas (and as part of AS Regen guidance), households are instructed to move their herd to areas specifically defined within their RGU, which in many cases are not the same as the radius measures used. Given these complications, an important limitation of the IE is that we cannot judge if AS Regen has led to an improvement or deterioration in the pasture conditions in the areas where households move their herds close to their homes, as *measured by NDVI values*.[20] Future studies of interventions similar to AS Regen may consider analysis at the grazing plan level instead (i.e., the entire area each community divides into paddocks), with corresponding placebo areas for control units. Additionally, Appendix E highlights some limitations inherent to using NDVI data in regions with sparse vegetation.

The evidence from the qualitative interviews further shows a high degree of satisfaction with pasture quality among members of treatment communities. Respondents in most interviews noted improvements in grass availability and quality. Many respondents also noted that these improvements are due to enhanced rangeland management practices, such as community-wide adherence to a shared grazing plan.

Herd conditions: Our analysis shows that the condition of the herd is much better for treatment households compared to their control counterparts. Treatment households were 70.9 percentage points more likely to think that the overall condition of their herd had improved over the past year compared with control households. This perception of improvement is corroborated by the share of animals considered to be in good condition. For all three herd types, a higher share was considered to be in good condition[21] in treatment areas compared with control areas. The largest impact is seen for cattle: the herd for treatment households was 44.3 percentage points more likely to be in good condition compared with the herd for control households. For camels and sheep/goats, the differences are slightly lower but still sizable (38.4 and 33.9 percentage points, respectively). These positive results are closely associated with positive results in related secondary indicators, like the value and size of the herd, and milk production (see our analysis under Herd conditions below).

The FGDs provided similar results. Respondents reported significant improvements in livestock health, condition and productivity from better access to pasture brought about by AS Regen. Most respondents consistently linked observed improvements in herd condition to better access to pasture and the effectiveness of planned grazing. Respondents also frequently noted improvements in livestock milk and meat production and quality, as well as increased livestock reproduction rates.

Analysis of data

Here we build on the key findings, providing detailed analysis of the quantitative and qualitative data. Figure 2 shows the causal chains and observed impacts of AS Regen on outcomes, based on qualitative and quantitative data. This section provides a more in-depth exploration of the evidence across these crucial areas, demonstrating the linkages between the intervention's mechanisms and the observed impacts. Our analysis is divided into the three categories of primary indicators, with an additional subsection discussing the impacts on well-being measures.

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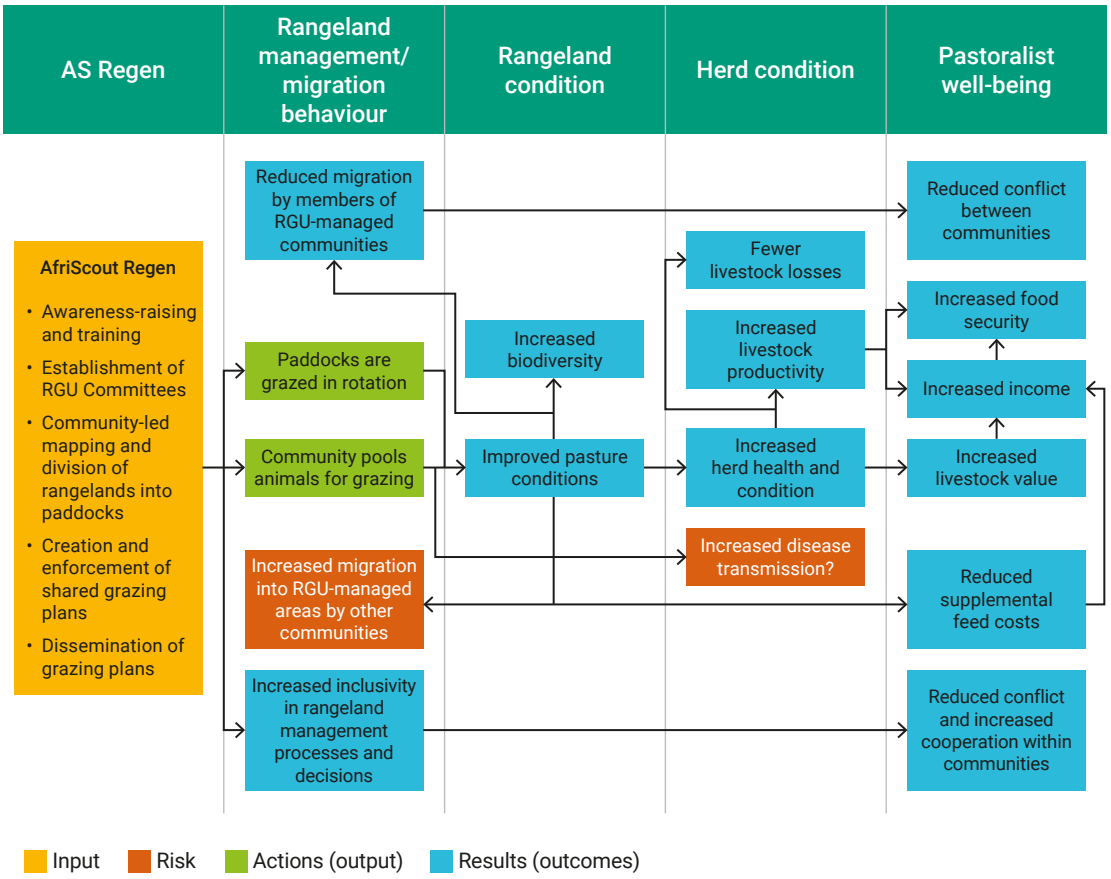
20 To obtain a causal estimate of the impact of AS Regen on NDVI in the areas where households keep their herds, at the very least we would have needed to ask each household/community the specific location where they move their herd to pasture. This would be time consuming and complicated.

21 Households were asked to determine how many of their animals were in good, moderate and poor condition. In each case households were shown pictures of animals.

FIGURE 2. CAUSAL MECHANISMS OF AS Regen



Source: Authors' own

Rangeland management capacities and behaviour changes

An important objective of AS Regen is to encourage collective decision-making, to incentivise households to design and follow specific grazing plans, and to provide them with the tools to effectively follow AMP livestock practices. We describe the significant changes induced by AS Regen in rangeland management and grazing behaviour, drawing from both quantitative survey data and qualitative insights.

Grazing plans: AS Regen has been highly successful in establishing and promoting adherence to shared grazing plans within communities. Households in treatment areas were overwhelmingly more likely to have and use the shared grazing plan (98%) versus control areas (8.06%). This uptake signifies a fundamental shift in grazing management practices, moving away from more traditional or individualistic approaches.

Qualitative data strongly supports this high uptake of AS Regen's hands-on grazing planning advice. Awareness of RGU plans and adherence to grazing plans were consistently reported as high. Respondents attributed this adherence to strong leadership and enforcement by RGU committees and the tangible positive outcomes observed from following the plans. RGU committee members actively oversee implementation and enforce bylaws through awareness-raising, regular monitoring and penalties, which typically range from 1,000 to 1,500 Ethiopian Birr (ETB) for violations. A male household decision-maker from Golbo noted, *'We had some discussion in the past but there was a lack of enforcing that agreement. This project supports the idea with enforcing body including formal and informal management system. Therefore, there is system of enforcement of the bylaws.'* The effectiveness of these enforcement

mechanisms in ensuring adherence is evident. One respondent stated, *'Once punished, people protect their livestock from the prohibited area effectively.'*

Beyond enforcement, adherence is also significantly motivated by increased knowledge of pasture management and the positive outcomes experienced. Respondents reflected at length on the benefits of plans, including improved pasture availability and livestock productivity, which in turn motivates continued adherence. A Kebele Chair from Filtu summarised this: *'Communities have been following up the plan because they have seen the importance of paddock-based grazing. With paddock grazing we have access to pasture the whole year and we migrate less. Our livestock body condition, milk and butter yield and market value substantially improved. As pastoralists we are relieved of usual worries, migration and livestock death.'*

Collective decision-making: AS Regen has facilitated a shift from individual to collective decision-making on livestock movement and grazing. Quantitative results demonstrate that treatment households were 41.44 percentage points more likely than control households to live in communities where decisions around migration and grazing are made collectively. Conversely, they were 39.30 percentage points less likely to make such decisions individually.[22] This highlights an important transformation in governance.

Qualitative data further confirms this paradigm shift. Prior to AS Regen, individual households made migration decisions, often guided by broad rules from elders. However, under the current RGU management system, grazing decisions are made in accordance with collectively agreed plans, led by RGU committees. A male household decision-maker from Wayama explained, *'We had no collective decision before this project. Decisions on when and how to migrate used to be made by every individual. After this project we started to have collective decisions. RGU management works on decisions related to where and when to graze in consultation with community.'*

This collective decision-making process has also fostered more inclusive participation. Treatment households reported a significantly higher sense of influence over rangeland management and condition decisions in their community (90.77% vs 37.16% in control areas). Qualitative data supports this – respondents noted that while RGU committees lead decisions, they actively seek input from various stakeholders including the general community through community meetings. Critically, both male and female respondents acknowledged increased participation among women and youth in decision-making and awareness-raising efforts. The inclusion of youth, for instance, has helped demonstrate the long-term deterioration of rangelands, fostering greater buy-in for the programme's protective measures. However, some cultural norms present challenges to full participation, particularly for women and youth, suggesting an area for further investigation.

Interaction with other communities: AS Regen has led to changes in how treatment communities interact with neighbouring communities. Qualitative evidence indicates increased collaboration, including sharing project ideas and learnings to spread the benefits of AS Regen. A Field Agent from Golbo stated, *'Some community members have shared the idea of this project to the neighbouring kebeles and become the ambassador of AfriScout Regen project.'*

Yet the success of RGU-managed rangelands in improving pasture quality has created challenges too: attracting pastoralists from surrounding kebeles, particularly during the dry season, has sometimes led to disruptions to grazing plans. RGUs have generally shown willingness to accommodate migrating pastoralists, however, provided that they adhere

22 Both results are statistically significant at a 1% Type I error level.

to the established grazing plans. Disputes have largely been resolved peacefully through collaboration and awareness-raising. This ongoing challenge has led some respondents to recommend the expansion of AS Regen to other communities, recognising the shared nature of rangelands and the need for widespread adoption for long-term sustainability. A Kebele Chair from Wayama articulated, *'We cannot fully protect other communities from entering our paddocks. Therefore, I recommend this project should be expanded to the other kebeles for the sustainability of this programme. This is because their problem is our problem, and our problem is their problem.'*

Capacity-building: AS Regen has significantly enhanced the technical knowledge and understanding of rangeland management within the community, fostering a higher sense of confidence in their ability to manage rangelands. The quantitative survey indicates that close to 90% of treatment households feel confident or very confident in their community's rangeland management capabilities (see Table 4). This increased confidence is partly driven by community engagement and inclusivity in plan construction, but also by the technical knowledge provided by AS Regen. Almost all treatment households reported that they find the regular guidance from RGU management easy to understand and highly useful.

Qualitative interviews corroborate this, with community members reporting significant learning about rangeland management and the benefits of RGU grazing plans. Technical knowledge gained includes understanding carbon accumulation, grass maturation, water infiltration and soil fertility. A male household decision-maker from Gomole shared their understanding: *'Grass is ready to graze when it grows and flowers … If you graze before flowering, no seed bank and the species will disappear.'* This enhanced capacity has notably improved resilience, particularly in facing dry seasons, with respondents indicating reduced livestock losses due to starvation and dehydration. A male Rangeland Representative from Gomole stated, *'Previously, during the dry season, livestock would die. Now, even during the dry season, the livestock can survive.'* However, water access challenges have remained a limitation for some communities, which is beyond the current scope of the intervention.

Rangeland conditions

There have been important changes in the way decisions around rangeland management and grazing are made, which households view as positive and necessary to improve pasture conditions. Many more households in treatment areas are satisfied or very satisfied (by 82.7 percentage points) with the quality of the pasture compared with their control counterparts, and they feel much more confident in their community's ability to effectively manage the rangelands (by 78.7 percentage points).

Respondents in qualitative interviews consistently reported improvements in pasture quality and availability from AS Regen. This confirms the quantitative evidence of the intervention's effect on household satisfaction with pasture quality. Most interviewees noted that implementation of the project has increased the availability and quality of grass, the regeneration of degraded lands and the revival of various grass species. A female herder from Wayama noted: *'That plan has helped in restoring grasses everywhere in our kebele, including the area around the village and on the field farther from the village.'*

Respondents frequently attributed these improvements in pasture conditions to enhanced rangeland management practices like rotational grazing, and to increased collective decision-making. They noted that pasture can rest and recover, preventing its degradation. A male household decision-maker from Hammer explained: *'Grazing is done tidy within the identified paddocks, adhering to allocated days per paddocks, thus grazing land gets rest*

and regenerates good pasture, there is no over-grazing'. A female household decision-maker from Filtu stressed the importance of collective decision-making and the RGU committee's oversight in improving pasture conditions: *'Previously the community seldom discussed, but now we discuss and make joint decisions and the decisions are monitored by the RGU committee and community leaders. This approach helps us manage our grazing and we are able to get good pasture even during dry seasons.'*

Improvements in pasture quality and availability have prompted the return of several wildlife species that had disappeared from communities due to drought conditions and land degradation. Most interviewees noted the return of various wild flora and fauna following the implementation of the grazing plans and improvements in pasture conditions. Respondents noted that gazelles, zebras, kudus, oryx, and dik-dik had returned, with a few mentioning predators like cheetahs and lions. A female herder from Golbo commented: *'Zebras were not in our kebele before this project. Our children had never seen zebras before this project. But now there are zebras in our kebele. Children had no idea when they first saw a zebra. They said, "We have seen colourful wild animals in the grazing area". Due to the improvement of rangelands, we are expecting many more wild animals.'*

Herd conditions

AS Regen has led to substantial improvements in herd conditions, which is a critical outcome for pastoralist livelihoods. Treatment households overwhelmingly reported better overall herd health and condition compared to control households. This was visually evident in the higher proportion of animals in good condition across cattle, camels and sheep/goats in treatment areas, with cattle showing the most pronounced gains.

Reasons for herd condition improvements: The quantitative and qualitative evidence consistently points to improved pasture quality as the primary driver of enhanced herd condition. Among treatment households reporting improved herd condition, over 90% cited better pasture as an important reason. This is supported by quantitative data showing that control households reported pasture shortage as a cause of death for sheep/goats (43.12% vs 14.68% in treatment areas) and cattle (64.46% vs 17.51% in treatment areas). Qualitative interviews consistently linked better herd condition to improved access to pasture and the effectiveness of planned grazing. A female herder from Dirre noted, *'Previously we didn't have pasture, and livestock were weak and lacked meat and milk. But now we learned and plan and save pasture and get milk, butter, and meat. Our livestock are in a good condition, and we too are in a good condition.'*

While corroborated less explicitly by qualitative data, the quantitative findings also suggest that better water access may have contributed to improved herd condition – nearly 70% of treatment households cited an increase in water sources as a reason for better herd condition. Furthermore, the implementation of preventative animal care measures (e.g., vaccinations, deworming and dipping) was significantly higher in treatment areas for cattle and also shows positive impacts for sheep/goats and camels. Although AS Regen was not designed to provide these services, these downstream impacts might stem from increased collective decision-making and information sharing, or from higher livestock income that has enabled access to such services.

Effects on herd size, value and productivity: The positive impact on herd condition has translated directly into substantial increases in herd size and monetary value (Table 5). Treatment households reported increased ownership of cattle and camels (by 16.08 and 9.78 percentage points, respectively). The average herd size, measured in TLU, was

significantly larger in treatment areas (16.11 TLU vs 10.11 TLU in control areas), representing a 57% increase over control values. This growth, combined with better animal condition, has resulted in a considerably higher monetary value of the herd in treatment areas, averaging 384,497 ETB more than in control areas (which is over 100% of the control group's average herd value). This increased value has been driven both by larger herd sizes and the significantly higher prices fetched by animals in good condition (e.g., cattle in good condition are 3.6 times more valuable than those in poor condition).

TABLE 5. PERCENT OF HOUSEHOLDS OWNING DIFFERENT ANIMALS, HERD SIZE (TLU) AND VALUE OF THE HERD (ETB)

Outcome	Control		Treatment			
	Mean	N	Mean	N	Treat. effect	P-value
Percent of households owning cattle	62.39%	670	79.08%	650	16.08***	0.00 †
Percent of households owning camels	15.22%	670	25.85%	650	9.78***	0.00 †
Percent of households owning sheep/goats	86.12%	670	92.46%	650	-0.00	0.00 †
Average herd size (TLU)	10.11	669	16.11	649	5.83***	0.00
Average monetary value of the herd (ETB)	339,517	636	726,281	624	384,497***	0.00

Note: † Baseline value of the outcome variable available.

Source: Authors' own

Improvements in herd productivity were also widely reported and quantitatively supported. Qualitative FGD evidence consistently indicates increases in the quantity and quality of meat production, as well as significant increases in milk production and quality. This links directly to improved livestock nutrition and health. Quantitative data on milk productivity corroborates this: for instance, the average milk per animal per day during the dry season increased for cattle by 0.11 litres ($p < 0.001$) and for sheep/goats by 0.06 litres ($p < 0.001$). Total milk produced per day and the monetary value of milk produced also increased significantly across different herd types and seasons in treatment areas. For example, the total value of milk produced per day during the rainy season for cattle was 122.63 ETB higher in treatment areas than control areas ($p < 0.01$).

The overall impact on disease prevalence has been mixed. Some qualitative evidence shows concerns about pooled grazing, yet several respondents indicated improved livestock health and reduced disease incidence, partly due to controlled grazing limiting exposure to outbreaks in other areas. The average mortality rate for cattle was 6.83 percentage points lower in treatment areas than control areas ($p < 0.001$). Furthermore, the shortage of water as a cause of death for sheep/goats and cattle was significantly lower in treatment areas than control areas (by 9.60 and 11.87 percentage points, respectively).

Well-being

As depicted in Figure 2, improvements in rangeland conditions and herd health driven by AS Regen are hypothesised to lead to enhanced pastoralist well-being overall. The findings strongly corroborate this causal pathway, demonstrating significant positive impacts across financial, non-financial and subjective dimensions of well-being.

Financial well-being: Pastoralism is the main livelihood for around 80% of households in the study (agro-pastoralism accounts for the remaining 20%). In addition, the sale of livestock is

the most important source of income for around 84% of households and own-production is the most important source of income for 74% of households. Thus, the improved livestock condition and productivity described in previous paragraphs has translated directly into substantial improvements in households' financial well-being.

Even though the quantitative survey did not include an income module, it is to be expected that higher-value livestock assets and higher milk production have led to higher incomes. Larger herd sizes and a higher proportion of animals in better condition should have led to higher levels of milk and meat consumption also.

The qualitative evidence overwhelmingly supports these quantitative findings, with respondents frequently citing increased income from livestock and livestock products (milk, butter, meat). One respondent explained, *'Our livelihood is based on livestock such as goats, sheep and cattle. Since livestock have better pasture, their productivity is increasing and they are contributing to the improvement of our consumption. So, we are getting better milk and meat as well as better income from the sale of our livestock. Therefore, we are in a very good condition.'*

Furthermore, improved pasture conditions have led to reduced costs associated with livestock care. Quantitative data indicates that treatment households were significantly less likely to provide supplemental feed and/or water for their animals compared to control households (e.g., 19.82 percentage points less likely to provide both for cattle, $p < 0.001$). This reduction in expenditure, combined with increased income, has likely contributed to a higher net income from livestock. Participants also highlighted the enabling effect of improved livestock income, allowing them to pay off debts and cover essential household needs such as school fees. A female herder from Wayama shared, *'We are sending our children to school. In the past, we had challenges in covering school fees because of loss of livestock productivity. If we keep implementing the project and get sufficient rain, I believe that we can handle the cost related to education and support our families.'*

Non-financial well-being: Beyond financial gains, AS Regen's impact on livestock productivity and income has led to notable improvements in food security, household resilience and reliance on coping strategies.

Treatment households exhibited higher food security, with an adjusted food consumption score (aFCS)[23] that is 1.53 units higher than control households ($p < 0.001$). This improvement in dietary diversity and frequency has been driven largely by increased consumption of livestock products. The most significant differences are observed in dairy products (17.3 percentage points higher in treatment areas) and meat (12.7 percentage points higher in treatment areas), which directly reflect the enhanced availability and access to own-produced nutritious foods. Qualitative interviews consistently reported improvements in household food security, often linked to increased incomes and self-consumption from improved livestock productivity, with particular emphasis on positive impacts for children.

The intervention has fostered a greater sense of resilience among pastoralist households. Quantitative data shows large and statistically significant differences, with a higher percentage of treatment households strongly agreeing with statements indicating their ability to 'bounce back from any challenge' (53 percentage-point difference against control areas), to 'change primary income or source of livelihood if needed during hardship' (48 percentage-point difference)

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23 The FCS (World Food Programme, 2024) is constructed by asking households on how many days during the past week they have consumed listed goods, multiplying each one of those values by the weight and adding all values. Therefore, the FCS scale spans 0 to 112. An adjusted version of the FCS was used in this study, from 0 to 16.

and to 'find a way to get by if threats became more frequent and intense' (46 percentage-point difference). These findings suggest strengthened capacity to adapt and recover from shocks.

To understand household resilience and vulnerability comprehensively, the quantitative survey asked households about coping strategies used in the past seven days and the past three months. Reflecting improved food security and resilience, treatment households were significantly less reliant on negative coping strategies when faced with food shortages. These households were 42.96 percentage points more likely than control households to have not used any coping strategies over the past seven days ($p < 0.001$), and 31.47 percentage points more likely over the past three months ($p < 0.001$). For short-term strategies (past seven days), the most notable reductions are in relying on less preferred or less expensive foods (by 34.2 percentage points), borrowing food or relying on assistance (by 33.9 percentage points), and reducing the number of meals eaten per day (by 32.7 percentage points). Over the past three months, key reductions include selling female livestock (by 22 percentage points), borrowing money (by 20 percentage points), and eating less or changing food type (by 19.3 percentage points).

Qualitative findings further highlight AS Regen's positive impacts on non-financial well-being by reducing stress, saving time and fostering greater cooperation. Respondents in approximately half of the qualitative interviews reported improved stress levels, attributing this to fewer concerns about livestock health and food security, and less frequent long migrations. Time savings were noted by herders and household decision-makers due to reduced needs for scouting, migration and foraging. Pooled grazing has allowed shared labour, which has particularly benefited households with children attending school. A female herder from Wayama explained, *'[the project] helps us pool together our limited labour for livestock keeping ... one individual can manage the cattle for the entire village since we graze in the same paddock. As a result, our culture of mutual assistance has flourished.'* Women have also experienced time savings from reduced travel distances for water and hay. Finally, AS Regen has fostered a stronger culture of cooperation and collaboration, with respondents noting that inclusive, collective decision-making has led to greater social cohesion and mutual support within and between communities.

Views on pastoralism: Beyond the tangible and non-tangible benefits, AS Regen has profoundly influenced pastoralists' subjective views on their way of life. It has instilled a renewed sense of hope and confidence in pastoralism as a viable livelihood. Quantitative survey results show that treatment households are significantly more optimistic than control households about the viability of pastoralism (by 43.3 percentage points), they feel they have significant agency to influence their well-being (by 55 percentage points) and they perceive a trend of people in their community moving towards pastoralism (by 37.2 percentage points). This positive shift is further underscored by a large reduction in perceived out-migration, with only 1.5% of treatment households reporting an increase, compared to 42.7% of control households.

Qualitative interviews echoed this renewed optimism. Respondents frequently linked their positive outlook to improved rangeland conditions and enhanced livestock health, productivity and income. A male herder from Wayama reflected, *'We were thinking about dropping out from livestock rearing and thinking about other livelihood options before this project. But after this project, because of those changes, such as in livestock body condition and rangeland condition, we are planning to further strengthen this programme.'* This indicates that the practical improvements brought by AS Regen have fundamentally altered pastoralists' long-term perspectives and aspirations for their traditional livelihood.

6. CONCLUSION

This study set out to evaluate the causal impacts of two interconnected interventions – AS Steward in Kenya and AS Regen in Ethiopia – on pastoralist decision-making, rangeland conditions, herd health and overall well-being. The research provides critical insights into how targeted information and regenerative grazing practices can foster resilience in these dynamic socio-ecological systems, addressing the increasing vulnerability of pastoral livelihoods due to climate change, land pressures and resource competition. By employing a rigorous mixed-methods approach, combining quantitative IE with in-depth qualitative inquiry, the study measures outcomes and also describes the underlying mechanisms and contextual factors driving observed changes.

The research makes significant contributions to the existing literature. It is the first study to evaluate the digital AS mobile application in depth in a real-world pastoralist setting, building on previous work that assessed earlier, paper-based versions of the intervention (Machado et al., 2020). Our findings offer novel insights into the effectiveness of digital tools in delivering timely and accurate information for migration decisions, while also shedding light on challenges such as information spillovers that complicate causal attribution in interconnected communities. Furthermore, this study is among the few to rigorously examine the impact of AMP regenerative grazing practices on pastoralist well-being, livestock health and conflict within a low-income country context. By exploring a wide array of outcomes and leveraging rich qualitative data, we contribute to bridging the knowledge gap between theoretical benefits of AMP and its practical application and impact in unique pastoralist societies.

Overall, the findings present a picture of both a highly effective intervention and one with mixed results. In Ethiopia, AS Regen shows large and statistically significant positive impacts across rangeland management capacities, rangeland conditions (particularly satisfaction with pasture quality) and herd conditions. The causal pathway for AS Regen is strongly corroborated by qualitative evidence, indicating that the adoption of collective rangeland management practices has led to improved pasture conditions. In turn, this has resulted in healthier and more productive herds, which has directly translated into substantial improvements in financial and non-financial well-being, and a renewed sense of optimism in pastoralism. These results underscore the transformative potential of intensive, community-led rangeland management to enhance pastoralist livelihoods.

In contrast, the results for AS Steward in Kenya are more ambiguous. Qualitative evidence consistently shows that pastoralists have experienced important improvements in areas such as herd health, access to pasture and reduced stress, and respondents attributed some of these positive changes to AS Steward. While the quantitative evidence shows a substantial increase in pastoralists' reliance on the app for migration information, the data is inconclusive regarding AS Steward's impact on key outcomes like herd condition. But this lack of statistically significant results must be interpreted with caution. The large and pervasive information spillovers observed in Kenya may have diluted the measured treatment effects, complicating precise causal attribution and making it difficult to conclude definitively that the app has had no impact. These spillovers, which compromised the initial RCT design, should not be viewed as a negative outcome in and of themselves, however. The fluidity with which information spreads is a valuable characteristic of these communities, suggesting that a targeted training approach may be an effective implementation strategy. Rather than

providing training to all households, interventions could focus on specific individuals or groups from whom information would naturally disseminate, thereby leveraging existing social networks to achieve wider reach.

The distinct approaches of AS Steward and AS Regen have contributed to their respective successes while also presenting unique challenges. AS Steward's impact has been driven largely by pastoralists' positive views on the app's accuracy and reliability, which has significantly enhanced their confidence in migration decisions and improved their navigation to better pastures and water sources. Its ability to reduce unnecessary migrations has also enhanced herd well-being and lowered stress. However, challenges exist, including information lags and manual update requirements, technical language barriers, poor functionality in low-network areas and a lack of structured market information. For AS Regen, success has stemmed from its effectiveness in establishing shared grazing plans and promoting adherence through strong RGU committee leadership and enforcement. This has led to a notable shift towards collective decision-making and more inclusive participation, building confidence and technical knowledge in rangeland management. A key challenge for AS Regen has been the attraction of pastoralists from neighbouring communities to improved pastures, which has sometimes disrupted grazing plans. Disputes have largely been resolved peacefully, however. Both models have also faced broader limitations such as pre-existing cultural norms that may have hindered full participation, and persistent challenges with access to critical services like water and veterinary care.

While challenges remain, the insights gleaned from this evaluation offer clear steps for policy-makers and practitioners seeking to support sustainable pastoralism – as detailed in the recommendations that follow.

7. RECOMMENDATIONS

Recommendations for AS Steward

Implementers of AS Steward should consider:

- **options to expand offline access and information availability for app users**, based on user requests for better functionality in low-network areas;
- **incorporating marketing information more systematically into the app**, given the utility of this information for users when making selling decisions. This could include publishing information on the location, opening times and days of livestock markets, as well as price;
- **making adjustments to improve the user interface and incorporate additional training materials onto the app**, in response to challenges related to app navigation. Built-in support, such as video tutorials, could be useful in the absence of Field Agents to provide troubleshooting support;
- **providing additional human resources or establishing collaborations for technical support**, given the vastness of mapped areas which limits the availability of Field Agents. Additional human resources could include actors such as Promoters or Ambassadors, or the programme could leverage collaborations with other governmental or non-governmental organisations with an in-field presence;
- **further exploring the causes of barriers to real-time data and identify strategies to overcome these**. These may relate to delays in the approval process for publishing alerts, connectivity challenges or making manual app updates.

Recommendations for AS Regen

Implementers of AS Regen should consider:

- **mechanisms to boost inter-community coordination to ensure the security of RGU managed areas**, given that rangeland conditions may attract migration from neighbouring communities and potentially disrupt grazing plans;
- **expanding AS Regen to additional areas**, given its proven success. Expansion efforts could be implemented in collaboration with other actors, such as RGU committee members and other governmental or non-governmental organisations also working to support pastoralists;
- **supporting the remaining gaps identified by pastoralists**, specifically water access and veterinary services, to further boost pastoralist resilience. Carbon credits or collaboration with other actors could be leveraged to address these challenges.

This study has also identified unanticipated outcomes that may warrant further research to inform future action, specifically: the effects of pooled grazing on disease and the possible gendered benefits of AS Regen.

Recommendations for policy-makers

Policy-makers should:

- **ensure interventions are designed and tailored to local contexts**. Both AS models offer unique strengths, with their success dependent on leveraging specific contextual factors. AS Regen's collective approach shows significant results, but these may be limited in contexts that lack pre-existing collective decision-making structures. The high uptake and perceived value of AS Steward highlights the importance of co-creating information platforms and content with intended pastoralist users. Smartphone literacy and prevalence should also be considered for interventions that utilise digital platforms for information dissemination;

- **consider the trade-offs between impact, scalability and budget in intervention design**. Intervention design and funding should consider the cost-benefit analysis of different approaches in order to effectively meet objectives. For example, localised, intensive advisory support is highly impactful but it may be more costly and less scalable than more generalised support. In contrast, digital platforms can be highly effective at disseminating information, with a low cost per unit for implementation. Impacts will also depend on local contextual factors.

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