



**CARIIAA**  
*Collaborative Adaptation Research  
Initiative in Africa and Asia*



**ASSAR**  
*Adaptation at Scale in Semi-Arid Regions*

# Addressing the issue of *Prosopis juliflora* in Ethiopia

*CARIIAA-ASSAR Working Paper*

*Mark Tebboth, Mohammed Assen, Mekonnen Degefu, and Roger Few*



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### About CARIAA Working Papers

This series is based on work funded by Canada's International Development Research Centre (IDRC) and the UK's Department for International Development (DFID) through the **Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA)**. CARIAA aims to build the resilience of vulnerable populations and their livelihoods in three climate change hot spots in Africa and Asia. The program supports collaborative research to inform adaptation policy and practice.

Titles in this series are intended to share initial findings and lessons from research and background studies commissioned by the program. Papers are intended to foster exchange and dialogue within science and policy circles concerned with climate change adaptation in vulnerability hotspots. As an interim output of the CARIAA program, they have not undergone an external review process. Opinions stated are those of the author(s) and do not necessarily reflect the policies or opinions of IDRC, DFID, or partners. Feedback is welcomed as a means to strengthen these works: some may later be revised for peer-reviewed publication.

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## About ASSAR

All authors of this working paper are team members in the ASSAR (Adaptation at Scale in Semi-Arid Regions) project, one of four hotspot research projects in CARIAA. The international and interdisciplinary ASSAR team comprises a mix of research and practitioner organisations, and includes groups with global reach as well as those deeply embedded in their communities. The ASSAR consortium is a partnership between five lead managing institutions - the University of Cape Town (South Africa), the University of East Anglia (United Kingdom), START (United States of America), Oxfam GB (United Kingdom) and the Indian Institute for Human Settlements (India) – and 12 partners – the University of Botswana, University of Namibia, Desert Research Foundation of Namibia, Reos Partners, the Red Cross/Crescent Climate Centre, University of Ghana, ICRISAT, University of Nairobi, University of Addis Ababa, Watershed Organisation Trust, Indian Institute for Tropical Meteorology, and the Ashoka Trust for Ecology and the Environment.

Working in seven countries in semi-arid regions, ASSAR seeks to understand the factors that have prevented climate change adaptation from being more widespread and successful. At the same time, ASSAR is investigating the processes – particularly in governance – that can facilitate a shift from ad-hoc adaptation to large-scale adaptation. ASSAR is especially interested in understanding people's vulnerability, both in relation to climatic impacts that are becoming more severe, and to general development challenges. Through participatory work from 2014-2018, ASSAR aims to meet the needs of government and practitioner stakeholders, to help shape more effective policy frameworks, and to develop more lasting adaptation responses.

### **Why focus on semi-arid regions?**

Semi-arid regions (SARs) are highly dynamic systems that experience extreme climates, adverse environmental change, and a relative paucity of natural



resources. People here are further marginalised by high levels of poverty, inequality and rapidly changing socio-economic,

governance and development contexts. Climate change intersects with these existing structural vulnerabilities and can potentially accentuate or shift the balance between winners and losers. Although many people in these regions already display remarkable resilience, these multiple and often interlocking pressures are expected to amplify in the coming decades. Therefore, it is essential to understand what facilitates the empowerment of people, local organisations and governments to adapt to climate change in a way that minimises vulnerability and promotes long-term resilience.

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## 1. Executive Summary

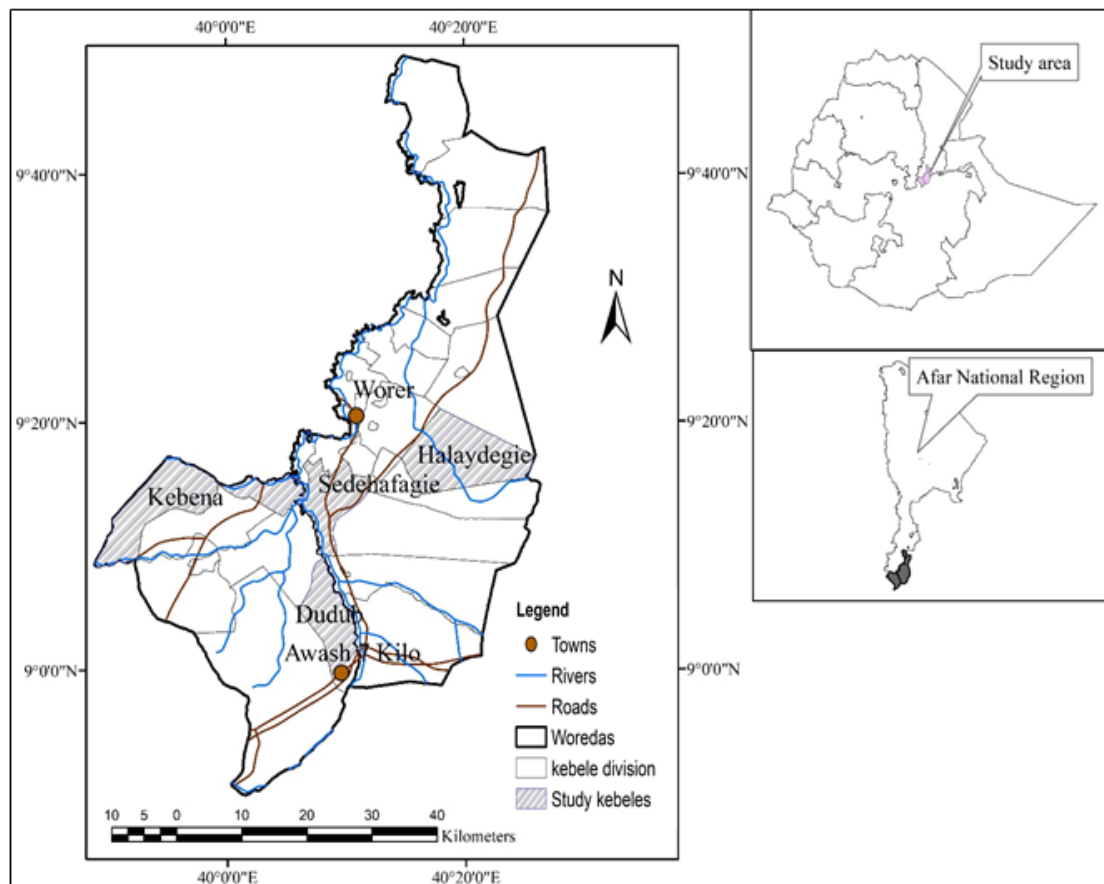
- The invasive plant species *Prosopis juliflora* is continuing to expand into new areas within the Middle Awash Valley. *P. juliflora* is a huge issue for populations in semi-arid lands, reducing pasture for livestock, blocking access to water, causing physical harm, and creating other negative impacts.
- Our research shows that there are differences between and within communities for preferred management interventions. Within communities these differences are influenced by age, gender, location and main livelihood. Government, non-governmental organisations (NGOs) and individual communities also have different preferences for how to deal with *P. juliflora*.
- It is important to recognise that there are different views and perspectives on the best ways to manage or use *P. juliflora* and these perspectives need to be explicitly acknowledged in the design and implementation of management strategies and interventions. These issues highlight the importance of consulting and engaging in ways that are sensitive to differences within and between communities.
- The management of alien invasive species, specifically *P. juliflora*, requires a national platform. This platform would support coordination among stakeholders, provide a forum for sharing and exchanging information, knowledge, learning and approaches, and increase the chances of sustaining funding. To initiate this platform and to make it meaningful requires commitment nationally and changes in policy and the allocation of resources.
- There is a clear gap concerning the transfer and update of knowledge between researchers, practitioners, policy makers, and communities. Understanding how to better integrate research and research outputs into the design and implementation of interventions and vice versa is necessary to enhance efforts to manage alien invasive species.



## 2. Introduction

This research brief presents a summary of work on *P. juliflora* carried out under the five-year ASSAR project (Adaptation at Scale in Semi-Arid Regions, 2014-2018). The research focuses on and was undertaken in Awash Fentale and Amibara *woredas* in the Middle Awash Valley (see Figure 1), with additional data collection at regional and national levels. The brief presents the main findings under four headings: (1)

Spread, distribution and rate of change of *P. juliflora*, (2) impacts, (3) views on management options, and (4) broader implications. The findings include data from 55 key informant interviews, four semi-structured group interviews (total of 32 people), three workshops with affected communities (totalling 60 people), one workshop with 7 representatives from NGOs and one with 12 representatives from local and government and two further stakeholder meetings at local (33 participants) and national level (14 participants).

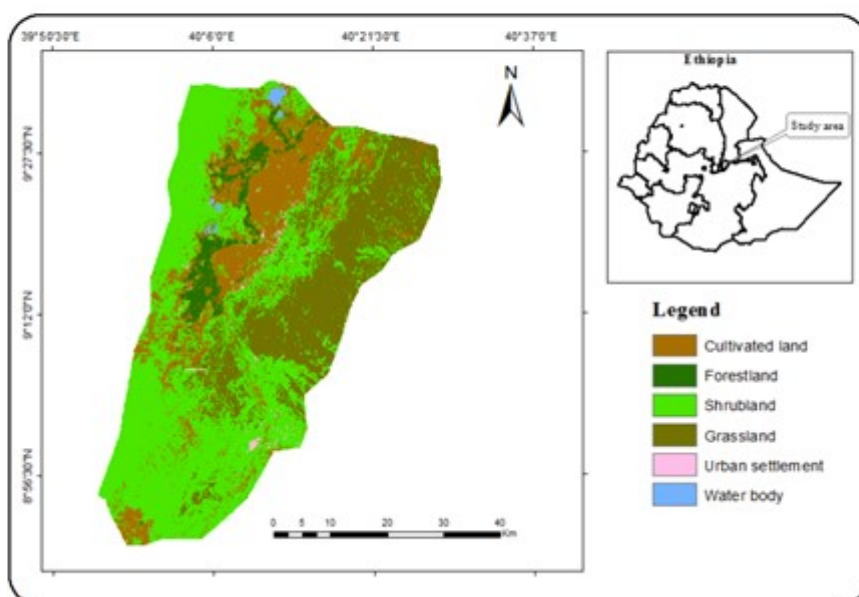


**Figure 1:** Study site, Southern Afar

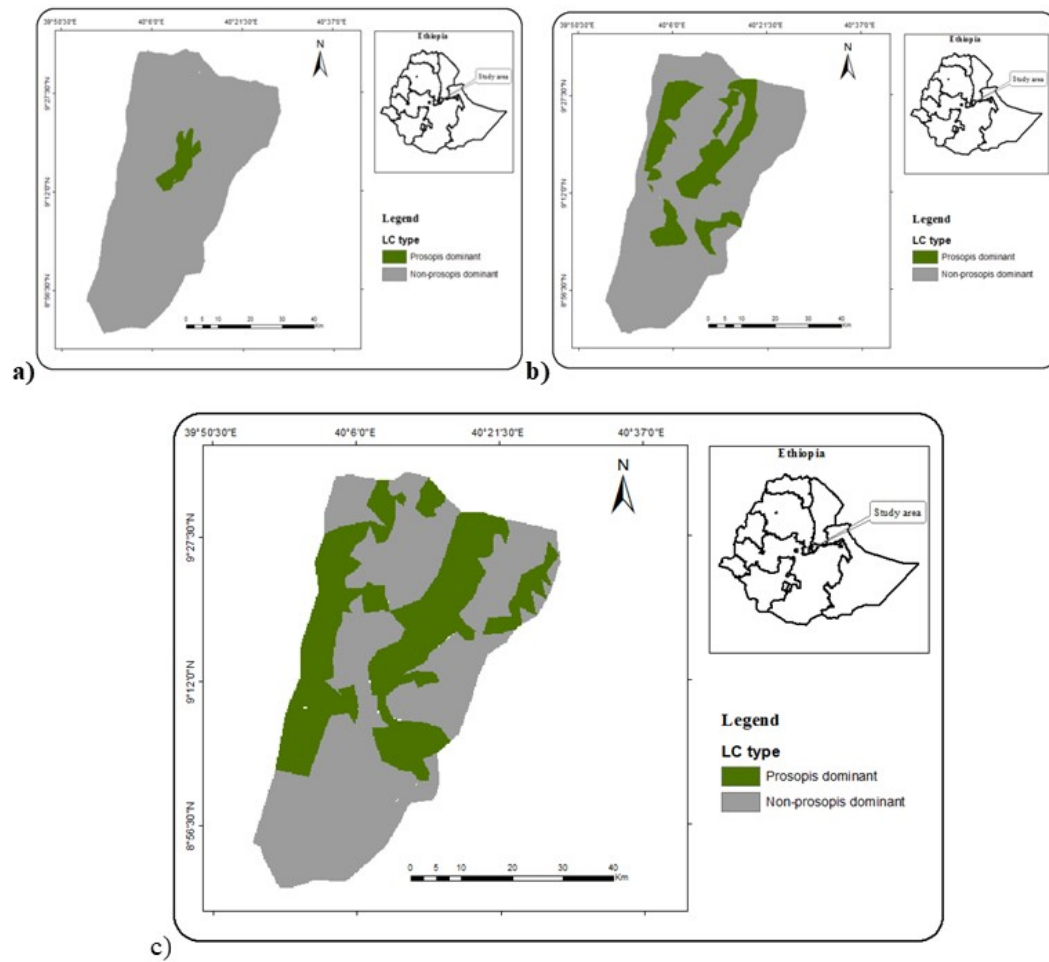
### 3. Spread, distribution and rate of change

Research on land use and land cover (LULC) change was undertaken in Amibara and Awash Fentale *woredas* in the Middle Awash Valley, Southern Afar. These two *woredas* are already heavily invaded by *P. juliflora*.

During the last 29 years, cultivated land expanded at a rate of 2.6% per year while forestland and grassland have shrunken at a rate of 1.2% per year and 2.4% per year respectively. Shrubland that contains *P. juliflora* species had the largest area coverage (Figure 2). The extent of *P. juliflora* expansion is shown in Figure 3 (overleaf). *P. juliflora* coverage has increased from less than 3.7% in 1987, to 21.3% in 2002 and to 37.9% in 2016. As confirmed from field verification, most of the expansion was observed along river banks and roads, and in grazing lands and settlement areas. The evidence collected through the LULC research and that from the affected populations confirms that *P. juliflora* is an aggressive invader that is continuing to expand rapidly into new locations whilst consolidating its presence in existing locations.



**Figure 2:** LULC classes in 2016



**Figure 3:** Extent of *P. juliflora* dominated land cover in a) 1987, b) 2002, and c) 2016

## 4. Impacts

*P. juliflora* is an ecosystem engineer and is having a significant impact on the ecology and populations in the affected locations, threatening native flora and fauna as well as land critical for livelihoods such as grazing and cropland areas and water points. Broadly speaking, *P. juliflora*'s impacts as identified members of affected communities can be grouped under three headings: (1) impacts on population, (2) impacts on livestock and farming, and (3) impacts on ecology (see Table 1).

<b>People</b>
Risk of injury from plant: injury from the thorns; heightened risk for elderly populations.
Risk of injury from wild animals that shelter in <i>P. juliflora</i> thickets: reported increase in large predators and snakes.
Rips and tears clothing.
Loss of native flora: affects people's sense of place and connection with the landscape.
Shortage of construction materials for traditional houses: <i>P. juliflora</i> , when used, was reported to be not as durable (lasting 3-6 months compared to roughly 12 months); reported as particularly affecting women's access to construction materials.
Relocation of dwellings due to invasion of plant into settlements.
Irritation associated with <i>P. juliflora</i> wood as it breaks down: when used to construct dwellings, dust caused by <i>P. juliflora</i> breaking down leads to skin irritation; tends to affect women and young children who spend more time indoors.
Diversion of resources to control invasion: time and energy used to keep critical areas free of plant.
Increasing scarcity of resources: livestock forced to migrate further (impacts on younger men) and leads to increased risk of conflict (but the latter not widely reported).
Shortage of milk and meat: because livestock has to migrate further for longer for pasture.
Blocks access routes for people: particularly impacts women who are responsible for water collection.
Risks to children: fewer safe spaces for recreation and increased risk of attack from wild animals; reported increases in parental anxiety.
<b>Livestock / Farming</b>
Animals suffer physical injury from thorns.
Livestock risk injury or death from wild animals sheltering in <i>P. juliflora</i> thickets: exacerbated as <i>P. juliflora</i> decreases ability of herders to scan horizon for dangers.
Reduction in availability of pasture leads to decline in quality and quantity of livestock.
Blocked movement corridors for livestock.
Difficult for animals to access water points.
Health complications associated with livestock eating the pods in large quantities. Pods of <i>P. juliflora</i> are attractive for livestock. Problems associated when consumed in large quantities.
Reduces productivity of farmland: resources required to keep farmland free of <i>P. juliflora</i> .

**Table 1:** Main reported negative impacts of *P. juliflora* (data from 60 participants)

Ecology
Outcompetes indigenous flora: <i>P. juliflora</i> is well suited to arid conditions and temperature extremes and suppresses growth of other plants.
Reduces availability of water/soil moisture: plant's extensive root system maximises its extraction of soil moisture.
Change in ambient conditions: some respondents perceived that <i>P. juliflora</i> increases ambient temperature and/or reduces air flow.
Increase in mosquitoes associated with increasing humidity.
Increase in large predators associated with more favourable habitats.

**Table 1 (cont.):** Main reported negative impacts of *P. juliflora* (data from 60 participants)

Notwithstanding the negative impacts, a range of positive attributes are also associated with *P. juliflora* (although this is dependent on the degree to which the plant is present in the environment) in the Middle Awash Valley (see Table 2).

Use	Number of groups*	Comment
Fencing to demarcate dwelling boundaries and for animal enclosures	5 out of 12	Not preferred as supports encroachment of the plant into settlements.
House construction	6 out of 12	Not as durable as native woods
As shade for people and animals	4 out of 12	Not viewed as favourably compared to native species.
Firewood	8 out of 12	Not viewed as favourably compared to native species.
Charcoal making	7 out of 12	Not viewed as favourably compared to native species.
Animal feed (Prosopis pods)	3 out of 12	Utilised only in times of scarcity
Soil conservation	2 out of 12	Disputed within the proponents' groups

**Table 2:** Most commonly perceived positive uses associated with *P. juliflora* (data from 60 participants).

In summary, whilst the plant has positive ecological attributes (potentially protecting against soil erosion, for flood control, and to combat saline soils) and benefits for people (shade from sunlight and for privacy, greenness, firewood and charcoal and as a food source for livestock), the majority of participants in the research felt that, due to the significant impacts on local environmental services (particularly on rangeland and water resources) and livelihoods (health, income and food security), *P. juliflora* is a major social-ecological issue requiring urgent attention.

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\* In each community workshop, participants were split into four groups (older men, older women, younger men, and younger women), the data above shows the number of groups that mentioned the uses listed.

## 5. Management approaches and study sites

Through the research undertaken by ASSAR, the values and preferences of different groups of stakeholders towards four hypothesized management options were explored (see Figures 4a – 4d). The groups of stakeholders consulted included groups of younger women, younger men, older women, and older men from three communities affected by *P. juliflora* and representatives from NGOs and local government. The research used hypothetical management interventions to support stakeholders to think through and discuss the potential implications of those interventions (the strengths and weaknesses of different approaches and who would be likely to do well / not well if the scenario was implemented).

### Scenario 1: Containment

- The main focus of management activities is on limiting the spread of *P. juliflora* and containing the invasion.
- Local networks are formed to prevent spread into areas that are highly valued and currently free from *P. juliflora* (but susceptible to invasion)
- Existing infestations are tackled to prevent expansion by controlling the outer perimeter
- Greater efforts are made to reduce reliance on pods for feed and at times of scarcity (during the dry season and droughts)



**Figure 4a:** Hypothetical management scenario 1

### Scenario 2: Targeted eradication

- The main focus of management activities is on targeted eradication: that is clearing *P. juliflora* in areas of high value and not intervening in areas considered low value
- Where practicable, mechanized or biological controls are used and in other locations more labour-intensive methods are employed (such as cutting and burning, chemical application etc.)

- As land must be utilized to prevent reinvasion, the areas targeted for clearance tend to be those that are suitable for more intensive land uses (such as farming)



**Figure 4b:** Hypothetical management scenario 2

### Scenario 3: Large-scale, commercial utilization

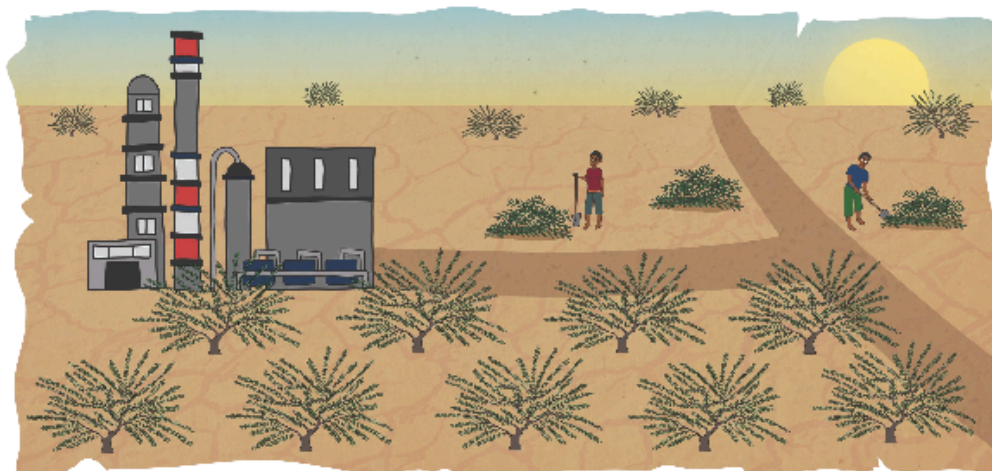
- *P. juliflora* infestations are managed with the intention of producing a useable biomass resource at a commercial scale
- *P. juliflora* is actively managed and controlled in locations close to the road network and around biomass plants
- In more remote locations, where exploitation is not possible, the plant continues to spread
- There is not much support provided for affected communities outside of areas that are suitable for the commercial exploitation



**Figure 4c:** Hypothetical management scenario 3

### Scenario 4: Community-focused utilization

- Communities are central to the overarching policy goal of utilisation, control is encouraged by creating a favourable environment through which communities can derive livelihoods from *P. juliflora*
- The main focus of utilization efforts is through smaller-scale exploitation by cooperatives and businesses that produce charcoal, flour, animal feed, etc.
- High inputs of skills, knowledge and labour in geographically dispersed locations
- Attempts to control *P. juliflora* are widespread as affected communities lead the efforts but very dense and aggressive infestations are difficult to tackle



**Figure 4d:** Hypothetical management scenario 4

The research worked intensely with three communities within Awash Fentale and Amibara Woredas (see Table 3). The communities represented different livelihoods (from pastoral to more sedentary and farming based) and proximity to urban areas (from more remote to close proximity to a large town). In addition, we also worked with groups of representatives from local government and NGOs as well as other stakeholder.

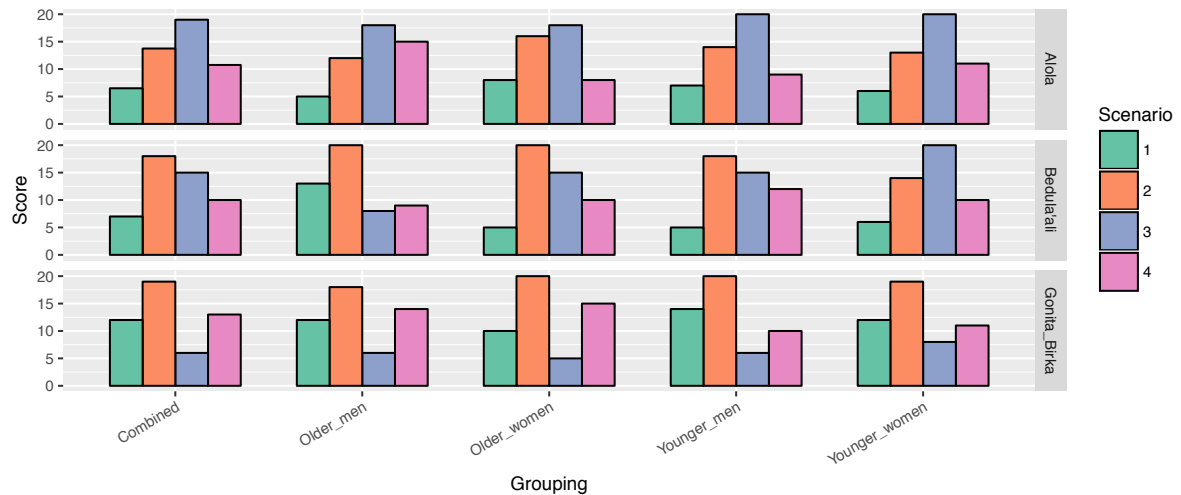
Study site / Kebele	Woreda	Livelihood type	Further information
Alola	Awash Fentale	Pastoral	Located close to main town of Awash Sabat Kilo. Prosopis is present in the area but is yet to form very dense thickets proximate to the settlement
Bedula'ali	Awash Fentale	Agro-pastoral	All households have been allocated farmland and the land is used more intensively with irrigated sugar cane and cotton plantations close to the settlement. The area around the settlement is densely invested with Prosopis
Gonita Birka	Amibara	Pastoral	More remote settlement and the one most reliant on pastoralism. Land around the settlement is rangeland of which large areas are invested with Prosopis. In some areas this is impeding movement and migration corridors

**Table 3:** Characteristics of the community study sites / kebeles

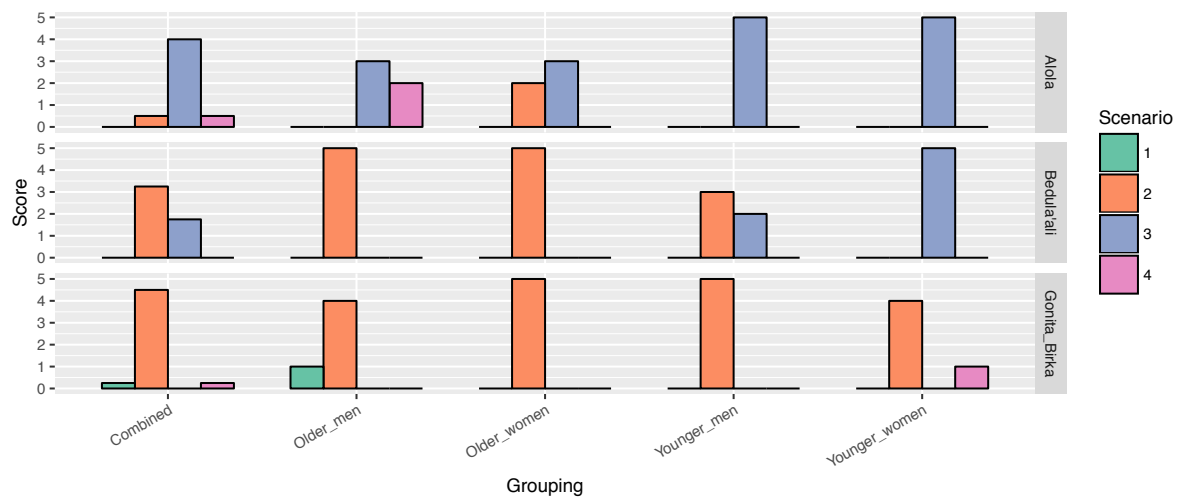
## 6. Results of study

### Age, gender, and location/ livelihood influence the perception of trade-offs

Across the three communities, either scenario 3 (commercial utilization) or scenario 2 (targeted eradication) scored the highest and the scenarios received the greatest number of first-choice preferences (see Figures 5 and 6).



**Figure 5:** Scenario scoring (data from 60 participants), combined scores show mean of four sub-groups (older men, older women, younger men, and younger women)



**Figure 6:** First-choice preferences (data from 60 participants), combined preference show mean of four sub-groups (older men, older women, younger men, and younger women)

In Alola, scenario 3 was scored the highest by each of the socially differentiated groups and received the most first choice preferences. In Bedula'ali there was slightly more

variation in scoring and in the preferences exhibited by the socially-differentiated groups compared to Alola. Overall, scenario 2 scored the highest and scenario 3 was second. Scenario 2 received the greatest number of first choice preferences, again scenario 3 was second. The voting patterns in Gonita Birka were much more uniform compared to the other two communities. Scenario 2 was scored the highest by all four socially-differentiated groups. This pattern of voting more closely resembled Bedula'ali but not Alola which exhibited a preference for scenario 3. Interestingly, scenario 3, which scored the highest in Alola and the second highest in Bedula'ali was scored the lowest in Gonita Birka.

First-choice preference voting revealed distinctions based on age in the communities of Alola and Bedula'ali. In these communities, the groups of younger men and younger women exhibited a preference for scenario 3. In contrast, the groups of older men and women universally favoured scenario 2 (in the case of Bedula'ali) or exhibited more mixed preferences split between scenarios 2, 3 and 4. The most likely explanation for this divergence is linked to the perceived distribution of benefits amongst the social-differentiated community. All groups in Alola felt that the younger generation were more likely to benefit from scenario 3 as they have more skills (linked with higher educational attainment) and labour and are better placed to take advantage of the sorts of opportunities that would arise through the development of a commercial operation. Similarly, in Bedula'ali, scenario 3 was the second most selected in terms of first choice preference. The main reason given for this choice was that the younger generation thought it would lead to more livelihood and income-generating activities. By way of contrast, the group of older men showed much more scepticism and questioned whether their community would benefit from this sort of development.

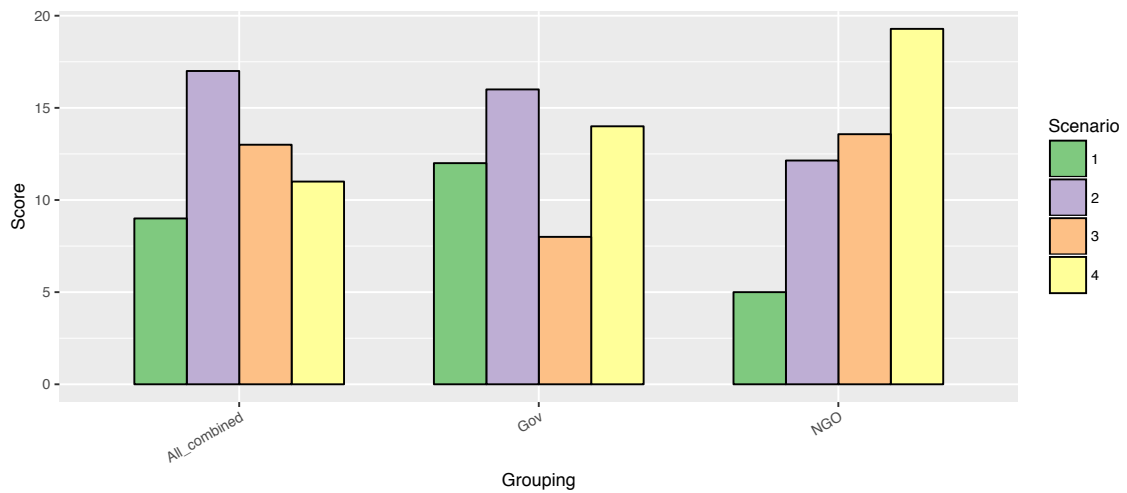
## **Comparing the perspectives of communities, government and NGOs**

In terms of preferences for a specific management scenario, the intention of the government representatives most closely matched the overall preferences of the communities in selecting scenario 2. In contrast, the NGO representatives favoured scenario 4 which was one of the two least favoured scenarios at a community level. Comparing the cumulative scores of representatives from government and NGOs with the individual community highlights some interesting convergence and divergence (see Figures 7 and 8). The governments cumulative scores most closely aligned with the preferences of the community from Gonita Birka, as both scored scenario 2 most highly followed by scenarios 4, 1 and 3 respectively.

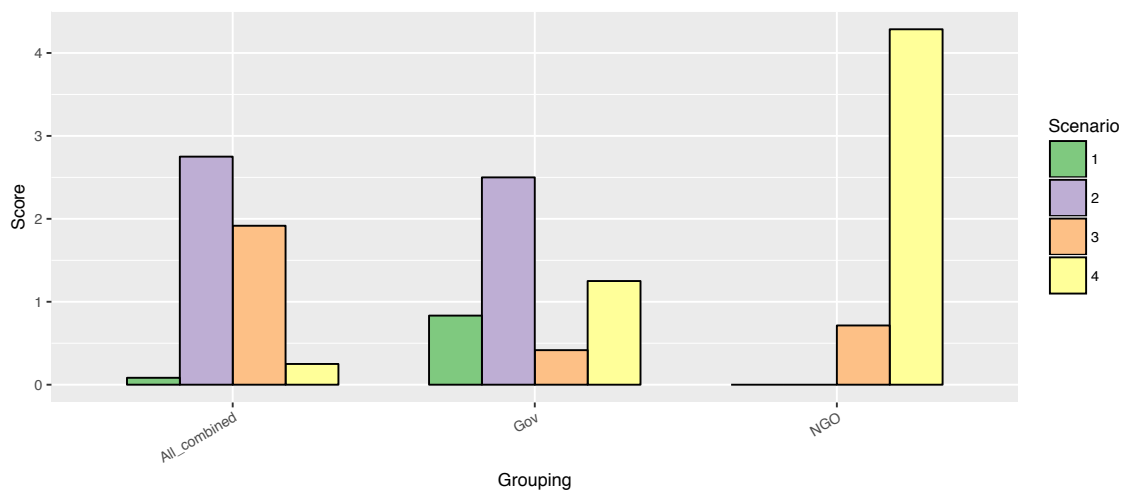
For first-choice voting preferences there was again similar voting patterns although the degree of similarity was slightly less (see figures 5 and 2). For the other two communities, the government representative voting was more closely aligned to Bedula'ali compared to Alola. The explanation for these patterns might lie in the extent to which the participants from Alola saw urbanisation as the key to development within their community and favoured a scenario (3) that offers the greatest potential for this. The representatives from both government and NGOs were predominantly drawn from areas that specialise in rural development, water and agricultural issues. People with knowledge in issues that are more closely aligned to rural development issues appear

more likely to share the preferences of more rural and remote communities rather than those that are proximate to urban areas.

The representatives from NGOs voted strongly in favour of scenario 4. Interestingly, this scenario was not the favoured scenario in any of the community workshops. Only in Gonita Birka did scenario 4 score in the top two for the cumulative score and across all of the community workshops only 3 people voted for it as a first-choice preference. The disparity between the preferences at a community level and those from NGOs is striking. The difference may be related to the very strong bottom-up, community-focused ethos that are central to the NGOs. However, it is clear from the voting at a community level that their preferences did not mirror the NGOs.



**Figure 7:** Scenario scoring (data from 60 community participants, 12 government and 7 NGO representatives), combined score shows mean of all community participants. Weighted to enable comparison.



**Figure 8:** First-choice preferences (data from 60 community participants, 12 government and 7 NGO representatives), combined preference shows mean of all community participants. Weighted to enable comparison.

## 7. Broader implications

Preferences for scenarios differ by location, livelihood, age and between community groups. There are large differences between and within communities. These results show that for any management interventions there are likely to be groups of people within communities and even whole communities that feel like they are missing out or not getting as much benefit compared to others. Recognising that there will be winners and losers whenever an intervention is implemented emphasises the need for good consultation and effective design to ensure that the perceived differences in who benefits are minimised.

Furthermore, the differences in preferences between and within communities (for example between the older and younger generation) highlight the very real risk that the design and consultations on interventions can be significantly skewed depending on how and where one goes for input. Preferences also differ according to the type of stakeholder. There was clear divergence between government, NGOs and communities demonstrating that management interventions would look very different if only one group was consulted in the design and development of a response strategy.

Communities are adept at understanding the complex nature of problems, can interpret solutions and readily identify if it is in their interest to participate in actions that will potentially impact on them and their community. Previous interventions that have failed make it much more difficult for actors that are rooted in places to 'start over', with every failure making it more difficult for the next intervention. To overcome this issue, very clear and unambiguous consultation is needed, with clear pathways to delivery identified prior to the substantive engagement. From the outset, transparent discussions about the costs and benefits, about who will win and who will lose out are required to avoid getting into a cycle of mistrust and ever narrowing reciprocity.

More generally, stakeholders recognise that *P. juliflora* is a long-term issue affecting many locations in Ethiopia (Somali, Afar, Oromiya, Tigray, SW Ethiopia) and other countries in the Horn of Africa. The deeply entrenched nature of the problem means that long-term commitment is required and this is often not practicable through short-term project funding (whether for implementation or research). National, and ideally regional, commitment is required on a sustained basis.

Research on the issue of *P. juliflora* is required to inform effective and equitable management, implementation and action, yet too often the engagement between research and implementation is poor. Much research on *P. juliflora* has taken place in the past or is ongoing and yet this has not been converted to action. Even if there are implementable recommendations to control and manage *P. juliflora* few plans have been proposed for large-scale implementation projects. Insights on the feasibility of management options are thus only applicable to small pilot sites.

Interventions and research are often generated in a 'foreign' context and can be unsuitable as a result. More work is needed to understand how actors and stakeholders can come together around a common goal or preferred management option to achieve more tangible results on the ground especially in situations where there are different institutional set-ups in operation that do not work cohesively together (for example customary and non-customary governance arrangements).



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