

TECHNICAL NOTE – ቱክኒካዊ መዘከር

About the new salvia weed (*Salvia tiliifolia*) in Tigray



ብዘዕባ ሓድሽ ዓሌት ፃህያይ ሰልሽያ ኣብ
ትግራይ (*Salvia tiliifolia*, ሰልሽያ ቲሊፎልያ)

by

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Summary

The new salvia weed that invades farmlands and rangelands in Tigray, formally called *Salvia tiliifolia*, is an annual plant native to Mexico and surroundings. It thrives in tropical, seasonally dry environments. It was introduced to Ethiopia in the late 20th century and made its way to Tigray after 2010. With its many branching stems and profusion of seeds, this upright pioneer plant becomes dominant in the herbaceous layer of wastelands and roadsides before spreading to all other land uses, including agricultural land. Visual observations show that in areas with "cut & carry" grass harvesting, or those with less grazing pressure, salvia is not prevalent. Farmers in the research area have ability uprooting salvia, which is rather simple because this species is easily recognized, and its roots do not withstand much force. In collaboration with the community, we have selected a highly infested location on the outskirts of Hagere Selam and have developed a plan to eradicate all salvia plants from 7.66 hectares of wasteland before the seeds have a chance to grow. The labour-intensive weeding required 45 person-days per hectare to complete a single manual salvia weeding operation in wasteland. Annual repetition of such an operation would be necessary, with a gradual decrease in burden predicted. As an alternative, to maximize grass production, we recommend converting the rangelands into managed exclosures. There will be salvia, but not a lot of it. This would keep the most significant salvia seed supply area under control and reduce the weeds invading farmlands.

ፅሑፍ

ሳልቭያ ቲሊፎሊያ (*Salvia tiliifolia*) ኣብ ትግራይ ኣብ ተሓረስቲ ቦታታትን መውዓሊ ከፍትን ዘስፋሕፍሕ ዘሎ ሓድሽ ዓሌት ፃህያይ ክኸውን ከሎ መበቐሉ ድማ ኣብ ሜክሲኮን ከባቢኡን ከምዝኸነ ዝፍለጥ ዓመታዊ ፃህያይ እዩ። ኣብ ወቕታዊ ናይ ድርቂ ባህሪ ዘለዎም ከባቢታት ትሮፒክስ ድማ ብሰፊሑ ይርከብ። ናብ ኢትዮጵያ ኣብ መወዳእታ 20 ክፍለ ዘመን ዝተኣታተወ ክኸውን ከሎ ኣብ ትግራይ ድማ ድሕሪ 2010 ዓ.ም ኣቆፃፀራ ፈረንጂ ወይ ድማ ድሕሪ 2003 ዓ.ም ክረኣ ጀመሩ።

እዚ ፃህያይ እዙይ ቀጥ ዝበለ ቅርፂ ክህልዎ ከሎ ጨናፍር ዘለዎም ጉንድታትን ብርክት ዝበለ ዘርኢ ብምፍራይን ይፍለጥ። ናብ ካልኣት ቦታታትን ናይ ሕርሻ ግራውትን ቅድሚ ምስፍሕፍሑ ድማ ኣብ ጥቕሚ ኣብ ዘይወዓሉ ሳዕሪማዕሪ ዝበቐሉሎም ከባቢታትን ኣብ ወሰን መንገድታትን ብብዝሒ ይበቁል።

ብዓይንና ተዓዚብና ብዘረጋገፅናዮ መሰረት እዙ ፃህያይ እዙይ ሳዕሪ ተዓዲዱ ብፀውራ ኣብ ዝውሰደሎም ከባቢታት ወይ ድማ ውሑድ ጸቕጢ ናይ ስዲ ጋዲ ኣብ ዘለዎም ከባቢታት ብሰፊሑ ኣይበቁልን። እዚ ፃህያይ እዙይ ብቐሊሉ ስለዝልለን ስሩ ድማ ነዊሕ ብዘይምዃኑ ብዙሕ ጉልበት ስለዘየድልዮን እዙ መፅናዕቲ እዙይ ኣብ ዝተኸየደሉ ከባቢ ዝርከቡ ሓረስቶት ነዚ ፃህያይ ሳልቫያ በቐሊሉ ካብ ሱሩ በቐሶም ይድርብዎ።

ምስ ናይቲ ከባቢ ሕብረተሰብ ብምትሕብባር ኣብ ወሰን ከተማ ሃገረሰላም ካብ ዝርከቡ ፃህያይ ሳልቫያ ብብዝሒ ዝበቐሉሎም ኣብ ጥቕሚ ካብዘይወዓሉ ቦታታት ሓደ 7.66 ስፍሓት ዘለዎ ቦታ ብምምራፅ ዘርኢ ናይቲ ኣብቲ ዝተመረፀ ቦታ ዘሎ ፃህያይ ናብ ካልኣት ቦታታት ቅድሚ ምግፍሑን ምዝርግሑን በቐሶና ንኸነጥፍኦ ትልሚ ሒዝና ተንቀሳቂስና። እዚ ስራሕ እዙይ ብዙሕ ሓይሊ ሰብን ፃዕርን ዝሓትት ስራሕ ክኸውን ከሎ ኣብ ሓደ ሄክታር ኣብ ጥቕሚ ዘይወዓለ ቦታ ዝበቐለ ፃህያይ ሳልቫያ ሙሉእ ንሙሉእ ብኢድ ፃሂኻ ንምውዳእ 45 ሰብ ኣብ ሓደ መዓልቲ የድሊ።

እዚ ስራሕ እዙይ በብዓመቱ ክደጋገም ዘለዎ ኾይኑ በዚ ሜላ እዙይ ቀስ ብቐስ እቲ ፃዕርን ዘድሊ ብዝሒ ሓይሊ ሰብን ንሓዋሩ ክንኪ ክምዝኸእል ይግመት። ከም መማረፂ ግን ምህርቲ ሳዕሪ ንኸውስኸን መጠን ፃህያይ ሳልቫያ ምእንቲ ክቕንስን እቶም ንዝርግሑ ሳልቫያ ተቓሊዖም ዘለዉ ኣብ ጥቕሚ ዘይወዓሉ ቦታታት ንኸሕዝኡን ኣብ ጥቕሚ ንውዕሉን ንመክር። ፃህያይ ሳልቫያ ጠቐሊሉ ዋላ እኳ እንተዘይጠፍኦ መጠኑ ግን ኣዚየ ክንኪ ይኸእል እዩ። በዚ ሜላ እዙይ እቶም ምንጪ ዝርገሑ ዘርኢ ሳልቫያ ኮይኖም ዘገልግሉ ዘለዉ ቦታታት ኣብ ትሕቲ ቁፅፅር ክውዕሉ ይኸእሉ ብኡ ኣቢልካ ድማ ዝርገሑ ወይ ምስፍሕፍሕ ፃህያይ ሳልቫያ ናብ ተሓረስቲ ቦታታት ምንካይ ይከኣል።

1. Introduction

Here we discuss the recently appeared *salvia* weed that rapidly spreads in the Tigray highlands (northern Ethiopia), and document efforts to control it in the Hagere Selam area (13°39'N, 39°10'E; around 2650 m a.s.l.). It seemed urgent to publish our insights, given that locally farmers are very worried by the invasive weed, especially as they are already coping with the social, agronomic and environmental impacts of the recent Tigray war.



Figure 1. Since approximately 2019, *Salvia tiliifolia* has appeared in the study area, where it now occupies large areas, especially where soil is reworked, such as dumped soils, roadsides (here in Hagere Selam, along the old road to Mekelle), building sites, densely grazed areas, and further down in fresh alluvium along rivers. All photos were made in 2023 and 2024. – ካብ ኣስታት 2012 ጀሚሩ፡ ሳልቫ ቲሊፎልያ (*Salvia tiliifolia*) ኣብቲ መጽናዕቲ ዝተካየደሉ ከባቢ ክርእ ጀሚሩ። ኣብዚ ሕጂ እዋን ድማ ሰፊሕ ቦታታት ሸፊኑ ይርከብ። ብፍላይ ድማ ሓመድ ኣብ ዝተኸዳቱሎም ወይ ዝተኣከቡሎም ቦታታት፡ ኣብ ዝተጉሓፈ ሓመድ ወይ ኣብ ወሰን ጽርግያ። ኣብ ህንጻታትን ኣብ መጓሰዪ ቦታታትን እውን ይበቁል። ካብዚ ሓሊፉ ኣብ ርባታት ኣብ ዝርከቡ ውሕጅ ዘምፀኡም ሓደሽቲ ድቦታት ወይ ናይ ሓመድ ኩምራታት ንረኽቡ። ኩሎም እዞም ስእልታት እዚኣቶም ኣብ 2016ን 2017ን ዝተሳለሉ እዮም።

Native from Mexico and surrounding countries, *Salvia tiliifolia* is mostly found in tropical, seasonally dry habitat, with a quite rapid expansion to other continents after 1980, including Ethiopia, where it has been observed in locations spread over the country. In wide areas of wasteland, the species dominates the landscape (Figure 1), while it is only marginally present in areas with natural vegetation. The growth of grasses in rangelands has been strongly suppressed by salvia and there is now a shortage in livestock fodder.

We assessed one labour-intensive approach to control this salvia species, weeding it out from extensive wastelands (7.66 ha), to decrease its presence in the next year. We will also discuss the alternate nature-based strategy, which involves managing the rangelands into exclosures, i.e. communal lands where open access for grazing or wood harvesting has been abandoned, rather than using the free grazing system to maximize grass production. In this scenario, the species will be present in the herbaceous layer but not predominate. Indeed, the conventional strategy has long been the extensive and methodical clearance of (exotic) invasive species (herbs or trees), with mixed results. The ecological integration between native plants and trees could eventually enable subduing *S. tiliifolia* at a lower economic cost.

2. *Salvia tiliifolia* characteristics

In recent years *Salvia tiliifolia*, an annual plant, belonging to the mint family, Lamiaceae (Table 1, Figure 2) has been observed to expand rapidly in Ethiopia. The species is indigenous to Mexico and nearby countries.



Figure 2. *Salvia tiliifolia*, flowering and dry. – ኡብ ምዕንባብ ዝርከብን (ፀጋማይ ስእሊ) ዝነቐፀን (የማናይ ስእሊ) ሳልቲያ።

Medicinal use: In Mexico, *Salvia tiliifolia* is used in traditional medicine as an analgesic and anti-inflammatory; these effects have been proven in the laboratory. Its leaves may be used to kill head lice.

Use as food: The seeds are known as “chia” and constitute a staple food in Mexico and Central America. *Salvia tiliifolia* is wild collected there for its chia seeds. For instance, the seeds are used to make cold drinks (a mix of raw seeds, lemon juice, sugar and water). The seed fibre produces a highly viscous mucilage when the seed becomes wet. Some people find this slimy texture unpleasant, but it helps the seeds swell, which induces a full feeling. Seeds are also

roasted and grounded, then combined with maize flour to prepare flatbread or a hot beverage. *Salvia tiliifolia* has small seeds that shatter easily, hence seed collection is difficult.

Table 1. *Salvia tiliifolia* characteristics

Plant	An erect, shortly hairy, annual herb with many branched stems, between 20 cm and 1.6 m high
Leaves	The soft, bright green leaves are arranged in pairs that alternate at a 90° angle from one another. The leaves are simple, ovate with truncate base, serrate margin, usually with wide teeth.
Flowers	Tiny blue flowers, upper calyx lip with three veins, corolla 4 - 10 mm long, clustered in spikes up to 30 cm long
Seeds	Calyx elongating to 10 mm in fruit, enclosing 3-angled ovoid nutlets (mericarps), brown and irregularly marbled with a darker tone

Note: There are several native *Salvia* species in the study region (*S. schimperi*, *S. merjamie*, *S. nilotica*), with their own local names and which do not have such a weedy behaviour. Here the common name "salvia" is specifically used for *S. tiliifolia*. – አብ ትግራይ ብርክት ዝበሉ ዓሌታት ሳልቪያ (ናይ ትግርኛ አስማት: አባደራ፡ እንጣጢዕ ወላካ፡ ፈረሽይ) ኣለው፣ ግን ድማ ሓደ ዓይነት ናይ ፃህያይ ባህሪ ዘይብሉም እዮም። ኣብዚ መዘክር እዙይ፡ ነቲ ሓደሽ ዓይነት ፃህያይ "ሳልቪያ" ዝብል ስም ተጠቒምና ኣለና።

3. Worldwide distribution

Salvia tiliifolia is mostly found in tropical, seasonally dry habitat. In recent centuries, the plant has been taken to other continents, most probably accidentally together with commercial products.

In South Africa, it has been present since the 1940s but it became a menace in many parts of the country after 2010. There, it grows in dense stands in both sunny and partially shaded sites, overruns rocky hillsides, roadsides, waste sites, urban open spaces, and prefers moist places. It rivals with native species and may eventually supplant them.

In southern China, *Salvia tiliifolia* first appeared in the 1990s. It is regarded as a high-risk plant.

4. *Salvia tiliifolia* as an invasive weed in Ethiopia

Native to Central America, it is a recent exotic invasive species in Ethiopia, first formally collected and described in the Kombolcha area in 1996. It is now quite widespread over the Ethiopian highlands.

There are hardly any studies about the behaviour and environmental preferences of this new weed species in Ethiopia. Near Harar in eastern Ethiopia, *Salvia tiliifolia* was observed to be the dominant herbaceous species in coffee plantations. In 2012, the species was reported

around Aksum. The few plant inventories where the species is recorded in Ethiopia explicitly mention that salvia has no local name (except ‘new weed’), which stresses its relatively recent introduction.



Figure 3. In the Gra Arho eucalyptus plantation, which is at the edge of Hagere Selam town, many trees have been cut in 2021 and 2022. There was almost no electricity at that time and firewood fetched good prices. The dominant dry brown herbs are the new invasive weed, *Salvia tiliifolia*. – እዚ አብ ግራ አርሆ፡ አብ ወሰን ከተማ ሃገረሰላም ዝርከብ ጫካ ቀላሚጦስ እዩ ነይሩ። አብ 2014ን 2015ን፡ አብቲ እዋን ብዝነበረ ናይ ኤሌክትሪክ ምቁራጽ ስዒቡ ዋጋ ዕንጨይቲ ክባር ስለዝነበረ ብዙሓት አግራባት ናይቲ ቦታ ተቐሪጾም እዮም። እቲ ጫካ ዝነበረ ቦታ ድማ መውዓሊ ከብትን አጣልን ክኸውን ክኢሉ እዩ። እቶም አብዚ ስእሊ ብብዝሒ ዝራኦ ዘሎ ንቕፅ ቡናዊ ዝሕብሩ ፃህያይ ድማ እቲ ሓድሽ ዓይነት ጻህያይ ሳልብያ እዩ።

Also, in the Dogu’a Tembien district, where we studied it, it arrived relatively late. Dr. Raf Aerts (K.U. Leuven University) who made extensive inventories of plant species in Dogu’a Tembien and adjacent districts during the period 2001-2006, explicitly mentioned that this species was absent at the time (personal communication). Farmers commonly mention approx. 2019 as its time of arrival in the district capital Hagere Selam, where it has totally invaded grassy areas surrounding the town, particularly those with heavy livestock browsing (Figures 1 and 3; Table 2). The species is not toxic, but according to the farmers useless, and it occupies space. Also here, there is no local name for the plant. On well-managed farmlands, one will generally not observe this weed because the farmers remove it very easily: easy to identify, easy to pick out. *S. tiliifolia* is now the main weed; it grows rapidly and even suppresses the other weeds.

Table 2. Occurrence of *Salvia tiliifolia* around Hagere Selam, as observed in the field in November 2023 and September 2024. All sites are open to livestock grazing, except otherwise indicated.

Dominant among herbaceous species	Conspicuous in the herbaceous layer
<i>Eucalyptus</i> plantation (open or semi-closed canopy)	Grass strips between croplands (not grazed)
<i>Acacia</i> woodland	Banks of ephemeral waterway
Wasteland near town	In gullies
Formal waste dump	Banks of grassed waterway (not grazed)
Dirt roadsides at urban fringe	At the edges of a permanent spring (not grazed)
Rocky gorge	
Coarse alluvial deposits	
Sides of footpaths and rural roads	

Note: *Salvia tiliifolia* was not seen in rainfed and irrigated croplands, because the species is weeded out. No observations either in exclosures with dense vegetation.

The localized dominance of this salvia weed in the herbaceous layer seems an extreme manifestation of the typical mechanism by which invasive weeds proliferate in such settings. Browsing livestock continually removes the other herbs while avoiding the unpalatable salvia. The low grass and other herbs are further suppressed by the salvias. Visual observations show that salvia is not prevalent in places with reduced grazing pressure - such as those with "cut & carry" grass harvesting or exclosures, i.e. communal lands where open access for grazing or wood harvesting has been abandoned.

5. *Salvia tiliifolia* control worldwide

Salvia tiliifolia spreads by seeds that drop when the plant dries after the rainy season; the seeds may be transported to adjacent places by mammals and birds.

In its region of origin, it is not considered as a major problem, though it occurs as weed in coffee orchards and also along roads and at the edges of field crops. There, it usually does not grow in big numbers.

The situation is however different in other continents. In southern China, it was suggested that land managers in the area monitor the species and take action to stop its spread.

In South Africa, *Salvia tiliifolia* is regarded as a difficult plant to control since it just keeps growing back and will not go away until every plant in an area is removed but in hot and dry years the plant is strongly subdued. In South Africa, it is recommended to uproot the plants before they flower and set seed.

6. *Salvia* weed control in Tigray

a. Study area, semi-natural vegetation, and farming system

The research region, the Dogu'a Tembien district, is situated between 30 and 70 km west of Mekelle, the regional capital. Overall, Tigray is hot semi-arid, and annual rainfall ranges from 500 mm to 900 mm. There is a long-term tendency toward increased precipitation and warmer temperatures. In Hagere Selam, yearly rainfall from 2016 to 2022 ranged from 770 to 850 mm, 7 to 18% over the long-term normal.

In this mountain area, the farming communities typically use steeper slopes as rangeland, where livestock is allowed to wander freely, and the more level areas for crops. Oxen are used for traction in the small-scale family farms of Tigray, which follow a permanent farming system based on cereals. Goats and sheep are also raised, primarily as a safety net in case of emergencies. After harvest, stubble grazing occurs on cropland as well. As a remarkable move, many sloping lands—both rangelands and marginal croplands—have been converted into exclosures over the past 40 years. The natural vegetation is mainly open *Olea-Acacia* woodland, remnants of the primary dry Afromontane evergreen forests. The woodlands have a low, single-story, discontinuous canopy and comparatively few tree species. Under this open canopy, grasses and herbaceous vegetation appear during the rainy season.



Figure 4. *Salvia* weeded out from croplands in Addi Qolqwal and left to dry in a rocky area. – ኣብ ዓዲ ቆላቄል ካብ ግራውቲ ተፃህዩ ኣብ ከውሒ ንኽነቅፅ ዝተሰጥሐ ፃህያይ ሰልብያ ።

b. Farmers' salvia weed management on croplands

The farmers in the study area have experience with uprooting salvia weed, which is quite easy, because very recognizable and the roots do not resist much. On their farmlands they weed it out manually (Figure 4). However, and depending on time constraints, it is often not weeded out from farm boundaries (Figure 5) and rangeland nearby farmlands, which will be a source of salvia weed seed in the next cropping season.



Figure 5. *Salvia tiliifolia* left to grow at the edge of a wheat field in Hech'i. – ኣብ ወሰን ስርዓይ ዝተዘርአ ግራት ዝበቐለ ፃህያይ ስለሺያ ።

c. Weed control experiment on communal land

A much-followed approach in annual weed control is removing plants before they set seed. Whereas it is impossible in this way to totally “get rid of” the invasive plant, it may subdue the growth in that area in the next year, and with annual repetitive removal, exhaust the seed bank. For instance, in South Africa, manual removal of *Salvia tiliifolia* before it sets seed is promoted.

We have selected a heavily infested area at the outskirts of the town of Hagere Selam and discussed with the community. Overall, in the discussions, the approach of exhausting the seed bank in this way was approved, and it is similar with the way in which farmers handle for instance thistles on and around their farmlands. However, traditionally, weed removal is the

responsibility of the landholder, and is not done through organized community work, which is reserved for other works of public interest such as soil and water conservation, reafforestation, school building etc.

As a matter of experiment and demonstration, we have organized the weeding out of salvia on 7.66 ha of land, just east of Hagere Selam, as paid work. The area is heavily infested by salvia (Figures 1 and 3), and consists of roadsides, waste dumping areas, an open eucalyptus plantation, an ephemeral stream, rock outcrops and several footpaths. It also functions as a standing place for livestock nearby the formal cattle market (on Saturdays). Grazing pressure on this land is high.



Figure 6. Community salvia weeding in a rangeland near Hagere Selam. The agave live fence marks the boundary with the “Meles Park”. – ማሕበረሰብ ኣብ ወፈሪ ምፅሃይ ፃህያይ ሳልቪያ ኣብ ጥቓ ሃገረሰላም ኣብ ዝርከብ ቦታ፡፡ እቲ ብዲቃ ዝተሐፀረ ዝመስል ሓፁር ድማ ናይ “መናፈሻ መለስ” ወሰን እዩ ።



Figure 7. Salvia weeding at the outskirts of Hagere Selam. At lower right and upper left in the photo, heaps of weeded salvia are visible. – ማሕበረሰብ ኣብ ወፈሪ ምፅሃይ ፃህያይ ሳልቪያ ኣብ ወሰን ከተማ ሃገረሰላም፡፡ ኣብ የማናይ ጎረ ናይ ታሕተዋይ ወገንን ጸጋማይ ጎረ ናይ ላዕለዋይ ወገንን እቲ ስእሊ ኩምራታት ናይቲ ዝተፅሃየ ሳልቪያ ይረኣዩ።

Workers for salvia weeding were recruited through the traditional ‘idir neighbourhood association; 61 people participated in the weeding and a total of 340 person-days (between 30 September and 9 October 2024) were necessary to weed the overall steep land through group work (Figure 6).

The work was considered difficult because of the presence of steep slopes and because it functions as a waste dump area. Due to the war and its aftermath, municipal services have not yet fully resumed, so people continued dumping waste at the outskirts of the towns.

When the weeding started, *Salvia tiliifolia* plants were relatively high, at the verge of setting seed, and the soil was quite dry already, as the rains had stopped some weeks earlier. Better would have been to weed it a month earlier. Sometimes plants could be pulled up, but often they were cut by sickle (Figure 7). When very dense, the weeding operation was done in rows of workers, just like the harvesting of crops (Figure 8).



Figure 8. Community salvia weeding at Gra Arho near Hagere Selam. Labourers organized themselves in lines, just like for weeding or harvesting cropland. – ማሕበረሰብ ኣብ ወፈሪ ምፅሃይ ፃህያይ ሳልቪያ ኣብ ግራ ኣርሆ ከባቢ ሃገረሰላም። ኣብዚ ስጵሊ እዚ ሽቃሎ ልክዕ ከምቲ ግራውቲ ንምፅሃይን እኹሊ ንምፅፃድን ዝገብርዎ መስመር ሒዞም ተወዲቦም ፃህያይ ሳልቪያ እንዳፀሃዩ ከለዉ ይረኣዩ።

On 17 October 2024, the 50-cm high heaped weeds were sufficiently dry for controlled burning.

The weeding of the total 7.66 ha required 340 person-days, and two weeks later, an additional 5 person-days for burning the collected weed heaps. Totally, this corresponds to 45 person-days per ha for a one-time manual salvia weeding operation in wasteland. This will need to be repeated year after year, while the workload is expected to gradually decrease.

d. Natural control of salvia weed

In the nearby exclosures, in the period of the salvia weeding experiment on wasteland, the communities harvested grasses from their exclosures. In between the grass, salvia coexisted with other herbs in several exclosures, especially in the "Meles Park" next to the salvia-infested area, but it did not dominate. The grasses and herbs—including salvia—were all harvested together (Figure 9), to serve as fodder for livestock. In contrast to thistles for instance, farmers accept salvia as a part of the harvested hay.



Figure 9. View of “Meles Park”, an exclosure near Hagere Selam, just after grass cutting. Grasses and most herbs, including salvia, have been harvested together and used as fodder for dairy cows. — ትርኢት ፓርክ መለስ ከባቢ ሃገረሰላም፡ ድሕረ ምዕፃድ ሳዕሪ ። ሳዕርን ሳልቫዎ ሓዋሱ መብዛኢትኦም አትክልትን ብሓባር ተዓዲዶም ከም ምግብ ጸባ ንዝህባ ኣላሕም ኣብ ጥቕሚ ውዲሉ እዩ።

Similarly to Dogu’a Tembien, in other districts of Tigray, salvia grows densely in areas disturbed by humans and livestock, while it is totally absent in exclosures away from roads (Figure 10). Establishing exclosures hence seems the most cost-effective strategy to control salvia weeds, while sustaining fodder production. Reversely, opening the exclosures for free grazing to relieve the fodder crisis caused by the salvia invasion would only result in the opposite effect, with the exclosures being invaded by salvia weeds in turn.



Figure 10. At Jira (tabiya Doctor Ataklti in Keyih Tekli district), *Salvia tiliifolia* grows densely along footpaths (upper photo), while it is totally absent from the adjacent exclosure (lower photo). – እዘን ስእልታት እዚኣን ኣብ ጂራ (ጣብያ ዶክተር ኣታኽልቲ ወረዳ ቀይሕ ተሽሊ) ዝተወሰዱ ክኾና ከለዎ እቲ ላዕሊዎይ ስእሊ ኣብ ጥቓ ናይ እግሪ መንገዲ ፅዕቕ ኢሉ ዝበቐለ ሳልቪያ ከሪኤና ከሎ እቲ ታሕተዎይ ስእሊ ድማ ኣብ ጎኒ እቲ ኣብ ላዕሊዎይ ስእሊ ዝተርአየ ቦታ ኣብ ዝርከብ ዝተሓዘአ ወይ ዝተሸልከለ ቦታ ዝበቐለ ፃህያይ ሳልቪያ ፍፁም ከምዘየሎ የሪኤና።

7. Conclusions

Salvia tiliifolia is omnipresent, and it is there to stay. The way in which livestock is traditionally managed, with free movement throughout the landscape helps spreading the weeds. As free grazing is still the dominant way of feeding, which has even expanded due to the Tigray War, livestock strongly contributes to the vigorous salvia weed growth, as potential competing

plants are systematically removed from the grazing lands through browsing. In exclosures where grass is harvested and carried off, *Salvia tiliifolia*, if present, is just one among the many other flowering plants.

The large patches of *Salvia tiliifolia* that nowadays cover grazing lands are an important seed source for salvia weeds on croplands, where its weeding is an added burden for farmers.

Basically, there are two options for the communities in the study area to subdue salvia. Either they shift away from the free grazing system, turn the rangelands into managed exclosures to optimize grass production. At heavily infested places, the salvia will need to be weeded out when establishing the exclosure. After that, salvia may still be present but not dominate. In this way the most important seed source is under control, and there will be less weeds invading the farmlands.

Alternatively, yearly the villages need to organise large community works to weed out salvia from their communal grazing lands. Preferentially, this must be done amid the rainy season, when uprooting is easy with relatively small plant size and moist soil. In the first years it will be large work, but with time seedbanks diminish and weeding of rangelands would remain necessary but need lesser amounts of work. The main issue here is that such weeding activities should take place exactly in the same period when there is much work on farmlands, including weeding.

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