

Consultancy on a tree seed sub-sector assessment

August 2019

TECHNICAL

**Provision of Adequate Tree Seed Portfolios' (PATSPO Project) –
Consultancy on a tree seed sub-sector assessment**

August 2019

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Consultancy Report for PATSPO

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1. PATSPO Project – context for the consultancy

The ‘Provision of Adequate Tree Seed Portfolios’ (PATSPO Project) is designed to support the Government of Ethiopia in its large forest land rehabilitation programme, in particular through strengthening of the tree seed sector in the country. The expected impact (or development goal) of PATSPO will be enhanced current and future landscape restoration activities in Ethiopia involving the use of trees.

The main effect will be through increased productivity by (i) making available better adapted planting material, and (ii) improving the accessibility of the material from nurseries to tree planters and appropriate post planting management to ensure survival and optimal growth.

To meet the project purpose, four major outputs have been identified: 1) Seed sector analysis and development including delivery systems, 2) Tree seed and seedling knowledge and information systems, 3) Mobilising and building the tree genetic resources for the future, and 4) Capacity building of the national tree seed sector in Ethiopia.

It is assumed that no single institution in Ethiopia will ever be in a position to control and coordinate seed procurement, tree improvement or gene resource conservation at a national scale. The project will consequently emphasise support to the national and regional institutions (tree seed centers, NGOs and private companies) engaged in tree seed procurement.

The major support will be given to i) institutional setup; ii) knowledge development, compilation, and dissemination; iii) establishment of seed production cum gene conservation areas and iv) human resource development.

The role of the private sector and the interaction between private business, civil society organisations (NGOs) and the government regulations and institutions are considered of particular importance.

The project document estimates that to meet about half of the restoration targets with planting will require some 500 million seedlings annually, which using a variety of species with different seed characteristics will amount to some 250 tons of seed per year. Direct sowing of a relatively small area, e.g. 50,000 ha would alone require the same amount. Collection and handling of the right seeds for the right place and the right purpose in such amounts is a huge challenge. But if the initial target is going to be 250 tons per year of 20 species or 1000 tons of only 10 species can only be realistically determined after a survey has taken place.

1.1 ToR Consultancy – Major objectives related to the consultancy

“The consultants will study in detail the tree seed situation in Ethiopia, analyse the seed supply/seed demand situation, and from this, make recommendations on the necessary course of action to be undertaken by the project. Specific tasks will be as follows (the tasks in italics are addressed in this report):

- *Survey of current and planned planting programmes in the country.*
- Survey all existing seed sources in the country.
- *Survey existing seed procurement practises and institutions in the sector*
- *Survey existing nursery structure (location, capacity, species, owners, customers).*
- *Establish the main constraints to effective use of tree seed in the country and recommend the necessary seed research and extension activities to overcome them.*
- *Make a critical analysis of seed supply/seed demand situation in the future with a view towards defining seed supply potential from local sources, the needs of development of new seed sources, seed importation needs and institutional development in the sector*

1.2 Policy, strategic and institutional contexts

Ethiopia’s development policies and strategies have been implemented through preparation and implementation of development plans. The past plans include the Plan for Accelerated and Sustainable

Development to End Poverty (PASDEP) from 2005/06-2009/10), and the first Growth and Transformation Plan (GTPI) from 2010/11-2014/15 (MoFED 2010). The national development plans describe the strategic directions, objectives and targets for the different economic and social sectors.

The country has in 2011 launched an ambitious plan of becoming "green economy front-runner" in its Climate Resilient Green Economy (CRGE) strategy (FDRE 2011). The vision of CRGE is to achieve middle-income status by 2025 in a climate-resilient green economy, while limiting 2030 GHG emissions to around today's 150 Mt CO₂e – around 250 Mt CO₂e less than estimated under a conventional development path. The CRGE is based on four pillars- agricultural improvement, forest development and protection, expansion of power generation, and modernizing transport, industrial sectors and buildings. The CRGE outlines that about 9 million ha of land could be deforested by 2030 for agricultural expansion and it needs to be reversed. It also outlines that 3 million hectare of land should be put under afforestation and reforestation and 4 million ha of forests and woodlands need to be under sustainable forest management by 2030 for improved abatement potential.

The second Growth and Transformation Plan (GTPII) has been under implementation as of 2015/16 to 2019/20. The GTPII agricultural sector development plan targets for accelerated and sustained growth of agriculture within the framework of the Climate Resilient Green Economy Strategy and include increasing the area of land rehabilitated through area closure from 10.86 million hectare in 2014/15 to 22.54 million hectare by the end of the plan period, and increasing the area of watersheds supported with physical soil and water conservation structures from 8.12 million hectare in 2014/15 to 27.23 million hectare by the end of the plan period. In addition, the GTPII sets a target of increasing the national forest coverage from 15.5% in 2015/14 to 20% by the end the GTP II period.

Furthermore, Ethiopia has pledged to restore 15 million hectares of land by 2030 under the Bonn challenge, which is a global effort to bring 150 million hectares of degraded and deforested land into restoration by 2020 and 350 million hectares by 2030. Forest landscape restoration, which is the country-driven process for regaining ecological functionality across forest landscapes through various intervention that includes tree planting, underlies the Bonn challenge. The Bonn challenge commitment of country is expounded by further commitments in the UNFCCC summit in New York in 2014 to 22 million hectares for the implantation of the Paris Agreement to the UNFCCC. Ethiopia is also party to the Pan African Great Green Wall for the Sahel and Sahara Initiative (GGWSSI) to establish a green wall to prevent the expansion of the Sahara Desert

In addition, The REDD+ program of Ethiopia is believed to play a significant role in achieving the ambitious goals of Ethiopia's green growth goals. The REDD+ program is planned to be up-scaled to the national level after piloting in selected regional states. First, a regional REDD+ program was designed for the Oromia from 2013 – 2015 and its implementation has started in 2017. Following that, additional regional REDD+ programs have been initiated in three regional states namely, Southern Nations Nationalities and Peoples, Amhara and Tigray. The program mainly focuses on conservation of forests and restoration of lost forest areas. The REDD+ strategy, in the short term, emphasizes on the sustainable management of existing natural forests and increasing forest cover through afforestation/ reforestation and rehabilitation of degraded forests.

Ethiopia has recently issued a Forest Development, Conservation and Utilization Proclamation (FDRE, 2018). The proclamation identifies four types of forest ownership: private forest, community forest, association forest and state forest, which is further classified as productive forest, protected forest and preserved forest. The private forest is recognized as a forest other than state or community forest; community forest is a forest developed, conserved, utilized and administered by community; association forest is developed, conserved, utilized and administered by associations established to develop forest; and state forest is a forest conserved or a productive forest under the ownership of the federal government or a regional state. It stipulates the rights (and incentives) and obligations of private forest developers, community forest developers and associations of forest developers.

The aforementioned national policies, strategies and development plans and international pledges are translated into practice with government institutions, NGOs and the public through resources mobilized from the financing of the Ethiopian Government and the Development Partners. The Ministry of Agriculture

(and Natural Resources/ Rural Development/ Livestock) and the respective Regional Bureaus are the major players in implementing the Agricultural policies, strategies and plans. The Ministry of Agriculture (MoA) has been also responsible for forestry and agroforestry activities. However, with the establishment of the Ministry of Environment and Forest (MEFCC) in 2013, the forestry and agroforestry related duties and responsibilities of the Ministry of Agriculture has been shared between the two Ministries. National Forest Sector Development Program (NFSDP) was initiated by MEFCC with the goal to provide the master plan that serves as the roadmap for future forestry actions considering the mandate of National Regional States for natural resources management and other stakeholders (NFSDP, 2018a, 2018b, 2018c). The Ministry of Environment and Forest was renamed as the Ministry of Environment, Forest and Climate Change (MEFCC), and as of October 2018 it is organized as the Ethiopian Environment, Forest and Climate Change Commission (EECCC).

2. Tree seed supply/demand situation

2.1 Estimating demand

Federal Government sets national targets for tree planting as given in the Growth and Transformation Plans (GTP) of MoA and MEFCC. The Regional States have their corresponding GTP targets for tree planting, which are cascaded down to Zonal and Woreda levels. The statistics at the levels above Woreda are only indicative targets (see Table 1) for number of seedlings to be planted.

Until a few years ago, all tree-planting activities were under MoA, which has extension agents in all regions down to the Kebele level. Agroforestry is still within the mandate of MoA.

Table 1 below shows the number of trees planted as per the GTP plan for Ethiopia. Almost all tree planting takes place in the 4 provinces of Oromia, SNNP, Amhara and Tigray. The corresponding areas planted assume a certain planting density, which are averages of different situations. Typically, plantations (of exotic species) will have higher planting density than planting (mainly indigenous species) for restoration. The fiscal planning process in Ethiopia is highly decentralised and with plan targets cascading from Federal to Regional and down to Woreda/Kebele levels and reporting on fulfilment of plans accumulating upwards from Woreda/Kebele to the Federal level. Because targets are obligations that are linked to fiscal support, it is likely that reporting will aim to fulfil the targets, such that numbers reported in table 1 are somewhat higher than the reality in the field.

Table 1. Planted seedlings in 2016/17 and planned seedling production in 2017/18

No.	Region	Planted seedlings in 2016/17		Planned seedling production in 2017/18	
		No. of seedlings ¹ (billion)	Area (Ha)	No. of seedlings ¹ (billion)	Area (Ha)
1	Oromia	1.31	207,778	1.56	389,557
2	SNNP	0.86	193,135	1.00	227,506
3	Amhara	1.21	184,851	1.53	287,390
4	Tigray	0.15	68,000	0.15	79,880
5	Other	0.02	9,902	0.03	15,667
Country total		3.55	663,666	4.27	1,000,000

Source: MEFCC 2010 FY Plan.pdf (translated by Abayneh Derero). The targets include all tree planting (MEFCC and MoANR).

¹These numbers correspond to plants per hectare from 1,915 to 6,546 and corresponding to planting distances of respectively 1.2m and 2.3m (see calculation in appendix 1)

2.1.1 Major conditional grant programmes under MoA - Federal, Regional and Local.

The major conditional grant programmes under MoA, supporting tree planting, are (i) Sustainable Land management programme (SLMP), Productive Safety Net Program (PSNP), and Agricultural Growth Program (AGP). **MEFCC** coordinates a relatively large number of smaller projects under the CRGE umbrella and REDD+.

MoA does not (seem to) compile statistics on planting of individual species (personal communication Girma Kibret, SLMP II), however a survey on SLMP was conducted for the year 2007/2008 E.C (2015) from which we could count seedling production per species (see table 2 below for regional counts of seedlings and appendix 4 with species-wise details). For PNSP we found data from 2011 (see table 2), which may illustrate the probable magnitude of tree planting under that programme. For AGP, which probably to a larger degree than the other two programmes support planting of fruit trees and other cash crops (but not exclusively), we have not found quantitative data on number of seedlings produced or trees planted. However as indicated in the table 2 below, a considerable proportion of household plant trees under the AGP. It appears that about 1.1 billion tree seedlings are planted through support from SLMP and PNSP or about 30% of the overall GTP target for Ethiopia.

Table 2. Data for SLMP, PSNP and AGP

		2015	2010-15 (annually)	2009-2011
		SLMP1	PSNP2	AGP-tree planting3
		Seedlings	Seedlings	% communities planting
1	Oromia	816,316,082		0.0
2	SNNP	37,434,367		12.0
3	Amhara	39,024,325		8.1
4	Tigray	4,153,072		24.3
5	Other	14,780,210		
Total		911,714,057	232,394,742	

1 Raw data from Girma Kibret, SLMP II (June 2018); 2 World Bank (2017); 3 Berhane et al. 2013)

SLMP is the largest single tree planting programme in the Ethiopia (around 1/5 to 1/4 of seedlings planted, depending on the estimated total number¹). The categories of planting situations are: communal land, farm land, woodlot, gullies, and backyard/homesteads. The planting distances for these types of plantings are probably quite high (except for woodlots). The proportions of indigenous to exotic species (Ind./Exot.) varies between regions from 0.2 to 2.8 and probably reflects priorities between establishment of woodlots (mainly exotics) and other planting situations. See appendix 4 for distribution of species in four regions.

Table 3. Exotic and Indigenous species planted by SLMP

Region	# species – Exotic	# species – indigenous	# Seedlings – Exotic	# Seedlings – indigenous	Ind./Exot.
Amhara	25	18	23,306,821	15,717,504	0.7
Oromia	22	18	674,036,500	142,279,582	0.2
Tigray	10	13	1,105,802	3,047,270	2.8
SNNP	21	19	16,691,647	20,742,720	1.2

Source: Raw data from Girma Kibret, SLMP II (Kibret, June 2018). Species lists can be seen in appendix 4.

¹ 0.9/4.27 to 0.9/3.55

A rough estimate would be that the projects under MoA plant some 1,2 billion seedlings or about 30% of the overall GTP target for Ethiopia.

2.1.2 Projects under the umbrella of MEFCC and Forest Enterprises

Direct tree planting is one of several types of intervention in these projects, which occur in all four regions. For example, the Short Rotation and Rehabilitation Project planted about 16 million seedlings in 2017 (2009, Ethiopian calendar). MEFCC does not compile information on tree planting in these projects.

The two large Forest Enterprises in Amhara and Oromiya have their own plantation programmes (on own land and outsourced to smallholder farmers). Amhara Forest Enterprise produced around 13 million seedlings in 2016-17 (some 2.6-3.5 million seedlings planted). Oromiya Forest Enterprise produced around 17 million seedlings in 2017 (and around 18 million seedlings in each of 2015 and 2016).

A rough estimate would be that the projects under MEFCC plant some (five) hundreds of millions of seedlings or about 14% of the overall GTP target for Ethiopia.

2.1.3 Non-Governmental Organisations (NGOs) in Ethiopia.

A large number of tree planting NGOs operate in Ethiopia, many of which are customers of the Tree Seed Centres. We organised a survey through SurveyMonkey.com and visited several of the larger NGOs – all in the hope of obtaining information on their distribution of seedlings. The response was disappointingly low.

Two Ethiopian NGOs, Relief Society of Tigray (REST) and Organization For Rehabilitation and Development in Amhara (ORDA) produce respectively around 17 million and 9 million seedlings per year, while others² produce between 20,000 and 700,000 seedlings per year

We estimated average seed/seedling use based on seed purchases from the Tree Seed Centres (see appendix 2). If these averages represent NGO seed use, it would correspond to actual seedlings to between 85,000 to 820,000 seedlings planted per NGO. Taking this as a yardstick, a hundred NGOs would perhaps plant around 80-350 million seedlings per year. It seems that NGOs directly contribute relatively little to the GTP figure of 3.55 billion seedlings planted. However, there is a possibility that NGOs have switched from procuring seed from the Tree Seed Centres and instead procure seed from local seed collection in their project areas and from private suppliers. For example, until recently World Vision was the largest customer at the FRC seed centre but has now decentralised seed procurement. A tentative estimate would therefore be that NGOs contribute to some 10% of the GTP plan.

Overall the combined demand through the programmes of MoA, MEFCC, and NGOs may correspond to about 2 billion out of the GTP plan figure of 4.27 billion (see also Table 1). We assume that the unaccounted 2.27 billion target is supposed to be met by government, community and private plantings that are not accounted to any of the above programmes.

2.2.1 Supply from the Tree Seed Centres

The Tree Seed Centres produce seed that correspond to the production of around 600-800 million seedlings (after correcting for mortality in the production, using standard estimates of mortality), see table 4. The Tree Seed Centres may thus supply between 17 to 22% of the estimated demand³. Reporting in weight of seed is less informative, as seed weight can vary enormously, than converting weight of seed into numbers of seeds

² Action For Development (AFD); Organization for Sustainable Development(OSD); Catholic Relief services(CRS),Ethiopia; Hope Ethiopia; SOS Sahel Ethiopia- Hawassa Field Office

³ 0.6/4.27 to 0.8/3.55

per kg x weight of seed. The exotic plantation species (e.g. eucalypts and *Cupressus*) and *Sesbania sesban* (which may be of two varieties⁴) have very small seed (see also appendix 8 for seed weight of species).

Table 4. Sales of seed from 4 TSCs in 2009/2016-2017

Tree Seed Centre	# Customers	# Kg	# Seedlings
Amhara	446	14,926	985,575,106
Oromia	259	25,984	1,757,902,113
FRC	256	3,331	157,939,595
Hawassa	228	9,067	418,327,130
Total (without reduction for mortality)			3,320,743,944
Reduction for seed and seedling mortality x ¼			830,185,986
Reduction for seed and seedling mortality x 1/5			664,148,789

Source: Data provided by the Tree Seed Centres and compiled by authors

The tree seed centres supply seed based on the demand and the low ratio (Ind/Exot.) of indigenous to exotic species indicate that most of their customers demand seeds for plantation and woodlot establishment (see table 5). See appendix 5 for sales of species in four regions.

Table 5. Exotic and Indigenous species sold by the Tree Seed Centres

Tree Seed Centre	# species – Exotic	# species – indigenous	# Seedlings – Exotic	# Seedlings – indigenous	Ind%.
Amhara	16	22	891,917,975	94,657,131	10%
Oromia	19	12	1,245,361,763	512,540,350	29%
FRC	13	13	120,747,650	37,191,945	24%
Hawassa	3	9	358,676,500	59,650,630	14%

Source: Data provided by the Tree Seed Centres and compiled by authors. Species lists can be seen in appendix 5.

The tree seed centres collect seed from many sources (table 6). Farmland sources comprise indigenous and exotic trees growing in farmland either as remnants of natural vegetation or as trees planted by farmers. Natural forests are the remaining natural forest and rarely have exotic species (unless the species have been naturalised). Plantations are mainly exotic industrial plantation species. An important PATSPO activity is to describe the sources to document their genetic quality.

⁴ The species *Sesbania sesban* occurs in Ethiopia with two varieties. Var. *nubica* is native to Ethiopia, while Var. *sesban* is introduced (and cultivated for many years in Egypt og Sudan). It would require a separate botanical investigation to know with any certainty their relative abundance in nurseries. We will treat *Sesbania sesban* as an indigenous in this document.

Table 6. Tree Seed Sources in the four tree seed Centres

Tree Seed Centre	Farmland	Natural Forest	Plantation	Others	Total
Amhara – Exotics	0	1	113		114
Amhara – Indigenous	22	52	8		82
FRC – Exotics	0	0	22	7	29
FRC – Indigenous	3	12	2	3	20
Hawassa – Exotics	4	0	4		8
Hawassa – Indigenous	23	18	0		41
Oromia – Exotics	63	2	43		108
Oromia – Indigenous	32	34	7		73
Total	147	119	199	10	475

Source: Data provided by the Tree Seed Centres and compiled by authors.

2.2.2 From seedlings to hectares

Comparing the sales information from the Tree Seed Centres with the SLMP data, the most obvious difference is the different ratios of indigenous species to exotic species and correspondingly to the type of planting (plantations and woodlots versus restoration plantings). Planting distances vary considerably between the two different planting situations and thus the areas (hectares) covered per number of seedlings planted.

Restoration plantings, for example homegardens, gullies, communal lands typically have larger planting distances than plantations and woodlots. Planting distance in homegardens (backyard/homesteads) vary considerably from 4.6m to 8.9m (Tesfaye et al., 2013; Endale et al., 2017).

Planting distance in woodlots varies from less than a meter to 2 m for *Eucalyptus camaldulensis* and *Eucalyptus globulus* (Jagger and Pender, 2000) and the stocking can reach as high as 50,000 stems per ha (Bekele, 2011). Planting distances vary in government plantation between 2x2m to 2.5x2.5m (Bekele, 2011; Jiru and Mihretu, 2010; Pukkala and Pohjonen (1993).

To get estimates of planting areas, it is necessary to average the numbers. One way to do it is as follows:

The total number of seedlings planted in table 1 are 3.55 billion and 4.24 billion seedlings for respectively 2016/17 and 2017/18. The average proportion of “Ind./Exot.” in tables 3 and 5 are respectively 1.2 and 0.25 and the average of those two are 0.7 (about 4/6). We will use 6 meters as the average planting distances for indigenous species in restoration plantings (about 280 plants per hectare), and 2.5 meters as the average planting distance for exotic species in woodlots and plantations (about 1600 plants per hectare).

The results in table 7 are approximate, but it is useful to separate the two kinds of species (exotic and indigenous) because they are used in different types of planting situations. Even though the seed/seedling production of exotic species is higher, it covers fewer hectares, because of the higher planting density in woodlots and plantations.

Table 7. Estimating Exotic plantation species and indigenous restoration species in the GTP plan

	Total Seedlings (Billions)	Year	Indigenous # seedlings (Billions)	Exotic # seedlings (Billions)	Indigenous # hectares	Exotic # hectares
Total	3.55	2016/17	0.4 x 3.55= 1.42	0.6 x 3.55= 2.13	1.42/280= 5,071,429	2.13/1,600= 1,331,250
Total	4.24	2017/18	0.4 x 4.24= 1.70	0.6 x 4.24= 2.54	1.70/280= 6,071,429	2.54/1,600= 1,587,500
Oromia	1.31	2016/17	0.52	0.79	1,871,429	491,250
Oromia	1.56	2017/18	0.62	0.94	2,228,571	585,000
SNNP	0.86	2016/17	0.34	0.52	1,228,571	322,500
SNNP	1.00	2017/18	0.40	0.60	1,428,571	375,000
Amhara	1.21	2016/17	0.48	0.73	1,728,571	453,750
Amhara	1.53	2017/18	0.61	0.92	2,185,714	573,750
Tigray	0.15	2016/17	0.06	0.09	214,286	56,250
Tigray	0.15	2017/18	0.06	0.09	214,286	56,250

Note: See text for proportion Ind./Exot. and for planting density, See the row “Total” to see details of calculation; In last two rows multiplication with 1,000,000,000 is not shown.

From tables 1 and 7 it is now possible to estimate (in table 8) how much the tree seed centres contribute to the GTP plans in three regions (Oromia, SNNP, and Amhara). It seems clear that the TSCs covers a much larger proportion of the exotic species than the indigenous species. The comparison is relatively crude (because of the very limited information available), but it does support the intuitive notion that it is much easier to access seed of the small-seeded exotic plantation species as compared to most indigenous species (except perhaps *Sesbania sesban*, see footnote 3 above and appendix 5 for the example of Oromia indigenous species).

Table 8. Exotic and Indigenous species in Hectares TSC compared to GTP plan for 3 regions

Tree Seed Centre	# Seedlings Indigenous TSC	# Seedlings Indigenous GTP Plan	# Seedlings – Exotic TSC	# Seedlings – Exotic GTP Plan	% of Indigenous 2016	% of Exotics 2016
Oromia	512,540,350		1,245,361,763			
In hectares	1,830,501	1,871,429 ¹	778,351	491,250	98% ¹	158%
SNNP	59,064,750		358,676,500			
In hectares	210,946	1,228,571	224,173	322,500	17%	70%
Amhara	94,657,131		891,917,975			
In hectares	338,061	1,728,571	557,449	453,750	20%	123%
FRC	37,191,945		120,747,650			
In hectares	132,828		75,467			

Source: Data from tables 1 and 7. ¹ A very large proportion of indigenous seedlings are of one species, *Sesbania sesban*.

3. Private seed suppliers, local collection - Regions, Zones or Woredas? – Where are plans translated into decisions on procurement of species?

As described above, the information at a central level is inadequate for determining with a good level of precision demand and supply of tree seed in Ethiopia. The interactions in the tree seed sector are governed by many actors, with most interactions invisible to the Tree Seed Centres. It must therefore be almost impossible for the tree seed centres to respond efficiently to demand and supply as there is no transparent market place.

As described above, it appears that the Tree Seed Centres provide less than half of the seed for the planting programmes in Ethiopia. However, by converting seed numbers into hectares, it seems that the Tree Seed

Centres cover a large proportion of the exotic plantation and woodlot programmes, and less of restoration with indigenous species.

A large proportion of seed used in Ethiopia appears to be provided by private seed suppliers and by local procurement. We have compiled a list of around 85 seed dealers (the majority from Amhara and SNNP regions), the actual number is likely to be considerably higher (see below for survey results) - Amhara region is actively registering seed dealers, while in SNNP regions, where seed dealers are well known, no registry of seed dealers is kept. Oromia and Tigray probably have more seed dealers than we have identified. Time has not permitted a detailed survey of their sales, but our visits revealed that several of the businesses are well-organised and large scale. A consistent concern of the seed dealers is the lack of seed quality criteria in government procurement decisions, which according to the seed dealers makes it difficult to compete on quality.

The most parsimonious explanation, for lack of information at a central level on procurement of amounts of seed for species, is that decisions on procurement of seeds of specific species take place at the decentralised level of Woredas or perhaps even at Kebele levels. The description of the administrative planning processes between Kebeles/Woredas-Zones-Regions (Baraki, 2015, see also appendix 3) does indicate that the administrative level of Woreda is the point where general plans for tree planting are translated into actual procurement of species. It is quite possible that much of the seed is collected locally on the initiative of local governments in the more than 700 Woredas in the country. It is also likely that the influence of MEFCC/MoA on seed procurement is proportional to the number of Woreda level staff of each line ministry at Woreda level. This in turns seems to indicate that MoA is the dominant influence on species selection in the decentralised procurement by Woredas.

However, judging from the TSC sales (see figure 1), it seems that the patterns differ between the regions (see figure 1 below). For Amhara, substantial purchases are done by the Woreda Bureaus (3 times more than Regional Bureaus and some 28 times more than Zonal Bureaus). For FRC only Woreda Bureaus have considerable purchases, while Regional and Zonal Bureaus do not appear as customers. For Oromia, purchases by the Regional Bureau is 5 times larger than Woreda Bureaus and 35 time larger than Zonal Bureaus. For Hawassa Zonal Bureaus are 13 times larger than Woreda Bureaus and Regional Bureaus do not appear as customers.

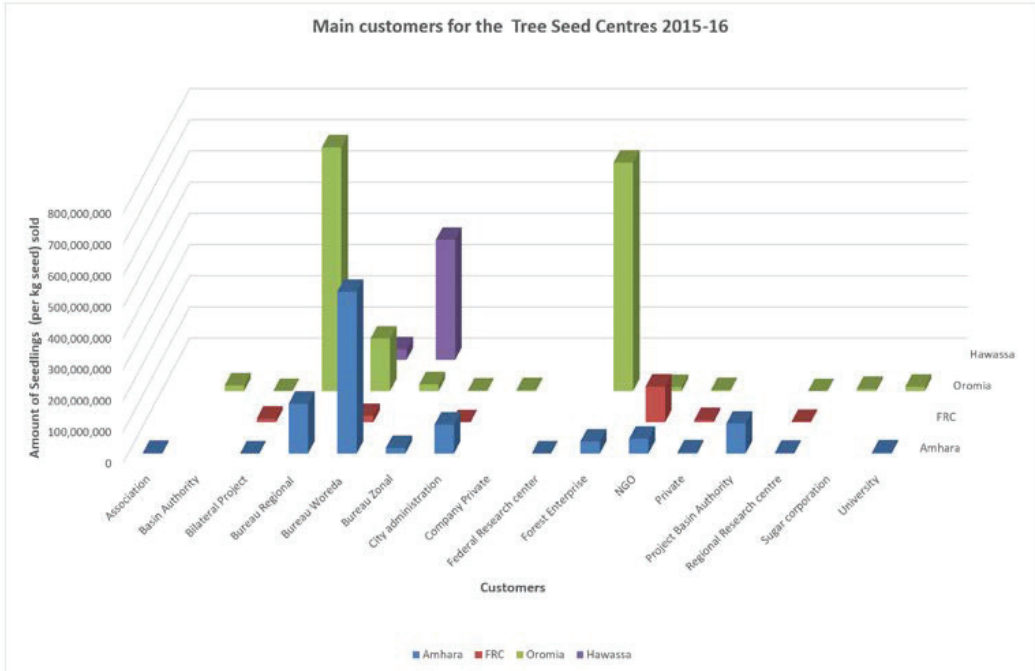


Figure 1. Figure 1. Customers and amounts sold from the 4 Tree Seed Centres. Source: Data provided by the Tree Seed Centres and compiled by authors

The seeds purchased at Regional and Zonal levels are sent to the Woredas and on to nurseries at the Kebele level. In principle, it should thus be possible to get more information from Regions and Zones on their procurement decisions.

4. Seed quality

Quality is a central concept in any procurement/distribution system. For tree seed there are two aspect of quality.

One aspect relates to the physiological and physical quality of the seed itself - how well a seed lot is able to germinate and grow into healthy plants. This aspect is often measured in terms of germination percentage and purity and is in particular dependent on maturity at time of harvesting of seeds/fruits, handling of the seeds after harvest and cleaning of seed from chaff. This aspect of seed quality is relatively easy to determine, however, it does not inform on the growth and survival after planting and also not on the quality of the products produced by the mature trees.

The genetic quality is the second and more important aspect. Genetic quality is about using planting material (seed and seedlings) that can make productive plantings on a given planting site. Genetic quality requires that knowledge on the species is available to producers and users of seed.

Growth performance and local adaptation of species needs to be explained at evolutionary scale. The genetic structure of tree populations is continuously shaped by evolutionary forces: gene mutation, genetic drift, mating system, gene flow and selection. For example, species like *Cordia africana* that occur over a wide range of rainfall and temperature may consist of populations that are adapted to different parts of the distribution area of the species. If that is the case, then quality of seed from one population cannot be considered good quality for all area of distribution – only in areas with similar rainfall and temperature. The application of such a precautionary evaluation system requires that species-wise information is available to seed producers/distributors and seed users.

The performance of germplasm from such natural sources when introduced to other areas may not be precisely predicted or known unless a multi-location adaptation trials are implemented, for which it will take some years to get results. However, in the short term it is possible to use a precautionary principle and the potential natural vegetation map of Ethiopia can be a helpful tool to guide decisions on germplasm deployment for planting.

For exotic species which have already been tested in multi-location adaptation trials, the matching of provenances with environment in Ethiopia can be applied immediately.

4.1 Current application of quality in the tree seed sector

There are strong indications that government procurement follows a bidding system⁵, with price as the main criterion for successful sales and with little concern for genetic and physiological quality. Practically seeds in Ethiopia are collected from undocumented seed sources from farmland, plantations and natural sources. The actual collection is done by local - in most cases untrained - people who are contracted by government officials and private suppliers

First, improving quality would require that criteria for quality is introduced into the administrative systems of Regions, Zones and Woredas and MoA (MEFCC has little presence in the Woredas and little influence on conditional grant programmes under MoA). Such criteria for quality will only be relevant if linked to actual availability of quality seed. Genetic quality is the most important criterion, while setting standards for minimum germination percentages is not very important for the future growth of the planting material. Often

⁵This has consistently been reported by practically all persons interviewed (private suppliers as well as government officials in Regional, Zonal and Woreda offices

germination percentage only tells about the price per seed rather than about the quality of the resulting plants⁶.

Secondly, planting zone maps should be available to all actors in the sector for all relevant tree species in Ethiopia.

Thirdly, seed collectors could be made more efficient and transparent if organised into cooperatives that received training in good seed collection and transport of seed to ensure that physiological seed quality is maintained during procurement.

Fourth, recommendation domains for species and sources could help to maintain genetic quality of the seed used, such that the seeds used are matched to planting sites.

Fifth, establishing BSOs and introducing the concept of genetic improvement - that use of improved seed sources lead to better plantings with higher productivity, survival and health of trees, whether for plantations, woodlots or restoration – would help to introduce the notion that improved seed is more valuable than average seed.

Last, but not least, more should be known about the decision-making processes in seed procurement within the regions. This would help the Tree Seed Centres to understand, where and how quality can be introduced as an important parameter in seed procurement and tree planting. This would help the Tree Seed Centres to become better at supporting the supply of indigenous and exotic species.

5. PATSPO Nursery survey 2018

In view of the lack of available statistics on tree planting, PATSPO decided to carry out a survey of nurseries in the four regional states, where most tree planting takes place - Amhara, Oromia SNNP, and Tigray. The objective of the survey was to contribute to understanding of the tree seed supply/demand situation. The more detailed objective of the survey is to produce a snapshot of nursery activities in the 4 regions. The survey is intended to provide information on:

- Species produced in 3 main categories of nurseries
- Categories of actors involved in procuring and distributing seed, including local collection, and seed distribution by Federal and Regional Seed Centres and private (licenced) seed suppliers
- Categories of seed sources utilised

Based on a stratified random selection, a total of 36 Woredas were selected in the four regions. The map of potential natural vegetation was used for stratifying into agro-ecological zones. Out of the different potential natural vegetation zones, the following were targeted for the survey since these are the major vegetation zones with relatively large area coverage and suitable for afforestation and reforestation:

- Afromontane moist transitional forest (Fe)
- Afromontane rain forest (Fa)
- Complex of Afromontane undifferentiated forest with wooded grasslands and evergreen or semi-evergreen bushland and thicket at lower margins (Fb/wd)
- Dry combretum wooded grassland (Wcd)
- Upland Acacia wooded grassland (We)

⁶ The authors have been presented with table of minimum germination percentages for a large number of species. The minimum percentages are very high.

PATSPO nursery survey 2018 - selected woredas

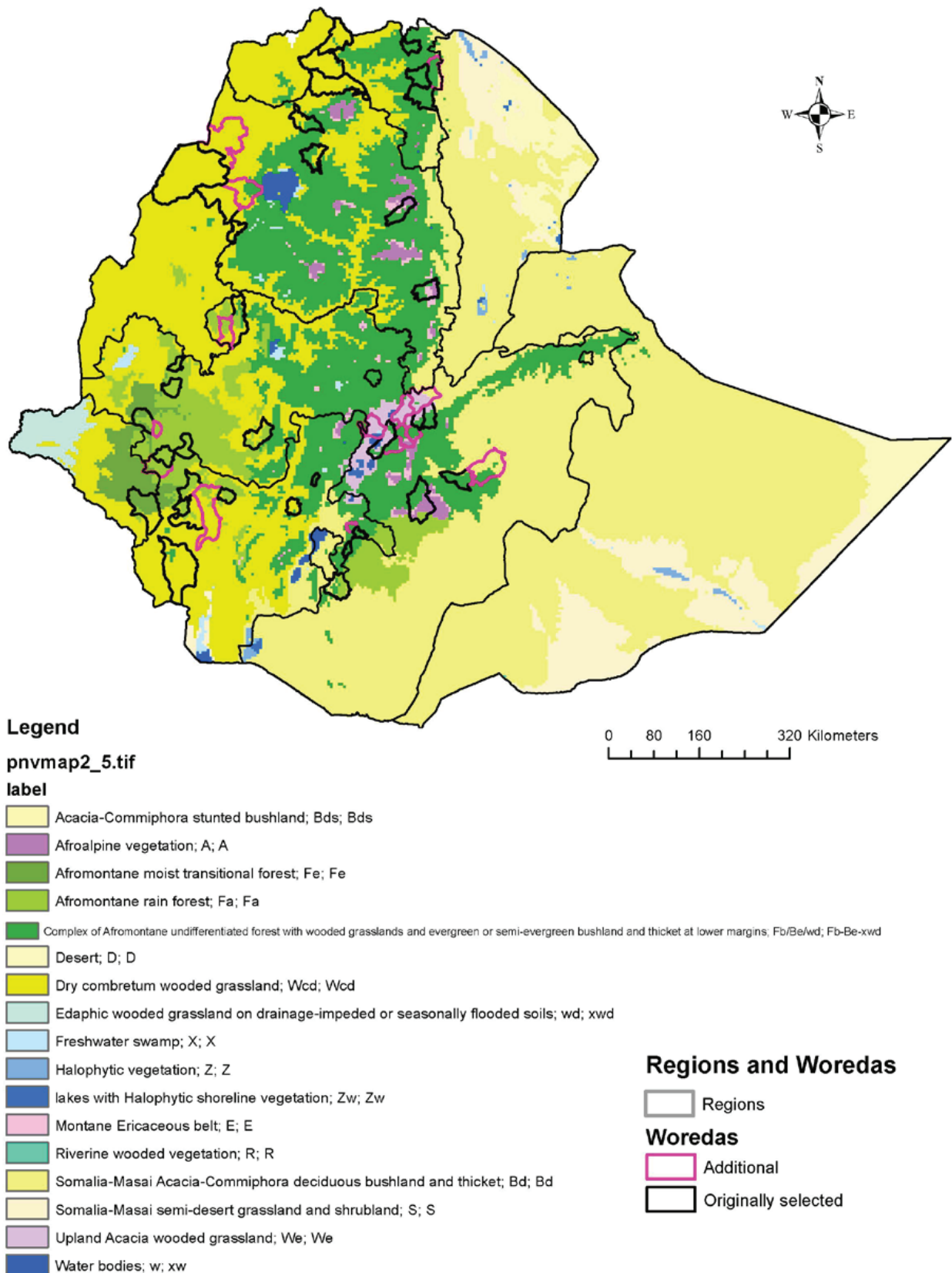


Figure 2. Selected Woredas – Fe, Fa, and Fb/wd are wetter zones and Wcd/Wd is drier

Table 9. Woredas per Potential vegetation type

Region	Vegetation type		
	Fb/Wd	Wcd or Wd	Fe or Fa
Tigray	3	3	
Amhara	3	3	
Oromia	3	3	6
SNNP	3	3	6

Enumerators were identified from each target Woreda, in collaboration with Regional Bureaus of Agriculture. Six supervisors were selected to be responsible for each 6 enumerators. The questionnaire was pre-tested during a training workshop in Bishoftu shortly before the commencement of the survey.

15 each of three types of nurseries - (i) Central; (ii) Community; Private were selected randomly (to the degree possible) from long-lists of nurseries that had been collected by enumerators. We agreed with the participants to focus on five kebeles in each Woreda, using the criteria of accessibility and representativeness and create long-lists of nurseries from which to select the categories of nurseries randomly. In some woredas the the originally selected woredas did not have 15 nurseries of each kind, in which case the enumerators selected nurseries from adjacent woredas.

The actual survey was made between May-June 2018 when the seedlings were well grown but before seedling dispatch was started.

5.1 Main findings from Nursery Survey – only major findings presented here

5.1.1. – Questions 3.4 and 3.4.1. Who Started and Purpose

70%, 30% and 0% of respectively Central nurseries, Community nurseries, and Private nurseries were started by a government project with the purpose of providing seedlings for soil conservation/watersheds. 20% of community nurseries and 50% of private nurseries were started with the purpose of making money. 20% of private nurseries were started by owners to meet own seedling needs.

Table 10. Who started nursery and with what purpose

Nursery Types	3_4 Who Started	3_5 Purpose	Count	Relative
Central	Government Project	Provide seedlings for soil and water conservation / Watershed protection	131	0.7
Central	NGO	Provide seedlings for soil and water conservation / Watershed protection	18	0.1
Central	Donor Project	Provide seedlings for soil and water conservation / Watershed protection	13	0.1
Central	Gvmt/NGO/Donor	Various production goals	18	0.1
Community/Group	Government Project	Provide seedlings for soil and water conservation / Watershed protection	47	0.3
Community/Group	Nursery Group	Sell and make profits	29	0.2
Community/Group	Nursery Group	Provide seedlings for soil and water conservation / Watershed protection	19	0.1
Community/Group	Nursery Group	Provide species for wood production	15	0.1
Community/Group	Gvmt/NGO/Donor/NursG roup	Various production goals and sell for profit	70	0.4
Private	Self/Owner	Sell and make profits	83	0.5
Private	Self/Owner	Meet own seedlings needs	36	0.2
Private	Self/Owner	Provide seedlings for soil and water conservation / Watershed protection	25	0.1

5.1.2 – Question 4.A_customers

Private individuals are the dominant customers for all three types of nurseries. Use of own seedlings is also important for central nurseries and may be interpreted as use of seedlings for plantings associated with the Government restoration and afforestation and reforestation programs.

Most of “Schools/Church/Mosque” are churches and mosques – so religious organisations seem to be at least as important as “NGOs and Donor/National projects” in the organisation of tree planting, but both categories are still only 10% or less.

Government organisations are more important for central nurseries, but only 30% for central, 10% for Community, and less than 10% for private. “Private individuals” + “Own use” = 90% for private nurseries; = 70% for Community nurseries; and = 50% of Central nurseries.

Table 11. Customers for nurseries

Count	Q	Nursery Type	Customer	Percentage	Avg	Size	
151	Private	Private individuals	151	71	10,725	0.6	18,078
122	Private	Own use of seedlings	122	48	5,817	0.3	
51	Private	Schools/Church/Mosque	51	16	840	0.0	
10	Private	Private companies	10	24	237	0.0	
10	Private	Government organisations	10	18	178	0.0	
9	Private	NGOs	9	14	128	0.0	
9	Private	Donor/National Projects	9	10	93	0.0	
5	Private	Other	5	12	60	0.0	
142	Community/Group	Private individuals	142	57	8,106	0.5	17,995
82	Community/Group	Own use of seedlings	82	47	3,817	0.2	
53	Community/Group	Government organisations	53	47	2,471	0.1	
104	Community/Group	Schools/Church/Mosque	104	23	2,377	0.1	
11	Community/Group	Other	11	45	500	0.0	
12	Community/Group	NGOs	12	31	370	0.0	
11	Community/Group	Private companies	11	17	192	0.0	
11	Community/Group	Donor/National Projects	11	15	162	0.0	
162	Central	Private individuals	162	47	7,682	0.4	17,802
119	Central	Government organisations	119	44	5,199	0.3	
156	Central	Schools/Church/Mosque	155	16	2,555	0.1	
28	Central	Own use of seedlings	28	42	1,169	0.1	
26	Central	NGOs	26	29	747	0.0	
20	Central	Donor/National Projects	20	15	305	0.0	
24	Central	Private companies	24	6	145	0.0	
9	Central	Other	9	15	136	0.0	

5.1.3 Seed suppliers

Overall, private dealers supply 43 percent of seed to nurseries and nurseries collect 31% of their seed (counted as the proportion of seedlings derived from supplier types), see table 12.

Tree seed centres are registered directly for only 2 percent of seed, however TSCs deliver a proportion of the seed delivered to the remaining 24% of seed. The TSC contribution is thus somewhere between 2 and 26%.

Table 12. Relative importance of types of suppliers for the 3 nursery types

5 2 SupplierType	Sum of seedlings	Relative
Private Dealer	14,311,576	0.43
Own collection	10,132,954	0.30
Government programme	3,578,144	0.11
Research and Education	2,053,494	0.06
Forest Enterprise	1,880,207	0.06
Tree Seed Centre	749,795	0.02
NGO	552,697	0.02
Private Company	167,500	0.01
Unknown	214,225	
Total	33,640,592	
Total known	33,426,367	

Private dealers and own collection are the two most important ways of procurement by nurseries. However, there are differences in the relative importance, see table 13. Own collection is much more important for Community and Private nurseries with respectively 42% and 76% in contrast to Central nurseries with 21%. Private dealers are the most important for Central nurseries with 44% in contrast to Community and Private nurseries with respectively 46% and 16%. NGOs directly produce seed to 2% of Central nurseries, and 2% of Community nurseries and 0% of private nurseries. It is however likely that NGOs contribute to the running costs of many Central nurseries and thus indirectly fund purchase and collection of seed.

The combined procurement from government organisations (including Tree Seed Centres) are respectively 31%, 9%, and 8% for Central, Community, and Private nurseries.

Table 13. Relative importance of types of suppliers for the 3 nursery types

Nursery Type	Supplier Type	Sums of seedlings	Relative
Central	Private Dealer	10,302,883	0.44
Central	Own collection	4,929,536	0.21
Central	Government programme	3,113,468	0.13
Central	Research and Education	1,937,594	0.08
Central	Forest Enterprise	1,657,995	0.07
Central	Tree Seed Centre	700,448	0.03
Central	NGO	381,638	0.02
Central	Private Company	159,000	0.01
Community/Group	Private Dealer	3,583,908	0.47
Community/Group	Own collection	3,229,041	0.42
Community/Group	Government programme	338,031	0.04
Community/Group	Forest Enterprise	208,614	0.03
Community/Group	NGO	164,628	0.02
Community/Group	Research and Education	56,400	0.01
Community/Group	Tree Seed Centre	48,840	0.01
Private	Own collection	1,974,377	0.76
Private	Private Dealer	424,785	0.16
Private	Government programme	126,645	0.05
Private	Research and Education	59,500	0.02
Private	Forest Enterprise	13,598	0.01
Private	Private Company	8,500	0.00
Private	NGO	6,431	0.00
Private	Tree Seed Centre	507	0.00
Central	Unknown	54,222	
Community/Group	Unknown	102,310	
Private	Unknown	57,693	
Total		33,640,592	
Total known		33,426,367	

5.1.4 Not available

Nurseries were asked “List of species you want to produce but you cannot” and to provide the name of the species along with the reason for not producing. The total list of species provided, mainly contains species that are generally produced in the nurseries (see appendix 7 for the long list).

All three nursery categories have the same top two reasons (see table 14): “Not available for own collection” (respectively 40%, 30% and 40% for Central, Community, and Private nurseries) and “Too expensive to purchase” (respectively 30%, 40%, and 30% for Central, Community, and Private nurseries). Technical problems are 10% for all nursery categories.

Table 14. Reasons given for species not being available

Nursery Type	6 2 notprod	CountOf6 2 notprod	Relative
Central	Not available for own collection	159	0.4
Central	Too expensive to purchase	130	0.3
Central	Germination / propagation problems	56	0.1
Central	Not available for free	42	0.1
Central	Other	47	0.1
Community/Group	Too expensive to purchase	155	0.4
Community/Group	Not available for own collection	148	0.3
Community/Group	Germination / propagation problems	62	0.1
Community/Group	Not available for free	36	0.1
Community/Group	Other	31	0.1
Private	Not available for own collection	158	0.4
Private	Too expensive to purchase	140	0.3
Private	Germination / propagation problems	41	0.1
Private	Uncertain demand / price	32	0.1
Private	Other	34	0.1

The long list contains 114 species that are considered not available. As can be seen in the table 15 below containing the ten most mentioned species, *Grevillea robusta* is the top species, while the next five species are indigenous.

Table 15. The 10 highest ranked species that are considered not available

Species	Count	Overall %
<i>Grevillea robusta</i>	161	0.11
<i>Olea europaea subsp. cuspidata</i>	107	0.07
<i>Cordia africana</i>	86	0.06
<i>Afrocarpus falcatus</i>	72	0.05
<i>Juniperus procera</i>	59	0.04
<i>Rhamnus prinoides</i>	53	0.04
<i>Cupressus lusitanica</i>	47	0.03
<i>Persea americana</i>	44	0.03
<i>Moringa oleifera</i>	41	0.03
<i>Azadirachta indica</i>	40	0.03

6a. Media used for seedlings in nurseries

The media used in nurseries are mainly of importance for survival after planting in the field. Overall 57% of seedlings are grown in nurseries as bare-root, which translates into low survival in the field. 50%, 60% and 80% of seedlings in respectively Central, Community and Private nurseries are bare-root. See table 16 below.

Table 16. Media used for seedlings in the nurseries

Nursery Type	5 1 2 media	SumOfSumOf5 1 1 seedIngno	% of nursery Type
Central	No Info	162,582	0.0
Central	Bare-root	12,473,165	0.5
Central	pot (10cm)	1,550,858	0.1
Central	pot (12cm)	332,155	0.0
Central	pot (14cm)	454,700	0.0
Central	Pot (8cm)	8,097,857	0.3
Central	pot (above 16cm)	197,625	0.0
Community/Group	No Info	120,490	0.0
Community/Group	Bare-root	4,733,009	0.6
Community/Group	pot (10cm)	953,494	0.1
Community/Group	pot (12cm)	70,957	0.0
Community/Group	pot (14cm)	81,486	0.0
Community/Group	Pot (8cm)	1,801,611	0.2
Community/Group	pot (above 16cm)	4,510	0.0
Private	No Info	32,520	0.0
Private	Bare-root	2,060,067	0.8
Private	pot (10cm)	106,866	0.0
Private	pot (12cm)	50,591	0.0
Private	pot (14cm)	40,742	0.0
Private	Pot (8cm)	410,837	0.2
Private	pot (above 16cm)	21,719	0.0

6b. Use of species – relative amounts of exotic and indigenous

Three sources of species use are available

- Data for TSC sales of seed
- Data for seedlings of species in nurseries (from Nursery survey)
- Data on seedlings of species from SLMP (year)

We are here interested in looking at the relative importance of exotic/indigenous species.

6.b.1.1 Data for TSC sales of seed

Data on seed sales (in Kg) were compiled from the four TSCs in Amhara, Oromia, SNNP and Tigray.

The conversion of seed sales to corresponding seedlings were done by using information on number of seeds per Kg per species (see appendix 8). This provides raw data on number of seeds per species. To convert from number of seeds to number of seedlings ready for planting in nurseries a reduction factor will eventually have to be used (to account for mortality in germination and in nursery). However, since we are looking for the relative importance of species, we have not used reduction factors here.

The full lists and charts for each of the four TSCs Amhara, Oromiya, SNNP, and FRC are available in the appendix 5. Here we present the ten most sold species in table 17.

Table 17. The most sold species from the four TSCs (E=exotic; N= indigenous)

Origin	Species	Sums of Seedlings
E	<i>Cupressus lusitanica</i>	1,021,196,750
N	<i>Sesbania sesban</i>	409,355,100
E	<i>Eucalyptus camaldulensis</i>	378,959,000
E	<i>Acacia decurrens</i>	272,965,000
E	<i>Casuarina equisetifolia</i>	189,825,000
E	<i>Grevillea robusta</i>	155,346,000
E	<i>Eucalyptus globulus</i>	139,373,600
E	<i>Eucalyptus saligna</i>	128,160,000
N	<i>Juniperus procera</i>	123,963,750
E	<i>Cytisus proliferus</i>	80,505,000

Source: Data provided by the Tree Seed Centres and compiled by authors.

6.b.1.2 Data on seedlings of species from SLMP (year)

The full lists and charts for each of the four Regions Amhara, Oromiya, SNNP, and Tigray are available in the appendix 4. In table 17, we present the ten most used species in table 18.

Table 18. The most common species in SLMP (E=exotic; N= indigenous)

Origin	Species	Sums of seedlings
E	<i>Grevillea robusta</i>	344,879,434
N	<i>Sesbania sesban</i>	141,357,060
E	<i>Cytisus proliferus</i>	112,304,201
E	<i>Cajanus cajan</i>	104,521,190
E	<i>Acacia saligna</i>	92,867,091
E	<i>Casuarina cunninghamiana</i>	31,507,600
E	<i>Eucalyptus globulus</i>	6,775,085
E	<i>Acacia decurrens</i>	5,039,693
E	<i>Cupressus lusitanica</i>	4,973,866
N	<i>Cordia africana</i>	4,082,383

Source: Raw data from Girma Kibret, SLMP II (June 2018)

6.b.1.3 Data for seedlings of species in nurseries (from PATSPO nursery survey)

The full lists and charts for each of the four Regions Amhara, Oromiya, SNNP, and Tigray are available in the appendix 6. In table 18, we present the ten most used species in table 19.

Table 19. The most common species in PATSPO Nursery Survey ((E=exotic; N= indigenous))

Origin	Species	Sums of seedlings
E	<i>Eucalyptus globulus</i>	5,332,326
E	<i>Grevillea robusta</i>	3,342,911
E	<i>Eucalyptus camaldulensis</i>	3,285,567
N	<i>Coffea arabica</i>	3,227,966
E	<i>Cupressus lusitanica</i>	3,081,286
E	<i>Acacia saligna</i>	1,408,952
E	<i>Acacia decurrens</i>	1,339,879
N	<i>Acacia polyacantha</i>	1,184,047
N	<i>Sesbania sesban</i>	821,384
N	<i>Juniperus procera</i>	796,763

6.b.1.4. Estimates of relative amounts of exotic and indigenous species

The relationship between exotic (E) and indigenous (N) are quite similar for the TSC and SLMP seedlings – around 8:2 for E: N, while seedlings in PATSPO nursery survey are somewhat lower, but still high, see table 20.

The main explanation is that a small handful of exotic plantation species with prolific seeding and small orthodox seeds dominate.

Table 20: Estimates of relative amounts of exotic and indigenous species

Programme	Seeds or seedlings	Exotic	Indigenous	Exotic (E) %	Indigenous (N) %
Tree Seed Centres (TSC)	Seed	2,634,778,138	685,965,806	79%	21%
SLMP	Seedlings	715,140,770	169,525,888	81%	19%
PATSPO survey	Seedlings	22,854,750	10,785,842	68%	32%

Note: The TSC numbers have not been reduced for mortality - we are just estimating in the relationship between E and N

Note for SLMP: If *Sesbania sesban* were considered an exotic instead of native, the relationship would be E:97% and N:3%

Note for TSC: If *Sesbania sesban* were considered an exotic instead of native, the relationship would be E:92% and N:8%

Note for PATSPO survey: If *Sesbania sesban* were considered an exotic instead of native, the relationship would be E:70% and N:30%

7. Demand and supply of tree seed in the four regions

Below in table 21a is the list of PATSPO nursery survey Woredas and the number of nurseries that were active during the season of the survey in 2018 (year of the survey) according to the Woreda offices.

Table 21a. Active nurseries in Woredas in 2018

No.	Region	Woreda	PNV	Central	Community	Private
1	Amhara	Delanta	FbBewd	12	17	2960
2	Amhara	Menz Gera Midir	FbBewd	5	62	940
3	Amhara	West Belesa	FbBewd	8	26	186
4	Amhara	Dabat	Wcd	9	7	816
5	Amhara	Quara	Wcd	1	0	70
6	Amhara	Jawi	Wcd	5	20	572
		Amhara Average		6.7	22	924
7	Oromia	Gida Ayana	Fa	1	12	334
8	Oromia	Lalo Asabi	Fa	5	12	86
9	Oromia	Nole Kaba	Fa	5	5	36
10	Oromia	Limu Kosa	Fa	5	32	180
11	Oromia	Bure	Fe	4	7	12
12	Oromia	Bule Hora	FbBewd	5	9	134
13	Oromia	Adaba	Fa	5	40	265
14	Oromia	Gasera	FbBewd	2	8	9
15	Oromia	Jeju	FbBewd	4	8	19
16	Oromia	Dodota	We	3	7	24
17	Oromia	Sire	We	3	15	12
18	Oromia	Ziway Dugda	We	1	8	2
		Oromia Average		3.6	13.6	92.8
19	SNNP	Chena	Fa	1	73	84
20	SNNP	Telo	Fa	5	8	125
21	SNNP	Sayilem	Fa	5	12	96
22	SNNP	Masha	Fa	5	22	43
23	SNNP	Shay Bench	Fa	5	79	311
24	SNNP	Gurafereda	Fe	5	15	116
25	SNNP	Maji	Wcd	8	9	19
26	SNNP	Menit Goldiye	Wcd	5	12	122
27	SNNP	Kindo Koysha	Wcd	5	23	28
28	SNNP	Anigacha	FbBewd	5	14	200
29	SNNP	Bule	FbBewd	5	10	320
30	SNNP	Hulla	FbBewd	3	31	143
		SNNP Average		4.8	25.7	133.9
31	Tigray	Enderta	FbBewd	11	5	74
32	Tigray	Ganta Afeshum	FbBewd	12	13	44
33	Tigray	Kelete Awelallo	FbBewd	7	7	16
34	Tigray	Asgede Tsimbila	Wcd	5	7	67
35	Tigray	Lelay Adiyabo	Wcd	5	11	40
36	Tigray	Tselemti	Wcd	5	12	25
		Tigray Average		7.5	9.2	44.3

We estimated the number of seedlings in the regions and in the nursery types, see table 21b.

Table 21b. Estimated annual seedling production by nursery type and region

Region	NursType	Sums seedlings	# Nurstype	Average # Seedlings	# Per Woreda	# Woredas	Total number of seedlings
Amhara	Central	4,706,013	30	156,867	6.7	129	135,580,235
Amhara	Community/Group	2,229,842	30	74,328	22	129	210,943,053
Amhara	Private Nurseries	346,506	30	11,550	924	129	1,376,737,639
Oromiya	Central	7,994,917	60	133,249	3.6	260	124,720,705
Oromiya	Community/Group	2,241,616	60	37,360	13.6	260	132,105,903
Oromiya	Private Nurseries	1,088,988	60	18,150	92.8	260	437,918,374
SNNP	Central	5,735,604	60	95,593	4.8	136	62,403,372
SNNP	Community/Group	1,673,207	60	27,887	25.7	136	97,469,885
SNNP	Private Nurseries	1,135,682	60	18,928	133.9	136	344,687,058
Tigray	Central	4,800,250	30	160,008	7.5	34	40,802,125
Tigray	Community/Group	1,587,107	30	52,904	9.2	34	16,548,236
Tigray	Private Nurseries	100,860	30	3,362	44.3	34	5,063,844
TOTAL							2,984,980,429
Regions	Amhara						1,723,260,927
	Oromiya						694,744,983
	SNNP						504,560,315
	Tigray						62,414,205
NursTypes	Central						363,506,436
	Community/Group						457,067,077
	Private Nurseries						2,164,406,916

Our estimate is that about 2.98 billion seedlings are produced in the 4 regions in 2017/18. According to the MEFCF, the plan was to produce 4.27 billion seedlings in the four regions in the 2017/18 budget year (Table 1), and it means about 70% was achieved according to our estimate.

Coffee seedlings are produced in the nurseries (2,657,531; 393,366; and 177,069 seedlings in respectively Central, community and Private nurseries), while coffee is not included in the MEFCF plans. Deducting the coffee seedlings only changes the percentages very marginally and the percentage remains at 70%.

In table 22, we calculate the absolute and relative seedling production in regions and nurseries. More than half of the total production of seedlings take place in Amhara and only a very small proportion in Tigray.

In Amhara 80% of the seedlings are produced in Private nurseries, which are also dominant in Oromiya and SNNP with respectively 64% and 69%. In Tigray Central nurseries are dominant with 65%, and with only 8% in Private nurseries.

Table 22. Estimated of annual seedling production by nursery type and region - percentages

Nursery types in regions		Sum seedlings	Relative in region	Relative total
Amhara	Central	135,580,235	0.08	
Amhara	Community/Group	210,943,053	0.12	
Amhara	Private Nurseries	1,376,737,639	0.80	
Amhara	Total region	1,723,260,927		0.58
Oromiya	Central	124,720,705	0.18	
Oromiya	Community/Group	132,105,903	0.19	
Oromiya	Private Nurseries	437,918,374	0.63	
Oromiya	Total region	694,744,983		0.23
SNNP	Central	62,403,372	0.12	
SNNP	Community/Group	97,469,885	0.19	
SNNP	Private Nurseries	344,687,058	0.68	
SNNP	Total region	504,560,315		0.17
Tigray	Central	40,802,125	0.65	
Tigray	Community/Group	16,548,236	0.27	
Tigray	Private Nurseries	5,063,844	0.08	
Tigray	Total region	62,414,205		0.02
Grand total	Total 4 regions	2,984,980,429		

8. Summary

- The support to tree planting for restoration in Ethiopia is very much a decentralised process, where the decisions on species and source selection are taken at the Woreda level.
- Most of the seeds are procured from private seed dealers and own collection as part of the decentralised process of tree planting.
- Most of the seeds are collected from trees in farmland, plantations and natural forest. Hardly any tree seed is procured from improved sources and with little concern for matching seed sources with planting site.
- It is likely that the large proportion of seed procured from private seed dealers is procured through a bidding process, where the only criteria for purchase are price and possibly germination percentage. The most important criterion - genetic quality of seed - is not considered.
- The tree seed centres currently have opportunities for influencing quality for the proportion of the seed (about 30%) that is procured through government restoration programmes.
- There are opportunities for ensuring the quality of the remaining 70% of seed, which are procured through private dealers and own collection.
- There are opportunities for increasing the support to small private nurseries, which appear to produce about 70% of the seedlings for restoration in Ethiopia
- About 70% of seedlings are from a handful of exotic plantation species with small orthodox seeds. These species are probably easy to access.
- Only about 30% of seedlings are from indigenous species. It is probably a challenge to procure good genetic quality seed in large quantities of these species.

9. Recommendations from PATSPO Tree Seed Sector Assessment Workshop

The findings in this report were presented at a PATSPO Tree Seed Sector Assessment Workshop held 26 February 2019 in Addis Ababa (see separate document “Note on PATSPO Tree Seed Sector Assessment Workshop”).

The purpose of the workshop was to discuss the findings with the invited participants from relevant sectors in Ethiopia and to collect the recommendations produced by the plenary discussions and group discussions.

The following is a brief of pertinent points raised by the participants:

1. Existing tree seed sources need to be defined, registered and mapped and proper prioritization of species need to be conducted for ensuring quality and quantity. Training on genetic diversity and genetic quality is essential. Potential roles of native trees and the side effects of exotic species should also be covered. Descriptions of seed sources should include seed sources documentation, management and improvement and superior trees selection. Germination percentage is only a physiological seed quality and seed quality assessment should look in to the seed source quality. This knowledge could improve the seed bidding system which currently is favouring only least (lowest cost) bidders. Licensing and standardizing seeds should be based on seed source types.
2. The dominance of exotic tree species in nurseries could be a challenge in meeting the objective of forest land restoration programme. Introduction of incentives for planting native trees may help. Also, mandatory guidelines for producing and planting of certain proportion of native tree could help.
3. Federal regulatory body to support seed suppliers in seed sources registry, enact and enforce regulations, check procurement processes and ensure customers are supplied with good quality seed.
4. The role played by private tree seed centres is essential. But capacity building and other policy and other supports with strong regulatory system in place can help create a vibrant private sector that supplies quality

seed. Seed collectors can be organised into cooperatives based on their own will following pertinent rules and regulations. This could make them more efficient, visible and cost effective. Public tree seed centres can offer the private dealers with technical support, seed testing services and help them in markets and networking.

5. The gap between demand and supply of different tree species could be narrowed by knowing the demand for the species at national level, through putting in place a species-based targeting and a national information exchange system, through collaborations between public and private suppliers.

6. The central statistics agency (CSA) could produce national report on seeds and other inputs used for seedling production, seedlings produced and seedling survival.

7. Because the advantage of private nurseries outweighs their disadvantages, they should be facilitated and supported so that they even replace seedling production by government nurseries.

8. Improving information flow between producers and consumers can give producers better knowledge on actual demands, customers could get updated and periodic information on available seeds and linkages among producers can improve supplies of seeds with reported shortages in supply. Stakeholder mapping and establishment of tree seed database at national level with a mandated body for collection and dissemination of information is essential.

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Appendices

Appendix 1. Seedlings per hectare calculation (MEFCC table)

Appendix 2. NGO planting

Appendix 3. The Practice Of Fiscal Federalism In Ethiopia

Appendix 8. Species Seeds per Kg

In a separate file in A3 format:

Appendix 4. SLMP Distribution of seedlings in four regions

Appendix 5. TSC Sales of seed in four regions

Appendix 6. PATSPO Nursery survey – species in four regions

Appendix 7. PATSPO Nursery survey – species “not available”

Appendix 1 Seedlings per hectare calculation (MEFCC table)

Seedlings per hectare

See also table 1. From the table below, the number of seedlings per hectare and planting distance are calculated as:

Appendix table 1. Seedlings per hectare and planting distance

		2016/17	2017/18	2016/17	2017/18
		Plants/ha	Plants/ha	Plant dist.	Plant dist.
1	Oromia	6,305	4,005	1.3	1.6
2	SNNP	4,453	4,395	1.5	1.5
3	Amhara	6,546	5,324	1.2	1.4
4	Tigray	2,206	1,878	2.1	2.3
5	Other	2,020	1,915	2.2	2.3
Country total		2,695	4,307	1.9	1.5

Calculated from numbers in table1

Density of seedlings per hectare obviously depends on the purpose of planting, from high-density pole production of eucalypts to low density soil amelioration. It is not obvious why density of planting should vary between regions and years.

Appendix 2 NGO planting

A large number of NGOs support tree planting. We asked some 50 NGOs to respond by a questionnaire through SurveyMonkey and/or by direct mails. We only got two responses on the SurveyMonkey. In addition, we visited 7 of the larger NGOs (identified by their seed purchase from the TSCs). We received responses from 3 of these. *ORDA* (probably the largest NGO in Amhara) plans to produce about 9 million seedlings in 2018. *World Vision* (formerly the single largest customer of FRC) has decentralised seed procurement and is unable to provide any information. *Hopethiopia* produced 120,000 seedlings in 2017 (down from 1.2 million in 2015). *Organization for Sustainable Development(OSD)* produced 25,000

seedlings in 2017 (down from 75,000 in 2015). Action For Development (AFD) 48,000 Seedlings in 2017. SOS Sahel Ethiopia- Hawassa Field Office 320,000 seedlings in 2017 (down from 1.1 million in 2015).

We calculated averages of NGO procurement from TSCs (table 3) to get an estimate of what an NGO on average procures.

Appendix table 2. The average amount of seed (number of kg x number of seeds per kg) procured from TSCs by NGOs from 3 TSC over 3 (4) years (no reduction for mortality from seed to seedling production):

	2007/2013-14	2008/2014-15	2009/2015-2016	2010/2016-17
Bahirdar		1,492,660	423,670	643,278
Oromia		13,985,453	2,365,467	3,465,875
FRC	7,361,830	13,102,793	3,967,139	3,292,755

Source: Data provided by the Tree Seed Centres and compiled by authors

If these averages represent NGO seed use, it would correspond to actual seedlings - (divided by 4 or 5) for the two latest years - to between 85,000 to 820,000 seedlings planted per NGO. Taking this as a yardstick, a hundred NGOs would perhaps plant around 80 million seedlings. Using the highest 2014/15 figure, the maximum would be around 350 million a year – it seems that NGOs contribute relatively little to the 3.55 billion seedlings reported by MEFC. However, there is a possibility that a large proportion of seedlings is from seed procured through “Own collection” supported by NGOs.

Appendix 3: The Practice Of Fiscal Federalism In Ethiopia

Baraki, G.T. 2015. The Practice Of Fiscal Federalism In Ethiopia: A Critical Assessment 1991-2012. An Institutional Approach. Doctoral Thesis. University Of Fribourg (Switzerland):

A State’s planning process starts at sub Kebele level. Local people identify their wish list of preferences and decide how much they would contribute in kind for the realization of capital investment projects through their General meetings. The **Kebele Executive bodies prepare development plan** taking into account the demands of the sub-kebeles and submit their plans to respective **Wereda Administration Office**. The latter, in turn, dispatches the Kebele plans to the **Office of Finance and Economic Development (OFED) and to concerned Offices for assessment and analysis**. The OFED together with respective sector Offices prepare a preliminary development plan and submit to the OFED. Then, the latter makes budget and priority analysis and prepare a **Wereda level development plan**. Finally it submits to the Wereda Head Administration and to Wereda Council budget standing Committee. The administration Head tables the plan to the **Executive Committee (Wereda Cabinet)** for discussion. After deliberations, it documents a **preliminary wereda development plan and sends it to the BoFED (Bureau of Finance and Economic Development)**. The latter prepares an indicative FYDP by making context analysis of the state, reviewing the wereda preliminary plans and taking into account the national FYDP. Then, the Executive **body of the state approves after due deliberations and sends it back to the Weredas** to adjust their development plan in line with the indicative plan. In the same fashion, Weredas prepare an indicative plan by taking into account the state’s indicative plan and **send it back to Kebeles**. The Kebele Executive bodies discuss on the issues with **representatives of sub-Kebele** and come up with a modified list of priority public service. **Kebele Council approves the plan and dispatches it to the Wereda Administration Office**. Each Sector Office prepares its final draft development plan by considering the Kebele and the state’s indicative plan and submits it to the OFED. Then the Office prepares a **Wereda draft development plan**.

Appendix 8 - Species Seeds per Kg

Species Seeds per Kg					
ID	Species correct	Average number of seeds per Kilogram	Main use	Establishment	Comment
1	Acacia abyssinica	17,000	Wood	Seedling	RELMA
2	Acacia decurrens	55,000	Wood	Seedling	RELMA
3	Acacia mearnsii	67,500	Wood	Seedling	RELMA
4	Acacia melanoxylon	150,000	Wood	Seedling	RELMA
5	Acacia nilotica	9,000	Wood	Seedling	RELMA
6	Acacia polyacantha	15,000	Wood	Seedling	RELMA
7	Acacia saligna	55,000	Wood	Seedling	RELMA, Tanz
8	Acacia senegal	9,500	Resin	Seedling	RELMA
9	Acacia seyal	20,000	Wood	Seedling	RELMA
10	Acacia tortilis	21,500	Wood	Seedling	RELMA
11	Afrocarpus falcatus	1,950	Wood	Seedling	RELMA
12	Albizia coriaria	15,000	Wood	Seedling	RELMA, Ken
13	Albizia grandibracteata	15,000	Wood	Seedling	FRC, Addis Abeba
14	Albizia gummifera	12,000	Wood	Seedling	RELMA, Ken
15	Albizia lebbeck	9,500	Wood	Seedling	RELMA, Ken
16	Albizia schimperiana	14,000	Wood	Seedling	RELMA, Tanz
17	Azadirachta indica	5,000	Medicine	Seedling	RELMA
18	Balanites aegyptiaca	1,000	Nuts	Seedling	RELMA
19	Boswellia papyrifera	44,400	Resin	Seedling	Tilahun
20	Boswellia pirottae		Resin	?	
21	Cajanus cajan	15,000	Fodder	Direct sowing	RELMA
22	Calliandra calothyrsus	19,000	Fodder	Seedling	RELMA, Ken
23	Callistemon citrinus	44,000	Ornamental	Seedling	RELMA, Tanz
25	Carica papaya	20,000	Fruit	Seedling	RELMA-Tan
26	Casuarina cunninghamiana	1,065,000	Wood	Seedling	RELMA
27	Casuarina equisetifolia	500,000	Wood	Seedling	Evans and Turnbull, 2004
29	Celtis africana	17,000	Wood	Seedling	RELMA
32	Coffea arabica	3,200	Berry	Seedling	AF Database
33	Combretum molle	12,500	Wood	Seedling	RELMA, Ken
34	Cordia africana	3,500	Wood	Seedling	RELMA
35	Corymbia citriodora	655,000	Wood	Seedling	RELMA
36	Corymbia maculata	110,000	Wood	Seedling	AF database
37	Croton macrostachyus	21,500	Wood	Seedling	RELMA
39	Cupressus lusitanica	245,000	Wood	Seedling	Evans and Turnbull, 2004
40	Cupressus sempervirens	190,600	Wood	Seedling	Spyroglou
41	Cytisus proliferus	45,000	Fodder	Seedling	RELMA
42	Dalbergia melanoxylon	42,000	Wood	Seedling	RELMA, Ken
43	Delonix regia	2,500	Ornamental	Seedling	RELMA, Ken
44	Dichrostachys cinerea	39,000	Wood	Direct Sowing	RELMA, Zam
45	Dodonaea angustifolia	100,000	Wood	Direct sowing	RELMA
46	Dodonaea viscosa	100,000	Wood	Seedling	RELMA
47	Dombeya torrida	235,000	Wood	Seedling	RELMA
48	Dovyalis abyssinica	48,000	Food	Seedling	http://epic.kew.org
49	Dovyalis caffra	37,000	Hedge	Seedling	RELMA, Ken
50	Ehretia cymosa	25,000	Fodder	Direct sowing	RELMA
51	Ekebergia capensis	5,600	Wood	Seedling	RELMA, Ken

Species Seeds per Kg					
ID	Species correct	Average number of seeds per Kilogram	Main use	Establishment	Comment
52	Entada abyssinica	3,900	Wood	Seedling	RELMA
53	Erica arborea	45,000	Wood	Seedling	RELMA
54	Erythrina brucei	6,800	Wood	Seedling	RELMA
55	Eucalyptus camaldulensis	700,000	Wood	Seedling	Evans and Turnbull, 2004
56	Eucalyptus globulus	80,000	Wood	Seedling	Evans and Turnbull, 2004
57	Eucalyptus grandis	625,000	Wood	Seedling	Evans and Turnbull, 2004
58	Eucalyptus saligna	400,000	Wood	Seedling	Chris H
59	Eucalyptus viminalis	350,000	Wood	Seedling	RELMA
60	Faidherbia albida	30,000	Fodder	Seedling	Evans and Turnbull, 2004
61	Faurea saligna	165,000	Wood	Seedling	RELMA
62	Grevillea robusta	40,000	Wood	Seedling	Chris H
63	Hagenia abyssinica	350,000	Wood	Seedling	RELMA
64	Jacaranda mimosifolia	70,000	Ornamental	Seedling	RELMA
65	Jatropha curcas	2,400	Oil	Seedling	RELMA
66	Juniperus procera	45,000	Wood	Seedling	RELMA
67	Leucaena leucocephala	30,500	Fodder	Seedling	Evans and Turnbull, 2004
68	Maerua aethiopica	3,800	Live Fence	Direct sowing	FRC, Addis Abeba
69	Mangifera indica	50	Fruit	Seedling	RELMA
70	Melia azedarach	2,100	Wood	Seedling	RELMA, Ken
71	Milicia excelsa	475,000	Wood	Seedling	RELMA
72	Millettia ferruginea	1,400	Wood/fodder	Seedling	Loha
73	Moringa oleifera	4,500	Food	Seedling	RELMA
74	Moringa stenopetala	1,940	Food	Seedling	http://epic.kew.org
75	Olea europaea subsp. cuspidata	8,000	Food	Seedling	RELMA
77	Olea welwitschii	3,000	Food	Seedling	RELMA
101	Oxytenanthera abyssinica	43,000	Wood	Seedling	http://epic.kew.org
79	Parkinsonia aculeata	13,000	Wood	Direct sowing	RELMA, Ken
80	Persea americana	15	Fruit	Seedling	RELMA-Tan
81	Phoenix reclinata	2,950	Ornamental	Seedling	RELMA
82	Pinus patula	130,000	Wood	Seedling	Evans and Turnbull, 2004
83	Pinus radiata	42,000	Wood	Seedling	RELMA
84	Pouteria adolfi-friedericii	450	Wood	Seedling	RELMA
85	Prunus africana	5,000	Medicine	Seedling	RELMA, Ken
86	Pterolobium stellatum	9,000	Fodder	Seedling	http://epic.kew.org
87	Rhamnus prinoides	44,000	Wood	Seedling	http://epic.kew.org
89	Schinus molle	37,000	Ornamental	Seedling	RELMA
90	Senna siamea	39,000	Wood	Seedling	RELMA
91	Sesbania bispinosa	50,000	Green manure	Direct Sowing	Uncertain; Indian Thesis
92	Sesbania sesban	110,000	Green manure	Direct Sowing	RELMA
93	Spathodea campanulata	150,000	Ornamental	Seedling	RELMA
94	Syzygium guineense	3,050	Fruit	Seedling	RELMA
95	Tamarindus indica	1,400	Fruit	Seedling	RELMA, Ken
96	Terminalia brownii	3,000	Wood	Seedling	RELMA
98	Vigna unguiculata	31,000	Food	Direct sowing	http://epic.kew.org
99	Ziziphus jujuba	3,300	Fruit	Seedling	http://epic.kew.org
100	Ziziphus spina-christi	1,500	Fruit	Seedling	RELMA

Appendix 4. Tree Seed Center Sales

Calculation of ‘seedlings’ were made by multiplying number and kg sold with the number of seeds per kg. Reduction for mortality not included (a reduction factor used is often ½ for germination and ½ for nursery mortality). Our objective is to know the relative importance of species

Amhara Seed Centre

Sorted by decreasing amounts			Origin	Establishment	Species correct	SumOfSumOfSeedlings	Farmland	Natural Forest	Plantation
Year	Seed Centre								
2009	Bahirdar	E	Seedling	<i>Eucalyptus camaldulensis</i>	262,150,000				5
2009	Bahirdar	E	Seedling	<i>Cupressus lusitanica</i>	206,265,500				15
2009	Bahirdar	E	Seedling	<i>Casuarina equisetifolia</i>	135,700,000				8
2009	Bahirdar	E	Seedling	<i>Eucalyptus globulus</i>	96,121,600				28
2009	Bahirdar	E	Seedling	<i>Acacia decurrens</i>	85,415,000				13
2009	Bahirdar	E	Seedling	<i>Cytisus proliferus</i>	32,130,000				4
2009	Bahirdar	E	Seedling	<i>Acacia saligna</i>	25,685,000		1	1	2
2009	Bahirdar	N	Seedling	<i>Faidherbia albida</i>	20,190,000	1			
2009	Bahirdar	N	Seedling	<i>Albizia gummifera</i>	15,816,000			8	
2009	Bahirdar	E	Seedling	<i>Grevillea robusta</i>	12,396,000				10
2009	Bahirdar	E	Seedling	<i>Schinus molle</i>	11,525,500				5
2009	Bahirdar	N	Seedling	<i>Cardia africana</i>	10,178,000	6	1	1	3
2009	Bahirdar	N	Seedling	<i>Acacia senegal</i>	9,408,895			2	
2009	Bahirdar	E	Seedling	<i>Eucalyptus saligna</i>	8,000,000				
2009	Bahirdar	E	Seedling	<i>Corymbia citriodora</i>	7,860,000				3
2009	Bahirdar	N	Seedling	<i>Olea europaea subsp. cuspidata</i>	7,320,000	1	6		
2009	Bahirdar	E	Seedling	<i>Pinus patula</i>	6,695,000				4
2009	Bahirdar	N	Seedling	<i>Acacia abyssinica</i>	5,822,500	1	5	5	2
2009	Bahirdar	N	Direct Sowing	<i>Sesbania sesban</i>	5,820,100				3
2009	Bahirdar	N	Seedling	<i>Hagenia abyssinica</i>	4,917,500			2	
2009	Bahirdar	N	Seedling	<i>Oxytenanthera abyssinica</i>	4,234,855				
2009	Bahirdar	N	Seedling	<i>Juniperus procera</i>	3,566,250			10	
2009	Bahirdar	N	Seedling	<i>Groton macrostachyus</i>	1,999,500	1	1	1	
2009	Bahirdar	N	Seedling	<i>Acacia nilotica</i>	1,449,000			3	
2009	Bahirdar	N	Seedling	<i>Acacia polyacantha</i>	1,402,500			1	1
2009	Bahirdar	N	Seedling	<i>Moringa stenopetala</i>	1,028,006				2
2009	Bahirdar	E	Seedling	<i>Eucalyptus grandis</i>	875,000				2
2009	Bahirdar	N	Seedling	<i>Rhamnus prinoides</i>	814,000	11			
2009	Bahirdar	E	Direct sowing	<i>Cajanus cajan</i>	585,000				3
2009	Bahirdar	N	Seedling	<i>Afrocarpus falcatus</i>	517,725		4		
2009	Bahirdar	E	Seedling	<i>Delonix regia</i>	270,375				3
2009	Bahirdar	E	Seedling	<i>Leucaena leucocephala</i>	244,000				5
2009	Bahirdar	N	Seedling	<i>Combretum molle</i>	62,500				
2009	Bahirdar	N	Seedling	<i>Milletia ferruginea</i>	48,650			2	
2009	Bahirdar	N	Seedling	<i>Balanites aegyptiaca</i>	30,500			1	
2009	Bahirdar	N	Seedling	<i>Tamarindus indica</i>	11,900			1	
2009	Bahirdar	N	Seedling	<i>Terminalia brownii</i>	10,500			1	
2009	Bahirdar	N	Seedling	<i>Ziziphus spina-christi</i>	8,250	1	4		

Species sold by Amhara SC 2009/2016-17

Potential seedling production=number of seeds

No reduction factor used (losses in germination and in nursery)

88-92% of seed from Plantations; 90% of seed from exotic species



Amhara Seed Centre

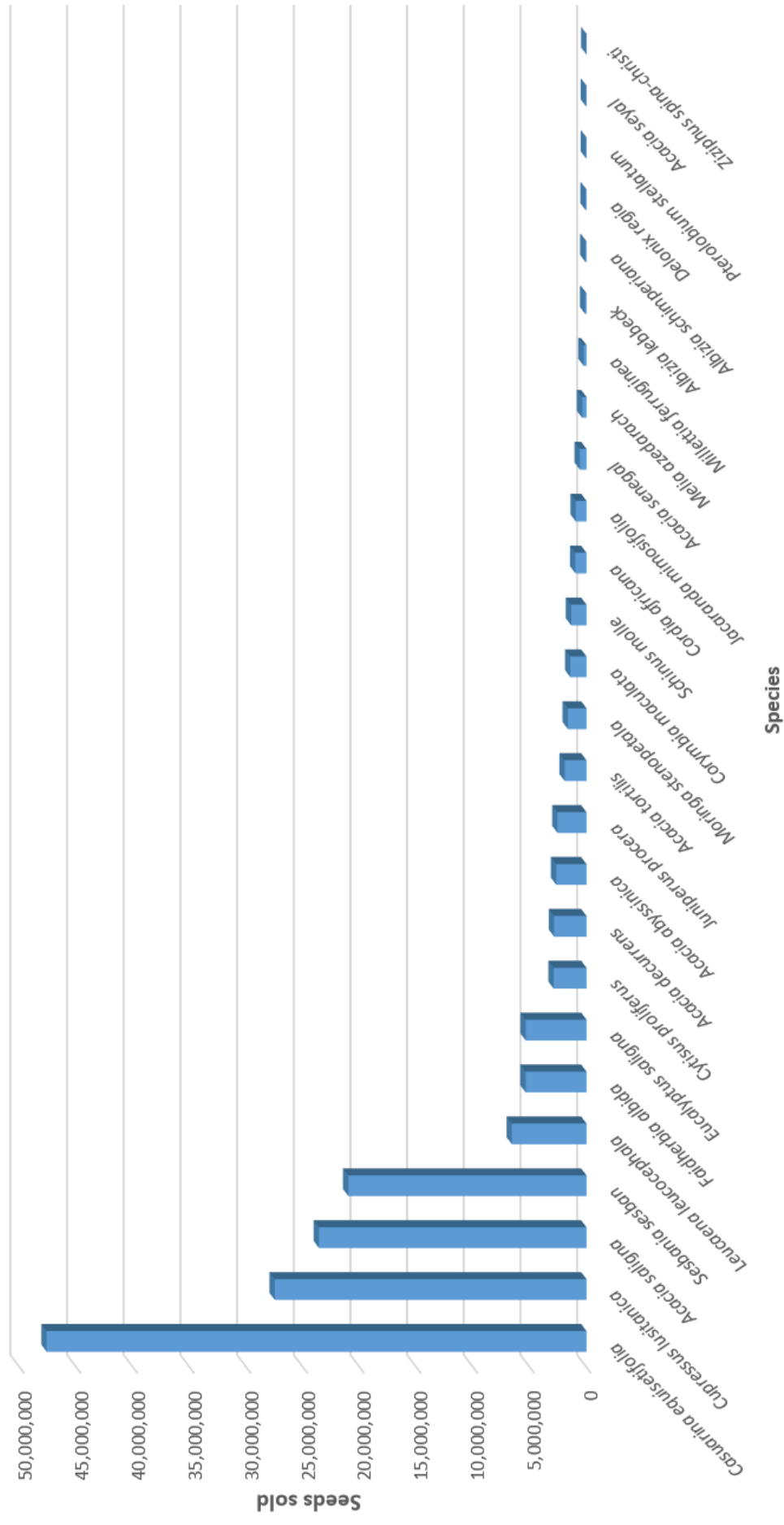
Sorted by decreasing amounts									
Seed Centre	Year	Origin	Establishment		Species correct	SumOfSumOfSeedlings	Farmland	Natural Forest	Plantation
FRC	2009	E	Seedling		<i>Casuarina equisetifolia</i>	47,625,000			7
FRC	2009	E	Seedling		<i>Cupressus lusitanica</i>	27,501,250			12
FRC	2009	E	Seedling		<i>Acacia saligna</i>	23,606,000			6
FRC	2009	N	Direct Sowing		<i>Sesbania sesban</i>	21,010,000			Unspecified SS
FRC	2009	E	Seedling		<i>Leucaena leucocephala</i>	6,588,000			Unspecified SS
FRC	2009	N	Seedling		<i>Faidherbia albida</i>	5,370,000			Unspecified SS
FRC	2009	E	Seedling		<i>Eucalyptus saligna</i>	5,360,000			8
FRC	2009	E	Seedling		<i>Cytisus proliferus</i>	2,902,500	1		1
FRC	2009	E	Seedling		<i>Acacia decurrens</i>	2,860,000			9
FRC	2009	N	Seedling		<i>Acacia abyssinica</i>	2,673,250		2	
FRC	2009	N	Seedling		<i>Juniperus procera</i>	2,565,000		5	
FRC	2009	N	Seedling		<i>Acacia tortilis</i>	1,924,250		3	
FRC	2009	N	Seedling		<i>Moringa stenopetala</i>	1,645,120	3		
FRC	2009	E	Seedling		<i>Corymbia maculata</i>	1,430,000			Unspecified SS
FRC	2009	E	Seedling		<i>Schinus molle</i>	1,359,750			Unspecified SS
FRC	2009	N	Seedling		<i>Cordia africana</i>	983,500	3	4	
FRC	2009	E	Seedling		<i>Jacaranda mimosifolia</i>	945,000			
FRC	2009	N	Seedling		<i>Acacia senegal</i>	586,625		2	
FRC	2009	E	Seedling		<i>Melia azedarach</i>	381,150			Unspecified SS
FRC	2009	N	Seedling		<i>Millettia ferruginea</i>	249,200		5	
FRC	2009	E	Seedling		<i>Albizia lebbeck</i>	114,000			2
FRC	2009	N	Seedling		<i>Albizia schimperiana</i>	91,000		5	
FRC	2009	E	Seedling		<i>Delonix regia</i>	75,000			Unspecified SS
FRC	2009	N	Seedling		<i>Pterolobium stellatum</i>	45,000			Unspecified SS
FRC	2009	N	Seedling		<i>Acacia seyal</i>	40,000		1	
FRC	2009	N	Seedling		<i>Ziziphus spina-christi</i>	9,000			Unspecified SS

Species sold by FRC SC 2009/2016-17

Potential seedling production=number of seeds

No reduction factor used (losses in germination and in nursery)

68-70% of seed from Plantations; 76% of seed from exotic species



Hawassa Seed Centre

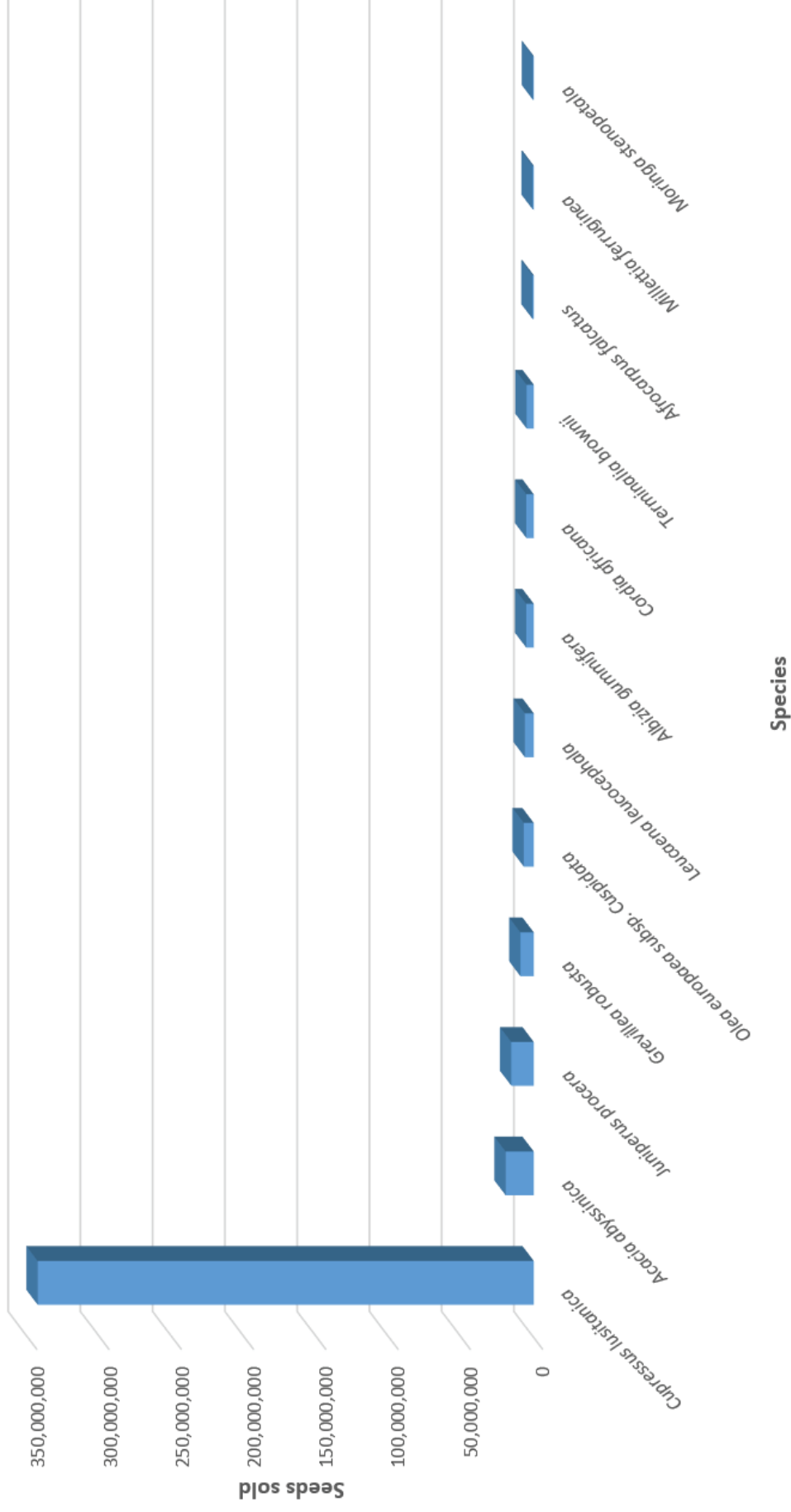
Sorted by decreasing amounts		Origin	Establishment	Species correct	SumOfSumOfSeedlings	Farmland	Natural Forest	Plantation	
Seed Centre	Year								
Hawassa	2009_2016-17	E	Seedling	<i>Cupressus lusitanica</i>	343,245,000	1		3	
Hawassa	2009_2016-17	N	Seedling	<i>Acacia abyssinica</i>	19,482,000	2			
Hawassa	2009_2016-17	N	Seedling	<i>Juniperus procera</i>	15,615,000	1	7		
Hawassa	2009_2016-17	E	Seedling	<i>Grevillea robusta</i>	9,240,000	1		1	
Hawassa	2009_2016-17	N	Seedling	<i>Olea europaea subsp. Cuspidata</i>	6,920,000	2	1		
Hawassa	2009_2016-17	E	Seedling	<i>Leucaena leucocephala</i>	6,191,500	2			
Hawassa	2009_2016-17	N	Seedling	<i>Albizia gummifera</i>	5,244,000	2			
Hawassa	2009_2016-17	N	Seedling	<i>Cordia africana</i>	5,152,000	7	2		
Hawassa	2009_2016-17	N	Seedling	<i>Terminalia brownii</i>	5,031,000	6	1		
Hawassa	2009_2016-17	N	Seedling	<i>Afrocarpus falcatus</i>	852,150		5		
Hawassa	2009_2016-17	N	Seedling	<i>Milletia ferruginea</i>	768,600	3	2		
Hawassa	2009_2016-17	N	Seedling	<i>Moringa stenopetala</i>	585,880				Unspecified SS
					418,327,130				

Species sold by Hawassa SC 2016-17

Potential seedling production=number of seeds

No reduction factor used (losses in germination and in nursery)

About 84% of seed from Plantations; 86% of seed from exotic species



Oromia Seed Centre

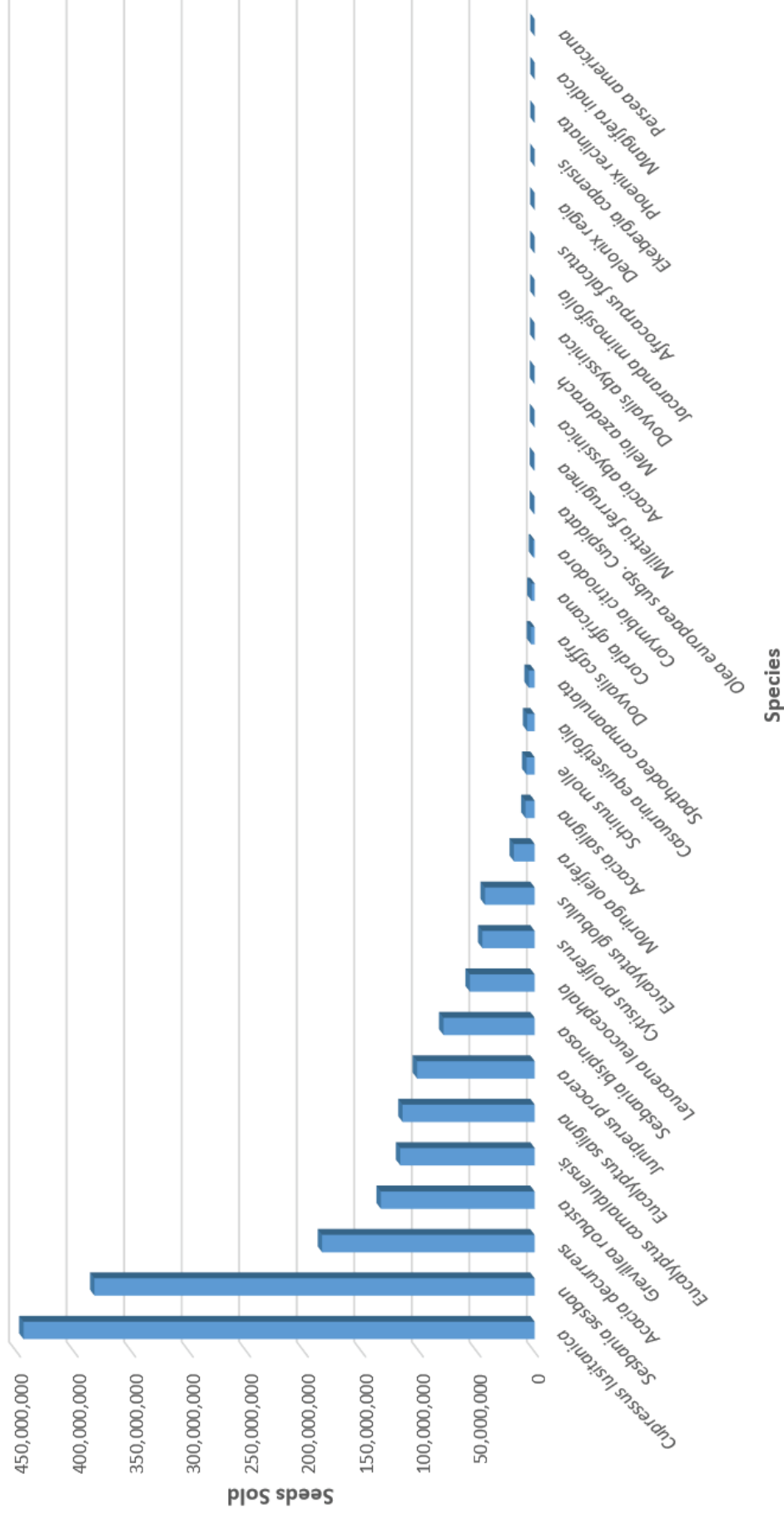
Sorted by decreasing amounts					Species correct	SumOfSumOfSeedlings	Farmland	Natural Forest	Plantation	
Seed Centre	Year	Origin	Establishment							
Oromia	2016-17	E	Seedling		<i>Cupressus lusitanica</i>	444,185,000			21	
Oromia	2016-17	N	Direct Sowing		<i>Sesbania sesban</i>	382,525,000	11			
Oromia	2016-17	E	Seedling		<i>Acacia decurrens</i>	184,690,000	11			
Oromia	2016-17	E	Seedling		<i>Grevillea robusta</i>	133,710,000			2	
Oromia	2016-17	E	Seedling		<i>Eucalyptus camaldulensis</i>	116,809,000			2	
Oromia	2016-17	E	Seedling		<i>Eucalyptus saligna</i>	114,800,000			8	
Oromia	2016-17	N	Seedling		<i>Juniperus procera</i>	102,217,500			7	
Oromia	2016-17	E	Direct Sowing		<i>Sesbania bispinosa</i>	79,300,000	4			
Oromia	2016-17	E	Seedling		<i>Leucaena leucocephala</i>	56,379,250	13			
Oromia	2016-17	E	Seedling		<i>Cytisus proliferus</i>	45,472,500	3			
Oromia	2016-17	E	Seedling		<i>Eucalyptus globulus</i>	43,252,000			3	
Oromia	2016-17	N	Seedling		<i>Moringa oleifera</i>	18,074,250	4			
Oromia	2016-17	E	Seedling		<i>Acacia saligna</i>	8,030,000	4			
Oromia	2016-17	E	Seedling		<i>Schinus molle</i>	7,178,000	7			
Oromia	2016-17	E	Seedling		<i>Casuarina equisetifolia</i>	6,500,000	1		2	
Oromia	2016-17	N	Seedling		<i>Spathodea campanulata</i>	5,100,000	2			
Oromia	2016-17	E	Seedling		<i>Dovyalis caffra</i>	3,145,000	2			
Oromia	2016-17	N	Seedling		<i>Cordia africana</i>	2,677,500	18			
Oromia	2016-17	E	Seedling		<i>Corymbia citriodora</i>	1,310,000			2	
Oromia	2016-17	N	Seedling		<i>Olea europaea subsp. Cuspidata</i>	568,000		6		
Oromia	2016-17	N	Seedling		<i>Milletia ferruginea</i>	547,400		14		
Oromia	2016-17	N	Seedling		<i>Acacia abyssinica</i>	357,000	2			
Oromia	2016-17	E	Seedling		<i>Melia azedarach</i>	357,000	3		3	
Oromia	2016-17	N	Seedling		<i>Dovyalis abyssinica</i>	240,000				Unspecified SS
Oromia	2016-17	E	Seedling		<i>Jacaranda mimosifolia</i>	140,000	1			
Oromia	2016-17	N	Seedling		<i>Afrocarpus falcatus</i>	113,100	4	11		
Oromia	2016-17	E	Seedling		<i>Delonix regia</i>	100,000	1			
Oromia	2016-17	N	Seedling		<i>Ekebergia capensis</i>	61,600	2	2		
Oromia	2016-17	N	Seedling		<i>Phoenix reclinata</i>	59,000		1		
Oromia	2016-17	E	Seedling		<i>Mangifera indica</i>	2,300	2			
Oromia	2016-17	E	Seedling		<i>Persea americana</i>	1,713		2		

Species sold by Oromia SC 2016-17

Potential seedling production=number of seeds

No reduction factor used (losses in germination and in nursery)

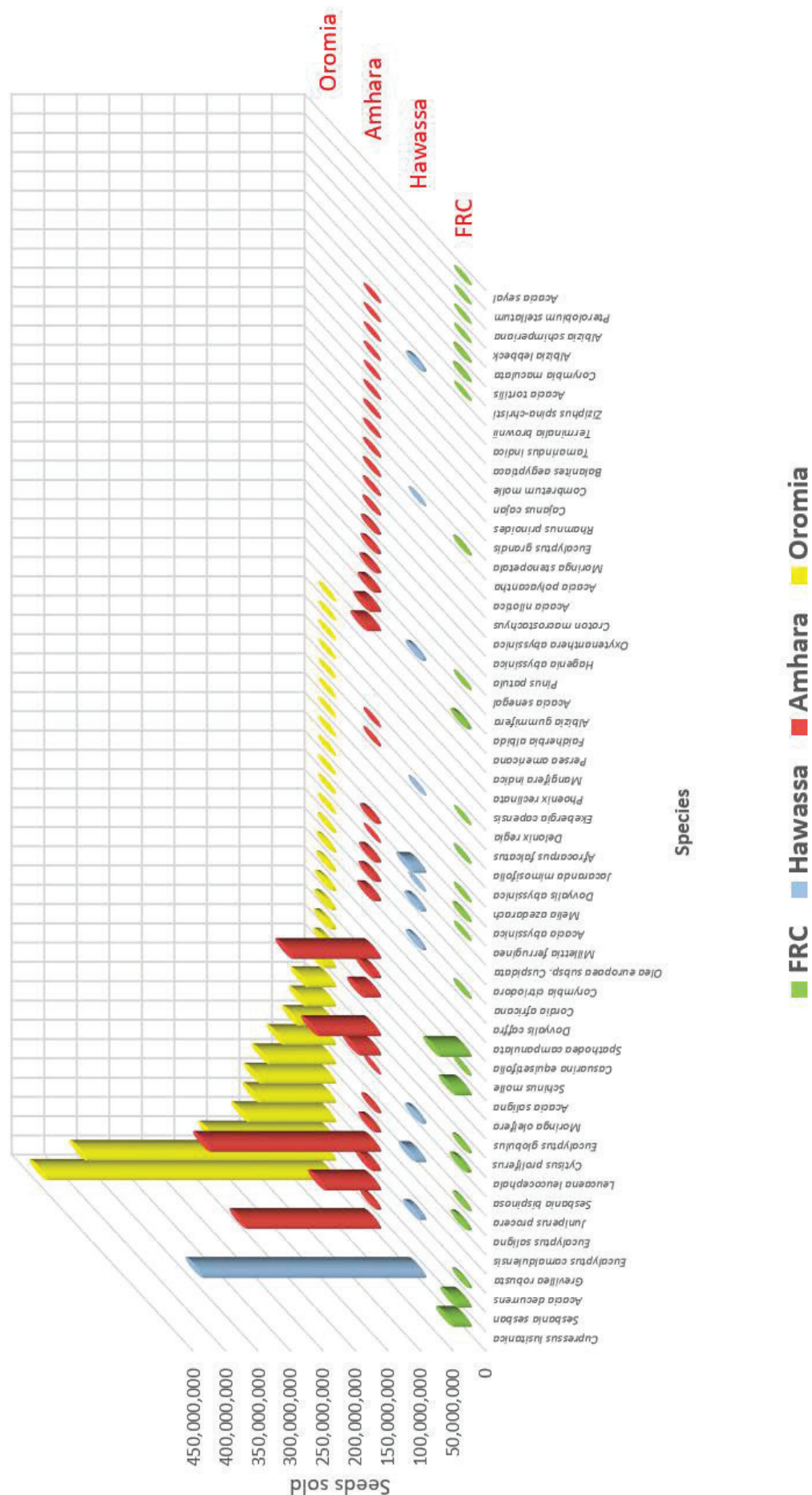
54-55% of seed from Plantations; 71% of seed from exotic species



4 Seed Centres, number of seedlings

Species	FRC	Hawassa	Amhara	Oromia
<i>Cupressus lusitanica</i>	27,501,250	343,245,000	206,265,500	444,185,000
<i>Sesbania sesban</i>	21,010,000		5,820,100	382,525,000
<i>Acacia decurrens</i>	2,860,000		85,415,000	184,690,000
<i>Grevillea robusta</i>		9,240,000	12,396,000	133,710,000
<i>Eucalyptus camaldulensis</i>			262,150,000	116,809,000
<i>Eucalyptus saligna</i>	5,360,000		8,000,000	114,800,000
<i>Juniperus procera</i>	2,565,000	15,615,000	3,566,250	102,217,500
<i>Sesbania bispinosa</i>				79,300,000
<i>Leucaena leucocephala</i>	6,588,000	6,191,500	244,000	56,379,250
<i>Cytisus proliferus</i>	2,902,500		32,130,000	45,472,500
<i>Eucalyptus globulus</i>			96,121,600	43,252,000
<i>Moringa oleifera</i>				18,074,250
<i>Acacia saligna</i>	23,606,000		25,685,000	8,030,000
<i>Schinus molle</i>	1,359,750		11,525,500	7,178,000
<i>Casuarina equisetifolia</i>	47,625,000		135,700,000	6,500,000
<i>Spathodea campanulata</i>				5,100,000
<i>Dovyalis caffra</i>				3,145,000
<i>Cordia africana</i>	983,500	5,152,000	10,178,000	2,677,500
<i>Corymbia citriodora</i>			7,860,000	1,310,000
<i>Olea europaea subsp. Cuspidata</i>		6,920,000	7,320,000	568,000
<i>Milletia ferruginea</i>	249,200	768,600	48,650	547,400
<i>Acacia abyssinica</i>	2,673,250	19,482,000	5,822,500	357,000
<i>Melia azedarach</i>	381,150			357,000
<i>Dovyalis abyssinica</i>				240,000
<i>Jacaranda mimosifolia</i>	945,000			140,000
<i>Afrocarpus falcatus</i>		852,150	517,725	113,100
<i>Delonix regia</i>	75,000		270,375	100,000
<i>Ekebergia capensis</i>				61,600
<i>Phoenix reclinata</i>				59,000
<i>Mangifera indica</i>				2,300
<i>Persea americana</i>				1,713
<i>Faidherbia albida</i>	5,370,000		20,190,000	
<i>Albizia gummifera</i>		5,244,000	15,816,000	
<i>Acacia senegal</i>	586,625		9,408,895	
<i>Pinus patula</i>			6,695,000	
<i>Hagenia abyssinica</i>			4,917,500	
<i>Oxytenanthera abyssinica</i>			4,234,855	
<i>Croton macrostachyus</i>			1,999,500	
<i>Acacia nilotica</i>			1,449,000	
<i>Acacia polyacantha</i>			1,402,500	
<i>Moringa stenopetala</i>	1,645,120	585,880	1,028,006	
<i>Eucalyptus grandis</i>			875,000	
<i>Rhamnus prinoides</i>			814,000	
<i>Cajanus cajan</i>			585,000	
<i>Combretum molle</i>			62,500	
<i>Balanites aegyptiaca</i>			30,500	
<i>Tamarindus indica</i>			11,900	
<i>Terminalia brownii</i>		5,031,000	10,500	
<i>Ziziphus spina-christi</i>	9,000		8,250	
<i>Acacia tortilis</i>	1,924,250			
<i>Corymbia maculata</i>	1,430,000			
<i>Albizia lebbeck</i>	114,000			
<i>Albizia schimperiana</i>	91,000			
<i>Pterolobium stellatum</i>	45,000			
<i>Acacia seyal</i>	40,000			

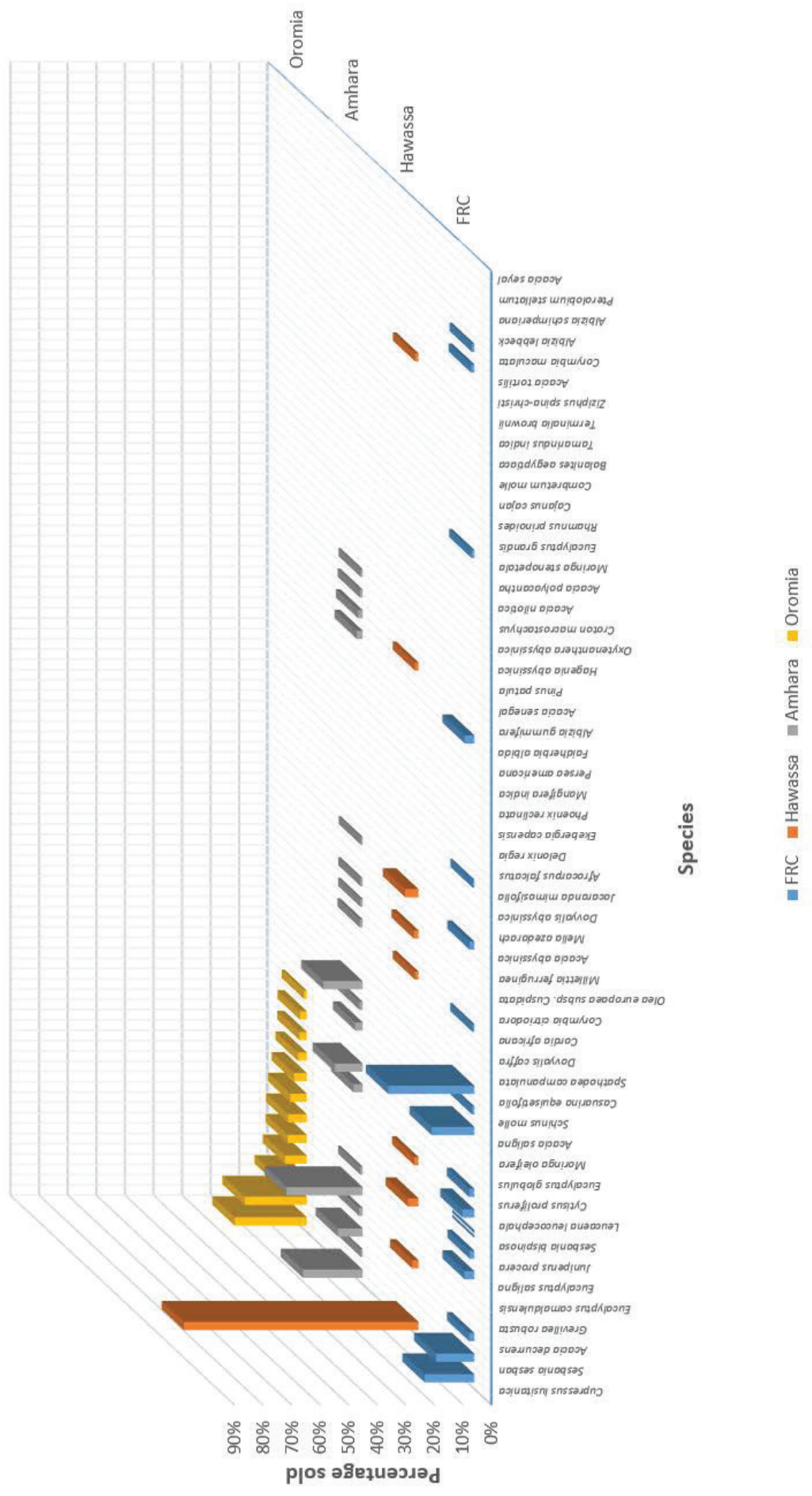
Species sold by 4 SC 2016-17 - Potential seedling production= number of seeds
 No reduction factor used (losses in germination and in nursery)



4 Seed Centres, percentages of seedlings

Species	FRC	Hawassa	Amhara	Oromia
<i>Cupressus lusitanica</i>	17%	82%	21%	25%
<i>Sesbania sesban</i>	13%		1%	22%
<i>Acacia decurrens</i>	2%		9%	11%
<i>Grevillea robusta</i>		2%	1%	8%
<i>Eucalyptus camaldulensis</i>			27%	7%
<i>Eucalyptus saligna</i>	3%		1%	7%
<i>Juniperus procera</i>	2%	4%		6%
<i>Sesbania bispinosa</i>	0%			5%
<i>Leucaena leucocephala</i>	4%	1%		3%
<i>Cytisus proliferus</i>	2%		3%	3%
<i>Eucalyptus globulus</i>			10%	2%
<i>Moringa oleifera</i>				1%
<i>Acacia saligna</i>	15%		3%	
<i>Schinus molle</i>	1%		1%	
<i>Casuarina equisetifolia</i>	30%		14%	
<i>Spathodea campanulata</i>				
<i>Dovyalis caffra</i>				
<i>Cordia africana</i>	1%	1%	1%	
<i>Corymbia citriodora</i>			1%	
<i>Olea europaea subsp. Cuspidata</i>		2%	1%	
<i>Millettia ferruginea</i>				
<i>Acacia abyssinica</i>	2%	5%	1%	
<i>Melia azedarach</i>				
<i>Dovyalis abyssinica</i>				
<i>Jacaranda mimosifolia</i>	1%			
<i>Afrocarpus falcatus</i>				
<i>Delonix regia</i>				
<i>Ekebergia capensis</i>				
<i>Phoenix reclinata</i>				
<i>Mangifera indica</i>				
<i>Persea americana</i>				
<i>Faidherbia albida</i>	3%		2%	
<i>Albizia gummifera</i>		1%	2%	
<i>Acacia senegal</i>			1%	
<i>Pinus patula</i>			1%	
<i>Hagenia abyssinica</i>				
<i>Oxytenanthera abyssinica</i>				
<i>Croton macrostachyus</i>				
<i>Acacia nilotica</i>				
<i>Acacia polyacantha</i>				
<i>Moringa stenopetala</i>	1%			
<i>Eucalyptus grandis</i>				
<i>Rhamnus prinoides</i>				
<i>Cajanus cajan</i>				
<i>Combretum molle</i>				
<i>Balanites aegyptiaca</i>				
<i>Tamarindus indica</i>				
<i>Terminalia brownii</i>		1%		
<i>Ziziphus spina-christi</i>				
<i>Acacia tortilis</i>	1%			
<i>Corymbia maculata</i>	1%			
<i>Albizia lebbeck</i>				
<i>Albizia schimperiana</i>				
<i>Pterolobium stellatum</i>				
<i>Acacia seyal</i>				

Species sold by 4 SC 2016-17 - Potential seedling production= number of seeds
 No reduction factor used (losses in germination and in nursery)
 Percentages of Seeds sold in each centre



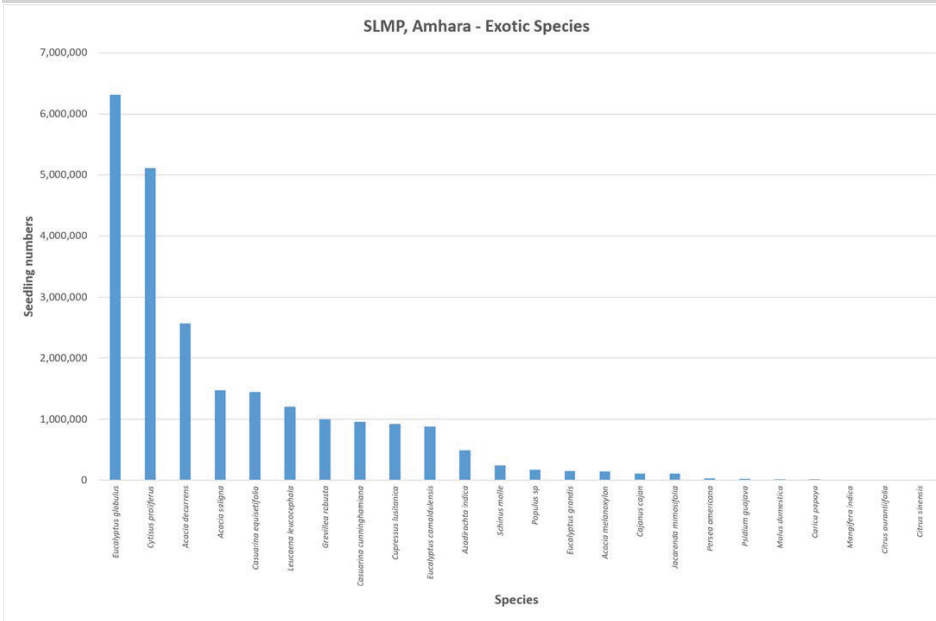
Seeds per Kg		
ID	Species correct	Average number of seed per Kilogram
1	<i>Acacia abyssinica</i>	17,763
2	<i>Acacia decurrens</i>	73,465
3	<i>Acacia mearnsii</i>	67,500
4	<i>Acacia melanoxylon</i>	84,592
5	<i>Acacia nilotica</i>	7,317
6	<i>Acacia polyacantha</i>	13,722
7	<i>Acacia saligna</i>	65,734
8	<i>Acacia senegal</i>	10,615
9	<i>Acacia seyal</i>	17,722
10	<i>Acacia tortilis</i>	14,675
11	<i>Afrocarpus falcatus</i>	1,603
12	<i>Albizia coriaria</i>	6,000
13	<i>Albizia grandibracteata</i>	
14	<i>Albizia gummifera</i>	12,000
15	<i>Albizia lebbeck</i>	9,454
16	<i>Albizia schimperiana</i>	14,000
17	<i>Azadirachta indica</i>	9,631
18	<i>Balanites aegyptiaca</i>	533
19	<i>Boswellia papyrifera</i>	54,500
20	<i>Boswellia pirottae</i>	
21	<i>Cajanus cajan</i>	7,898
22	<i>Calliandra calothyrsus</i>	19,000
23	<i>Callistemon citrinus</i>	4,904,365
24	<i>Callistemon sp</i>	
25	<i>Carica papaya</i>	50,000
26	<i>Casuarina cunninghamiana</i>	1,065,000
27	<i>Casuarina equisetifolia</i>	1,176,470
28	<i>Casuarina sp</i>	
29	<i>Celtis africana</i>	17,000
30	<i>Chloris gayana</i>	
31	<i>Chrysopogon zizanioides</i>	
32	<i>Coffea arabica</i>	3,200
33	<i>Combretum molle</i>	13,000
34	<i>Cordia africana</i>	6,141
35	<i>Corymbia citriodora</i>	180,000
36	<i>Corymbia maculata</i>	110,000
37	<i>Croton macrostachyus</i>	21,500
38	<i>Croton sp</i>	
39	<i>Cupressus lusitanica</i>	156,739

Seeds per Kg		
ID	Species correct	Average number of seed per Kilogram
40	<i>Cupressus sempervirens</i>	174,600
41	<i>Cytisus proliferus</i>	38,000
42	<i>Dalbergia melanoxylon</i>	10,000
43	<i>Delonix regia</i>	2,961
44	<i>Dichrostachys cinerea</i>	58,500
45	<i>Dodonaea angustifolia</i>	117,259
46	<i>Dodonaea viscosa</i>	100,000
47	<i>Dombeya torrida</i>	235,000
48	<i>Dovyalis abyssinica</i>	33,684
49	<i>Dovyalis caffra</i>	29,446
50	<i>Ehretia cymosa</i>	25,000
51	<i>Ekebergia capensis</i>	1,910
52	<i>Entada abyssinica</i>	3,900
53	<i>Erica arborea</i>	45,000
54	<i>Erythrina brucei</i>	6,800
55	<i>Eucalyptus camaldulensis</i>	1,887,507
56	<i>Eucalyptus globulus</i>	295,857
57	<i>Eucalyptus grandis</i>	3,267,974
58	<i>Eucalyptus saligna</i>	1,850,000
59	<i>Eucalyptus viminalis</i>	951,656
60	<i>Faidherbia albida</i>	11,447
61	<i>Faurea saligna</i>	165,000
62	<i>Grevillea robusta</i>	78,751
63	<i>Hagenia abyssinica</i>	333,577
64	<i>Jacaranda mimosifolia</i>	98,058
65	<i>Jatropha curcas</i>	2,400
66	<i>Juniperus procera</i>	55,850
67	<i>Leucaena leucocephala</i>	21,437
68	<i>Maerua aethiopica</i>	
69	<i>Mangifera indica</i>	50
70	<i>Melia azedarach</i>	4,695
71	<i>Milicia excelsa</i>	475,000
72	<i>Milletia ferruginea</i>	11,351
73	<i>Moringa oleifera</i>	4,500
74	<i>Moringa stenopetala</i>	1,980
75	<i>Olea europaea subsp. cuspidata</i>	10,020
76	<i>Olea europaea subsp. cuspidata?</i>	
77	<i>Olea welwitschii</i>	3,000
78	<i>Oxyanthera?</i>	

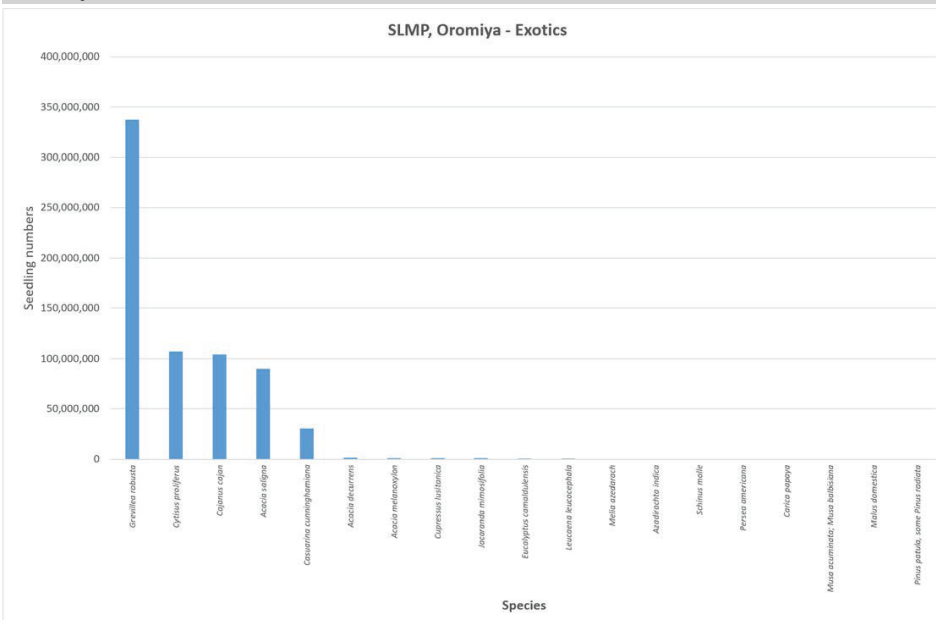
Seeds per Kg		
ID	Species correct	Average number of seed per Kilogram
79	<i>Parkinsonia aculeata</i>	11,282
80	<i>Persea americana</i>	15
81	<i>Phoenix reclinata</i>	2,900
82	<i>Pinus patula</i>	149,700
83	<i>Pinus radiata</i>	49,693
84	<i>Pouteria adolfi-friedericii</i>	450
85	<i>Prunus africana</i>	4,700
86	<i>Pterolobium stellatum</i>	34,045
87	<i>Rhamnus prinoides</i>	60,000
88	<i>Rhamnus sp</i>	
89	<i>Schinus molle</i>	28,335
90	<i>Senna siamea</i>	39,000
91	<i>Sesbania bispinosa</i>	
92	<i>Sesbania sesban</i>	72,643
93	<i>Spathodea campanulata</i>	205,939
94	<i>Syzygium guineense</i>	3,050
95	<i>Tamarindus indica</i>	2,174
96	<i>Terminalia brownii</i>	3,000
97	<i>Unknown</i>	
98	<i>Vigna unguiculata</i>	8,300
99	<i>Ziziphus jujuba</i>	2,500
100	<i>Ziziphus spina-christi</i>	2,542

Appendix 5 - Sustainable Land Management Project (SLMP) – Species

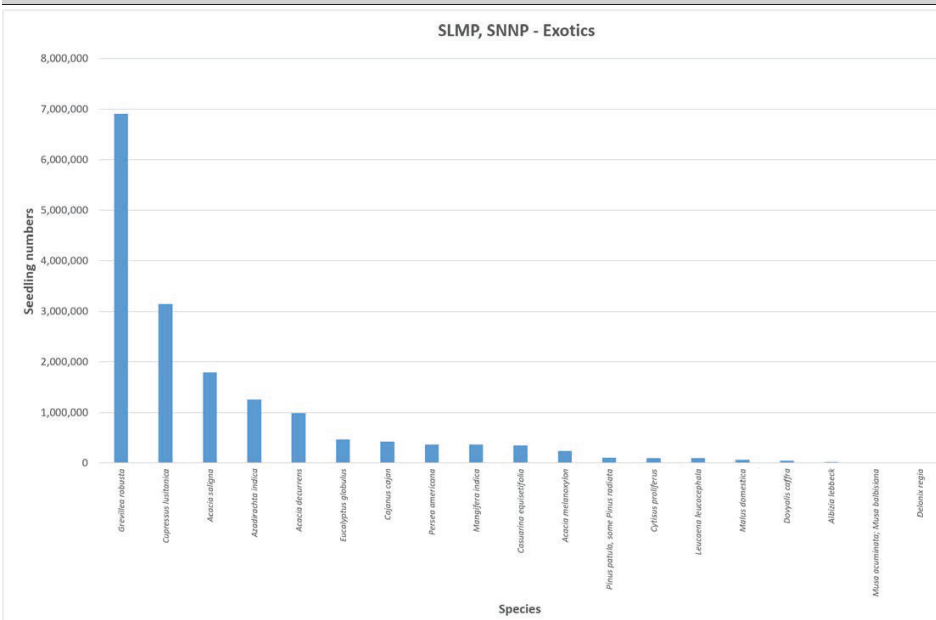
Amhara – note different scales on the Y-axis

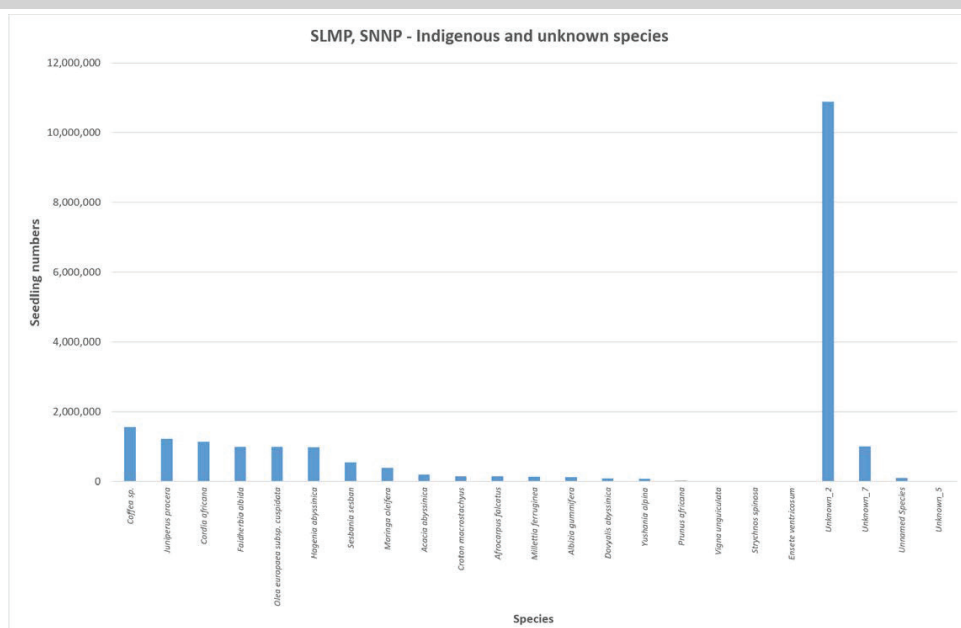
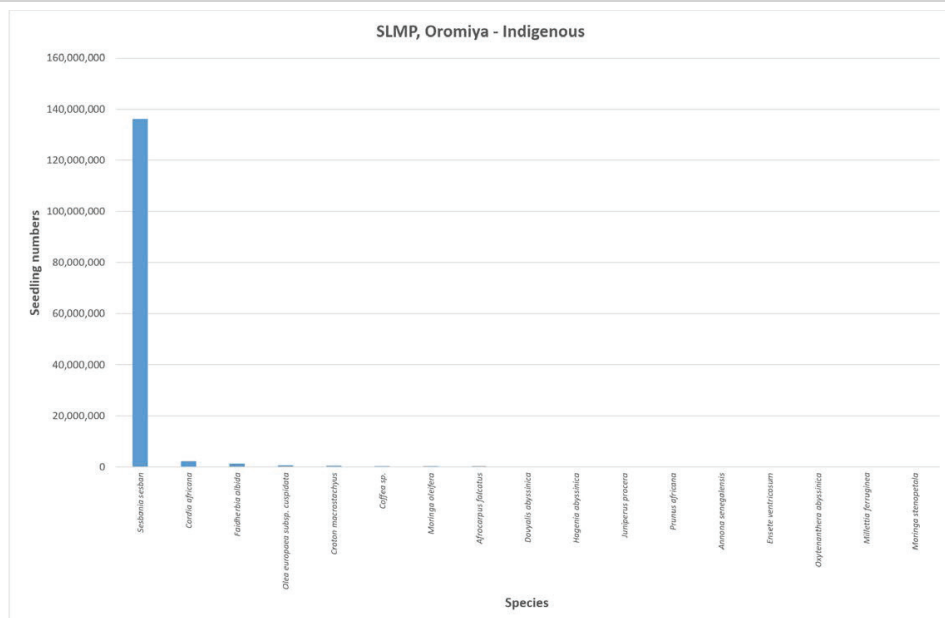
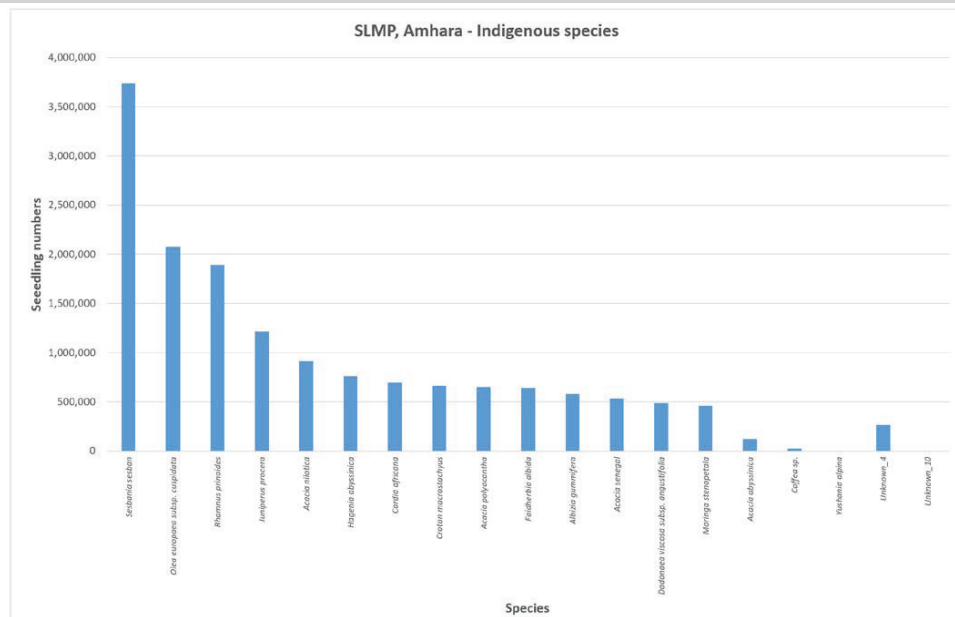


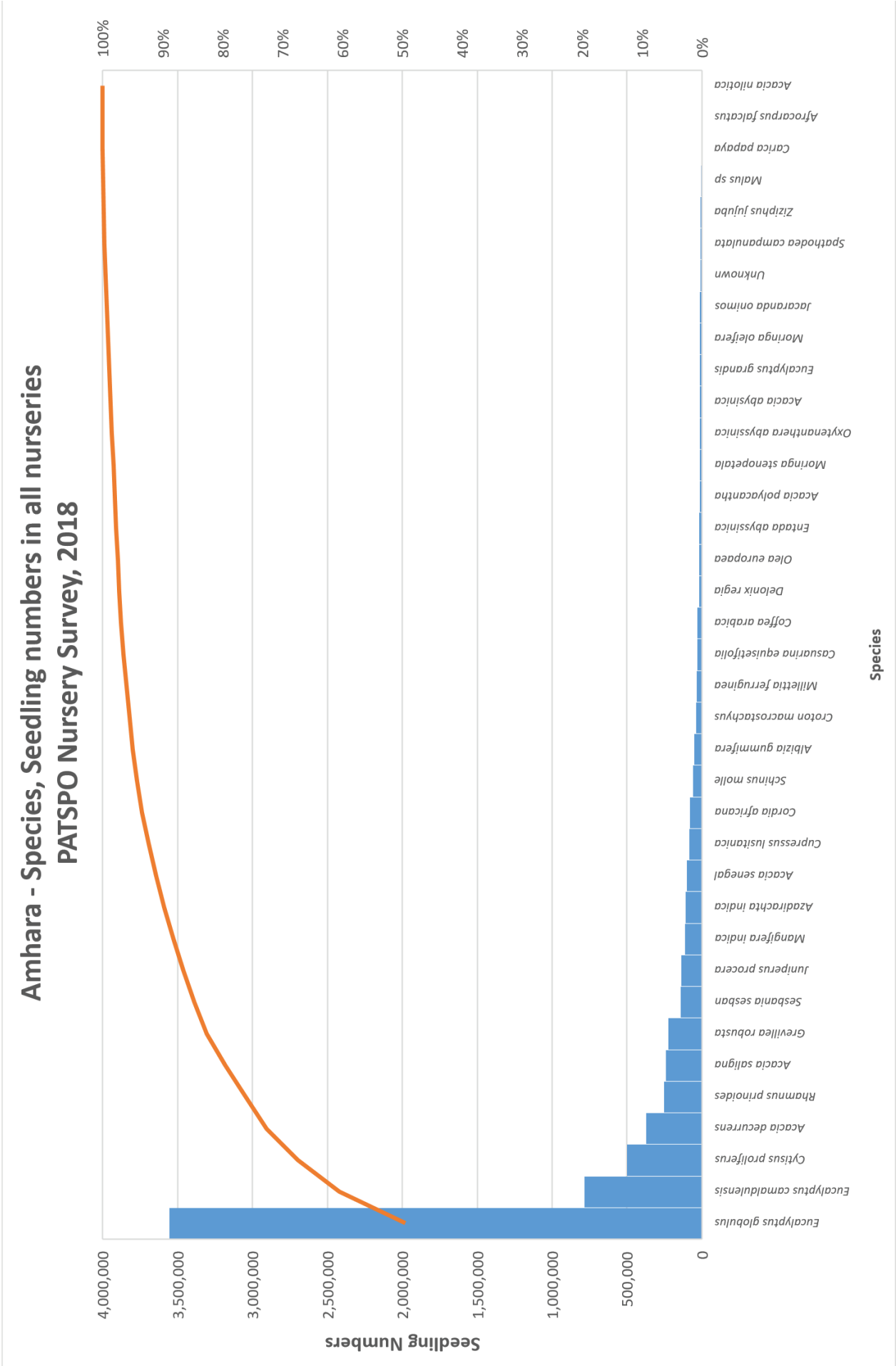
Oromiya – note different scales on the Y-axis



SNNP – note different scales on the Y-axis

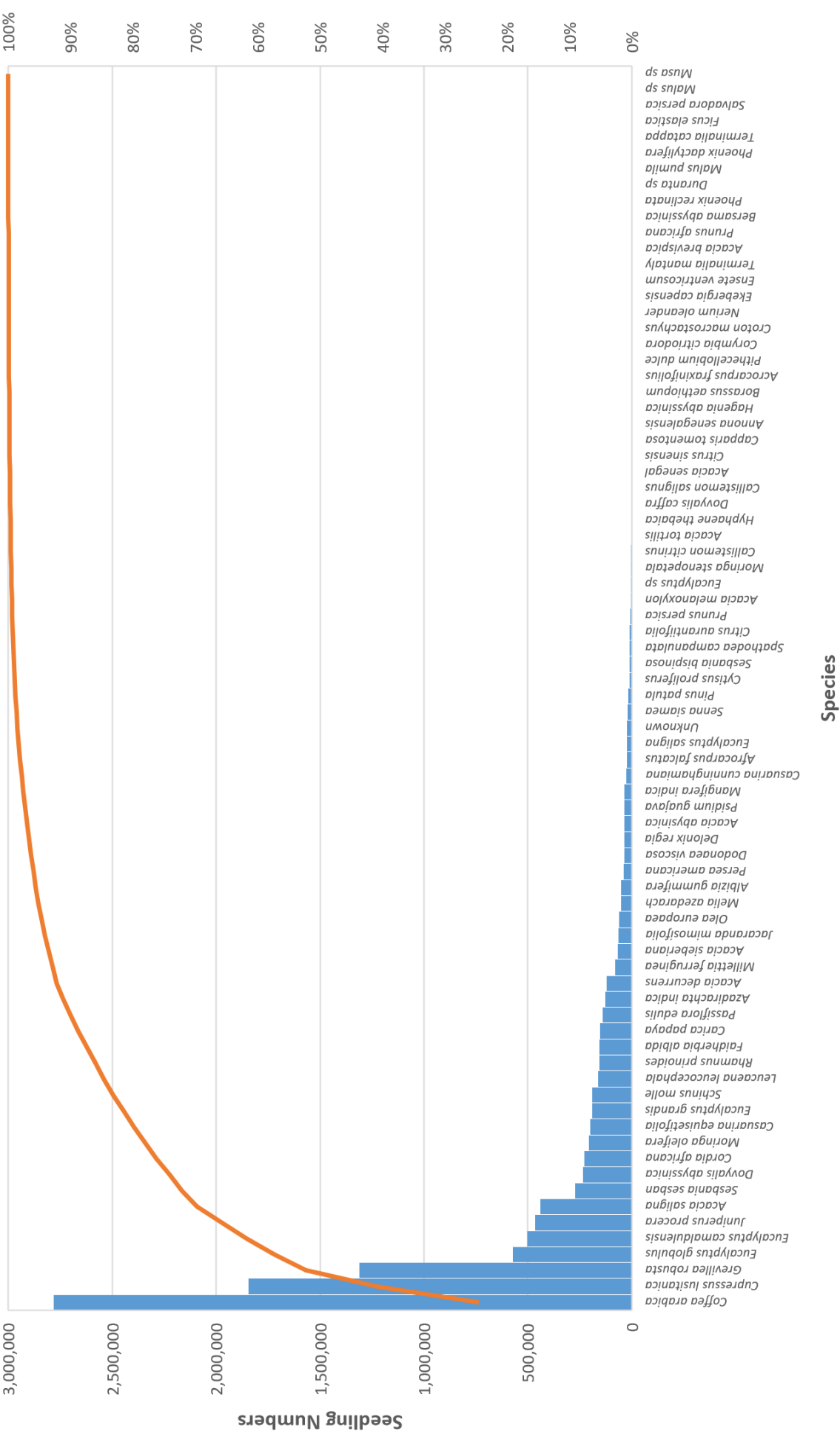






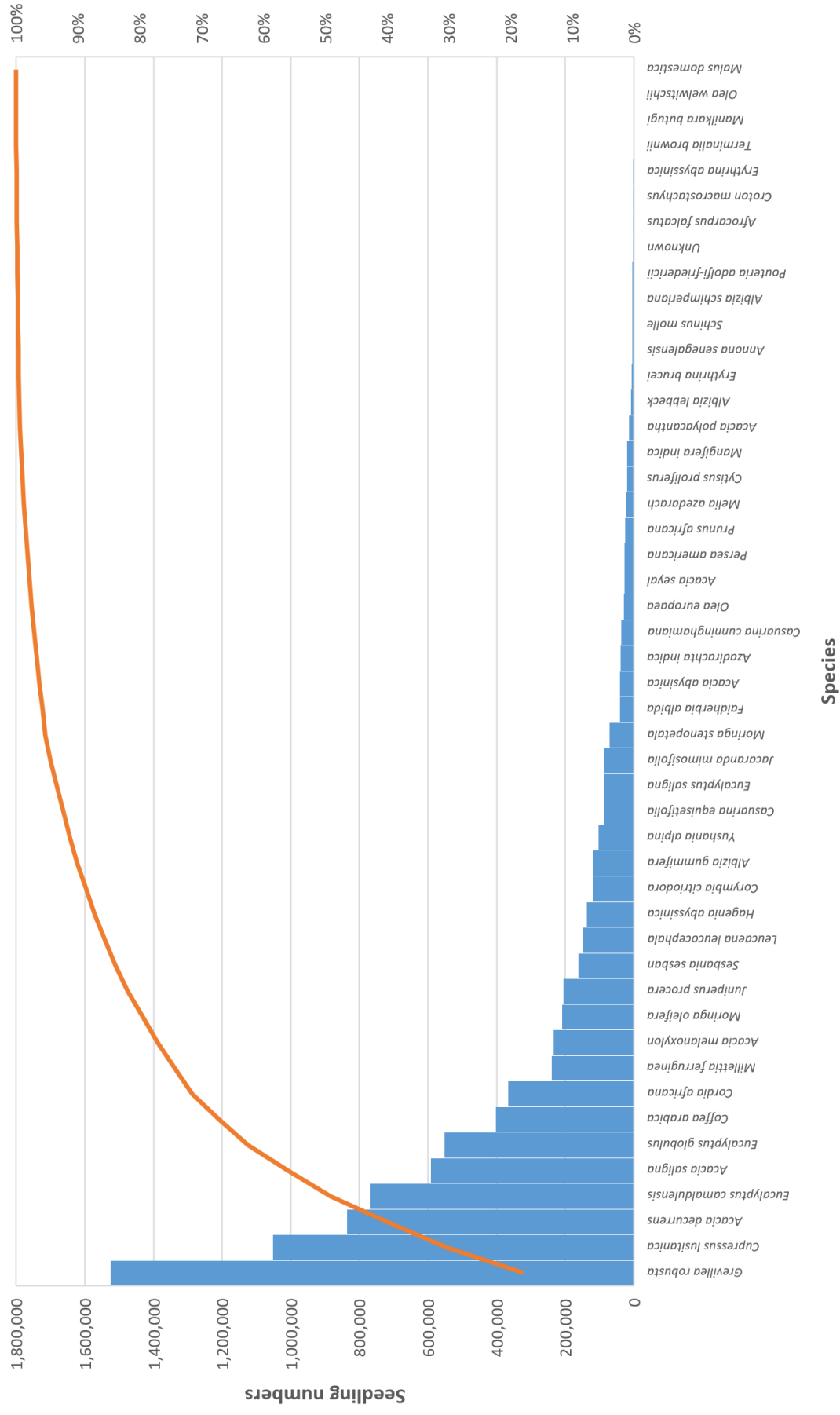
1_v_Reg_name_NEW	Final Name	SumOf5_1_1_seedIngno_
Amhara	Eucalyptus globulus	3,558,200
Amhara	Eucalyptus camaldulensis	787,078
Amhara	Cytisus proliferus	499,950
Amhara	Acacia decurrens	372,645
Amhara	Rhamnus prinoides	255,134
Amhara	Acacia saligna	240,544
Amhara	Grevillea robusta	224,882
Amhara	Sesbania sesban	144,940
Amhara	Juniperus procera	137,990
Amhara	Mangifera indica	112,936
Amhara	Azadirachta indica	110,630
Amhara	Acacia senegal	100,999
Amhara	Cupressus lusitanica	83,973
Amhara	Cordia africana	81,160
Amhara	Schinus molle	61,383
Amhara	Albizia gummifera	52,600
Amhara	Croton macrostachyus	39,240
Amhara	Millettia ferruginea	36,000
Amhara	Casuarina equisetifolia	32,730
Amhara	Coffea arabica	31,943
Amhara	Delonix regia	19,462
Amhara	Olea europaea	18,919
Amhara	Entada abyssinica	18,655
Amhara	Acacia polyacantha	18,000
Amhara	Moringa stenopetala	17,736
Amhara	Oxytenanthera abyssinica	17,682
Amhara	Acacia abyssinica	16,560
Amhara	Eucalyptus grandis	16,000
Amhara	Moringa oleifera	14,855
Amhara	Jacaranda onimos	14,100
Amhara	Unknown	13,130
Amhara	Spathodea campanulata	12,797
Amhara	Ziziphus jujuba	10,259
Amhara	Malus sp	9,600
Amhara	Carica papaya	1,672
Amhara	Afrocarpus falcatus	600
Amhara	Acacia nilotica	107

Oromiya - Species, Seedling numbers in all nurseries
PATSPo Nursery Survey, 2018



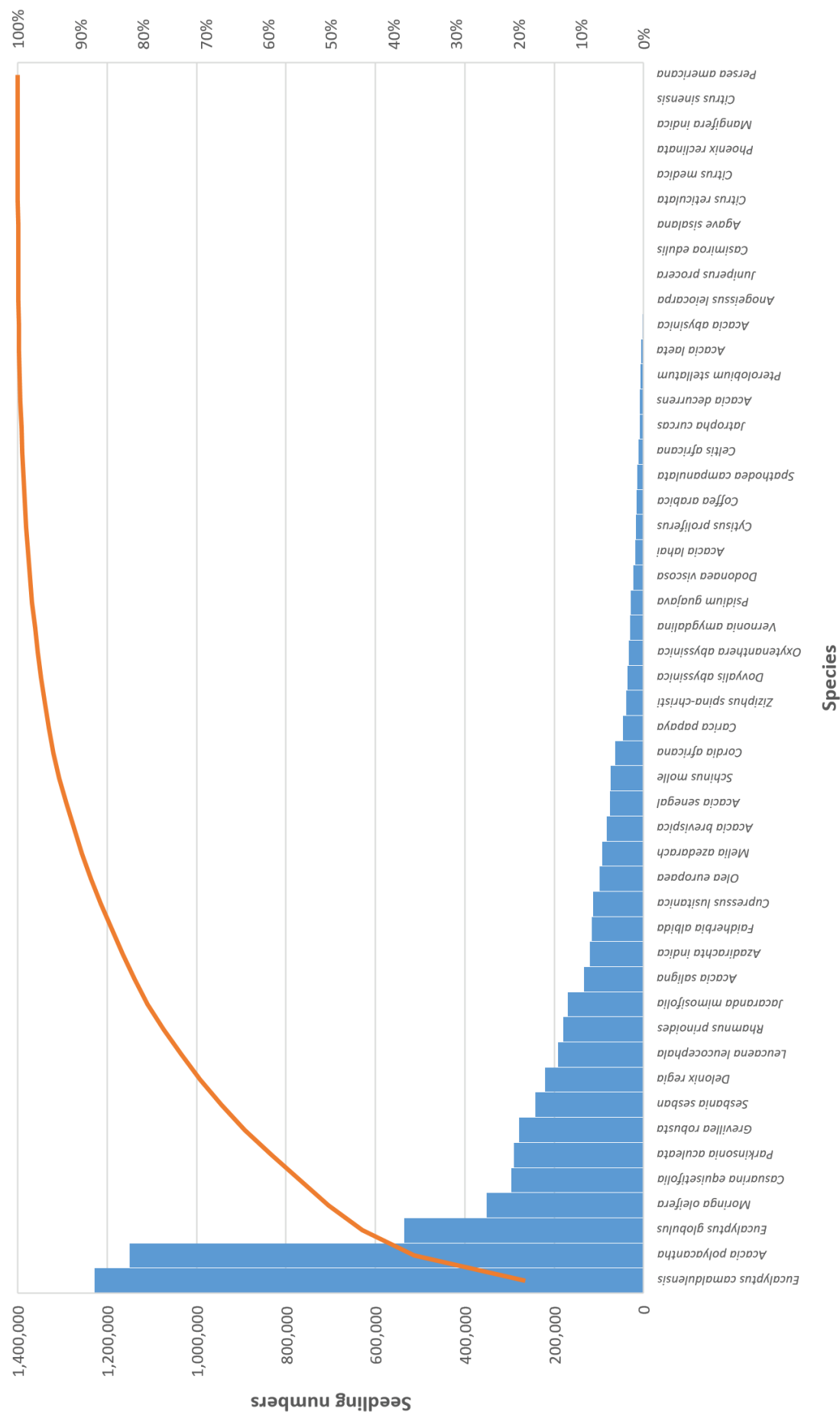
1_v_Reg_name_NEW	Final Name	SumOf5_1_1_seedIngn_	1_v_Reg_name_NEW	Final Name	SumOf5_1_1_seedIngn_
Oromia	Coffea arabica	2,783,465	Oromia	Pinus patula	17,500
Oromia	Cupressus lusitanica	1,847,116	Oromia	Cytisus proliferus	13,600
Oromia	Grevillea robusta	1,313,684	Oromia	Sesbania bispinosa	11,800
Oromia	Eucalyptus globulus	573,787	Oromia	Spathodea campanulata	11,520
Oromia	Eucalyptus camaldulensis	503,478	Oromia	Citrus aurantiifolia	10,660
Oromia	Juniperus procera	466,925	Oromia	Prunus persica	10,000
Oromia	Acacia saligna	442,867	Oromia	Acacia melanoxylon	7,100
Oromia	Sesbania sesban	272,529	Oromia	Eucalyptus sp	7,000
Oromia	Dovyalis abyssinica	237,470	Oromia	Moringa stenopetala	6,485
Oromia	Cordia africana	229,284	Oromia	Callistemon citrinus	4,456
Oromia	Moringa oleifera	208,404	Oromia	Acacia tortilis	4,142
Oromia	Casuarina equisetifolia	202,316	Oromia	Hyphaene thebaica	3,815
Oromia	Eucalyptus grandis	192,600	Oromia	Dovyalis caffra	3,800
Oromia	Schinus molle	191,238	Oromia	Callistemon salignus	3,790
Oromia	Leucaena leucocephala	163,697	Oromia	Acacia senegal	3,068
Oromia	Rhamnus prinoides	157,924	Oromia	Citrus sinensis	3,020
Oromia	Faidherbia albida	156,253	Oromia	Capparis tomentosa	3,000
Oromia	Carica papaya	155,078	Oromia	Annona senegalensis	2,900
Oromia	Passiflora edulis	143,000	Oromia	Hagenia abyssinica	2,800
Oromia	Azadirachta indica	128,143	Oromia	Borassus aethiopum	2,399
Oromia	Acacia decurrens	121,678	Oromia	Acrocarpus fraxinifolius	2,000
Oromia	Millettia ferruginea	81,367	Oromia	Pithecellobium dulce	2,000
Oromia	Acacia sieberiana	70,400	Oromia	Corymbia citriodora	1,500
Oromia	Jacaranda mimosifolia	66,120	Oromia	Croton macrostachyus	1,370
Oromia	Olea europaea	64,170	Oromia	Nerium oleander	1,200
Oromia	Melia azedarach	53,149	Oromia	Ekebergia capensis	1,194
Oromia	Albizia gummifera	52,720	Oromia	Ensete ventricosum	1,000
Oromia	Persea americana	40,803	Oromia	Terminalia mantaly	850
Oromia	Dodonaea viscosa	38,450	Oromia	Acacia brevispica	825
Oromia	Delonix regia	38,363	Oromia	Prunus africana	650
Oromia	Acacia abysinica	37,884	Oromia	Bersama abyssinica	520
Oromia	Psidium guajava	37,633	Oromia	Phoenix reclinata	500
Oromia	Mangifera indica	36,759	Oromia	Duranta sp	450
Oromia	Casuarina cunninghamiana	26,350	Oromia	Malus pumila	417
Oromia	Afrocarpus falcatus	25,067	Oromia	Phoenix dactylifera	250
Oromia	Eucalyptus saligna	24,500	Oromia	Terminalia catappa	200
Oromia	Unknown	23,940	Oromia	Ficus elastica	100
Oromia	Senna siamea	20,414	Oromia	Salvadora persica	100
			Oromia	Malus sp	55
			Oromia	Musa sp	20

SNNP - Species, Seedling numbers in all nurseries PATSP0 Nursery Survey, 2018

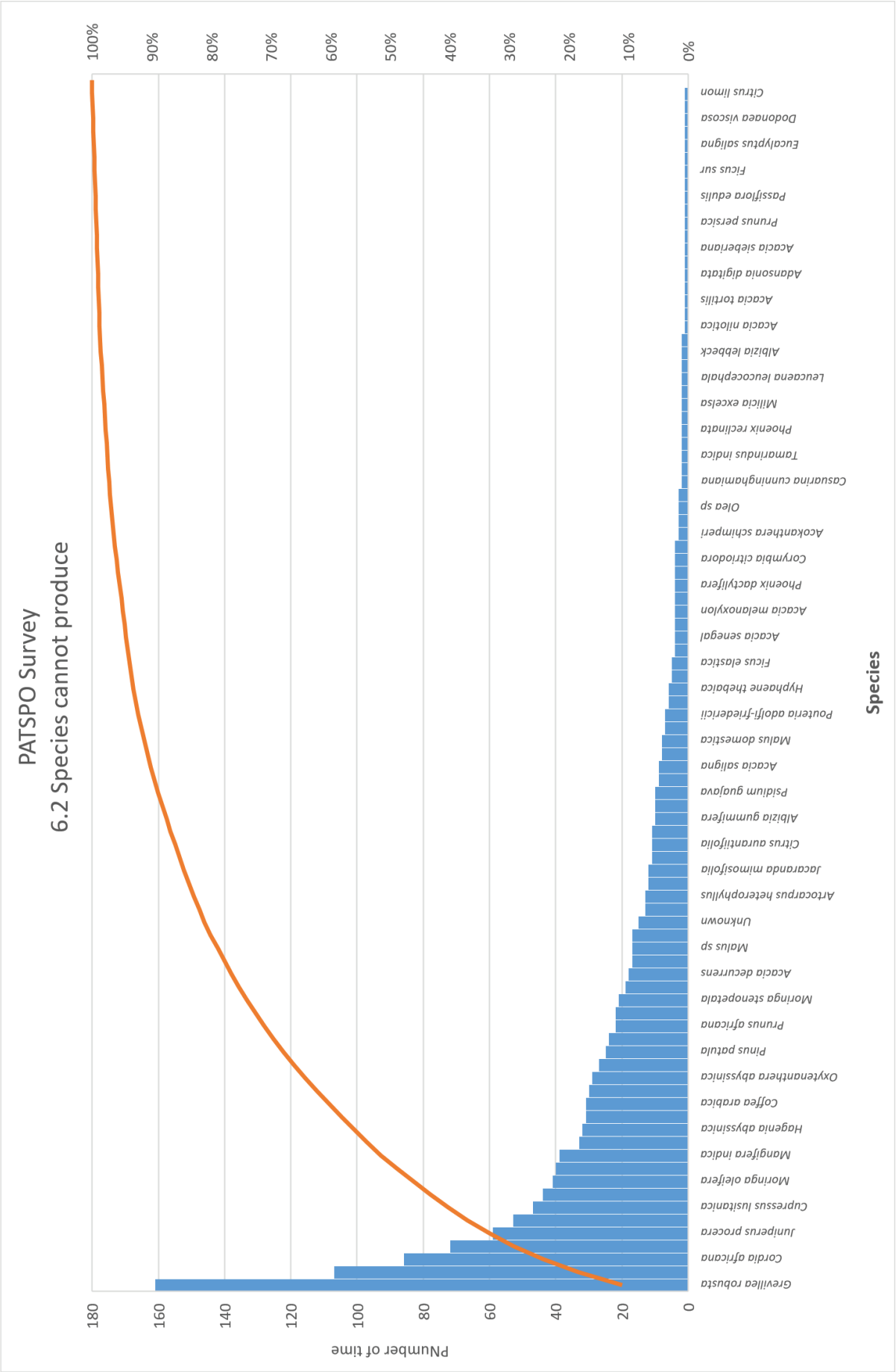


1_v_Reg_name_NEW	Final Name	SumOf5_1_1_seedIngno_
SNNP	Grevillea robusta	1,525,213
SNNP	Cupressus lusitanica	1,052,723
SNNP	Acacia decurrens	836,556
SNNP	Eucalyptus camaldulensis	770,158
SNNP	Acacia saligna	591,991
SNNP	Eucalyptus globulus	553,472
SNNP	Coffea arabica	402,600
SNNP	Cordia africana	366,777
SNNP	Millettia ferruginea	239,346
SNNP	Acacia melanoxylon	234,778
SNNP	Moringa oleifera	210,596
SNNP	Juniperus procera	205,898
SNNP	Sesbania sesban	162,388
SNNP	Leucaena leucocephala	149,040
SNNP	Hagenia abyssinica	138,655
SNNP	Corymbia citriodora	121,647
SNNP	Albizia gummifera	120,328
SNNP	Yushania alpina	104,284
SNNP	Casuarina equisetifolia	89,196
SNNP	Eucalyptus saligna	87,405
SNNP	Jacaranda mimosifolia	86,680
SNNP	Moringa stenopetala	72,105
SNNP	Faidherbia albida	41,056
SNNP	Acacia abysinica	40,761
SNNP	Azadirachta indica	39,104
SNNP	Casuarina cunninghamiana	38,381
SNNP	Olea europaea	30,789
SNNP	Acacia seyal	28,000
SNNP	Persea americana	27,500
SNNP	Prunus africana	26,480
SNNP	Melia azedarach	23,255
SNNP	Cytisus proliferus	20,751
SNNP	Mangifera indica	20,000
SNNP	Acacia polyacantha	15,318
SNNP	Albizia lebbeck	9,811
SNNP	Erythrina brucei	7,183
SNNP	Annona senegalensis	6,000
SNNP	Schinus molle	5,665
SNNP	Albizia schimperiana	4,731
SNNP	Pouteria adolfi-friedericii	4,600
SNNP	Unknown	4,050
SNNP	Afrocarpus falcatus	3,715
SNNP	Croton macrostachyus	3,000
SNNP	Erythrina abyssinica	2,613
SNNP	Terminalia brownii	903
SNNP	Manilkara butugi	513
SNNP	Olea welwitschii	267
SNNP	Malus domestica	251

Tigray - Species, Seedling numbers in all nurseries
PATSPo Nursery Survey, 2018



1_v_Reg_name_NEW	Final Name	SumOf5_1_1_seedIngno_
Tigray	Eucalyptus camaldulensis	1,228,353
Tigray	Acacia polyacantha	1,150,729
Tigray	Eucalyptus globulus	536,467
Tigray	Moringa oleifera	352,083
Tigray	Casuarina equisetifolia	296,864
Tigray	Parkinsonia aculeata	291,521
Tigray	Grevillea robusta	279,632
Tigray	Sesbania sesban	243,047
Tigray	Delonix regia	220,940
Tigray	Leucaena leucocephala	192,062
Tigray	Rhamnus prinoides	180,558
Tigray	Jacaranda mimosifolia	170,081
Tigray	Acacia saligna	133,550
Tigray	Azadirachta indica	120,793
Tigray	Faidherbia albida	117,318
Tigray	Cupressus lusitanica	114,374
Tigray	Olea europaea	99,526
Tigray	Melia azedarach	93,591
Tigray	Acacia brevispica	83,450
Tigray	Acacia senegal	75,572
Tigray	Schinus molle	75,106
Tigray	Cordia africana	64,984
Tigray	Carica papaya	47,000
Tigray	Ziziphus spina-christi	39,720
Tigray	Dovyalis abyssinica	36,607
Tigray	Oxytenanthera abyssinica	33,431
Tigray	Vernonia amygdalina	31,090
Tigray	Psidium guajava	29,062
Tigray	Dodonaea viscosa	23,600
Tigray	Acacia lahai	19,489
Tigray	Cytisus proliferus	17,320
Tigray	Coffea arabica	16,158
Tigray	Spathodea campanulata	14,466
Tigray	Celtis africana	12,000
Tigray	Jatropha curcas	9,262
Tigray	Acacia decurrens	9,000
Tigray	Pterolobium stellatum	7,672
Tigray	Acacia laeta	6,800
Tigray	Acacia abyssinica	3,880
Tigray	Anogeissus leiocarpa	2,500
Tigray	Juniperus procera	2,100
Tigray	Casimiroa edulis	1,720
Tigray	Agave sisalana	700
Tigray	Citrus reticulata	500
Tigray	Citrus medica	400
Tigray	Phoenix reclinata	300
Tigray	Mangifera indica	236
Tigray	Citrus sinensis	200
Tigray	Persea americana	100



<i>Final Name</i>	<i>CountOfFinal Name</i>	<i>Final Name</i>	<i>CountOfFinal Name</i>	<i>Final Name</i>	<i>CountOfFinal Name</i>
<i>Grevillea robusta</i>	161	<i>Dovyalis abyssinica</i>	9	<i>Adansonia digitata</i>	1
<i>Olea europaea</i>	107	<i>Acacia saligna</i>	9	<i>Araucaria sp</i>	1
<i>Cordia africana</i>	86	<i>Celtis africana</i>	8	<i>Acacia sieberiana</i>	1
<i>Afrocarpus falcatus</i>	72	<i>Malus domestica</i>	8	<i>Prunus sp</i>	1
<i>Juniperus procera</i>	59	<i>Acacia abyssinica</i>	7	<i>Prunus persica</i>	1
<i>Rhamnus prinoides</i>	53	<i>Pouteria adolfi-friedericii</i>	7	<i>Podocarpus falcatus</i>	1
<i>Cupressus lusitanica</i>	47	<i>Parkinsonia aculeata</i>	6	<i>Passiflora edulis</i>	1
<i>Persea americana</i>	44	<i>Hyphaene thebaica</i>	6	<i>Olea africana</i>	1
<i>Moringa oleifera</i>	41	<i>Albiza gummifera</i>	5	<i>Ficus sur</i>	1
<i>Azadirachta indica</i>	40	<i>Ficus elastica</i>	5	<i>Eucalyptus sp</i>	1
<i>Mangifera indica</i>	39	<i>Spathodea campanulata</i>	4	<i>Eucalyptus saligna</i>	1
<i>Malus pumila</i>	33	<i>Acacia senegal</i>	4	<i>Erythrina brucei</i>	1
<i>Hagenia abyssinica</i>	32	<i>Jatropha curcas</i>	4	<i>Dodonaea viscosa</i>	1
<i>Citrus sinensis</i>	31	<i>Acacia melanoxylon</i>	4	<i>Cytisus proliferus</i>	1
<i>Coffea arabica</i>	31	<i>Milletia ferruginea</i>	4	<i>Citrus limon</i>	1
<i>Delonix regia</i>	30	<i>Phoenix dactylifera</i>	4	<i>Moringa sp</i>	1
<i>Oxytenanthera abyssinica</i>	29	<i>Casimiroa edulis</i>	4		
<i>Faidherbia albida</i>	27	<i>Corymbia citriodora</i>	4		
<i>Pinus patula</i>	25	<i>Syzygium guineense</i>	4		
<i>Eucalyptus camaldulensis</i>	24	<i>Acokanthera schimperi</i>	3		
<i>Prunus africana</i>	22	<i>Erythrina abyssinica</i>	3		
<i>Dovyalis caffra</i>	22	<i>Olea sp</i>	3		
<i>Moringa stenopetala</i>	21	<i>Yushanya alpina</i>	3		
<i>Casuarina equisetifolia</i>	19	<i>Casuarina cunninghamiana</i>	2		
<i>Acacia decurrens</i>	18	<i>Strychnos spinosa</i>	2		
<i>Yushania alpina</i>	17	<i>Tamarindus indica</i>	2		
<i>Malus sp</i>	17	<i>Olea welwitschii</i>	2		
<i>Carica papaya</i>	17	<i>Phoenix reclinata</i>	2		
<i>Unknown</i>	15	<i>Albizia schimperiana</i>	2		
<i>Melia azedarach</i>	13	<i>Milicia excelsa</i>	2		
<i>Artocarpus heterophyllus</i>	13	<i>Duranta sp</i>	2		
<i>Schinus molle</i>	12	<i>Leucaena leucocephala</i>	2		
<i>Jacaranda mimosifolia</i>	12	<i>Ziziphus spina-christi</i>	2		
<i>Croton macrostachyus</i>	11	<i>Albizia lebbbeck</i>	2		
<i>Citrus aurantiifolia</i>	11	<i>Sesbania sesban</i>	2		
<i>Annona senegalensis</i>	11	<i>Acacia nilotica</i>	1		
<i>Albizia gummifera</i>	10	<i>Boswellia papyrifera</i>	1		
<i>Eucalyptus globulus</i>	10	<i>Acacia tortilis</i>	1		
<i>Psidium guajava</i>	10	<i>Araucaria columnaris</i>	1		



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