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PARTICIPATORY PLANTATION FORESTRY PROGRAMME

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ASSESSMENT OF WOODLOTS AND FOREST-BASED SMEs IN MAKETE DISTRICT

December 2020

United Republic of Tanzania
MINISTRY OF NATURAL RESOURCES AND TOURISM
Forestry and Beekeeping Division

Embassy of Finland
Dar es Salaam

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ABBREVIATIONS

DBH	Diameter at breast height
EUR	Euro
Hdom	Dominant height
MAI	Mean annual increment
OSH	Occupational safety and health
PFP	Participatory Plantation Forestry Programme
PPE	Personal protective equipment
SME	Small and medium enterprises
TGA	Tree growers' association
TIN	Tax Identification Number
TZS	Tanzanian shilling

EXCHANGE RATES

EUR to TZS 2 700

EXECUTIVE SUMMARY

Baseline data collection for the Participatory Plantation Forestry Programme Phase 2 (PFP 2) included a survey on smallholders' woodlots and a survey on forestry value chain SMEs, implemented in Makete District during September and October of 2020. This report presents the findings from these surveys.

The two surveys covered 23 villages with planned programme interventions. The woodlot survey involved visiting a total of 466 woodlots from 246 smallholder tree growers (12% women, 88% men) for measurements. The SME survey involved 174 interviews with SME owners (11% women, 89% men) as well as field visits to some of the SME operating sites.

Woodlots of up to 19 years of age were found in the survey. However, there were relatively few observations from woodlots over 12 years of age. The smallholder woodlots were mainly small, with the average size of 0.7 ha, while the observed size distribution was wide.

The most characteristic feature of the woodlots in Makete District was overstocking: the average stand density in all surveyed woodlots was 1 732 stems/ha. This is in stark contrast to the generally recommended planting density of 1 111 stems/ha and national thinning regimes that furthermore recommend reducing the stand density gradually down to 400 stems/ha. Overstocking was most prominent in those pine woodlots that had emerged through natural regeneration. Abundance of natural regeneration was another distinguished feature of forestry in Makete District.

Overstocking was found to have an effect on the DBH distribution of the surveyed woodlots, with large mean DBHs (25 cm and above) being relatively absent in the data. The site indexes, however, were found to be largely excellent. 40% of the woodlots matched or exceeded the performance of Sao Hill site index class I and 70% of the woodlots matched or exceeded the performance of Sao Hill site index class II. In fact, many woodlots performed so much better than Sao Hill class I that this would call in for inclusion of another, high-performing site index class in Makete District.

Apart from commonly applied access pruning the survey found deficiencies in standard management activities with weeding, high pruning and firebreak preparation rarely being applied. Fire was discovered to be a major risk for woodlots during the survey.

The smallholder woodlots in Makete District have a high production potential, but for it to get fully realised there is a need to facilitate the adoption of proper management activities. Stand density management through early respacing (on woodlots emerged through natural regeneration) and later thinnings is of key importance. Poor road network and challenging topography also present challenges to forestry development.

The most common types of activities among the interviewed SMEs were found to be charcoal production, sawmilling, forest harvesting (chain saw operations), and carpentry. Some SMEs were engaged with multiple activities, such as sawmilling and forest harvesting. The level of technology used by the SMEs was found to be low: only ding dong sawmills and earth pit kilns were being used by the sawmills and the charcoal makers, respectively, with no improved technology observed. This was leading to reduced recovery rates and poor quality of products.

The SMEs rarely had bank accounts or written business plans. The level of invested capital was found to be low. SME employees were found not to be covered by social support systems and the SMEs generally favoured temporary labour over permanent staff. Nevertheless, the employment effect of the forestry SMEs was notable in the 23 villages, with a total provision of over 1 000 jobs in the interviewed SMEs alone and an estimated 1 800 jobs in all forestry SMEs.

It was also found out that a notable share of SMEs seems to be making losses instead of profit.

Personal protective equipment was not being used and there had been little provision of training on occupational safety and health issues. A total of 122 accidents leading to injury or death of a worker were reported to have been occurred during the past year; however, two thirds of the SMEs reported that no accidents had occurred. The rate of accidents was highest in the SMEs with sawmilling activities.

The SMEs reported facing challenges generally in access to improved technology, equipment, services, and capital. This hindered them from effectively developing their businesses.

Based on the results of the two assessments as well as some other supporting data, rough estimates were calculated for overall production potential for plantation-based wood and for realised overall production rates for sawn timber and charcoal in Makete District.

The results indicated that a minimum of 680 000 m^3 of roundwood, including about 510 000 m^3 of sawlogs, could be produced annually in Makete if volume production of woodlots were optimised. Estimate for the realised annual production of sawn wood was 100 000 m^3, which furthermore indicated usage of 285 000 m^3 of sawlogs and production of 185 000 m^3 of wood waste annually. These results should, however, be treated as indicative due to large margins of error.

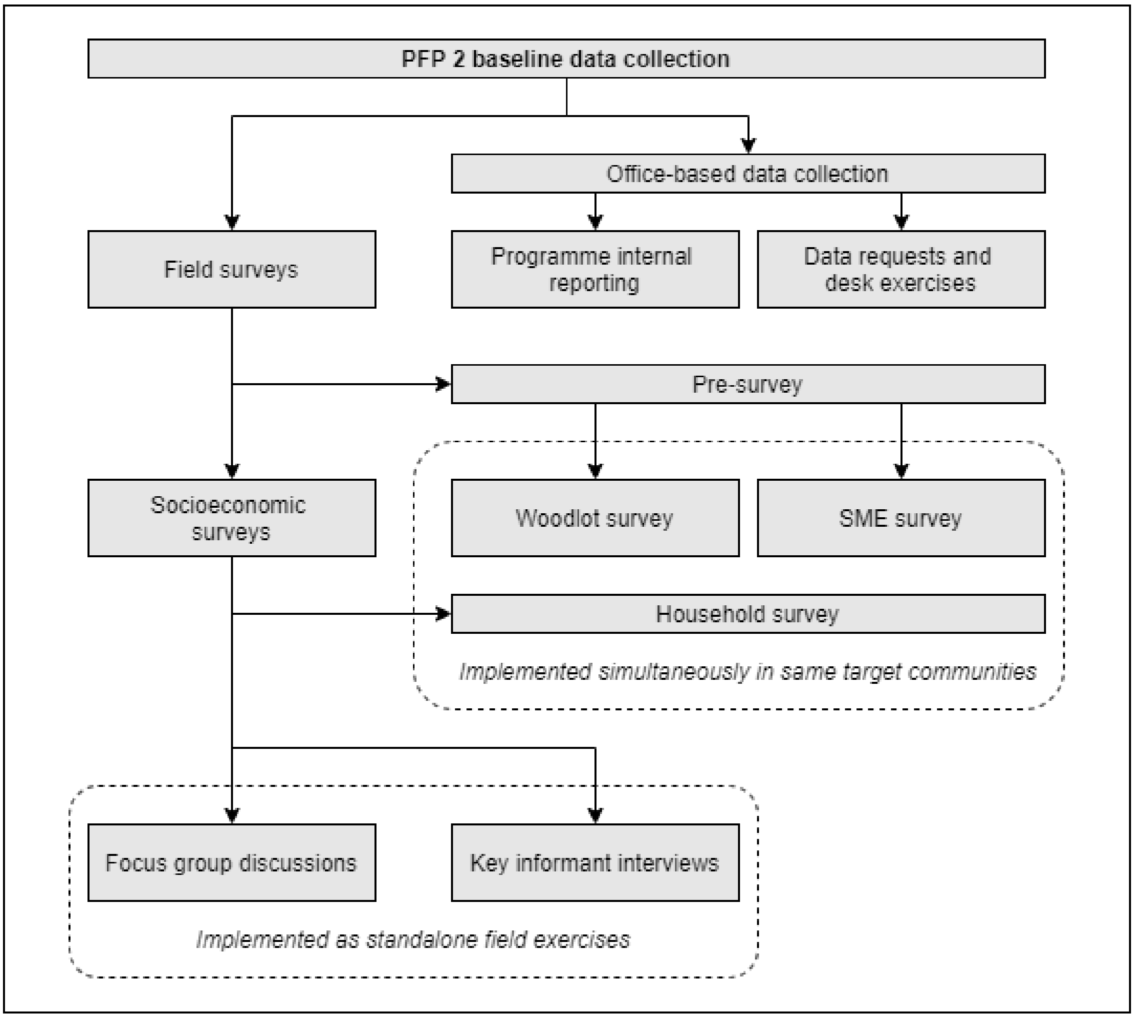
1. INTRODUCTION

1.1 PFP 2 baseline data collection

A series of exercises for baseline data collection of the Participatory Plantation Forestry Programme Phase 2 (PFP 2) were conducted during September and October of 2020. The general objectives of this data collection were: i) to provide baseline data for programme performance indicators, and ii) to provide additional information supporting the programme decision-making.

Figure 1 presents a breakdown of the PFP 2 baseline data collection design. Three thematic areas required field surveys: community socioeconomics, smallholders' woodlots, and small and medium sized enterprises (SMEs) within the forestry value chain. In addition to field surveys, baseline data was designed to be collected through programme internal reporting as well as through data requests and desk exercises.

Figure 1 PFP 2 baseline data collection design



The baseline data collection of the PFP 2 was designed to be a rolling exercise with the required field surveys being implemented locally as the programme initiates its operations in new districts in the early stages of the programme life span. During the first year of programme implementation, the focus of activities was planned to be in Makete District. The baseline data collection was hence first carried out in Makete District, allowing for piloting of the planned data collection methods.

1.2 Purpose and scope of this document

This document describes the results from two field surveys included in the PFP 2 baseline data collection in Makete District. These are:

i. Survey of smallholders' woodlots (referred to as the woodlot survey in this document)

ii. Survey of SMEs within the forestry value chain (referred to as the SME survey in this document)

The methodology for these surveys has been described in a separate document[1] and is hence not included herein in detail.

1.3 Timing and scope of the surveys

The woodlot survey and the SME survey were carried out between 23rd of September and 21st of October in 23 villages in Makete District. The included 23 villages were selected because they involved planned PFP interventions, including assignment of responsible programme Extension Officer and Extension Workers for extension services.

Figure 2 includes a map of Makete District, highlighting the 23 target villages. A list of the villages is included in Table 1 and in Table 3.

The two surveys were carried out simultaneously in the same target villages. The household survey under the socioeconomic baseline data collection was a third survey also implemented at the same time in the same villages.

1.4 Preliminary survey

The surveys included in this document were preceded by a preliminary survey, which included two main components: i) participatory mapping of smallholders' woodlots utilising satellite images, and ii) identification of forestry-related SMEs operating in the target village. The data collected through these exercises was used for drawing a sample for the woodlot survey and the SME survey. In addition, it provided findings of its own, also referred to in this document to provide a larger framework for the main surveys' findings.

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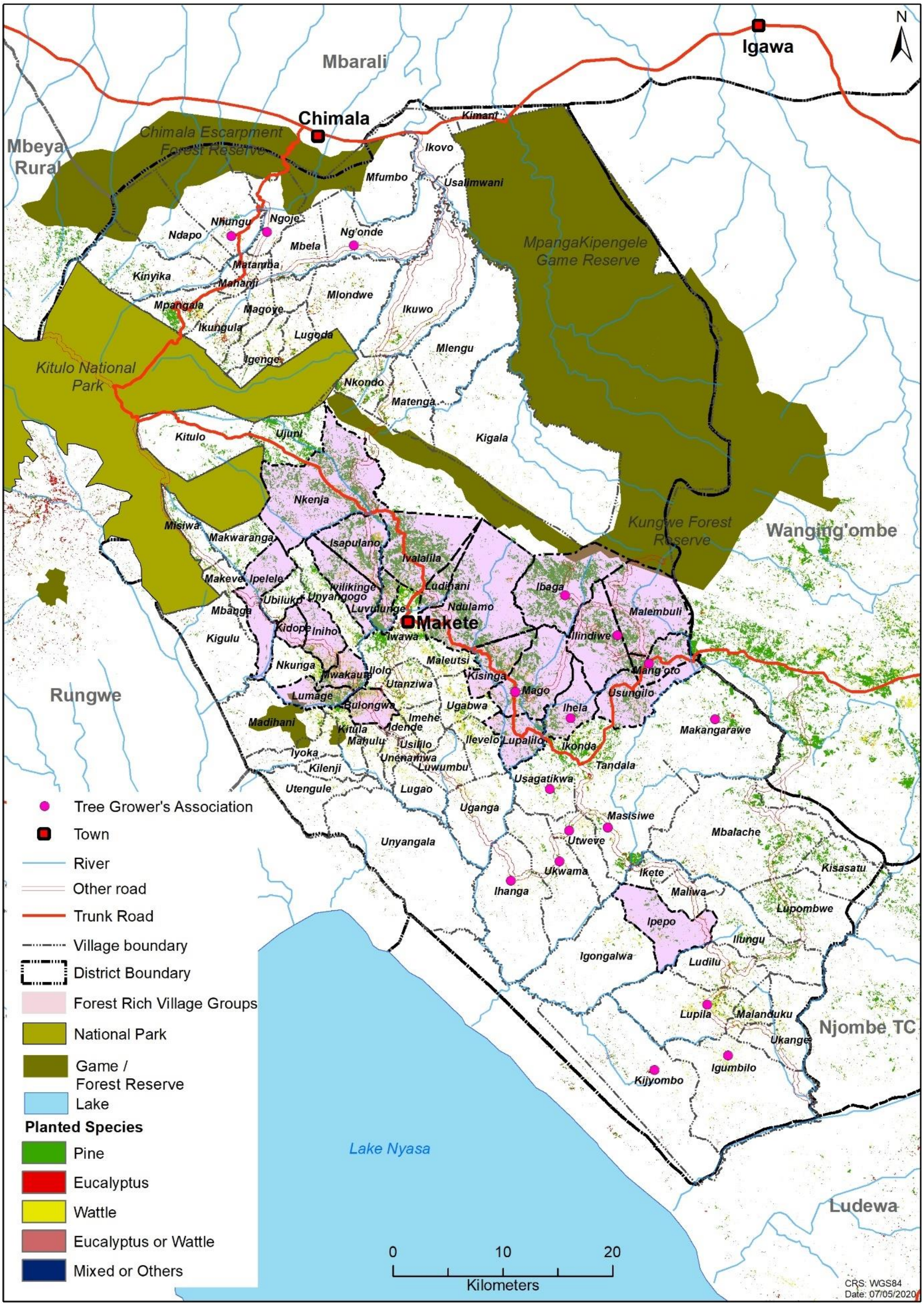
[1] PFP 2 (2020). PFP 2 baseline data collection. Description of methodology for: (1) Survey on smallholders' woodlots, and (2) Survey on SMEs within the forestry value chain

Figure 2 Makete District and the 23 villages included in the data collection



2. COVERED SAMPLE

2.1 Sample of the woodlot survey

2.1.1 Number of surveyed woodlots

The participatory woodlot mapping of the pre-survey provided tentative information from a total of 841 woodlots in the 23 target villages. 792 of these woodlots included boundary information based on identification of boundaries on a satellite image and they covered a total area of about 1 200 ha. The featured satellite imagery derived from open sources was to a large extent quite recent (see Annex 1), while in a few villages the available imagery was outdated which caused challenges in the mapping process.

Based on the tentatively identified pool of woodlots, a total of 466 woodlots were subsequently surveyed in the field. The selection of the woodlots for the field survey was done randomly, being subject to a practical limitation of the availability of the woodlot owners to show their woodlots. While the sample was mainly based on the pre-survey data, it also included some additional woodlots and woodlot owners that were not included in the participatory mapping but revealed/participated during the field survey instead.

Boundaries were verified with GPS measurements for 458 woodlots, covering a total area of about 310 ha. The figures are not directly comparable with the results of the participatory mapping since part of the woodlot information did not match one-to-one between the two exercises.

The number of field-surveyed woodlots per village varied between 12 and 33 (Table 1). The variation in the area covered per village was high because of wide woodlot size variation involving some larger individual woodlots.

Table 1 Number and area of surveyed woodlots by village

Ward	No.	Village	No. of surveyed woodlots	Total area of surveyed woodlots (ha)
Bulongwa	1	Bulongwa	25	5.5
Iniho	2	Iniho	19	6.9
	3	Kidope	12	4.3
	4	Lumage	24	20.8
	5	Mwakauta	19	11.3
Ipelele	6	Ipelele	12	10.4
Ipepo	7	Ipepo	20	15.3
Isapulano	8	Isapulano	25	16.3
	9	Ivilikinge	28	11.4
	10	Luvulunge	15	6.6
Iwawa	11	Ivalalila	22	11.9
	12	Ludihani	33	10.6
	13	Ndulamo	28	9.6
Kitulo	14	Nkenja	18	15.7
Lupalilo	15	Kising'a	16	43.8
	16	Lupalilo	23	12.8
	17	Mago	17	21.2
Mang'oto	18	Ibaga	13	6.3
	19	Ilindiwe	20	13.2
	20	Malembuli	16	14.7
	21	Mang'oto	25	19.3
	22	Usungilo	18	11.7
Tandala	23	Ihela	18	10.2
Total			466	309.7

The areas showed in the field (stands of even age and species) were smaller on average than areas identified in the participatory mapping. The general reason for this was that some woodlot owners had not been able to show their woodlot boundaries correctly on the satellite images. The issue was exacerbated by the nature of the Makete District landscape characterised by extensive forested areas with prevalence of natural regeneration and lack of identifiable landmarks such as fire breaks or roads. There were a few villages in which outdated satellite imagery caused problems. Some woodlot owners countered the issues by mapping larger family-owned areas on satellite images when they found it impossible to map individual stands.

2.1.2 Featured woodlot owners

Participatory woodlot mapping

The 851 woodlots mapped in the preliminary survey were owned by a total of 314 owners, the ratio between the two being 2.7. The figure does not represent the total number of woodlots owned by local smallholders on average but is rather a result of the selected sampling strategy of trying to involve large number of woodlot owners rather than a large number of woodlots per owner. The true average number of woodlots per owner is hence larger. Notably, however, 24% of the participants only mapped a single woodlot.

The share of women in the mapping participants was 14%, and their ownership of the mapped woodlots was about 11%. It cannot be assessed based on the data how well the share of women in participants reflects the share of women in all smallholder tree growers. Four mapped woodlots were owned by institutions.

17% of the participants reported being a member of a TGA while 83% reported that they were not a member of a TGA. Positive answers were only received in those eight villages that had a TGA, out of the 23 villages in total. In the eight villages with a TGA, the share of TGA members in the mapping participants was 44%, indicating that TGA membership could cover roughly a half of the tree growers on average in these communities.

Concerning investor types, almost all the mapping participants were resident villagers, with only five of them reporting for a different investor category as shown in Table 2.

Table 2 Investor types represented in participatory mapping results

Type of investor	Number of participants
Resident villagers	309
Residents of nearby villages	1
Government institutions	2
Religious organisations	2
Total	314

Woodlot survey

The 466 woodlots surveyed in the field were owned by a total of 245 owners. Hence, just below two woodlots were shown in the field on average by each participating tree grower.

Detailed information from 182 of these woodlot owners was available through the preliminary survey. These results indicated that the share of women in the field survey participants was 12% and the share of TGA members was 16%. Both figures were well aligned with the respective variables in the participatory mapping. The only investor type featured in the data from the field survey was resident villagers.

2.2 Sample of the SME survey

2.2.1 Number of SMEs and interviews

The basic unit of the SME survey was a structured interview conducted with the owner or the manager of the SME. In Makete District, only SME owners were interviewed, since in all included SMEs the owners acted as the managers for their respective SMEs.

Most of the SMEs in the included 23 villages were identified already during the preliminary survey. However, the SME survey team also discovered additional SMEs during their village visits, and these were subsequently included in the survey. Altogether, a total of 304 SMEs operating within the forestry value chain in the 23 villages were discovered. The number of SMEs varied widely between villages, ranging between 2 and 26.

Out of the 304 identified SMEs, a total of 174 were interviewed in the SME survey. The total number of identified SMEs and the number of conducted interviews disaggregated by village is included in Table 3

Table 3 Number of identified and interviewed SMEs by village

Ward	No.	Village	Total no. of identified SMEs	No. of SMEs interviewed in the SME survey
Bulongwa	1	Bulongwa	26	13
Iniho	2	Iniho	16	6
	3	Kidope	9	5
	4	Lumage	7	5
	5	Mwakauta	13	7
Ipelele	6	Ipelele	12	3
Ipepo	7	Ipepo	5	5
Isapulano	8	Isapulano	13	5
	9	Ivilikinge	6	5
	10	Luvulunge	2	2
Iwawa	11	Ivalalila	8	8
	12	Ludihani	23	15
	13	Ndulamo	14	12
Kitulo	14	Nkenja	21	13
Lupalilo	15	Kising'a	20	9
	16	Lupalilo	18	10
	17	Mago	15	9
Mang'oto	18	Ibaga	10	4
	19	Ilindiwe	4	3
	20	Malembuli	10	6
	21	Mang'oto	16	7
	22	Usungilo	23	11
Tandala	23	Ihela	13	11
Total			304	174

2.2.2 Gender distribution of respondents

Out of the total of 174 interviews, 20 interviews (11%) were conducted with female SME owners and 154 interviews (89%) were conducted with male SME owners.

Since all SME owners that were found to be available in each village were included in the interviews, it can be assumed that the observed gender distribution of the interviewed owners approximately reflects the overall gender distribution within all SME owners in the target communities.

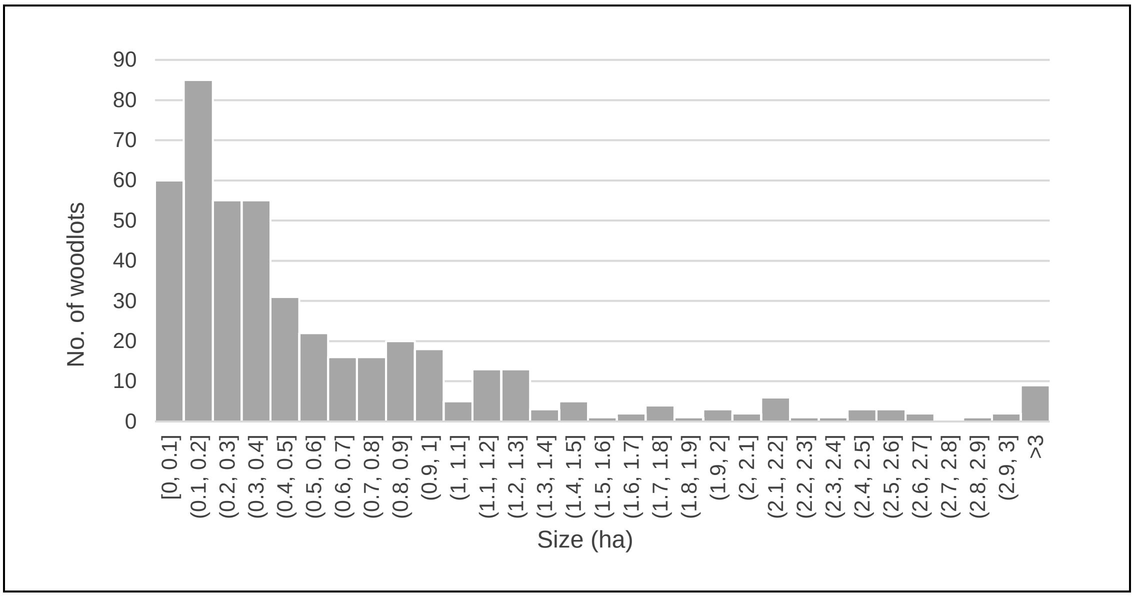
3. RESULTS FROM THE WOODLOT SURVEY

3.1 Woodlot size distribution

Boundaries for 458 woodlots were verified in the field. Most of the woodlots were found to have a relatively small area size. The average woodlots size in the survey was 0.68 ha. The distribution of the measured woodlot sizes, shown in Figure 3, was heavily skewed towards small woodlots with the median woodlot size being merely 0.35 ha.

There were also individual observations from notably large woodlots: the three largest woodlots measured in the survey had areas of 18.0 ha, 12.9 ha, and 5.7 ha. Nevertheless, only nine surveyed woodlots had an area greater than 3 ha.

Figure 3 Size distribution of the surveyed woodlots



3.2 Tree genera

Woodlots of four tree genera were included in the survey. **Pine** was by far the most common genus encountered, with 99.0% of the surveyed woodlots accounting for pine. Additionally, two woodlots of **eucalyptus** (0.4%) and two woodlots of **cypress** (0.4%) were covered in the survey, along with one woodlot of **black wattle** (0.2%).

The result does not directly reflect the area distribution of the tree species belonging to these genera in the target communities; however, it reflects what smallholder woodlot owners consider as their economically relevant properties. Eucalyptus trees were found not to be uncommon during the field work, but instead of being grown as homogenous woodlots these were commonly scattered trees or tree groups that the owners saw no immediate value of. Oversized eucalyptuses had been left standing and, on some occasions, felled down and abandoned on site without utilisation.

Remote sensing-based forest mapping results as well as reports from economic activities of people residing towards the western side of Makete District indicate that a considerable resource of black wattle exists in that area. This was not captured in the woodlot survey, even though field teams observed dense naturally regenerated black wattle thickets in the landscape during survey work in western Makete.

Mixed stands with more than one species were observed during the survey; however, it was typically easy to determine the species forming the main cohort. Nevertheless, natural regeneration of pine, eucalyptus, and wattle along with natural regeneration of indigenous hardwoods and bamboo occasionally produces quite heterogenic woodlots in Makete District, especially since the level of silviculture often remains low in these sites.

3.3 Planted woodlots vs. natural regeneration

Pine (specifically the predominant *Pinus patula*) regenerates well in Makete District due to the propitious climate and edaphic conditions.

The field teams assessed on individual woodlots whether they had been established primarily through planting or through natural regeneration. The assessment referred to the current main cohort of trees on the site and did not consider the method of establishment of any preceding tree generation on the same site.

The assessment was done for 433 woodlots. In about two thirds of the woodlots, the current tree stand was determined as having been established mainly through planting of seedlings. In one third of the woodlots, the current tree stand was determined as having been emerged mainly through natural regeneration (Table 4). It should be noted though that occasionally the two establishment/regeneration methods were both present up to some extent in the same woodlots.

Table 4 Regeneration method of the surveyed woodlots

Establishment method	No.	%
Planted woodlots	294	68%
Natural regeneration	139	32%

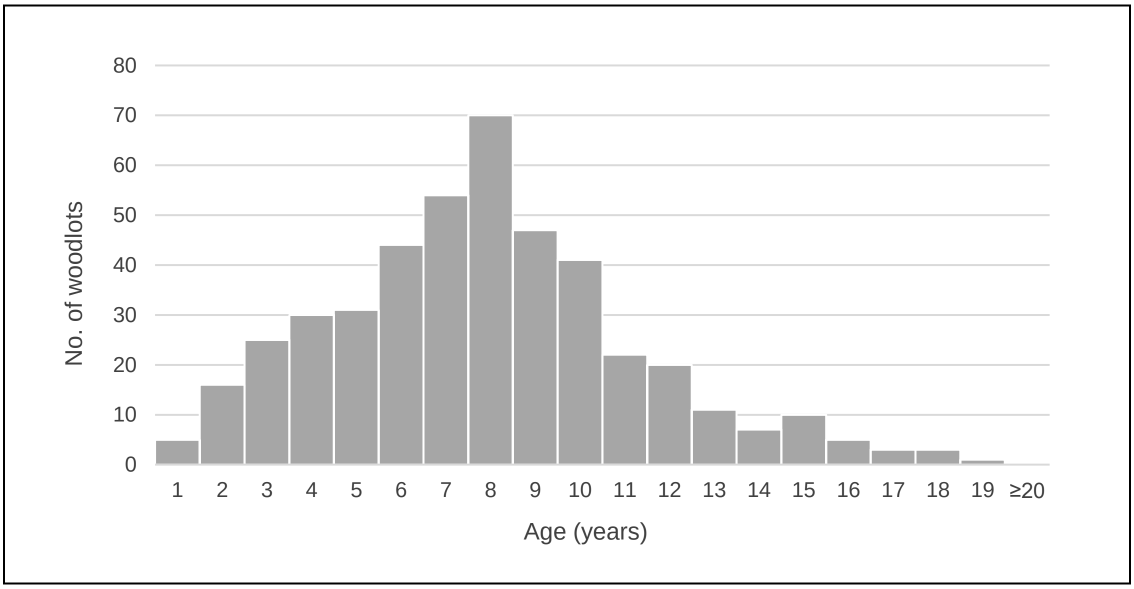
As with the observed tree genera, the result does not directly reflect the distribution between these two establishment methods in the target communities. Again, it reflects what smallholder woodlot owners consider as their economically relevant properties. The naturally regenerated pine stands, often demonstrating extremely high stand densities and hence low value by default, are not necessarily brought within the scope of the woodlot owner's main silvicultural focus.

Additional observations from field and from satellite imagery indicate that the share of natural regeneration from all forest resource in the target communities is higher than the observed 32%. However, part of this resource is economically unviable due to suppressed diameter growth.

3.4 Age distribution of the surveyed woodlots

A sample tree representing the main tree cohort was selected for destructive sampling in 464 woodlots and the annual rings were counted for determination of age. The most featured woodlot age group was eight years (Figure 4), which was also both the average and the median age of the surveyed woodlots. Relatively few woodlots were found to have age of more than 12 years. No observations from woodlots of 20 years of age or above were made during the survey.

Figure 4 Age distribution of the surveyed woodlots



Woodlots below eight years of age were practically underrepresented in the data. The sampling procedures favoured inclusion of maturing woodlots instead of recently established plantations, hence skewing the age distribution towards older woodlots.

Woodlots of over 10 years of age were commonly featured in the data, which contradicted presumptions that woodlots would generally be cut by that age in Makete District. Instead, a frequently quoted issue of premature harvesting was found to be more linked with the size of the trees (especially diameter) than the age of the trees. The woodlots of over 10 year of age commonly showed suppressed diameter growth and had not reached adequate dimensions for harvesting despite their age (see section 3.7).

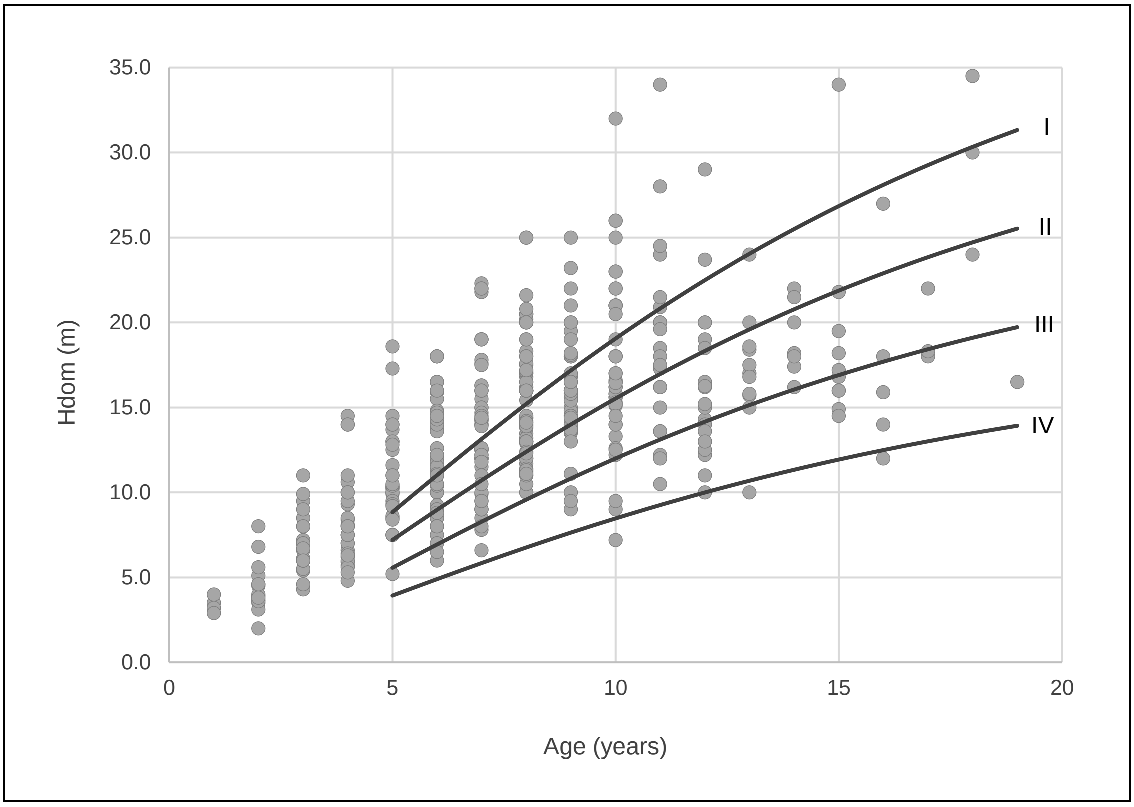
3.5 Height growth and site indexes

Mean height was determined for each woodlot through field measurements. An estimate for dominant height was calculated based on the mean height by adding 2 metres to the result. This allowed for estimating site indexes for the surveyed woodlots.

Sao Hill site index classes[2] were used in comparison to provide reference points for the growth observed in the target communities in Makete District.

Figure 5 shows the calculated dominant heights for the woodlots with their respective woodlot ages. It also shows site index curves for Sao Hill site index classes I–IV. Distribution of the surveyed woodlots according to the site index curves is shown in Table 5. Only woodlots of five years of age and above are included in the latter since the site index curves are not designed to work with woodlots below five years of age.

Figure 5 Age vs. dominant height with Sao Hill site index curves I–IV



[2] Malimbwi, R.E., Mugasha, W.A. and Mauya, E. (2016). Pinus Patula Yield Tables for Sao Hill Forest Plantations, Tanzania. Sokoine University of Agriculture, Morogoro. 38 pp.

Table 5 Distribution of woodlots according to Sao Hill site index curves

Lower curve	Upper curve	No.	%
Site index I	(no limit)	147	40%
Site index II	Site index I	109	30%
Site index III	Site index II	76	21%
Site index IV	Site index III	33	9%
(no limit)	Site index IV	3	1%
Total		368	100%

Note: Only woodlots with 5 years of age and above are included

The results show that 40% of the surveyed woodlots meet or exceed the performance of Sao Hill site index class I. Furthermore, 70% of the surveyed woodlots are above the Sao Hill site index class II. The actual figures are likely to be even higher since the applied linear correction of 2 metres between mean and dominant height is a conservative estimate on maturing woodlots.

The findings verify the result from another PFP-facilitated study that concerned natural regeneration in Makete District, and which found that 41% of measured woodlots exceeded the performance of Sao Hill site index I.

As seen in Figure 5, a large share of the woodlots in fact perform so much better than Sao Hill site index class I that this would call for inclusion of an additional site index class above the current class I. Sao Hill site index class IV, on the other hand, is largely irrelevant for classification of growing sites in Makete District due to low number of matching observations.

The results indicate that the growing conditions in Makete District are to a large extent highly suitable for pine, and with adequate silviculture there is potential for high average yields of timber. Observations from other species within this survey are insufficient for drafting a corresponding analysis.

3.6 Stand density

A notable characteristic of woodlots in the survey area was their commonly high figures for stand density (stocking).

Tree stands established through natural generation in Makete District were known to have generally high initial stand densities that can occasionally be extreme. This presumption was verified in the survey. Table 6 shows the recorded mean and median stand densities disaggregated by the determined method of stand establishment. Figure 6 shows the distribution of all recorded stand densities.

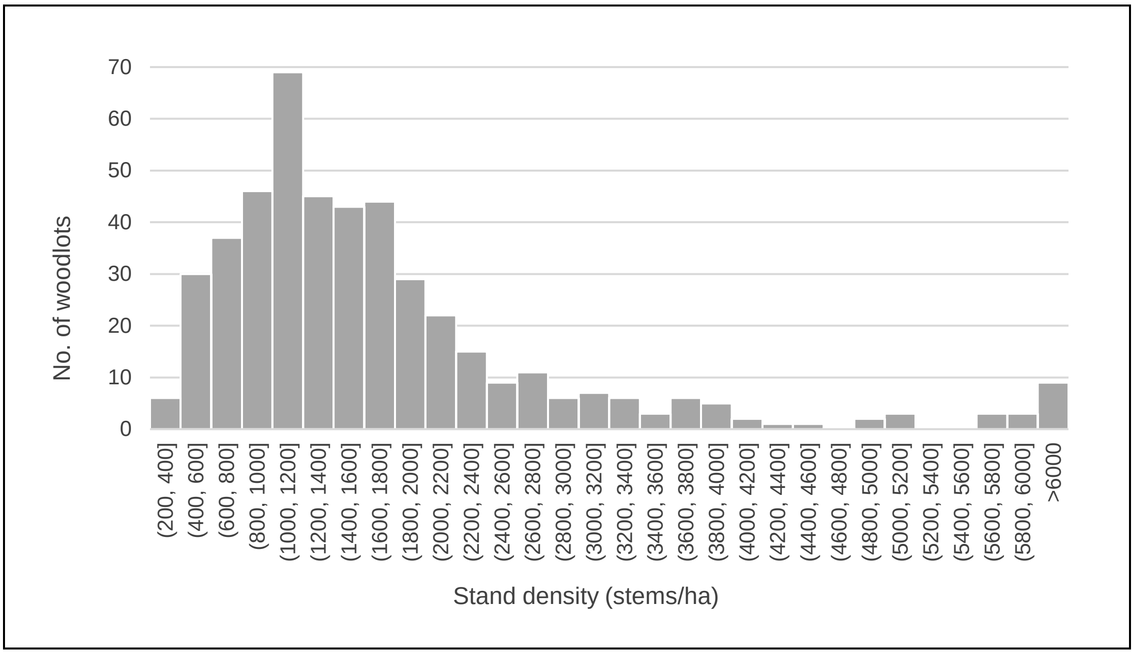
Table 6 Average stand densities for planted woodlots and natural regeneration

Establishment method	Average stand density (stems/ha)	Median stand density (stems/ha)
Planted woodlots	1 459	1 220
Natural regeneration	2 321	1 671
All woodlots (total)	1 732	1 376

The highest recorded stand density was 9 879 stems/ha which was measured in two different woodlots, both two years of age.

The calculated average stand density for the woodlots established through natural regeneration was 2 321 stems/ha, which is double the generally recommended initial stand density of 1 111 stems/ha resulting from the 3 x 3 metres planting grid. Notably, the average stand density was higher than this reference value also among the planted woodlots (1 459 stems/ha).

Figure 6 Stand density distribution of the surveyed woodlots



Plantation management guidelines for Tanzania[3,4] recommend that the stand density is gradually brought down through thinnings, first to 650 stems/ha and finally to 400 stems/ha before the final harvest. The survey data shows that such guidelines are not adequately followed within the surveyed target communities.

The survey teams observed signs of respacing and even some commercial thinning in surveyed woodlots, which proved that up to some extent these management activities were being practiced in the target communities. However, the stand densities were often found to remain high even after the management, indicating that the removal of trees had not been sufficiently aggressive to facilitate proper stocking of trees.

Lower stand density figures were not completely absent in the data, as can be seen in the histogram of Figure 6. The results included a total of 46 woodlots (10%) that had a stand density of 650 stems/ha or less. It should be noted though that the data does not differentiate between stocking reduction through thinnings and through biotic or abiotic damages.

3.7 Diameter growth

3.7.1 Observed DBH distribution

Mean diameter on breast height (DBH) was determined for each measured woodlot. Distribution of the recorded DBHs with the respective woodlot ages is shown in the first graph (a) featured in Figure 7.

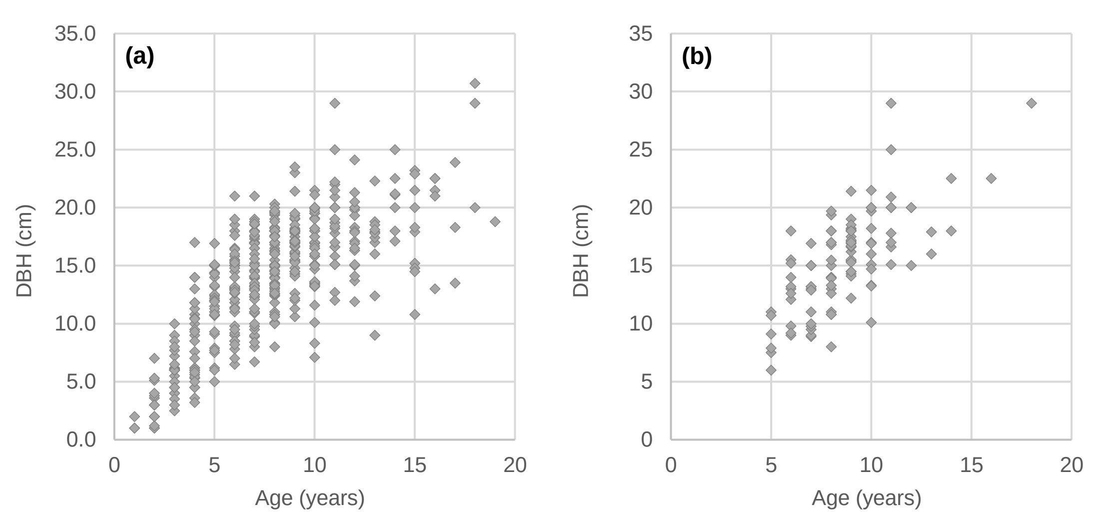
The data is characterised by the relative lack of large diameters. A mean DBH of 20 cm had been reached only by 40% of woodlots with 12 or more years of age, while this should have been reachable for all woodlots with the performance of Sao Hill site index class 2 or better, which were shown to comprise 70% of the data (see 3.5). Moreover, there were merely 5

[3] Tanzania Forest Services Agency (2018). Technical order no. 1 of 2018. Technical specifications for management of TFS forest plantations in Tanzania. 18 pp.

[4] Forestry and Beekeeping Division (2017). Forest plantation and woodlot technical guidelines. 55 pp.

observations from mean DBHs of 25 cm or above across all surveyed woodlots, and none of them exceeded 31 cm.

Figure 7 Age vs. DBH in all woodlots (a) and in woodlots with a site index between Sao Hill classes I–II (b)



3.7.2 Effect of stand density on DBH

The effect of the overly high stand densities was seen in the recorded diameter data.

The graph (a) in Figure 7 shows how the DBH distribution becomes wider as the woodlot age increases. By the age of four years the difference between the smallest and the largest recorded DBHs has reached 10 cm, and from the age of ten years onwards this gap widens to about 15 cm and above. The volume of an average tree can hence be radically different in the woodlots of same ages, especially in maturing plantations.

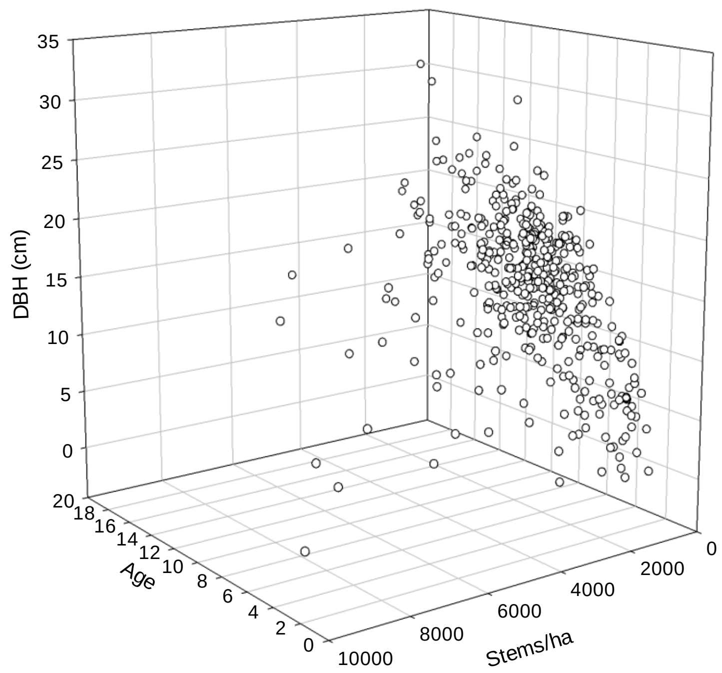
Differences in the mean tree DBHs (and, subsequently, in volume) in woodlots of same ages can be attributable both to site characteristics and to suppression of diameter growth due to overstocking. To reduce the effect of the former, the graph (b) featured in Figure 7 narrows the inspection down to a relatively homogenous site index group with a high number of observations: the 104 woodlots between Sao Hill site index curves I and III (see Table 5 and Figure 5).

Narrowing down the inspection has a rather limited effect on the observed DBH differences, as seen in the graph (b). Despite of similar site conditions, the DBH differences between the woodlots of same ages remain large, being about 10–15 cm in woodlots around 10 years of age.

The effect of the stand density on DBH is further visualised in Figure 8, which adds stand density as a third parameter in the age vs. DBH graph. The data shows that the DBH growth of overstocked woodlots (stand density of over 2 000 stems/ha) stagnates within the range of 15–20 cm. In fact, all observations from mean DBH above 20 cm are from woodlots with a mean stand density below 2 000 stems/ha. However, it seems that the DBH has potential to develop up to this level within the observed age range even on woodlots with stand density of 4 000 stems/ha and above.

The results show that management of the stand density has a paramount impact on the development of the mean DBH and volume, first as early respacing (in woodlots emerged through natural regeneration) and later as thinnings in maturing woodlots. The management should be done timely and enough stems should be removed in the process to avoid stagnation of growth.

Figure 8 Age vs. DBH vs. stand density



3.8 Survival of trees

While growth reduction due to overstocking was imminent in the results, recently occurred mortality of trees was rarely encountered in the sample plots. The average survival rate of trees across all woodlots was 99.8%. Juvenile woodlots of 2 years of age and below did not show notably worse results than the rest of the age groups. The worst survival rate measured for any woodlot was 75%, measured on a four-year-old pine stand.

Part of the good overall result is explained by the survey methodology, which only considered standing dead trees and not fallen ones. Hence, mortality could be recorded only for a limited time after its occurrence especially on young woodlots.

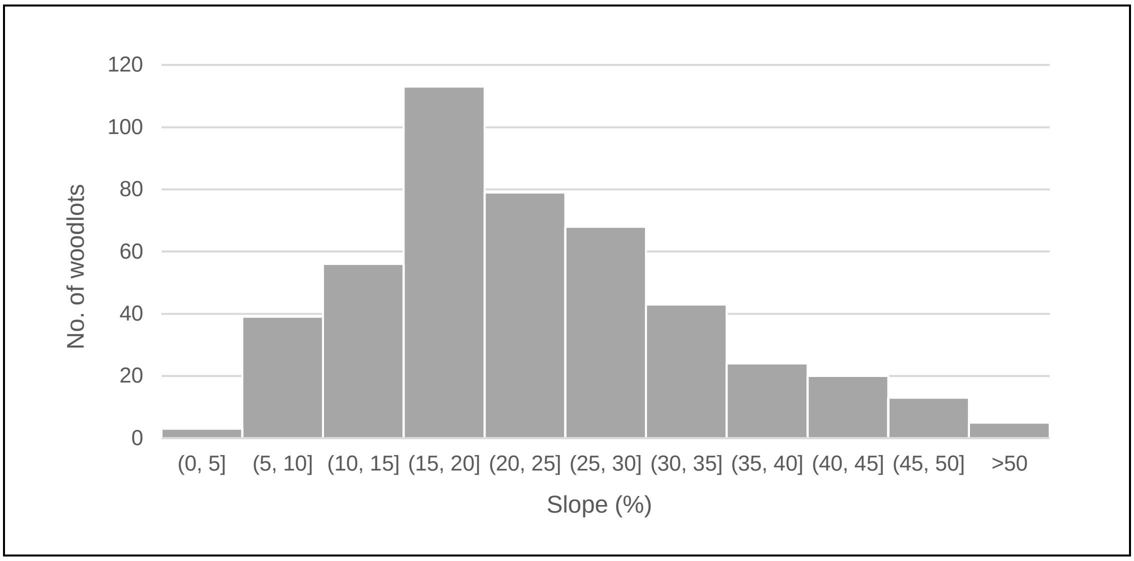
3.9 Slope

Slope was determined for each woodlot after the field work based on digital elevation model and sample plot coordinates. The resulting slope class distribution is shown in Figure 9. The average slope in the surveyed woodlots was found to be 23% (or, 13°), which is manageable for forestry operations.

Despite the reasonable average slope, steep woodlots were also featured in the survey. 62 woodlots had a slope greater than 35% (20° or more), which is generally considered steep enough to hamper mechanised forestry operations. The TFS guideline is not to plant on slopes of 60% or steeper[5]. This value was exceeded only by a single woodlot, which had a slope of 94% (43°), being considerably steeper than any other woodlot included in the study.

[5] Tanzania Forest Services Agency (2018). Technical order no. 1 of 2018. Technical specifications for management of TFS forest plantations in Tanzania. 18 pp.

Figure 9 Slope class distribution of the surveyed woodlots



3.10 Weeding status

Each woodlot was given score 0, 1 or 2 for based on the observed status of weeding as per the definitions included in Table 7.

Table 7 Applied scores for the status of weeding

Score	Label	Description
0	No weeding done	There are no signs of weeding activities done in the woodlot, or the signs of weeding are minimal.
1	Partial or insufficiently done weeding	Some weeding activities have been done in the woodlot, but either the quality of work is not up to a good silvicultural standard or the weeding has been done only for a part of the woodlot.
2	Weeding done according to a good standard	Weeding activities in the woodlot have been done up to a good silvicultural standard, efficiently reducing the competition imposed by weeds to the tree stand. Circle/strip weeding must be complemented by additional slash weeding.

Weeding was found to be rare. The total number of surveyed woodlots with some level of weeding activities done was 15. Five of these woodlots had been weeded up to a good standard (score “2”) and ten had been weeded partially or insufficiently (score “1”).

Unexpectedly, most of the observations from weeding were from woodlots above two years of age. Only three woodlots out of the total of 22 woodlots in the age range of 1–2 years showed any signs of weeding (Table 8). Hence, only 14% of woodlots in that age group that would most benefit from weeding had in fact been addressed with any weeding.

Table 8 Prevalence of weeding in woodlots of 1–2 years of age

Woodlot age	Number of woodlots			
	Score “0” (Not done)	Score “1”	Score “2”	Total
1 year	5	0	0	5
2 years	13	2	1	16

The remaining 12 woodlots that had been weeded were all older, up to 13 years of age.

The general lack of weeding is evident in the survey results. Furthermore, the observed weeding seemed to be done mainly for other than silvicultural reasons, i.e. for improving access or aesthetics in older woodlots rather than for reducing competition between weeds and juvenile trees on younger woodlots.

3.11 Pruning

3.11.1 Pruning status

Pruning status of each woodlot was assessed with a score from 0 to 3. The focus was on assessment of the technical quality of pruning in case it had been done.

Table 9 includes descriptions for the applied pruning quality categories and shows the survey results by category.

Table 9 Categorisation and observed results for pruning status

Score	Label	Description	Count	%
0	Not done	No pruning has been done.	51	11%
1	Poor	Significant stumps of branches are left to the pruned stems and/or notable damage has been done to the bark of the tree.	52	11%
2	Mediocre	Features from both the good and the poor pruning quality categories are present in the woodlot.	244	52%
3	Good	Branches cut clean along the surface of the stem or just above the branch collar and no damage has been done to the bark of the tree.	118	25%
Total			465	100%

Pruning was found to be a commonly applied management activity in the target communities. 89% of all visited woodlots had been pruned up to some standard. The technical quality of pruning was found to be mainly mediocre with the average score for pruned woodlots being 2.16.

Anecdotal evidence and technical observations shoved that bush knife (machete) was the only tool applied with pruning in the study area, and machete is highly likely to cause defects in the pruned trees as commonly observed in recently pruned stands.

Nevertheless, 25% of all surveyed were assessed as having been pruned up to a good standard. The relatively large share of woodlots in the "good" pruning quality category may have been affected by long, multiple year timespans between the time of pruning and the time of assessment. Diameter growth of the trees gradually covers defects caused by pruning over multiple years. The effect would get stronger the older the woodlot gets, since subsequent pruning activities (2^{nd} and 3^{rd} pruning) were rarely done in the study area as shown below.

3.11.2 Pruning height

The average pruning height across all pruned woodlots was **2.3 metres**. The number of woodlots pruned up to 3.7 metres (which is the minimum recommended height for the second pruning) or above was merely 17.

The results show that while pruning is a commonly applied management activity in the surveyed communities, only the first pruning (access pruning) is generally done and subsequent prunings are neglected.

3.12 Firebreaks

The results showed that only 5% of the surveyed woodlots were surrounded by a managed firebreak or belonged to a group of woodlots surrounded by a managed firebreak. 95% of woodlots were not protected by firebreaks.

The survey was conducted in a fire-prone period during the dry season and the survey teams participated in efforts to put down wildfires in burning forest plantations in three different villages during the survey work.

3.13 Eligibility for transmission poles

A special assessment was included in the survey design for eucalyptus woodlots of five years of age and above to assess how well their technical quality meets the technical eucalyptus pole specifications by TANESCO[6]. Only one eucalyptus woodlot meeting the age criteria was covered in the survey. The technical quality of the woodlot as per the pole specifications was assessed to be poor.

[6] TANESCO, Specification 11, Wood poles and blocks. October 2017.

4. CONCLUSIONS FROM THE WOODLOT SURVEY

4.1 Conditions for growing timber in target communities

Comparison of height growth of the surveyed woodlots against the prevailing Tanzanian site index classes applied in the Sao Hill plantation show that majority of the sites are highly suitable for pine (especially *Pinus patula*). The growth rate stands also regional comparison e.g. against the site index classification applied in South Africa[7], the classes of which for *P. patula* are slightly more moderate than in the current Tanzanian classification.

The potential timber growth and yield is hence excellent by large in the target communities. The reasons why it may be left unrealised are mainly related to the current silvicultural practices.

4.2 Silvicultural status of commercial woodlots in target communities

Based on the survey findings the silviculture in the target communities is largely suboptimal despite of being widely practiced as livelihoods. The following key management activities were found to be left largely undone in the woodlots:

1) Effective respacing of pine stands established through natural regeneration
2) Firebreak preparation and maintenance
3) Weeding of woodlots of 1–2 years of age
4) High pruning (2nd and 3rd pruning)
5) Effective thinnings

The following key management activities were found to be done relatively well in the woodlots:

1) Site preparation and planting of woodlots applying spacing of approximately 3 x 3 metres
2) Access pruning (1st pruning)

In addition, woodlots were being generally harvested before reaching adequate age, or size.

It should be noted that this conclusion looks the silvicultural status strictly from technical forestry perspective and it does not explore the smallholders' capacity to conduct science-based silviculture down to the detail or the rationale behind their decisions to do or not to do so.

It is important to recognise that from a smallholder woodlot owner's point of view, investment of time or money in timely woodlot management may not always be the optimum decision based on their overall socioeconomic situation. This needs to be understood before the technical forestry aspects can effectively be advanced.

4.3 Importance of promotion of thinning

A large part of commercial potential of growing timber in the target communities is currently left unrealised because trees are generally grown in too dense stands, which suppresses their diameter growth. Since tree volume development is exponential in relation to the diameter growth, the current stage of general overstocking has radical effect on the realised average volume of the harvested trees.

For comparison: a single *Pinus patula* tree with a DBH of 25 cm has a trunk volume of about 600 litres[8]. An equally tall *P. patula* with a DBH of 15 cm has a trunk volume of about 270 litres. Hence, this 10 cm DBH difference causes a reduction of 55% in the trunk volume. The effect gets stronger as the bigger DBH increases.

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[7] Kotze et al. (2012). Growth modelling and yield tables. In: South African forestry handbook, 5th edition. The Southern African Institute of Forestry. p. 175–228

[8] Calculations based on the height and volume equations presented by Malimbwi et al. (2016).

In the communities included in the survey, the issue of overstocking was found to be both common (i.e. occurring in a large share of woodlots) and intensive (i.e. the level of overstocking was high in the woodlots). Due to this, a change towards applying adequate stand densities should arguably be the single highest priority in development of the local silviculture.

The current thinning regimes available in Tanzania are not well suited for the case of smallholder-based forestry in Makete District since they require certain initial spacing and timely thinnings that are only based on the age of the stand. Should the tree grower skip any thinning in their suggested year or fail to respace stands emerged through natural regeneration during year one to 1 111 stems/ha, the regimes seize to apply. However, this does not mean that the stand would have become technically unviable to be managed towards a good commercial result. Continuous thinning models based on e.g. recommended level of basal area as a function of the stand dominant height would enable thinning need assessment at any point of time in maturing woodlots.

4.4 Forestry and topographic features of Makete District

Makete District landscape is hilly, even mountainous, which is often quoted as a challenge for forestry operations. Though far from being flat, the average slope of 23 percentage in the surveyed woodlots was still reasonable. However, 10–15% of the woodlots were in the steep end of the observed slope distribution with slopes of about 35 percentage or more. These woodlots can be expected to involve challenges in harvesting and transportation.

Another aspect related to the topography is that smallholders' woodlots are often located away from the village centres with poor road infrastructure leading to them. The challenge for forestry operations is not only in the steepness of the target woodlots but also in the topographic features along the route that leads to them, often further reducing the access to the resource.

4.5 Fire risk

Experiences from the field work conducted during the dry season indicate that fire is a major risk for forestry across the surveyed areas in Makete District. Wildfires were observed commonly in the landscape and in most cases there seemed to be little coordinated effort by the local communities to put them down. Meanwhile 95% of woodlots were not protected by firebreaks. Fire risk may also encourage tree growers to harvest their woodlots early.

To help tree growers in securing their assets during the woodlot rotation period, firebreak preparation and management should be encouraged. Firefighting and fire control would benefit from a coordinated approach that would ideally span across multiple villages if their forest resources are adjacent to each other.

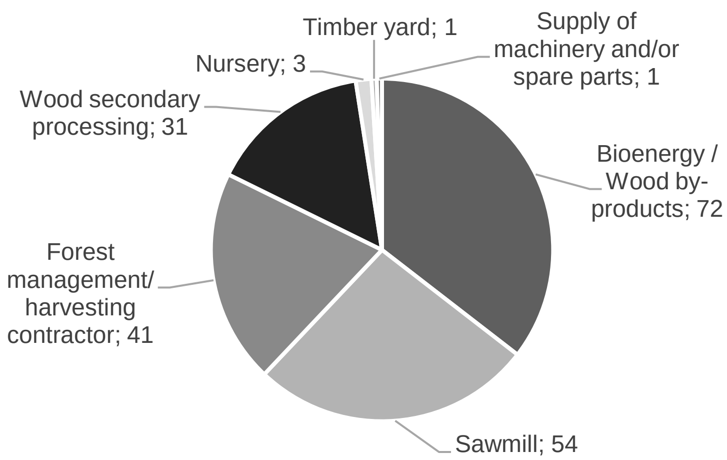
5. RESULTS FROM THE SME SURVEY

5.1 SME types based on their activities

5.1.1 Distribution as per the main SME typology

The interviewed 174 SMEs reported being engaged with a total of 203 forestry-related activities as per the typology applied in the survey. The distribution of the reported activities is shown in Figure 10. The most common activity was production of bioenergy or other wood by-products (N=72), followed by sawmilling (N=54) and forest management/harvesting (N=41). Wood secondary processing was also frequently featured (N=31).

Figure 10 Distribution of SME activities



The difference between the number of interviewed SMEs and the number of SME activities is caused by 29 SMEs reporting more than one type of activity. The most common combination of activities was sawmillers also doing forest management/harvesting.

No samples from production of poles, veneer or pine resin were included in the survey. There was however evidence of some pine resin collection being done in Makete District, while no evidence of pole or veneer production was discovered. Also, no interviews were captured from saw doctoring neither from wood transportation. Saw doctoring services were generally mentioned to be absent in Makete District, while the preliminary data collection included observations from ten wood transporters. However, none of these could be reached for the interviews.

5.1.2 Discovered subtypes based on products, services, and technology

The survey also featured identification of subtypes for most of the main activities, hence providing further information of the types of service or product, or the technology applied by the SME.

The level of technology applied was found to be low. All 54 sawmillers included in the study reported using ding dong (amec) sawmills only. In production of bioenergy / wood by-products, the only technology that was being applied was the traditional earth pit kilns used for producing charcoal. The only discovered subtype under the group of wood secondary processing were carpentry workshops. All three visited nurseries applied polytubes in seedling production.

Even though not directly quantified in the survey, the anecdotal evidence acquired during the interviews indicated that majority of the SMEs reporting for the group of forest management/harvesting contractors were chain saw owners/operators engaged in forest harvesting.

5.2 SME employees

5.2.1 Permanent labour vs. daily labour

The interviewed SMEs reported employing a total of 1054 people. The SME owners themselves are not included in the total, and 11 owners reported that they did not have any employees.

Only 117 (11%) of the employees were reported as being employed on a permanent basis whereas the remaining 937 (89%) were reported as being employed as daily labour. The result reflects the seasonality of work within the SMEs operating in the forestry sector.

The share of permanent labour was especially low in bioenergy SMEs (production of charcoal) and in forest management/harvesting (chain saw operators), both having roughly a mere 1% of their staff working on a permanent basis. However, the total number of employees in these SMEs was also low as compared to sawmills, which generally employed the most people (a total of 795).

The average figures for permanent and daily employees calculated per SME were 0.7 and 5.4, respectively. In other words, an average survey on 10 random SMEs would have brought up a total of 7 permanently employed persons and a total of 54 persons employed on a daily basis.

5.2.2 Gender distribution of SME employees

Share of SMEs employing women

Out of the total of 174 interviewed SMEs, 57 (or, 33%) employed women. The remining 117 SMEs (66%) only had male employees.

Share of women in SME employees

The discovered gender distribution of SME employees is included in Table 10. About two thirds of all employed persons were male and one third were female. The share of women in the permanent labour was lower than their share in the whole data, only 23%.

Table 10 SME employees disaggregated by gender and type of employment

Employment type	Female		Male		Total
	N	%	N	%	N
Permanent labour	27	23%	90	77%	117
Daily labour	357	38%	580	62%	937
Total	384	36%	670	64%	1 054

Sawmilling SMEs were found to employ a relatively large share of women. Within all SMEs that reported sawmilling activities (N=54) this share was 43%. The data did not, however, allow disaggregation of the employee numbers between different activities. In SMEs engaged in sawmilling only (N=35) the share of women was somewhat lower, 37%.

Early results from the PFP 2 socioeconomic surveys show that in Makete District women are often employed at ding dong sawmills in carrying sawn timber from the sawmill machine to roadside.

In SMEs producing charcoal the share of female employees was 24%.

One notable group that did not employ any women were those 17 SMEs that reported forest management or harvesting as their single activity.

5.2.3 Vulnerable and disabled SME employees

A total of 186 vulnerable persons (e.g. orphans, employees with HIV/AIDS), and 19 persons with disability[9] were reported to be employed by the SMEs (Table 11). The distribution of vulnerable and disabled employees was relatively even between the different types of SMEs.

Table 11 Number of vulnerable and disabled employees

Employee category	N	% of all employees
Vulnerable persons	186	18%
Persons with disability	19	2%

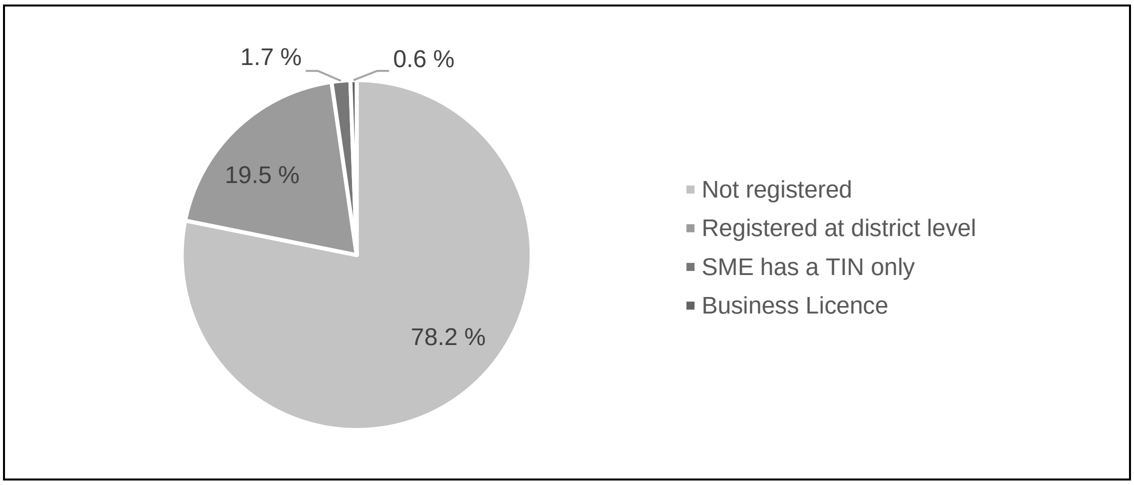
Number of all SME employees = 1 054

5.3 Administrative framework

5.3.1 Registration status

Over three quarters of SMEs (78%) were found to be operating without any type of official registration. The most common type of registration among the registered SMEs by far was registration at district level. Only three SMEs reported having a Tax Identification Number (TIN) and one SME, a carpentry workshop, reported having a business licence. The shares for different registration types are shown in Figure 11.

Figure 11 Registration status of SMEs



5.3.2 Bank account

Over three quarters of SMEs (77%) had no bank account whereas the remaining 23% reported having a bank account.

The share of enterprises that had a bank account was somewhat larger among the registered SMEs, with about one third (34%) having bank accounts, but this difference was not substantial.

The question concerned specifically a bank account registered for the SME, and any personal bank account of the owner was not considered herein.

[9] The UN Convention on the Rights of Persons with Disabilities (UNCRPD) recognises that 'disability is an evolving concept' (UNCRPD, 2006, p. 1). 'Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others' (UNCRPD, 2006, p. 4).

5.3.3 Business plans

Three SMEs (or, 2%) out of the total of 174 SMEs reported having a written business plan.

All three SMEs involved sawmills and had higher-than-average capital investment (see 5.4.1), ranging from TZS 2.9 million to over TZS 8 million. Especially two out of the three SMEs demonstrated a large volume of business and operations according to multiple variables. Both had additional activities: one was having a timber yard, and another was doing both harvesting and charcoal production in addition to sawmilling. They also had the total number of employees and the annual turnover both well over the observed average.

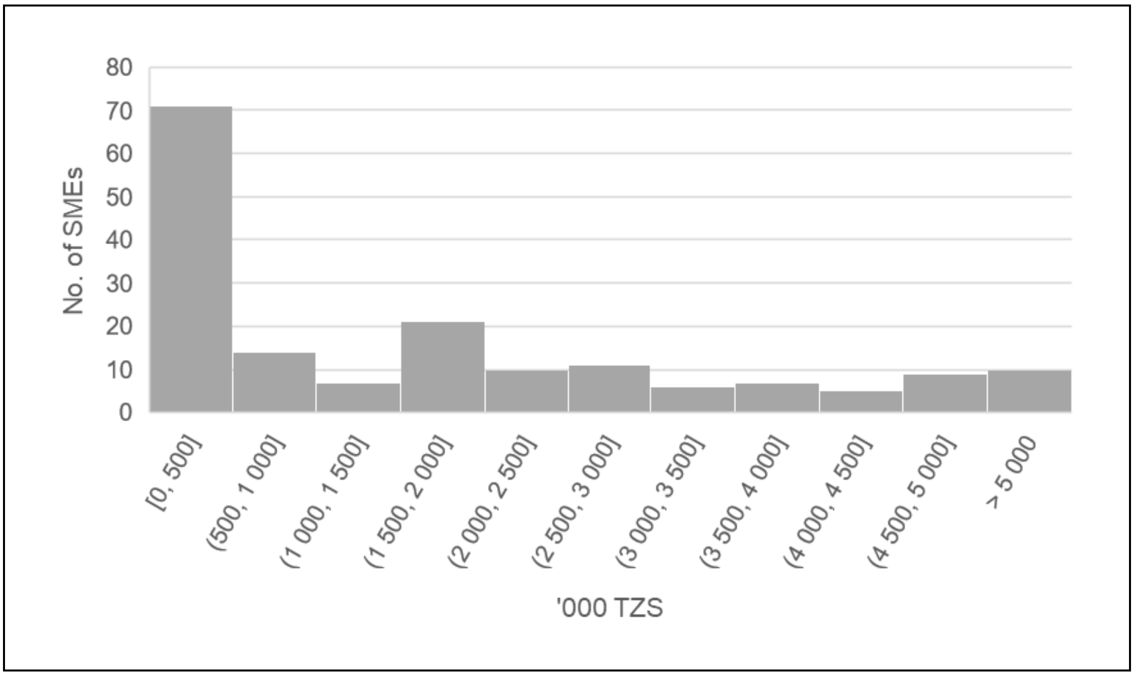
5.4 Finances

5.4.1 Capital investment

42% of SMEs who reported their capital investment in machinery and infrastructure only stated figures up to TZS 500 000 (EUR 185). A histogram of reported capital investment by the interviewed SMEs is included in Figure 12.

The average investment was TZS 1 995 000 (EUR 739), and the median investment was TZS 1 100 000 (EUR 407). Only 6% of SMEs stated a capital investment above TZS 5 million (about EUR 1 850). The maximum investment stated was TZS 36 million (about EUR 13 300). However, individual figures should be interpreted with caution since there was no way to verify the amount of investment stated by the SME owners.

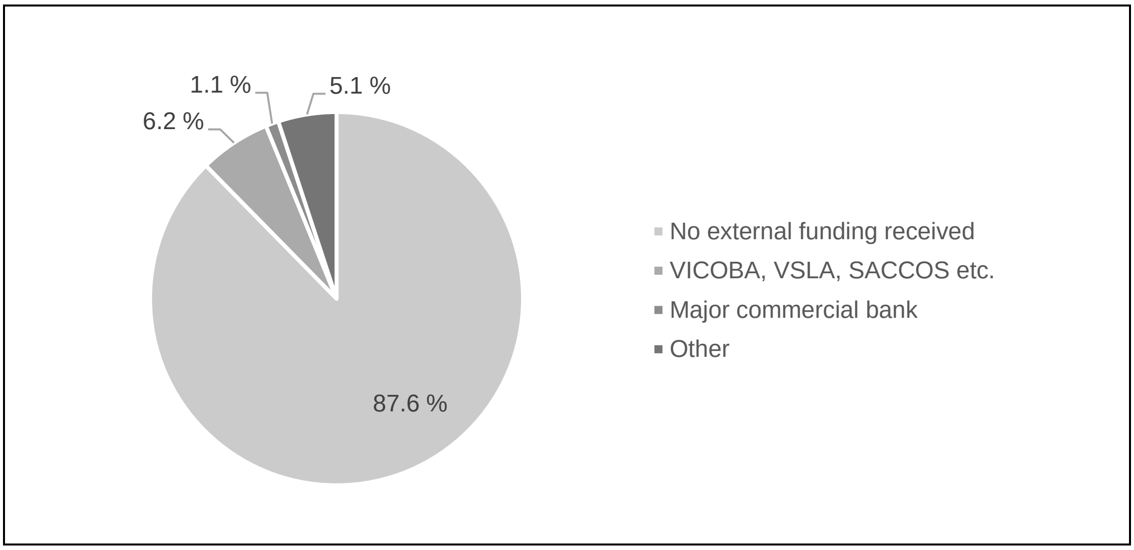
Figure 12 Distribution of capital investment by SMEs



5.4.2 Sources of external funding

11 SMEs stated they had received funding for their SME through microfinance schemes such as VICOBA, VSLA and SACCOS within the past two years. Two SME stated that they had received loans from major commercial banks. However, the vast majority of the SMEs stated they had not received external funding from any source (Figure 13).

Figure 13 Sources of external funding received by SMEs



The nine SMEs under the category “other” reported receiving funds from organised small saving groups, or from friends and relatives.

5.4.3 Costs, revenue, turnover, and profit

Table 12 shows the results for the annual costs, revenue, profit, and turnover of the SMEs. The figures are based on the statements by the SME owners.

Table 12 Financial indicators

Indicator	Annual figure in TZS		Annual figure in EUR	
	Mean	Median	Mean	Median
Costs	3 437 303	1 100 000	1 273	407
Revenue	6 263 398	2 000 000	2 320	741
Turnover	9 850 104	4 260 000	3 648	1 578
Profit	2 897 098	650 500	1 073	241

Observations from single SMEs demonstrating relatively high values have a large effect on the reported averages, hence median is featured above as an additional indicator. This effect is clearly seen in the histogram of annual turnover featured in Figure 14, with the considerably long “tail” of scattered individual observations towards the high end.

While it should be kept in mind that individual observations are to be interpreted with caution due to lack of means for verification, the results generally show that the SMEs within the forestry sector of Makete District vary widely from one to another in terms of their financial volume. While most of the SMEs operate with relatively low financial volumes, some SMEs on the contrary have significantly higher turnovers.

A notable feature of the observed profitability is that 26% of the SMEs appear to be making losses instead of profits. The distribution of calculated profits and losses is illustrated in Figure 15. While SME owners may be more likely to downplay their revenues and exaggerate their costs during interviews, which would affect the results, there is evidence from an ongoing PFP study on market systems that making losses is common among the SMEs. The issue is discussed further under conclusions in chapter 6.

Figure 14 Distribution of annual turnover of the SMEs

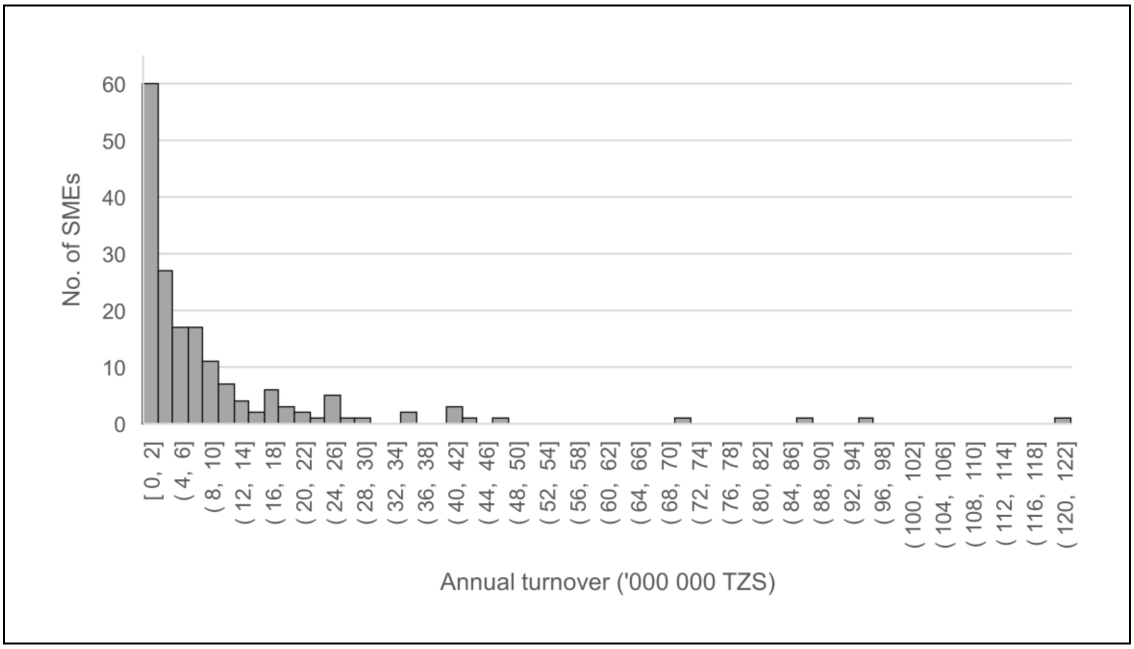
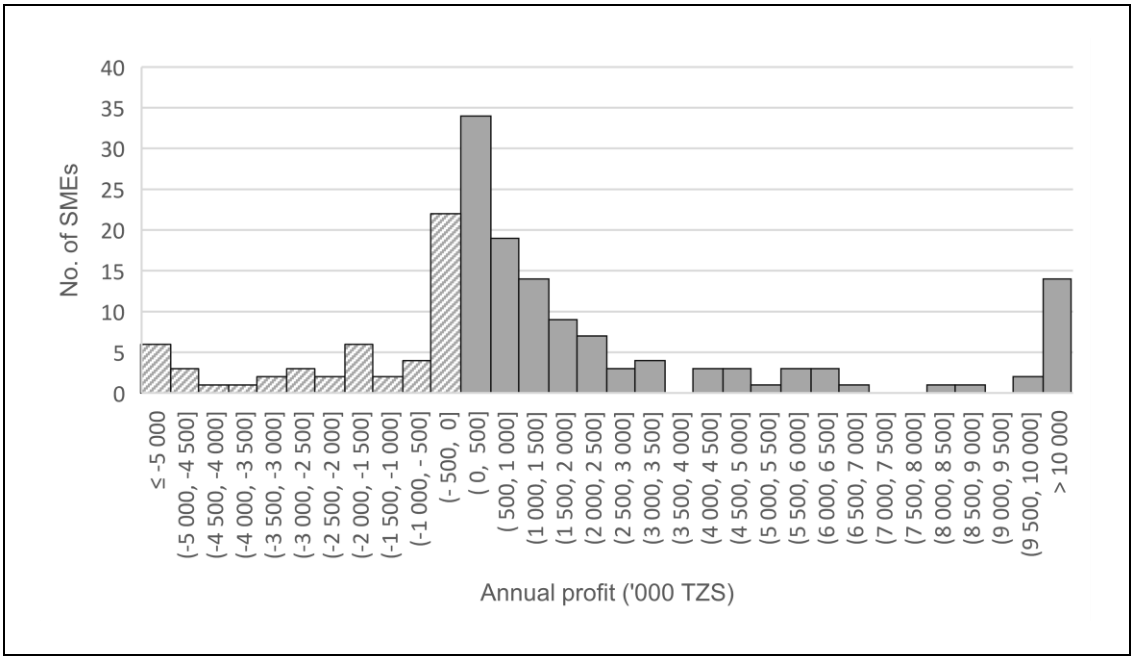


Figure 15 Distribution of the annual profit/loss of the SMEs



5.5 Access to markets

An assessment by the SME owners concerning the market access of their respective SMEs on a three-tier scale provided the following results:

- Good access: 9%
- Mediocre access: 69%
- Poor access: 22%

Sawmills were prominently featured in the group that considered the access to markets as poor. However, also the majority of the sawmills considered the access to markets as mediocre.

5.6 Social security

5.6.1 Social security systems

No formal social security systems were found to be provided by SMEs for their employees.

5.6.2 OSH training

95% of the SME owners reported that neither them nor any representative of theirs had received any training on occupational safety and health (OSH) issues. The remaining 5% reported having received OSH training.

5.6.3 Workplace accidents

Two thirds (66%) of the SMEs stated that there had been no such accidents that would have caused temporary or permanent incapacitation, or death, of an employee during the past 12 months (Table 13). However, the remaining 33% of SMEs reported a total of 122 such accidents. 71 of those accidents took place on SMEs with sawmilling activities, making sawmills an overrepresented SME type in the accident record.

Table 13 Frequencies for number of accidents during the past 12 months

Number of accidents during the past 12 months	Frequency
No accidents	114
1 accident	31
2 accidents	10
3 accidents	13
4 accidents	3
10 accidents	2

The average rate of accidents per SME per year was 0.7 for all SMEs and 1.3 for SMEs with sawmilling activities.

5.7 Specific data from sawmills

5.7.1 Innovative practices

SMEs with sawmilling activities were asked whether they had adopted any new and better practices during the last two years that would have helped to improve the operations of the sawmill. A total of five positive responses were received for this question (Table 14). The resulting prevalence of innovative practices in the target group was hence 9%.

Table 14 Reported innovative practices introduced in sawmills during the past two years

Reported innovative practices	No. of responses
Change from using a thick circular sawblade into using a thin one, improving the recovery rate	1
Introduction of sawblades with better quality	1
Engagement with improved sawmill maintenance service / skilful mechanics	2
Introduction of better saw doctoring practices	1
Total no. of responses	5

5.7.2 Usage of PPE within sawmilling SMEs

Only one out of 54 sawmilling SMEs reported any personal protective equipment (PPE) being used by the workers. The type of PPE specified by them was safety boots only.

5.7.3 Timber procurement contracts

Two out of 54 sawmilling SMEs (4%) reported having timber procurement contracts with producers. The length of these contracts could not be established.

The remaining 52 sawmilling SMEs stated that they had no timber procurement contracts.

5.7.4 Timber grading

53 out of 54 Sawmilling SMEs reported that they were applying timber grading. Timber grading in this context referred solely to customer-specific requirements for product quality and dimensions that the sawmills were striving to meet.

The average share of graded timber produced was 65%, ranging from 35% to 95%. The average volume of graded timber produced per SME per year as per their own assessment was about 470 m^3 while the median was 250 m^3.

5.8 Specific data from forest management/harvesting contractors

5.8.1 Chain saw training

None of the 41 interviewed SMEs with forest management or harvesting activities had received any technical training on the use of chain saw.

5.8.2 Usage of PPE within forest management/harvesting contractors

No PPE was being used in any SMEs within the target group.

5.8.3 Sorting of logs for different end uses

Prevalence of log sorting

Data from sorting logs for different end uses was acquired from 33 SMEs. Only two end uses for logs were reported by these contractors: i) sawmilling, and ii) bioenergy.

19 out of the 33 SMEs reported that all harvested logs were being delivered for sawmilling. One SME reported that all harvested logs were being delivered to be used as bioenergy.

The remaining 13 out of the 33 SMEs (or, 39%) applied sorting of logs for more than one end use (Table 15).

Share of logs by different end use

In those 13 SMEs that applied log sorting, on average 66% of logs were delivered to sawmilling and 34% were delivered to be used as bioenergy.

Across all 33 SMEs, both sorting and non-sorting ones, 83% of logs went to sawmilling and 17% to bioenergy.

Table 15 Sorting of logs for different end uses

Contractor groups based on sorting of logs	No.	%	% of logs delivered to sawmilling	% of logs delivered to bioenergy
Contractors sorting logs to multiple uses	13	39%	66%	34%
Contractors delivering logs to single use only	20	61%	95%	5%
All contractors	33	100%	83%	17%

5.9 Specific data from tree seedling nurseries

5.9.1 Nursery practices

Only three commercially based tree seedlings nurseries were found in the 23 villages included in the survey. These were in the villages of Ipepo, Lupalilo and Mang'oto.

None of the three nurseries were using any improved practices as defined in the questionnaire, instead relying on the traditional standard practices.

5.9.2 Use of improved seed

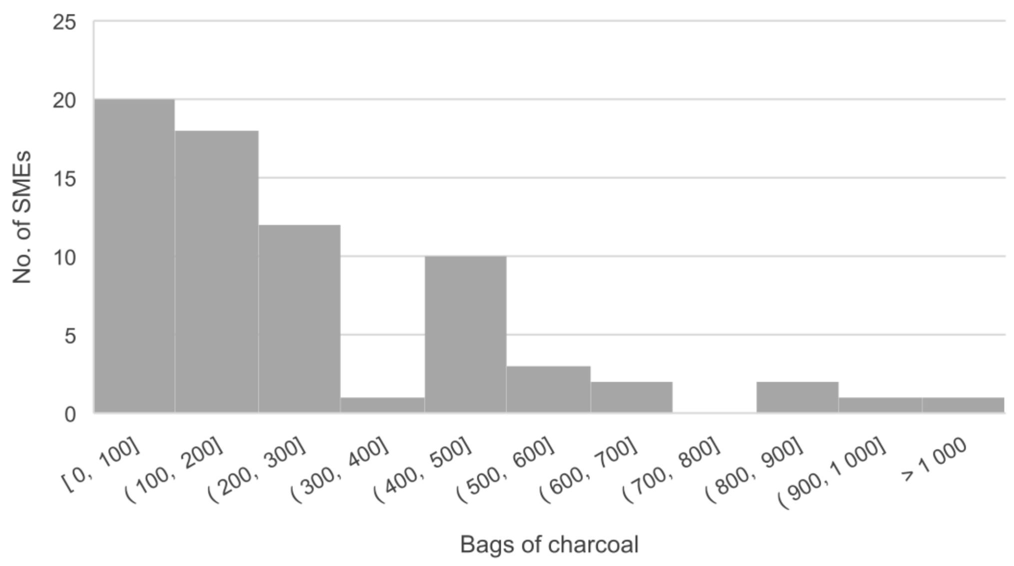
One nursery reported using improved seed only. The other two nurseries reported using standard non-improved seed, and a mixture of improved seed and non-improved seed, respectively.

5.10 Specific data from producers of bioenergy / wood by-products

5.10.1 Annual production rate

All interviewed SMEs within the bioenergy / wood by-product producer category were charcoal makers using the traditional earth pit kiln. Figure 16 shows the distribution of their reported annual production, in standard bags of charcoal (35 kg). The average reported production rate was 286 bags per year (about 10 000 kg) with the median being 200 bags per year.

Figure 16 Distribution of the number of charcoal bags produced annually



5.11 Challenges listed by SMEs

The interviewees were asked to provide a free description of the challenges faced by their SMEs, which returned a wide array of answers. They are recapitulated thematically in Table 16. As has been shown in the findings of this survey, SMEs face challenges from multiple sides that hamper their development. The challenges listed by the SME owners show that themselves they also widely recognise these issues.

Most challenges listed by the SMEs were related to poor and unpredictable market of their products, and limited access to better technology, proper tools & equipment, and adequate services such as machinery maintenance and training for skill development.

Table 16 Challenges listed by SMEs during interviews

Theme	Listed challenges
Finances and market	Limited access to capital, i.e. lack of external funding sources
	SMEs should be facilitated in organisation and management of SME groups to enable them to access finances together
	Poor and unreliable market for sawn timber
	Long storage periods of unsold timber during rainy season lead to decrease in quality of the timber
	Poor market for charcoal
	No price fixing for sawn timber
	Low bargaining power among sawmillers
	High CESS charges for charcoal
	Facilitation is needed in marketing of sawn timber and charcoal products
Costs	High fuel costs in in operating sawmills and chain saws
	High maintenance costs for sawmills and chain saws
Technology and processing techniques	Low level of wood processing technology; no exposure to modern technologies
	Poor processing techniques and low recovery rate in charcoal production
	Sometimes charcoal kilns collapse during night
Availability of equipment and services	Limited availability of spare parts and maintenance services
	Limited availability of proper tools
	Lack of saw doctors
	Poor maintenance of saw blade leads to low quality of sawn timber
	PPE is not available
	Training services are not available for improving practices
	Chain saw operators are few and often not available in time
	Unreliable supply of eucalyptus and cypress wood for carpentry
Skill gaps	Lack of skills in chain saw operations
	Lack of skilled maintenance personnel
	Lack of skills and awareness related to OHS issues
	Training needed in efficient and profitable charcoal production; need of training on the use of metal kilns
Infrastructure and topography	Road network is insufficient, leading into difficulties in harvesting and transporting the forest resources
	Road access during rainy season is poor
	High transport costs from forest to roadside
	Hard topography for forestry operations, increasing costs
	Lack of power supply for carpentry machinery
Workforce	Limited availability of skilled labour
	Worker absenteeism is an issue; sometimes workers disappear after receiving their advance payments

6. CONCLUSIONS FROM THE SME SURVEY

6.1 General

The SME scene within the forestry sector in Makete District is characterised by low processing technology and lack of improved practices, low level of capital investment, poor administrative framework, prevalence of temporary labour over permanent staff, and lack of social support systems. The SMEs generally face challenges in access to improved features, which hinders the development of their business. Despite of the seasonality of the work, the forestry SMEs form a locally major employer.

6.2 Technology transfer

The survey found no improved technology within the surveyed SMEs. Instead, the standard technologies and practices were commonly applied. This concerned all relevant SME groups including sawmills, charcoal production, and nurseries. The SMEs did recognise the issue as a challenge; however, two main reasons could be drawn that limited the SMEs from engaging into technology transfer: i) lack of capital, and ii) limited access to improved technology, including the necessary maintenance services and spare parts.

6.3 Profits and losses

Profit was often deemed insecure by the SMEs due to fluctuating markets and high production costs. The survey results indicate that a notable share of SMEs are in fact making losses. This finding is furthermore supported by the early results of a separate market systems study that is being conducted by the PFP 2.

The finding is linked with the overall challenges faced by the SMEs, involving the low processing technology leading to low quality of products, lack of market access and market information, and poor infrastructure reducing access to forest resource while increasing the costs. Weak administrational framework such as lack of written business plans and lack of adequate bookkeeping likely contributes to the problem while reducing the SMEs' capability to detect losses. The ongoing market systems study is expected to further explore the issue.

6.4 Employment provision

The interviewed SMEs provided 1 054 jobs. Extrapolation based on the share of interviewed SMEs from the total number of identified SMEs results in an estimate of over 1 800 jobs provided by forestry SMEs in the 23 villages.

Sawmills were cumulatively the largest employer out of the different forestry SME types.

6.5 Work seasonality and working conditions

While the total number of jobs provided by the SMEs in considerable, majority of the employment (89%) is in daily labour instead of permanent positions. For employees this causes lower security of income and is likely to lead into an uneven working record. For SME owners this causes lower commitment of their workers, leading into absenteeism and irregular skill sets represented in their workforce.

Market fluctuation as an underlying cause for seasonality of the work is an aspect outside of the SMEs' control. Aspects that could help to mitigate the seasonality include improved processing technology offering for better working conditions and higher production rates, increasing the share of the permanent staff required in the workforce. An example of this would be stationary sawmills with improved features. Better market information and improved administrational procedures could allow for better planning, decreasing the effects of the seasonality. The currently absent social security systems provided to the workers through their job are potentially another key feature in reducing large changes in the workforce.

There is also an urgent need to improve the status of OSH within the SME scene. Accidents were found to be most common with sawmilling SMEs. Few SMEs had received any training on OSH issues, and practically no PPE was applied. The issue could be improved through better, safer processing technology, increased knowledge on OSH issues, and enforcement of safety regulations generally within the forestry sector. Under the current conditions few SMEs are able to provide decent jobs for their workforce.

However, none of these changes are simply adopted by the SMEs which are currently facing multiple limitations from all sides. Development initiative such as PFP 2 is positioned to assess which limitations would be the most cost-efficient to alleviate through programme interventions.

6.6 Link between growers and processors

Low quality of products is caused not only by poor processing technology but by quality of raw material. The findings of the woodlot survey show that smallholder woodlots in Makete District are generally grown under suboptimal silvicultural regimes involving poor appliance of most standard management activities as well as harvested with low average diameters. Unless the raw material base is improved, the SMEs alone cannot shift their production into high-quality products.

7. ESTIMATES FOR FOREST PRODUCT PRODUCTION RATES IN MAKETE

7.1 General notes

The following presents estimates for (i) overall production potential for plantation-based wood and (ii) realised overall production rates for sawn timber and charcoal in Makete District, based on the data recorded in the woodlot assessment and the SME assessment as well as additional data from some other sources.

It should be noted that the presented figures are rough estimates with large margins of error, since the parent data and the methods, including extrapolation, do not allow for precision estimates. The figures are hence intended mainly to provide an understanding concerning the order of magnitude of the inspected production rates, and they should be interpreted accordingly.

7.2 Estimated wood production potential in Makete

Results from the woodlot survey were combined with other data sources to estimate the annual total wood production potential of woodlots in Makete District.

total wood production potential of woodlots in Makete District.

Results of a remote sensing-based forest plantation mapping of Southern Highlands published in 2017 by PFP[10] revealed about 27 700 ha of plantations in Makete District. Distribution of this plantation area between different site index classes was done based on the distribution of woodlots between different site index classes (applying Sao Hill site index classes of 2016) observed in the woodlot assessment reported in this document (Figure 5 and Table 5).

Sao Hill yield tables[11] were used for determination of wood production rate for each respective site index class. The yield tables involve scenarios with and without thinnings. For this assessment, the scenarios involving thinnings were selected. For maximisation of production over time, rotation period with the highest mean annual increment (MAI) was chosen for each respective site index class. In every class this rotation period was 15 years. Assuming harvest at this age, the MAI stands for the maximum harvestable volume per hectare per year in each site index class. The resulting total annual harvestable volume of roundwood, as shown in Table 17, is about 680 000 m^3 across the whole forest plantation area of Makete District.

Table 17 Estimated annual roundwood production potential in Makete

Reference site class for yield	Area share (%)	Total area (ha)	Age	MAI (m^3)	Max harvestable vol per year (m3)
Sao Hill class I	39.9%	11 063	15	33.8	373 941
Sao Hill class II	29.6%	8 203	15	24.6	201 804
Sao Hill class III	20.7%	5 720	15	14.6	83 509
Sao Hill class IV	9.8%	2 709	15	7.3	19 779
Total	100.0%	27 696	15	24.5	679 034

Assuming 75% of the harvested volume being sawlogs, the potential sawlog production rate in Makete is about 510 000 m^3 per annum. The applied sawlog percentage considers one thinning that is included in the yield table regimes.

[10] Private Forestry Programme (2017). Forest Plantation Mapping of the Southern Highlands. Final report. Iringa, Tanzania. Available online: http://www.privateforestry.or.tz/en/resources/view/forest-plantation-mapping-southern-highlands-final-report

[11] Malimbwi, R.E., Mugasha, W.A. and Mauya, E. (2016). Pinus Patula Yield Tables for Sao Hill Forest Plantations, Tanzania. Sokoine University of Agriculture, Morogoro. 38 pp.

The presented production rate results are conservative estimates since conservative assumptions are applied in the calculation: (i) the presented total plantation area generally lacks plantations of 1–2 years of age since the trees are too small to be picked up by remote sensing; and (ii) the applied reference yield is the minimum one for each class (read from the lower boundary graph of each site index band).

It should be noted that maximising the volume production does not maximise the value of the produced roundwood. Instead, even longer rotation periods would be needed especially in the lower site index classes for production of sawlogs with large enough dimensions to allow for processing valuable sawn timber sizes (such as 1'x10'). At 15 years of age, the mean DBH varies between 15.3–27.0 cm between the different site index classes.

7.3 Estimated sawn timber production in Makete

The realised sawn timber production in Makete District was estimated based on the production rates reported by interviewed sawmill owners and extrapolation of these figures.

It was assumed that the distribution of sawmilling SMEs between the surveyed 23 villages and the other villages in Makete District would rather follow the distribution of the plantation forest resources than the number of villages. Results from the remote sensing-based forest plantation mapping published in 2017 indicated that the 23 villages included in the survey covered 51% of the total plantation forest resource in Makete District.

Extrapolation based on this resulted into an estimate of about 220 sawmilling SMEs in Makete District in total, producing altogether about 100 000 m^3 of sawn timber annually.

Since the sawn timber production estimates were not verified through measurements, the median production rate (450 m^3 per year) as per the SME owner interviews was used instead of the average to eliminate effect of possible overestimated production rates and allow for a conservative estimate.

Assuming an average conversion rate of 35% from roundwood to sawn timber (all sawmills being ding dongs with generally low conversion rates), the estimated production figures involve usage of 285 000 m^3 of sawlogs and production of 185 000 m^3 of wood waste as sawdust and offcuts per annum in Makete.

The estimated sawlog usage is just above half of the annual minimum sawlog production potential estimated in section 7.2.

The annual sawn timber production estimate was crosschecked against the production figures indicated by the CESS collection from sawn timber by district authorities. The total CESS collection during financial year 2019/20 indicates that payments were made from 4.44 million pieces of timber, which converts into about 90 000 m^3 of sawn timber assuming an average volume of 20 litres per piece (2'x4' with a length of about 4 m).

The results indicate relatively similar total production rates, and as such, they do not show tax evasion of a massive scale. It should be noted however that conservative estimates were used in the estimation of the total sawn timber production, and that the total error margins of the estimates are large.

7.4 Estimated charcoal production in Makete

The CESS collection during financial year 2019/20 from charcoal production indicates that about 52 000 bags of charcoal (1 500 – 1 800 tonnes) were produced in Makete district within the course of one year. The amount of charcoal production not captured through the CESS collection remains unknown.

The total charcoal production rate based on the extrapolation of SME assessment results returned somewhat lower values than the estimate based on the CESS collection. The main conclusion from this is that there are more charcoal producers in the Makete District than what could be deduced based on the SME assessment results.

Annex 1 Pre-survey satellite imagery years of origin by village

Ward	No.	Village	Imagery date range	
			Earliest year	Latest year
Bulongwa	1	Bulongwa	2019	2020
Iniho	2	Iniho	-	2017
	3	Kidope	-	2017
	4	Lumage	2017	2020
	5	Mwakauta	2017	2020
Ipelele	6	Ipelele	2017	2019
Ipepo	7	Ipepo	-	2019
Isapulano	8	Isapulano	-	2017
	9	Ivilikinge	-	2017
	10	Luvulunge	-	2017
Iwawa	11	Ivalalila	2015	2018
	12	Ludihani	2015	2016
	13	Ndulamo	2015	2019
Kitulo	14	Nkenja	2017	2019
Lupalilo	15	Kising'a	2012	2019
	16	Lupalilo	-	2019
	17	Mago	-	2019
Mang'oto	18	Ibaga	2010	2012
	19	Ilindiwe	2012	2019
	20	Malembuli	2010	2019
	21	Mang'oto	-	2019
	22	Usungilo	-	2019
Tandala	23	Ihela	-	2019

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