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Woody plant Regeneration Status of Gamataja Community forest, in Goba district, Bale zone, Oromia regional state, Southeast of Ethiopia

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ABSTRACT

*Woody plant Regeneration Status and of Gamataja Community forest was studied in Goba district, Southeast of Ethiopia. The systematic sampling method was used to collect vegetation data. The regeneration status data were collected within 31 plots sized 20x20m for mature tree assessment and (5m*5m) for both Sapling and seedling. The woody plant regeneration status data were analyzed. Discopodium penninervum, Nuxia congesta, Helichrysum citrispinum had list number of seedling. The rest Crotalaria agatiflora subsp. erlangeri, Solanum incanum and Rosa abyssincia were the plant species with non-regeneration status. Erica arborea, Ritchiea albersii was the plant species with new regeneration status. Podocarpus falcatus, Prunus africanas were the plant species with poor regeneration status and the rest Hypericum revolutum had fair regeneration status. To enhance the regeneration status and limit conservation challenges all stake holders need to work in collaboration. Therefore based on the result of this study, recommended the detail regenerating studies of forest analysis and various environmental factors such as soil type and properties.*

Key words: - Community forest, Regeneration status, Woody plant.

1. INTRODUCTION

1.1. Background of the study

Ethiopia is considered one of the biodiversity-rich countries in tropical Africa, especially in terms of its higher endemic plant and animal diversity (Vivero et al 2006). The country's floral diversity is ranked as the fifth largest in Africa, with an estimated 6500–7000 species of higher

plants (vascular plants); 12% of these are endemic (Vivero et al., 2006). The mountain ecosystems of Ethiopia provide diverse ecosystem services including provisioning (e.g food, freshwater, wood, and medicine) (Bussman et al., 2011), regulating (e.g. Climate regulation, flood regulation, and water purification), supporting (e.g. Nutrient cycling, soil formation, and primary production) (Feyera Senbeta and Denich 2006; Ensermu Kelbessa and Teshome Soromessa 2008), and cultural (e.g aesthetic, spiritual, and recreational) services (Wesche et al., 2000).

However the country is also facing severe land degradation, the natural vegetation of the country was highly affected by several factors such as, agricultural expansion, settlement, deforestation, land degradation, and invasive species (Teshome Abate et al., 2009; Solomon Gebreyohans, 2015). The ultimate cause that has to be addressed for the forest destruction in Ethiopia is poverty, population growth, agricultural land expansion, extensive deforestation and encroachment (Ensermu Kelbessa et al., 1992; Tadesse Woldemariam et al., 2002). In Ethiopia, deforestation rates remain high and the gap between demand and domestic supply of forest products is expanding, even though government-initiated re-greening efforts began over a century ago(Mulugeta Lemenih and Habtemariam Kassa, 2014).

In order to minimize such threats, the country was striving for different conservation strategies like, watershed management, afforestation, and reforestation, restoration, and rehabilitation programs. These practices were found crucial to achieve better vegetation cover and contribute to improve livelihoods of local communities (Mengistu Tefera et al., 2005; Wondie Mebrat, 2015).

Community forestry refers to forest management that has ecological sustainability and local community benefits as central goals, with some degree of responsibility and authority in forest management formally vested in the community (Susan Charnley1 and Melissa R. Poe, 2007).The concept of community-based forest management emerged as a focus for addressing the linkages between forestry and rural people. Many countries are still at an early stage in the process of developing and introducing the concepts used in community forestry that may be appropriate to their situations. In others, community forestry has become central to the way forest resources are managed (Arnold, 2001).

Community forestry' is interpreted as "any situation that intimately involves local people in forestry activity" (FAO, 1978). It therefore covers a broad range of linkages among people, forests and the outputs of forests, from forest dwelling communities to populations who draw on

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nearby forests for part of their livelihood needs, and to those outside forests who manage tree stocks on farmland in order to sustain flows of forest outputs, or who engage in artisanal and other local small-scale commercial production and trade of forest products (Wiersum and Gilmour, 1999 : Fisher, 1997).

Population structure is the distribution of individuals of each species in arbitrarily to provide the overall regeneration profile of the study based on tree density, height, and frequency, diameter at breast height, species importance value and basal area (Peters, 1996; Getachaw Tesfaye et al., 2002; Simon Shibru & Girma Balcha, 2004). Information on population structure of a tree species indicates the history of the past disturbance to that species andthe environment and hence, used to forecast the future trend of the population of that particular species (Peters, 1996). From the population dynamics point of view, examination of patterns of species population structure could provide valuable information about their regeneration and/or recruitment status as well as the viability status of the population that could further be employed in devising evidence-based conservation and management strategies (Demel Teketay, 2005; Abiyu Tilahun et al., 2011).

The regeneration status/potential of species in a community can be accessed from the total population dynamics of seedlings and saplings in the forest community (Getachaw Tesfaye *et al.*, 2002; Duchok *et al.*, 2005). The overall pattern of population dynamics of seedlings, saplings and adults of a plant species can exhibit the regeneration profile, which is used to determine their regeneration status (Khan *et al.,* 1987; Tamirat Bekele, 1994).

A population with sufficient number of seedlings and saplings depicts the satisfactory regeneration behavior, while the inadequate number of seedlings and saplings of the species in a forest indicate poor regeneration (Khan *et al.,* 1987; Tripathi & Khan, 2007).

From the population dynamics point of view, examination of patterns of species population structure could provide valuable information about their regeneration and/or recruitment status as well as the viability status of the population that could further be employed for devising evidence-based conservation and management strategies (Damel Teketay, 2005; Abiyou Tilahun et al., 2011). The regeneration status/potential of species in a community can be accessed from the total population dynamics of seedlings and saplings in the forest community (Getachaw Tesfaye et al., 2002; Duchok et al., 2005). The overall pattern of population dynamics of seedlings, saplings and adults of a plant species can exhibit the regeneration profile, which is

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used to determine their regeneration status (Khan et al., 1987; Tamirat Bekele, 1994). A population with sufficient number of seedlings and saplings depicts the satisfactory regeneration behavior, while the inadequate number of seedlings and saplings of the species in a forest indicates poor regeneration (Khan et al., 1987; Tripathi & Khan, 2007).

The main objective of the current study was to assess the Woody plant regeneration Status of Community forest, in *Gamataja* of *Goba* district.

1.2. Statement of the problems

The forest is owned by local community and managed by Oromia Forest Enterprises (OFE) with the objective of forest conservation and sustainable utilization and sharing benefit for the local people. In line with this objective, Oromia Forest Enterprise and local people were jointly conserved the forest before, but at this time the forest is highly degraded in an alarming rate. Therefore, detailed woody plant regeneration status and other ecological studies are desirable to draw the attention of the actors in relative to biological resource conservation and local community so has to undertake appropriate conservation measures. The current study is aimed to assess the Woody plant regeneration status Gamataja community forest in Goba District.

1.3. Significance of the Study

The study results have identified the woody plant regeneration status, whether it has good regeneration, fair regeneration, poor regeneration and no regeneration as well aspects of deforestation and efforts to conserve forests in rural households in the study area. It had also played a major role in the assessment of the problem under consideration. This study was expected to be essential for all stakeholders to minimize the adverse effects of deforestation by conserving forests in the area concerned. The study was served as a good basis for the coming researchers who may have a strong desire to carry out a research on this or related topics in this district or elsewhere.

1.4. Objectives of the study

1.4.1. General Objective

The general objective of this study is to identify Woody plant regeneration status in Gamataja community forest, in *Goba* district, south east of Ethiopia.

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1.4.2. Specific Objectives

The specific objectives of this study are:

- To identify the Woody plant species regeneration status of Gamataja community forest in Goba district
- To identify major plant species in seedling, sapling and matured trees stages in Gamataja community forest
- To categorize major plant species in Gamataja community forest as good, poor and non regeneration status.

1.5. Research questions

1. What is the woody plant species present in the study area?
2. Which species of plants that have good regeneration status in Gamataja community forests?
3. Which plant species have poor regeneration status in Gamataja community forest?
4. Which species of plants that are non regenerating in Gamataja community forest?

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1.6. Delimitation of the study

The study was conducted only in and around the *Gamataja* community forest and the study was focused on Regeneration status of *Gamataja* community forests in this purposefully selected area due to time and financial problems.

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2. MATERIAL AND METHODOLOGY

2.1. Description of the study area

The Gamataja community forest is one of the community forests that are located in the Goba district of Bale zone. This community forest is owned by three villages, Lashqonna, Shifario, and Gamataja which are currently known as Itittu sura. It is located in the Bale zone at about 15km North West of Zonal capital Robe and 445km southeast of Addis Ababa**.** Goba is located in 07^0 00'338" N and $39^0$58'009"E and located in the North Western extreme parts of the Bale Zone. The elevation of the study area lies between 2410m – 2878m above the sea level. It is characterized by little flat land on the top; most of its parts are river gorges. The community forest is bordered by Burkitu village from the north, Shifario zone from the south, Goba town from the east and Dinsho from the west and totally the forest is 548.85 in a hectare.

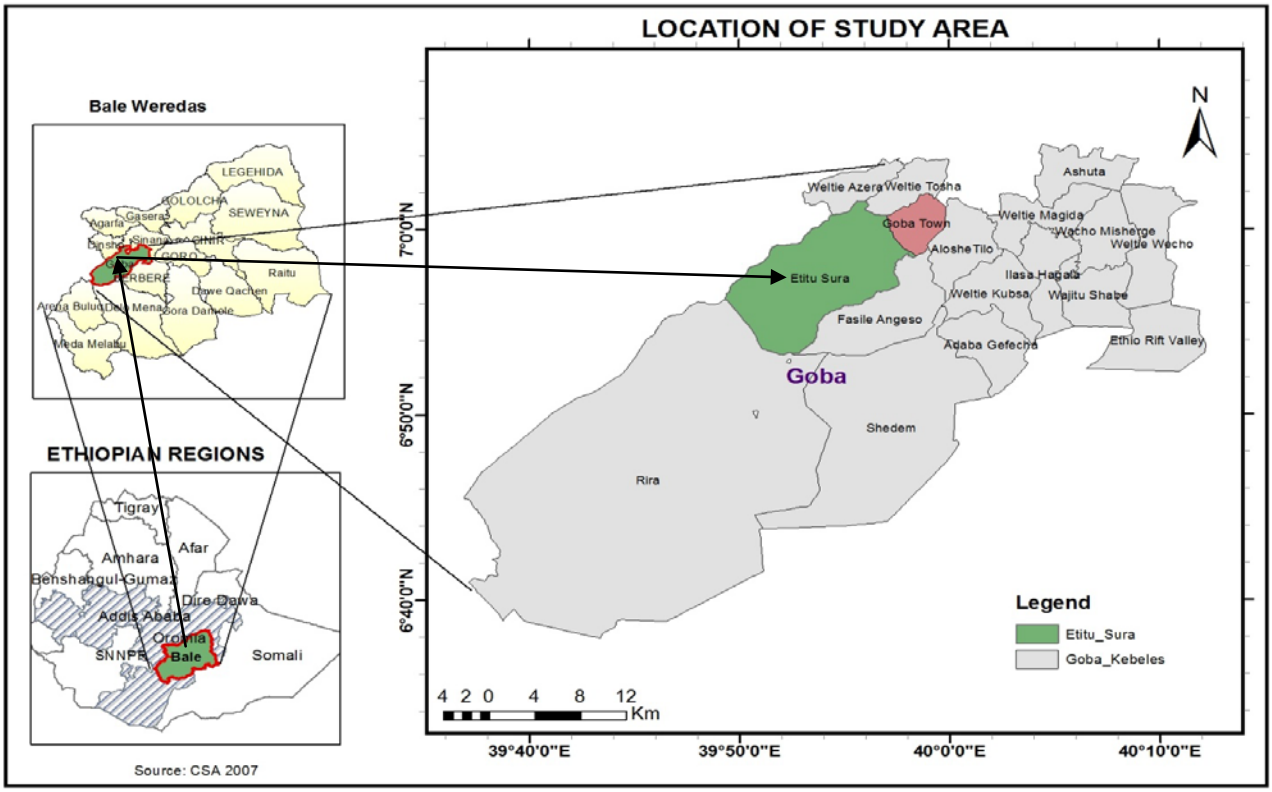

Figure 1. Map of the study area

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2.1.1. Vegetation and wildlife

The area is dominated by different tree, shrub and open grassland. Some of plant species that found in the study area are *Oliea europea* subsps *cuspidata*, *Eucalyptus globules*, *Junipares procera*, *Hypericum revolatum, Vernonia amigdalina, Ficus vasta, Hygenea abyssinica, Discopodium penninervum, Rosa abyssinica, Podocarpus falcatus, Rubus apetalus* are among others. The fauna includes, Spotted hyena (*Crocuta crocuta),* Colobus monkey, Warthog (*Phacochoerus africanus),* and Antelope (*Ammospermophilus nelson*) (personal Communication 6 June, 2019).

2.1.2. Topography and Hydrology

2.1.2.1. Topography

Gamataja community forest is characterized by heterogeneous hilly terrain. Large portion of the study area falls on the valley floor. The study area lies on the top edge of the *Garenno* River.

2.1.2.2. Hydrology

The study area has many small rivers among few includes "*Bamo"*, "*Garenno"*, "*Sa'ada* rivers" and "*Chaffa urana"* small springs.

2.1.3. Climate

The Goba district experiences dry and wet season with long wet season from March to November and relatively short dry season from December to February. During the wet season, most of the time, the area is blanketed by thick white fog and clouds usually accompanied with rain. The average monthly rainfall and temperature for the study area over ten years was obtained from the Ethiopian Meteorological Agency, Robe Field Station (EMA Robe field station, 2020).

The average monthly rain fall of Gamataja community forest is shown in figure 2 bellow. The region experiences a seasonal bimodal distribution of rainfall. Rainfall distribution for the region varies between average monthly minimum with in December, January, February and moderate rain fall with in June, November, March and May. While October, July, April, September and August experience the average maximum rainfall ranges from 102.5ml-155.5ml.

The temperature data of 2010 - 2019 indicates the maximum monthly temperature of the area lies within the temperature $20.5C^0$-$24.3C^o$ as shown in figure 3 bellow. The minimum temperature of the area lies within the average temperature ranges of 5.2 C^o-$10.0C^o$. The lowest temperature

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recorded in January and the highest temperature was recorded in July as shown in the figure 2 below.

2.2. Sampling Design

Regeneration status of woody plant species in Gamataja community forest

Following a reconnaissance survey, a systematic sampling technique was used to collect vegetation data in the Forest. Thirty one net quadrat size of 400 m^2 (20 m × 20 m) was used to count the matured trees. Within the main quadrat two opposite sides of sub quadrats each of with 25 m^2 (5 m × 5 m) for sapling and seedling of woody plants were laid down following (Tesfaye Bogale et al., 2017). Plots were laid systematically at every 300 m along transect lines, which will be 200 m apart from each other (Chauhan et al., 2008; Haile Yineger et al., 2008; Haile Adamu et al., 2012; Tiwari et al., 2010; Kindeye Gebrehiwot & Kitessa Hundera, 2014; Sharma & Ahmad, 2014).

2.3. Material

Tape meter was used to measure the size and distance of each quadrant from each other as well as the height of the trees. Rope was used to construct the quadrat and calipers was used to measure the DBH for seedling, sapling and matured trees. Clip board, pen, fixer, ruler and paper were used to record data during data collection.

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2.4. Method of Data Collection

2.4.1. Regeneration status of woody plant

In order to collect data on regeneration status of woody plants first reconnaissance survey was implemented. During this time the boundaries and visual observation of the forest cover, with our guiders and selected local framers. The GPS reading of each boundary points for demarcations and elevation of the areas, northing and easting of the points were recorded. The community forest map by using Arc GIS software by transferring (importing) reading data from GPS until Arc GIS software. The map was classified into different sized grid lines to develop imaginary transect lines and quadrant's of different sizes. The direction of transect line was from south to north side.

The numbers of total populations and sampling size was determined. Accordingly the number of the main quadrat such that 20*20m=400m^2 was 31, the distance of quadrat lines where 300m apart and the quadrats were 200m apart from each other accordingly seven transect lines were used and 31 quadrats were laid down. For matured trees assessment there were a total of 31 (20m*20m) net quadrants and 155 (5m*5m) were used and for assessment of both sapling and seedling.

Lastly, just to travel and identify each and every quadrat GPS was used so as to point out the direction northing and easting (X, Y) coordinate of each quadrant were feed into GPS and then transect lines were laid down as prepared and quadrants and sub-quadrants were identified. Sapling, seedling, matured trees were identified by using calipers to measure DBH and tape meter by to measure height. The DBH was measured at 1.3m from the ground. As a result plant with DBH from 5cm to 20cm and height greater than 150cm to 300cm was measured as sapling and plants DBH ≤2.5cm and height <0.6m were recorded as seedling (Parick et al. 2001), plants with DBH measure ≥ 10cm and height ≥ 3m was measured as matured tree used by (Parick et al. 2001). The elevation and plant local name was recorded and the plant sample was collected and taken to herbarium for identification.

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2.5. Data Analysis

2.5.1. Woody plant regeneration data analysis

The regeneration status of sample species in the forest was analyzed by comparing seedling with sapling and sapling with matured trees data (Shankar, 2001; Dhaulkhandi et al., 2008; Tiwari *et al.,* 2010; Gebrehiwot & Hundera, 2014) in the following categories: 1) “good” regeneration, if present in seedling > sapling > mature tree; 2) “fair” regeneration, if present in seedling > sapling< mature tree; 3) “poor” regeneration, if a species survives only in the sapling stage, but not as seedlings (even though saplings may be less than, more than, or equal to mature); 4) “none”, if a species is absent both in sapling and seedling stages, but present as mature; and 5) “new”, if a species has no mature, but only sapling and/or seedling stages.

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3. RESULTS

3.1. Woody plant Regeneration status

Composition, distribution and density of seedlings and saplings would indicate the status of the regeneration of the forest. The sustainability of natural forests depends on the regeneration capacity of each species in the forest and the sustainability of each species, in turn, depends on the sustainability of each individual woody plant. One of the major factors used to assess their conservation status is the regeneration or recruitment status of woody species (Taye Bekele *et al.*, 2003).

Seedlings of woody plant species were listed in table 1 below. Accordingly *Juniperus procera, Olea europaea* subsp *cuspidiata, Myrsine africana, Maytenus arbutifolia, Dovyalis abyssinica* where the top five woody plant species seedling counted in Gamataja community forest respectively. The rest *Maesa lanceolata, Hypericum revolutum, Discopodium penninervum,Vernonia amygdalaina, Helichrysum citrispinum, Nuxia congesta* were the list of woody plant seedling counted in Gamataja community forest. The total number of seedlings of woody plant species counted in community forest was 1204.

No	Species Name	Family name	Counted number
1	*Juniperus procera*	Cupressaceae	324
2	*Olea europaea*	Oleaceae	324
3	*Discopodium penninervum*	Solanaceae	24
4	*Maytenus arbutifolia*	Celastraceae	212
5	*Nuxia congesta*	Loganiaceae	6
6	*Myrsine Africana*	Myrsinaceae	80
7	*Maesa lanceolata*	Myrsinaceae	76
8	*Dovyalis abyssinica*	*Flacourtiacceae*	78
9	*Helichrysum citrispinum*	Asteraceae	8
10	*Vernonia amygdalaina*	Asteraceae	12
11	*Hypericum revolutum*	Guttiferae	60
	Total		**1204**

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Table 1. Seedling of woody plant species in Gamataja community forest

Sapling of woody plants in Gamataja community forest is listed in table 2 below. Accordingly *Juniperus procera, Maytenus arbutifolia, Olea europaea* subsp *cuspidiata, Maesa lanceolata, Discopodium penninervum, Dovyalisabyssinica, Myrsine africana, Nuxia congesta, Helichrysum citrispinum* and *Prunus africana* where the top ten plant species counted as sapling in Gamataja community forest respectively. The rest *Prunus africana, Vernonia amygdalina, Erica arborea, Ritchiea albersii, Hypericum revolutum, Podocarpus falcatus* were the list plant species counted as sapling respectively. Totally in 31sampled plots lied down in the study area which accounts about 1.24hac, there were 2351sapling plant species counted in Gamataja community forest.Table 2. Sapling of woody plant species in Gamataja community forest

No	Species Name	Family name	Counted number
1	*Juniperus procera*	Cupressaceae	650
2	*Olea europaea* subsp *cuspidiata*	Oleaceae	338
3	*Discopodiumpenninervum*	Solanaceae	188
4	*Maytenus arbutifolia*	Celastraceae	444
5	*Nuxia congesta*	Loganiaceae	112
6	*Myrsine Africana*	Myrsinaceae	116
7	*Maesa lanceolata*	Myrsinaceae	198
8	*Prunus Africana*	Rosaceae	46
9	*Dovyalis abyssinica*	Flacourtiaceae	124
10	*Helichrysum citrispinum*	Asteraceae	74
11	*Ritchiea albersii*	Capparidaceae	8
12	*Vernonia amygdalina*	Asteraceae	28
13	*Hypericum revolutum*	Guttiferae	7
14	*Erica arborea*	Ericaceae	12
15	*Podocarpus falcatus*	Podocarpaceae	6
	Total		**2351**

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The number of tree species is summarized in table 3. below. Accordingly *Juniperus procera, Olea europaea, Maytenus arbutifolia, Maesa lanceolata, Dovyalis abyssinica, Discopodium penninervum, Helichrysum citrispinum ,Myrsine Africana, Hypericum revolutum, Podocarpus falcatus, Nuxia congesta, Prunus africana,Vernonia amygdalaina* where the matured woody plant species counted within 31 plot of the study area.Out of this *Juniperus procera, Olea europaea* subsp *cuspidiata, Maytenus arbutifolia. Maesa lanceolata, Dovyalis abyssinica* were the top five dominant tree species counted in the study area and *Crotalaria agatiflora subsp.erlanrgeri, Solanum incanum, Rosa abyssincia* were also observed shrub tree species in thestudyarea.

Table 3. Tree and shrubs counted in Gamataja community forest

No	Species Name	Family name	Counted number
	Trees		
1	*Juniperus procera*	Cupressaceae	960
2	*Olea europaea* subsp *cuspidiata*	Oleaceae	590
3	*Discopodium penninervum*	Solanaceae	50
4	*Maytenus arbutifolia*	Celastraceae	342
5	*Nuxia congesta*	Loganiaceae	24
6	*Myrsine Africana*	Myrsinaceae	22
7	*Maesa lanceolata*	Myrsinaceae	102
8	*Prunus Africana*	Polypodiaceae	10
9	*Dovyalis abyssinica*	Flacourtiacceae	52
10	*Helichrysum citrispinum*	Asteraceae	22
11	*Vernonia amygdalaina*	Asteraceae	24
12	*Hypericum revolutum*	Guttiferae	14
13	*Podocarpus falcatus*	Podocarpaceae	28
	Shrubs		
14	*Solanum incanum*	Solanaceae	40
15	*Crotalaria agatiflora* Subsp *erlangeri*	Fabaceae	92
16	*Rosa abyssincia*	Rosaceae	40
	Total		**2412**

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When comparing the number of sapling, seedlings and mature trees and shrubs counted in the study plot in the study area, the matured tree was more abundant than the seedlings and the sapling were larger than the seedlings shown in Figure 2.

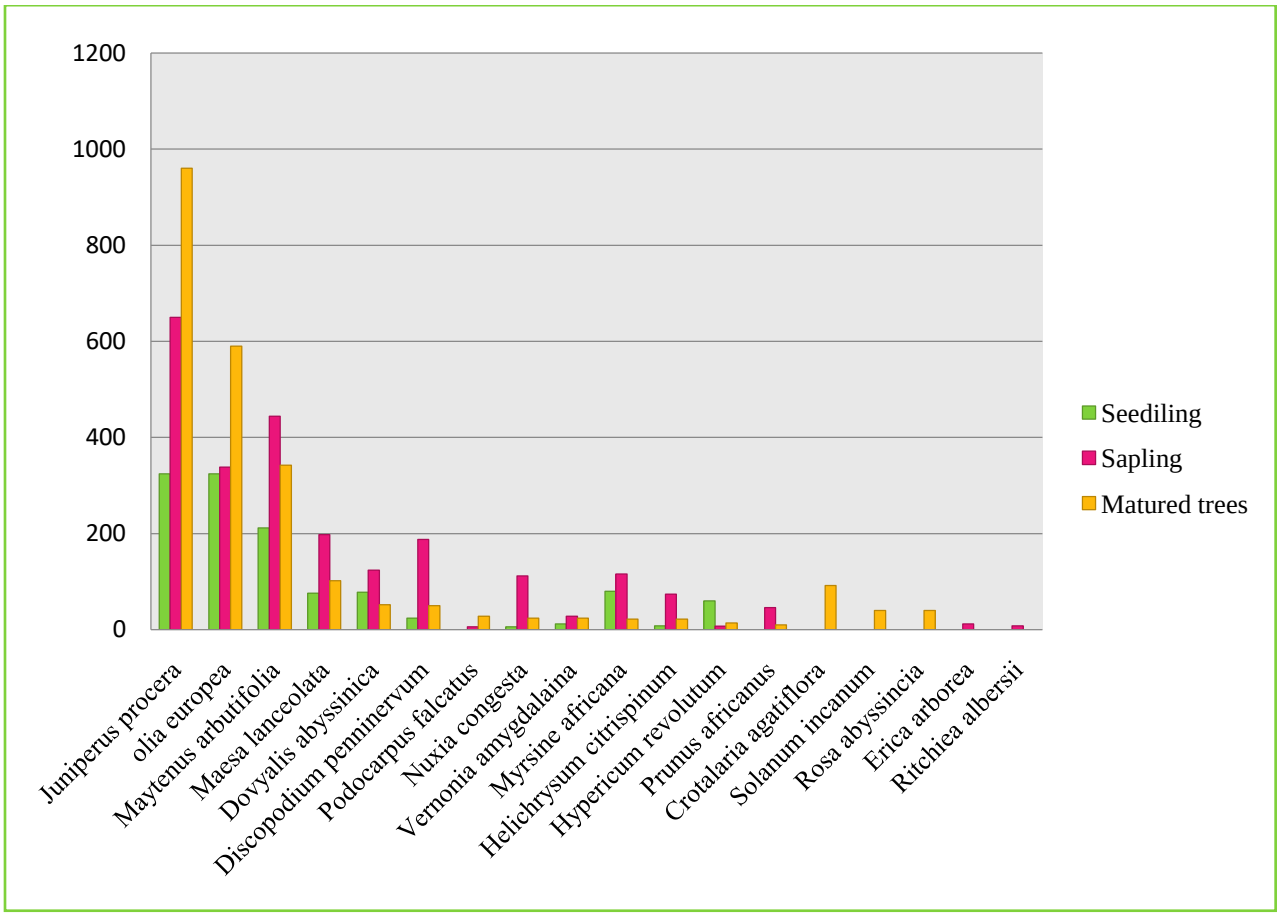

Figure 2. Seedling, Sapling and Matured trees in Gamataja community forest

The seedling, sapling and matured trees of Gamatja community forests were identified. Based on that *Juniperus procera, Olea europaea, Maytenus arbutifolia, Maesa lanceolata, Dovyalis abyssinia, Myrsine Africana* had better seedling stage as compared to the others. But it cannot be catagorized into good, fair, poor regeneration status. *Discopodium penninervu, Podocarpus falcatus, Nuxia congesta, Helichrysum citrispinum* had list number of seedling. The rest *Crotalaria agatiflora* subsp. *erlangeri, Solanum incanum, Rosa abyssincia* were the plant species with non-regeneration status. *Erica arborea, and Ritchiea albersii* were the plant species with

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new regeneration status in the study area. *Podocarpus falcatus*, *Prunus africanus* were the plant species with poor regeneration status.

Table 4. The seedling, sapling and matured trees of Gamataja community forest

No	Species Name	Family name	Seedling	Sapling	Matured tree and shrubs
	Trees				
1	*Juniperus procera*	Cupressaceae	324	650	960
2	*Olea europaea* subsp *cuspidiata*	Oleaceae	324	338	590
3	*Maytenus arbutifolia*	Celastraceae	212	444	342
4	*Maesa lanceolata*	Myrsinaceae	76	198	102
5	*Doveyalis abyssinica*	Flacourtiacceae	78	124	52
6	*Discopodium penninervu*	Solanaceae	24	188	50
7	*Podocarpus falcatus*	Podocarpaceae	-	6	28
8	*Nuxia congesta*	Loganiaceae	6	112	24
9	*Vernonia amygdalaina*	Asteraceae	12	28	24
10	*Myrsine Africana*	Myrsinaceae	80	116	22
11	*Helichrysum citrispinum*	Asteraceae	8	74	22
12	*Hypericum revolutum*	Guttiferae	60	7	14
13	*Prunus africanum*	Polypodiaceae	-	46	10
	Shrubs				
14	*Crotalaria agatiflora* subsp. *Erlangeri*	Fabaceae	-	-	92
15	*Solanum incanum*	Solanaceae	-	-	40
16	*Rosa abyssincia*	Rosaceae	-	-	40
17	*Erica arborea*	Ericaceae		12	-
18	*Ritchiea albersii*	Capparidaceae	-	8	-
	Total		**1204**	**2351**	**2412**

Composition, distribution and density of seedlings and saplings would indicate the status of the regeneration of the forest. The sustainability of natural forests depends on the regeneration capacity of each species in the forest and the sustainability of each species, in turn, depends on the sustainability of each individual woody plant. One of the major factors used to assess their

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conservation status is the regeneration or recruitment status of woody species (Taye Bekele *et al.*, 2003).

From the seedlings and sapling data 11 woody species (20.2%) representing 9 families were recorded for seedling and 15 woody species (39.4%) representing 13 families were recorded for sapling. The rest 13 woody species (37.54%) representing 11 families were recorded as trees and three woody species 172 (2.88%) representing 3 families were recorded as trees and shrubs respectively. The total density of the forest was 4812.2ha^{-1}. The analysis of woody plant species in the forest shows that the densities of seedling, sapling and trees were 970.97ha^{-1}, 1895.97 ha^{-1}, and 1945.2ha^{-1} respectively. In addition, in 11 species 9 families 1204(20.2%) tree seedling and in 15 woody species representing 13 families 2331(39.1%) tree sapling and 20(0.34%) were recorded as shrub sapling. The rest in 13 woody species representing 11 families (40.22%) tree seedling and in 3 woody species representing 3 families 172(2.88%) tree shrubs were recorded.

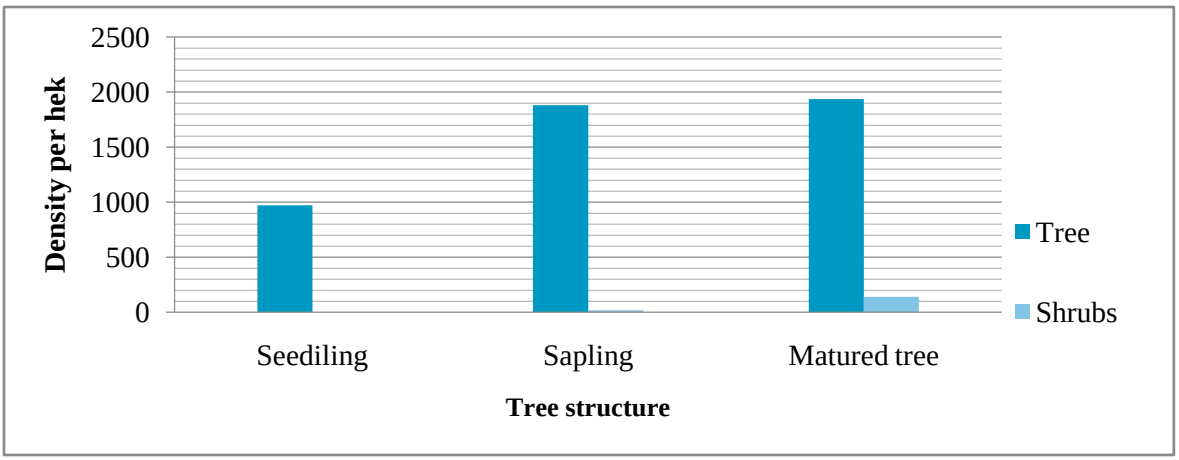

Figure 3. Distribution of seedling, sapling and mature woody plant species

Diameter class distribution

The distribution of trees/shrubs was categorized in to six DBH class. Class- I 10-20cm, class-II 20.1cm-50cm, class-III 50.1-80cm, class-IV 80.1-110cm, class-V110.1-140cm and class-VI>140cm. The total DBH measured matured tree/shrubs species were 2412 individual per hectare. The number of trees/shrubs in DBH class-I were 1648(68.33%), in class- II, were 423(17.54%), in class-III, were 198(8.21%), in class-IV were 68(2.82%). In class-V were 48(1.99%) and in class-VI were 27(1.12%) individual per hectare. This shows that the number of Individuals decrease as the DBH class of the individual increases.

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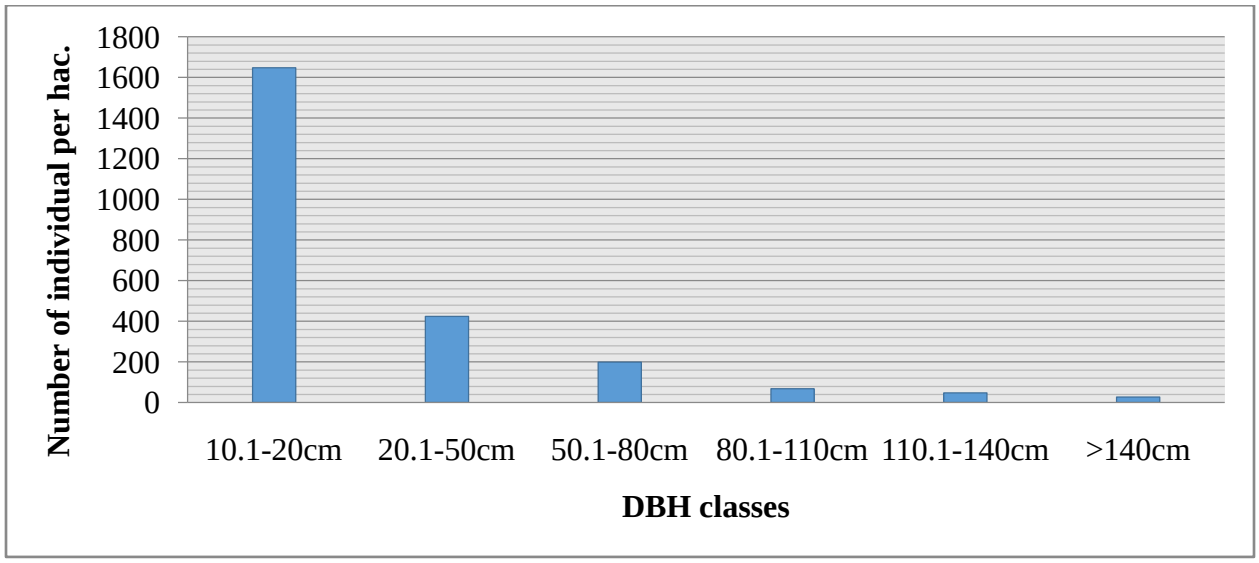

Figure 4. The diameter Class distribution of matured trees/shrubs in Gamataja community forest

The above standing vegetation regeneration status of all tree species and shrubs revealed the following general pattern of distribution categories. Pattern represented by *Podocurpus falcatus and Prunus africana* **(Figure 5a)**: This pattern of distribution shows a higher number of saplings than a matured tree but no seedling stage. The matured tree might be greater than or less than or equal to sapling. This pattern of distribution indicates poor regeneration status.

Pattern represented *Solanum incanum* **(Figure 5b):** This pattern has no seedlings and saplings, which substitute the mother tree. It also is true for *Crotalaria agatiflora*and *Roza abysinica*As shown in Figure 7b, plants of this pattern are poor in reproduction and recruitment potential since there is no more juvenile representation.

Pattern represented by *Juniperus procera* **(Figure 5c):** A maximum number of mature mother plants than saplings and lower number of seedlings characterize this pattern. This shows a J-shape regeneration pattern with higher recruitment than regeneration. Other tree species included in this pattern of regeneration is *Olea europaea* subsp *cuspidiata.*

Pattern represented by*Discopodium penninervum* **(Figure 5d):** This regeneration pattern is represented by a Gaussian type of distribution (Tagesse Wanaro, 2005), which satisfy more number of saplings than seedlings of the same species. Representative plant species, which suit this pattern of distribution, are*Maytenus arbutifolia,Nuxia congesta, Myrsine Africana, Doveyalis abyssinica, Helichrysum citrispinum,Vernonia amygdalaina,Maesa lanceolata,Prunus africanus*In this pattern, either the mother plant or the seedlings remain fewer than the saplings.

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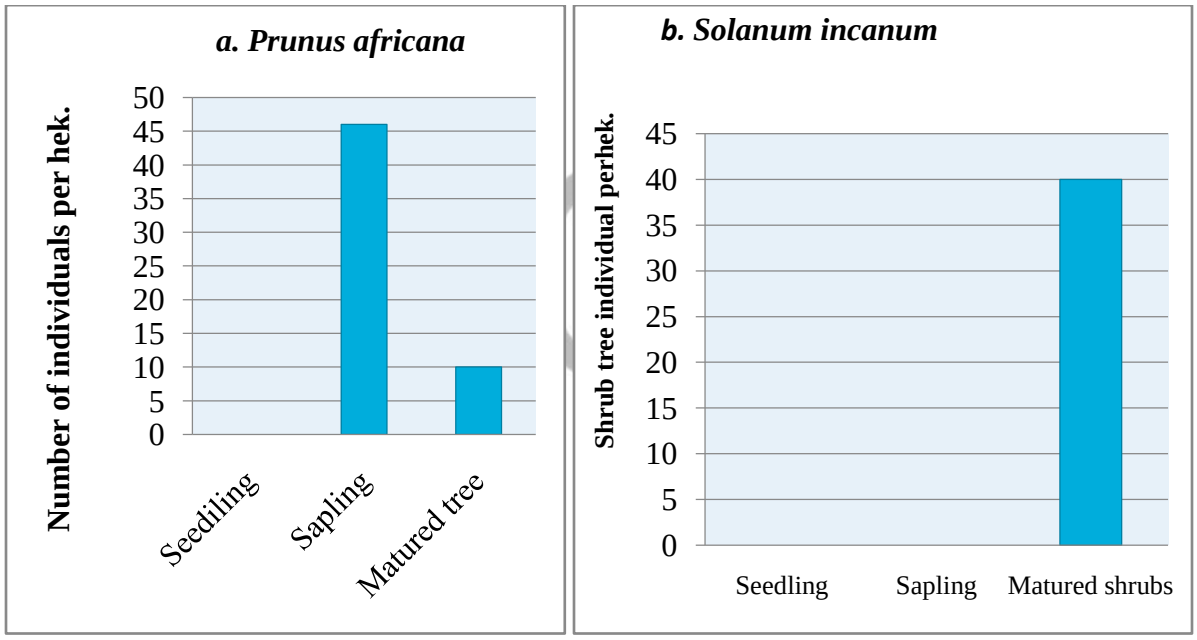
Pattern represented by *Hypericum revolutum* **(Figure 5e):** This pattern of distribution has maximum number of seedlings and mother plants (adult) than saplings. The figure forms a curve facing upward (U-curve) which shows a small number of saplings in relation to seedlings and mature woody plant species in the study area. It is the only member in this pattern of regeneration in the forest.

Pattern represented by *Erica arborea* (**figure 5f**): This pattern of distribution has only sapling stage with no mature trees and seedling. This type of distribution can be represented by plant species with new regeneration status in the study area. Other plant species that can be categorized under this category is *Ritchia albersi*.



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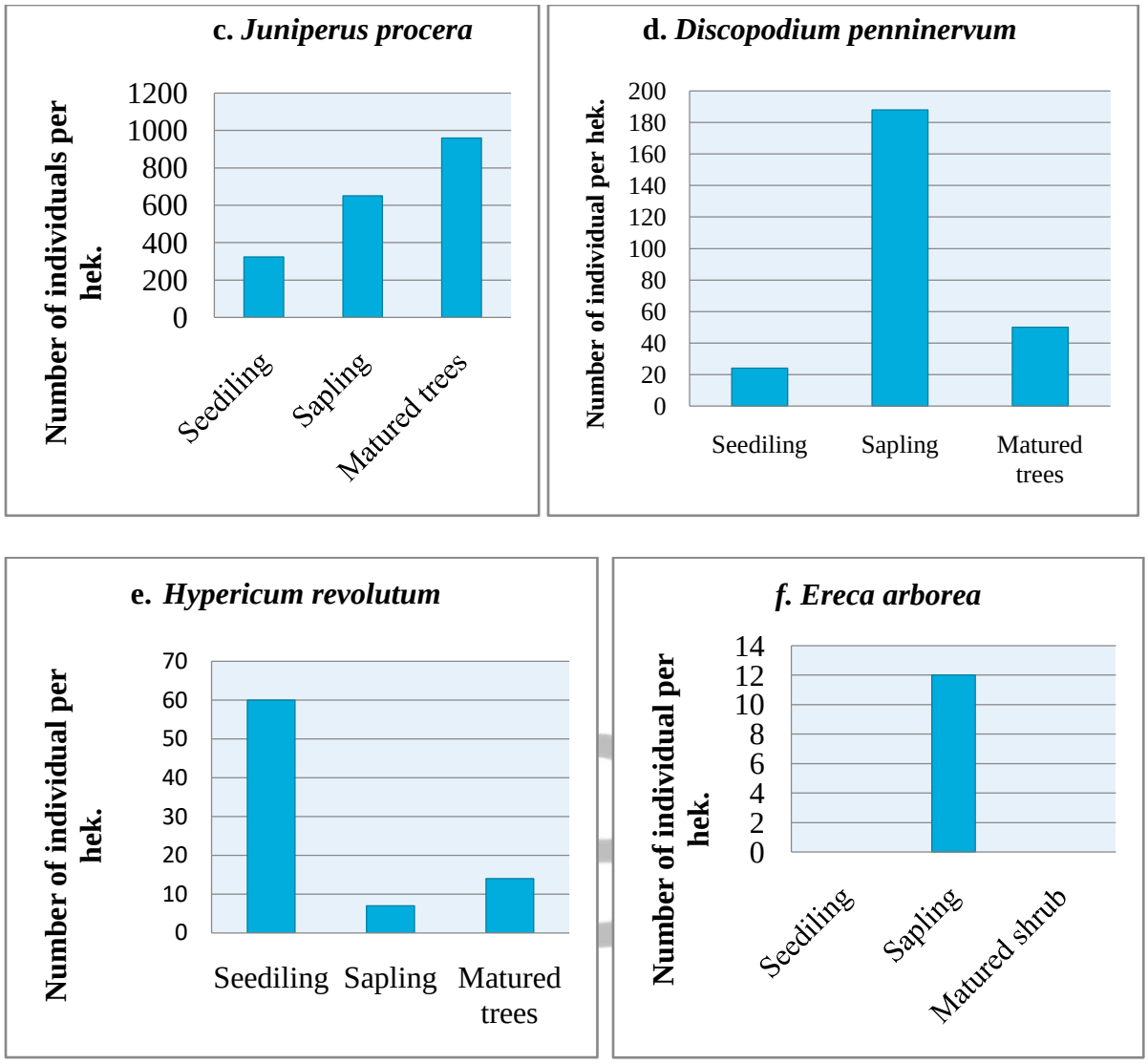

Figure 5 (a-f) Seedlings, saplings and woody plant species distribution of plant species in Gamataja community Forest.

4. DISCUSSION

4.1. Woody plant Regeneration status of Gamataja community forest

Assessment of the regeneration status of plant communities has a paramount importance for sustainable conservation and management (Khumbongmayum *et al.,* 2006). When we consider the regeneration status of woody plant of the Gamataja community forest of the total plant counted across 31 plots of the study area were 2351 or 39.4% of total counted tree species were sapling, 1204 (20.04%) plant species were seedling and 2412 (40.82%) plants were at mature

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tree stage. Therefore in the Gamataja community forest the number of mature tree and shrubs were greater than sapling and sapling were greater than seedling. This shows that the community forest is facing series conservation challenges as overgrazing, deforestation. Study by Wolde Mekuria and Mastewal Yami (2013) shows that in communal grazing lands, the low aboveground standing biomass, richness and diversity of plant species is a result of free grazing practices and human interference, resulting in severe overgrazing, which affects regeneration and growth of plant species negatively.

In the Gamataja community forest *Podocurpus falcatus and Prunus africana* shows a higher number of saplings than a matured tree but no seedling stage. The matured tree might be greater than or less than or equal to sapling. This pattern of distribution indicates poor regeneration status. This may be due to selective cutting of mature individuals for different purposes as firewood collection, feed for cattle and fences. Plants as Solanum *incanum, Crotalaria agatiflora* and *Roza abysinica* do not have seedling and sapling, but they appeared on maturing shrub stages representing poor in reproduction and recruitment potential. According to Bekele Taye *et al*. (2002), a tree species with no seedling and sapling in natural vegetation is under risky condition and it is suggested that these species are under threat of local extinction

Juniperus procera, Olea europaea subsp *cuspidiata* Maximum number of mature plants than sapling and a sapling is higher than seedling stages. This pattern of distribution shows j-shape regeneration with higher recruitment than regeneration and this may be due to their requirement by local community for different purposes as timber production, firewood collection and free grazing and others. This made these tree species to produce insufficient seeds that give rise to seedling. Some germination of seeds due to few remnant mother trees, most of these seedlings were perishing off before reaching sapling and mature stages for various reasons including grazers and browsers pressure (Gamechu Teshome et al., 2015).

Plant species as *Maytenus arbutifolia, Nuxia congesta, Myrsine Africana, Dovyalis abyssinica, Helichrysum citrispinum,Vernonia amygdalaina,Maesa lanceolata,Prunus africanus* has a higher number of sapling than seedling and matured tree. This might be due plant protections at some times that allow the higher number of sapling plant than seedling and matured trees. Because, the regeneration status of a given natural vegetation is considered as good if sapling >

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seedling > matures (Khumbongmayum et al., 2006; Dhaulkhandi et al., 2008; Tiwari et al., 2010). *Hypericum revolutum* has maximum number of seedlings and mother plants (adult) than saplings. The figure forms a curve facing upward (U-curve) which shows a small number of saplings in relation to seedlings and mature woody plant species in the study area. It is the only member in this pattern of regeneration in the forest. This might be due to selective removal of the medium sized individuals. Unfavorable environmental conditions such as rocky land and poorly developed soil, and human disturbance (Hileab Zegeye *et al*. 2011). *Erica arborea and Ritchia albersi* have no seedling and matured tree shrubs this indicates as they are newly generated in the study area.

Junipers procera, Olea europaea subsp *cuspidata, Maytenus arbutifolia, Maesa lanceolata, Dovyalis abyssinica, Myrsine africana* had better seedling stage as compared to the others. But even if all of them had seedling stage there were list number of seedling as compared to sapling and matured tree stages. This may be due to inappropriate cutting of the forest as well as insufficient matured tree prodding plenty of seeds to give rise to seedling. *Discopodium penninervu*m, *,Nuxia congesta, Helichrysum citrispinum* had list number of seedling.

According to Wonde Mabrat (2015) stated that natural forest regeneration is the germination of native plants from seeds or propagates without human intervention, leading to self-sustaining plant populations. Regeneration of a species encompasses the production and dispersal of seeds, their germination and subsequently the growth of the juveniles until they reach maturity and start producing seeds themselves. This practice becomes successful in protecting degraded areas from external interference through enclosure is one of the mechanisms that facilitate natural regeneration. This is employed in situations where there are some trees left in the landscape to act as seed sources during secondary succession.

5. CONCLUSION

Concerning the age structure of Gamataja community forest the number of woody trees and shrubs was greater than Sapling and sapling was greater than seedling. When we consider the individual above ground tree species, *Crotalaria agatiflora* subsp. erlangeri, *Solanum incanum, Rosa abyssincia* were the plant species with non-regeneration status. *Erica arborea, Ritchiea*

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albersii was the plant species with new regeneration status. *Podocarpus falcatus, Prunus africana* were the plant species with poor regeneration status and the rest *Hypericum revolutum* had fair regeneration status. This shows that the community forest was affected by many conservation challenges and needs highest the conservation priority. In addition in Gamataja community forest there is no plant species that had good regeneration status this shows as the community forest faced high conservation challenges.

6. Reference

Arnold (2001). Twenty five years of Community Forestry. *Food and Agriculture Organization of the United Nations*. Rome 2001.

Bekele Taye, Getachew Berhan, Elias Taye, Matheos Ersado, Kumlachew Yeshitela,. 2002. Regeneration status of moist montane forests of Yayu Ethiopia: conservation, part I: Boginda, Bonga, Masha - Anderacha and forests.Walya 22, 45e60.

Bussmann RW, Swartzinski P, Worede A, Evangelista P. 2011. Plant use and disease perception in Odo-Bulu and Demaro, Bale Region, Ethiopia. Journal of Ethnobiology and Ethnomedicine 7:28–49.

Chauhan, D. S., Dhanai, C. S., Singh, B., Chauhan, S., Todaria, N. P., & Khalid, M. A. (2008). Regeneration and Tree Diversity in Natural and Planted Forests in a Terai-Bhabhar Forest in Katarniaghat Wildlife Sanctuary, India. Tropical Ecology, 49, 53-67.

Demel Teketay,. (2005). Seed and Regeneration Ecology in Dry Afromontane Forests of Ethiopia: I. Seed Production-Population Structures. Tropical Ecology, 46, 29-44.

Ensermu Kelbessa ., Sebsibe Demissew., Zarihun Woldu., & Edwards, S. (1992). Some Threatened Endemic Plants of Ethiopia. NAPRECA Monograph, 2, 35-55.

FAO. *1978.* Forestry for local community development. Forestry Paper 7. Rome.

Feyera Senbeta , Denich M. 2006. Effects of wild coffee management on species diversity in the Afromontane rainforests of Ethiopia. Forest Ecology and Management 232:68–74.

Gemechu Teshome, Teshome Soromessa, Ensermu Kelbessa, 2015. Structure and regeneration of Gendo moist montane forest, East Wellega Zone, Western Ethiopia. J. Environ. Earth Sci. 5, 15.

Getachew Tesfaye, Demel Teketay & Masresha Fetene,.(2002). Regeneration of 14 Tree Species in Harenna Forest, Southeast Ethiopia. Flora, 197, 461-474. https://doi.org/10.1078/0367-2530-1210063

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www.globalscientificjournal.com

Hileab Zegeye, Demel Teketay & Ensermu Kelbessa E (2011) Diversity and regeneration status of woody species in Tara Gedam and Abebaye forests, northwestern Ethiopia. *Journal of Forestry Research* 22(3): 315-328.

Khan, M. L., Rai, J. P. N., & Tripathi, R. S. (1987). Population Structure of Some Tree Species in Disturbed and Protected Subtropical Forests of Northeast India. Acta Oecologica Oecologia Applicata, 8, 247-255

Khumbongmayum, A.D., Khan, M.L., Tripathi, R.S., 2006. Biodiversity conservation in sacred groves of Manipur, northeast India: population structure and regeneration status of woody species. Biodivers. Conserv. 15, 2439e2456.

Peters, C. M. (1996). The Ecology and Management of Non-Timber Forest Resources (p. 322). Washington DC: World Bank Technical Paper. https://doi.org/10.1596/0-8213-3619-3

Shankar, U. (2001). A Case of High Tree Diversity Ina Sal (Shorea robusta)—Dominated Lowland Forest of Eastern Himalaya: Floristic Composition, Regeneration and Conservation. Current Science, 81, 776-786.

Susan Charnley and Melissa R. Poe (2014). Community Forestry in Theory and Practice: Where

AreWe Now?*Annu. Rev. Anthropol*. 2007. 36:301–36. Washington, USA.

Vivero, J. L., Ensermu Kelbessa & Sebsibe Demissew,. (2006). Progress on the Red List of Plants of Ethiopia and Eritrea: Conservation and Biogeography of Endemic Flowering

Wolde Mekuria and Mastewal Yami(2013). Changes in woody species composition following establishing enclosures on grazing lands. *African Journal of Environmental Science and Technology* Vol. 7(1), pp. 30-40, Addis aba Ethiopia, January 2013.

Wondie Mebrat. Natural Regeneration Practice in Degraded High Lands of Ethiopia Through Area Enclosure. *International Journal of Environmental Protection and Policy*. Vol. 3, No. 5, 2015, pp. Adis ababa Ethiopia.

Wunder S. 2001. Poverty alleviation and tropical forests—what scope for synergies? *World Dev*. 29(11):1817–33

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