RESEARCH ARTICLE

FLORISTIC COMPOSITION IN THE RANGELANDS OF GAMBELLA, SOUTHWESTERN ETHIOPIA.

Ketema Tilahun*, Lisanework Nigatu2, Solomon Mengistu3 and John Barnabas4.

1. Gambella University, Department of Animal Production and Health, Gambella P.O.Box 126, Ethiopia.
2. Haramaya University. Department of Plant Science, Dire Dawa, P.O.Box 138, Ethiopia.
3. Ethiopian Institute of Agricultural Research (EIAR), Holeta Agricultural Research Centre, Holeta, P.O.Box 31 Ethiopia.
4. Gambella University, Department of Plant Science, Gambella, P.O.Box 126 Ethiopia.

A research study was conducted in the rangelands of Nuer pastoral area, Gambella, with the objective of investigating the herbaceous and woody vegetation composition of the rangeland. The pastoral area was stratified by districts namely: Itang and Jikawo and each district is further divided into four major grazing types (communal grazing, seasonal grazing, river basins and less grazed). The result revealed a total of 42 grass species, 5 legume species, 3 sedges and 9 non-grass herbaceous species and 31 tree/shrub species in the districts. Hyparrhenia rufa dominated the less grazed areas of the two districts. In seasonally grazed areas of Itang and Jikawo districts, H. filipendula and H. hirta, respectively were dominated. Echinochloa species were dominant in communally grazed areas and river basins of both districts. Accacia and Grewia species were found to be common and Combretom species were observed in the districts. There were significant (p<0.05) differences among the major grazing areas in their woody vegetation density. In Itang, there were 379; 300 No/ha, in less and moderately grazed areas and <80 No/ha in the communal lands and river basins. While, in the stated grazing areas of Jikawo the density of trees/shrubs were: 408; 329 and <90 No/ha, respectively. Therefore, it can be concluded that the floristic composition of the communally grazed and river basins the rangelands have highly affected by over grazing and invasion of unwanted species. This situation should be reverted through employing proper grazing systems, rehabilitation and conservation.

Copy Right, IJAR, 2017. All rights reserved.
along the Baro River basin in the extreme western part of the country (Coppock, 1993). Most of these areas are below 1,500 m.a.s.l (EARO, 2000), characterized by arid and semi-arid agro-ecologies; experienced a relatively harsh environmental condition of unreliable, low and erratic rainfall with annual range of 200 to 700 mm, a regularly high temperature, between 15 and 50°C, and low human population density (Beruk, 2003; Alemayehu, 2004; PFE, 2004), varied markedly in terms of the number of plant growing days per year, forage production, common plant associations, livestock and human carrying capacities and incidences of important livestock diseases (Coppock, 1993).

The pastoral areas of Ethiopia have a rich resource potential (PFE, 2001) despite the fact that, the country has not yet benefited from these resources. This could be attributed to various constraints (Coppock, 1994). Of the immense constraints, livestock feed scarcity resulting from rangeland degradation and productivity deterioration is known to be the prime and common features of the pastoral areas. Moreover, the current condition of rangelands, their future prospect and the pastoral production systems do not seem favorable (PADS, 2004). For efficient and sustainable utilization of the highest livestock potential from rangeland resources, ultimately, it is invaluable to understand the available resource base. Like other pastoral areas of the Ethiopia, in Gambella Regional State (GRS), extensive pastoral production system is experienced, predominantly in areas where the Nuer Pastoral communities inhabit. According to GRS (2003), the Nuer pastoral communities subsist on the more arid area of the regional state, which is unsuited for crop production. The area consists of wide treeless grassy and seasonally flooded plains of the Itang, Jikawo and Akobo district. The communities are grouped on language and territorial grazing area and move back and forth with the seasonal flooding regime of the rivers.

Various range research and development works were conducted in the southern and eastern rangelands of Ethiopia (Coppock, 1993), in Borana by Ayana (1999), Oba (2001) and Gemedo-Dalle (2004), Middle Rift Valley by Russel (1984) and Amsalu (2000), part of the Somali region by Ahmed (2003), Belayenesh (2006) and Amaha (2006). However, in the Gambella Regional State in general and the Nuer pastoral areas in particular, research and development interventions have never been done. Moreover, there are little or no researches and documentations made regarding floristic composition in this rangelands. The study of floristic composition helps to build a mental picture of an area under investigation and also permit the comparison as well as the ultimate classification of different units of vegetation (Kershaw, 1973). It is, therefore, necessary to develop baseline scientific information on the currently available rangeland resources in terms of the herbaceous and woody species composition. This would help to suggest ecologically sound and socio-economically feasible development and management interventions towards sufficient and sustainable use of the rangeland resources. To this effect the study aimed at investigating the herbaceous and woody species composition of the rangeland vegetation cover.

**Materials and Methods:**

**Description of the Study Area:**

The study was conducted in the Gambella Regional State which is located in the southwest part of Ethiopia, situated in the lowlands of the Baro-Akobo River Basin between latitudes 6°22' and 8°30' N, and longitudes 33°10' and 35°50' E, and covers a total area of about 34,063 square kilometers (GRS, 2003). The regional state is characterized as mid, lowland and semi-desert agro-ecological zones. Itang and Jikawo districts are located in the semi-desert agro-ecological zone. Forests and woodlands are in existent except for some scattered bushes and shrubs, thus it is logical to defining the grassland as open grassland (GRS, 2003) with an extensive plain topographic feature (PADS, 2004). The annual rainfall and mean annual temperature in the Regional State are 1,247 mm and 34.37 °C, respectively (IAR, 1990). The rainfall regime is unimodal, referred to as the “Sudan Type”, occurs in the lowlands along the border with Sudan (Coppock, 1994). Poorly drained vertisol is the characteristic soil type of the grassland (GRS, 2003). The highest livestock population in Tropical Livestock Unit (TLU) is found in Jikawo district 156,168.5 (53%), followed by Akobo, 114,390.8 (39.3%). The lowest TLU in Gog, which is, 1,341.6 (0.5%) (PADS, 2004). The major breed is the Nuer (zebu) which is a very good performer in dairying and beef production provided proper management levels (GRS, 2003) and considered to have high tolerance to tse-tse challenges (Alemayehu, 2004). A vegetation survey was conducted in the two districts (Itang and Jikawo) (Figure 1), which are predominantly inhabited by the Nuer pastoral community.
Site Selection and Sampling Procedure:
The sampling method used was ‘Systematically Stratified Random Sampling Technique’ (ILCA, 1990). Accordingly, each district was stratified into four range sites namely: communal grazing, seasonal grazing, river basins and less grazed areas, which represent the major grazing areas of the pastoral community. As a benchmark, the relatively less grazed areas were used for comparison with other grazing areas in their representative districts. A total of 11 range sites (3 from each of less grazed, communally grazed and river basins and 2 from seasonal grazing areas) were selected from Itang district. For each grazing types, from Jikawo district (3 range sites with a total of 12) were selected. Each range site was further divided into three randomly selected sample sites. Four samples from each sample site were grouped using 0.5 m x 0.5 m quadrat. Using GPS channel 12; the altitude, longitude and latitude readings of each range site were determined and recorded. From a randomly established reference points, samples were taken by radiating 30m to four directions. The random selection reference point was made using line coordination, for communal grazing lands, less grazed lands and seasonally grazed areas. Samples from river basin were taken on the flat side of the river within the range of 100 - 400 m from the river bank on non-water logged area. The assessment was carried out late in the long rainy season 2006, when most of the grasses were flowered.

Vegetation Composition Assessment:
Herbaceous vegetation layer:
At each range site, within 0.5m x 0.5m (0.25 m²) sample quadrats, herbaceous vegetation were harvested at ground level. Then the cut samples were weighted and put into paper bags, securely fastened at the top and kept in cool place till sampling was over. Within 12 hours, the samples were transported to Gambella Research Center and then species composition was determined by hand separating into its component species. In the field, the identities of almost all species were recorded (using their vernacular name) in each quadrat with the help of the elder pastoralists. Some of the sample specimens were pressed, labeled, and transported to Ethiopian Institute of Agricultural Research (EIAR) at Debre-zeit and some others to the Herbarium of Haramaya University for further scientific identification. Vegetation samples from each site were classified into grasses, legumes, sedges and forbs thereafter into different species. According to the succession theory (Dykstehuris, 1949; Tainton, 1981) and based on the information aid to semi-arid South Africa (Ivy, 1969; Tainton, 1981), classification of grasses into desirable species likely to decrease with heavily grazing pressure (decreases), intermediate species likely to increase with heavy grazing pressure (increasers) and undesirable species likely to increase or invade with heavy grazing pressure (pioneers), was done. The opinion of pastoralists on vigor and palatability of a particular species was considered. The fresh and dry weights of each individual species were determined by using an electronic digital balance. DM of each species was
determined on dry weight basis dried in an oven at 60°C for 72 hours. Total herbaceous dry weight, dry weight of grasses, increasers, decreasers and invaders of the experimental unit were derived from the dry weight of each species in each sample.

**Woody vegetation layer:-**
In each range site, for woody vegetation (trees/shrubs) within 20 m x 20 m (400 m²) quadrats, only live woody plant species were recorded and identified as presented. To estimate the woody plants density per hectare, the number of individuals of each tree and shrub species was counted. All plant height was measured using calibrated aluminum poles of 2 and 4 meters. For species composition assessment, the criterion developed by Baars et al. (1997) was used. Accordingly, in each quadrat, the density of woody plants (trees/shrubs) was enumerated and an area with no trees/shrubs was given 0 point and that with more than 20 trees/shrubs scored 10 points.

**Statistical Analysis and Interpretation:-**
For the herbaceous vegetation assessment, from each range site composite samples of the four quadrates of 0.5 m x 0.5 m (0.25 m²) was considered as an experimental unit. The composite samples were sorted out by districts and major grazing types. Thereafter, the data was subjected to ANOVA. Accordingly, 33 samples fell in the Itang district and 36 in Jikawo (a total of 69 samples) were used for the analysis. For the woody vegetation, from each range site, 20 m x 20 m (400 m²) quadrat was used as an experimental unit. Accordingly, a total of 46 samples (22 from Itang and 24 from Jikawo) were used for data analysis. The data obtained from the vegetation variables were subjected to ANOVA using the GLM procedure of Statistical Analytical System (SAS) (1999) computer software. Duncan’s Multiple Range Test was used for mean comparison.

**Results and Discussion:-**
**Floristic composition in the rangelands of the Nuer pastoral area:-**
A total of 42 grass species, 5 legumes species, 3 sedges and 9 non-grass herbaceous species were identified from the study districts of Nuer pastoral area (Table 1 and Table 2). The dominant and common grass species identified include: Aristida micans, Brachiaria xantholeuca, Cenchrus mitis, Chloris gayana, Digitaria adscendens, Echinochloa colunum, Eriochloa procera, Echinochloa pyramidelis, Hyparrhania filipendula, Hyparrhania hirta, Hyparrhenia rufa, Pennisetum adoensis, Pennisetum clandestinum, Pennisetum glabrum and Setaria verticillata. Some grass species appeared in both districts and others fell within a particular district. Hyparrhenia rufa dominated the relatively less grazed areas of the two districts. Digitaria adscense and Pennisetum clandestinum dominated the relatively less grazed areas of Jikawo and Itang respectively. In seasonally (moderately) grazed areas of Itang and Jikawo district, Hyparrhenia filipendula and Hyparrhania hirta dominated. Echinochloa species were the dominant in communally grazed areas and river basins of both districts. In the heavily grazed river basins of Itang and Jikawo, Echinochloa procera, Echinochloa pyramidelis, Pennisetum glabrum and Setaria verticillata were dominants. In terms of the woody vegetation a total of 31 shrubs/tree species were identified from the study districts (Table 3). Accacia species such as Accacia hecatophylla, Accacia hockii, Accacia seyal and Accacia Senegal and Grewia species like Grewia mollis and Grewia tenax were common in the districts. From Combretom species, Combretom adenogoniun, Combretom collium and Combretom molle were observed. In line with the concept of RISC (1983), by which the potential community of a site is dominated by one or a few species, which are best adapted to the specific combination of environmental factors of the site.
**Table 1:** Grass species categories and their distribution in major grazing areas of the study districts

| Scientific name         | Desirability | Itang                  | District                  | Jikawo                  |
|-------------------------|--------------|------------------------|--------------------------|-------------------------|
|                         | L | G | S | G | C | G | R | B | L | G | S | G | C | G | R | B |
| Andropogon schirensis   | HD|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Aristida micans         | UD|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Brachiaria comata       | HD| P |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Brachiaria deflexa      | HD| P | P |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Brachiaria seminundulata| HD|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Brachiaria xantholeuca  | HD| C | C |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Cenchrus mitis          | HD|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Chloris gayana          | HD| P |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Cynodon dactylon        | LD|   | C |   | C |   |   |   | P |   |   |   | P |   |   | C |
| Digitaria adscendens    | HD| P |   |   |   | C |   | P |   |   |   |   |   |   |   |   |
| Digitaria nuda          | LD| P |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Digitaria ternata       | LD|   |   |   |   | P |   |   |   |   |   |   |   |   |   |   |
| Digitaria velutina      | UD| C |   | P |   |   |   |   |   |   |   |   |   |   |   |   |
| Echinochloa colonum     | LD| P | P | D | P | P | P | C | C |   |   |   |   |   |   |   |
| Echinochloa pyramidalis| LD| P |   |   | P | C | C |   |   |   |   |   |   |   |   |   |
| Echinochloa stagnina    | LD|   |   | P |   |   |   |   |   |   |   |   |   |   |   |   |
| Eragrostis multiploosa  | LD| P | C |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Eragrostis pilosa       | HD| P |   |   | C |   |   |   |   |   |   |   |   |   |   |   |
| Eragrostis tremula      | UD| C |   | C |   | C |   |   |   |   |   |   |   |   |   |   |
| Eleusina africana       | LD|   |   |   | P |   |   |   |   |   |   |   |   |   |   |   |
| Eleusina indica         | UD| C | P | C | P |   |   |   |   |   |   |   |   |   |   |   |
| Eleusina jaegeri        | LD| P | P | C | P | P | C | P |   |   |   |   |   |   |   |   |
| Eleusina multiflora     | LD| P | C |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Eriochloa nubica        | LD| C |   | C |   | P |   |   |   |   |   |   |   |   |   |   |
| Eriochloa prochera      | LD| P |   | P | P | P | P | D | C |   |   |   |   |   |   |   |
| Hyparrhenia filipendula| LD| C | D |   |   | P | P |   |   |   |   |   |   |   |   |   |
| Hyparrhenia hirta       | LD| P |   |   | P | D |   |   |   |   |   |   |   |   |   |   |
| Hyparrhenia rafa        | LD| D | P |   | D |   |   |   |   |   |   |   |   |   |   |   |
| Linotonia nutans        | LD| P | C |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Loudetia simplex       | LD|   | P |   | P |   |   |   |   |   |   |   |   |   |   |   |
| Oryza barthi            | HD| P |   |   | P | P |   |   |   |   |   |   |   |   |   |   |
| Panicum hochstetteri    | HD| C |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Panicum maximum         | HD|   |   | P |   |   |   |   |   |   |   |   |   |   |   |   |
| Pennisetum adoense      | HD| C | C |   | P |   |   |   |   |   |   |   |   |   |   |   |
| Pennisetum clandestinum| HD| P |   |   | D | P |   |   |   |   |   |   |   |   |   |   |
| Pennisetum glabrum      | UD| P | C | C | D |   |   |   |   |   |   |   |   |   |   |   |
| Pennisetum polystachyon| LD| P | C |   | P | P |   |   |   |   |   |   |   |   |   |   |
| Poa annua               | LD|   | P |   | P | P |   |   |   |   |   |   |   |   |   |   |
| Setaria verticillata    | UD| P |   | D | C | P |   |   |   |   |   |   |   |   |   |   |
| Tetrapogon villosa      | LD|   | P |   | P | P |   |   |   |   |   |   |   |   |   |   |
| Rhynchelytrium nervillum| LD| P |   | P | P |   |   |   |   |   |   |   |   |   |   |   |
| Rhynchelytrium repens   | LD|   | P |   | P | P |   |   |   |   |   |   |   |   |   |   |

HD= Highly desirable; LD=Less desirable; UD= Undesirable; LG= Less grazed; SG= Seasonally grazed; CG= Communally grazed; RB= River basins; D= Dominant (>20% of DM); C= Common (>5% and < 20% of DM); P= Present (<5% of DM).
Table 2: Non-grass herbaceous species identified in the study districts

| Group/Scientific name | Family |
|-----------------------|--------|
| **Legumes**           |        |
| Aeschynomenna abyssinica | Fabaceae |
| Crotolaria brevidens | Fabaceae |
| Crotolaria goreensis | Fabaceae |
| Crotolaria ochroleuca | Fabaceae |
| Desmodium dichotomum | Fabaceae |
| Indigofera preureana | Fabaceae |
| Tephrosia linaris    | Fabaceae |
| **Sedges**            |        |
| Cyperus eleusinoides | Cyperaceae |
| Cyperus esculentus   | Cyperaceae |
| Cyperus rotundus     | Cyperaceae |
| **Forbs**             |        |
| Cissus quadrangular  | Vitaceae    |
| Commelina spp.       | Commelinaceae |
| Convolvulus olitorius | Convolvulaceae |
| Convolvulus sagittatus | Convolvulaceae |
| Convolvulus siculus  | Convolvulaceae |
| Ericastrum arebicu   | Brassicaceae |
| Hygrophylla auricula | Acanthaceae |
| Ipomoea aquatic      | Commelinaceae |
| Ipomoea eriocarpa    | Commelinaceae |
| Ipomoea purpurea     | Commelinaceae |
| Leucas mollis        | Lamiaceae |
| Leonotis raineriana  | Labiatae |
| Ocimum basilicum     | Lamiaceae |
| Sida ovata           | Malvaceae |

Table 3: The woody vegetation identified in major grazing areas of the study districts

| Scientific name | Family     | Life form |
|-----------------|------------|-----------|
| Accacia hecatophylla | Fabaceae   | Tree |
| Accacia hockii   | Fabaceae   | Tree |
| Accacia senegal  | Fabaceae   | Tree |
| Accacia seyal    | Fabaceae   | Tree |
| Balanties aegyptica | Balanitaceae | Tree |
| Cadaba farinosa  | Cadinaceae | Tree |
| Combretom adenogonium | Combretaceae | Shrub |
| Combretom collium | Combretaceae | Shrub |
| Combretom molle   | Combretaceae | Shrub |
| Crateva adansoni  | Capparidaceae | Tree |
| Crotolaria bongenisis | Fabaceae | Shrub |
| Euphorbia abyssinica | Euphorbiaceae | Shrub |
| Ficus sur         | Moraceae   | Tree |
| Ficus sycomorus   | Moraceae   | Tree |
| Fuggea virosa     | Euphorbiaceae | Tree |
| Grewia mollis     | Tiliaceae  | Tree |
| Grewia tenax      | Tiliaceae  | Tree |
| Gutenbergia corditolia | Asteraceae | Shrub |
| Indigofera brevicalyx | Fabaceae | Shrub |
| Lannea welwitschii | Anacordiaceae | Tree |
| Scientific name              | Av. H (m) | Grazing areas across districts |
|-----------------------------|-----------|--------------------------------|
|                             | D    | %    | D    | %    | D    | %    | D    | %    | D    | %    | D    | %    |
| *Portulaca oleracea*        | 4.71 | 13   | 7.7  | 4    | 2.4  | 1    | 0.6  | 6    | 3.57 | 0    | 0.00 | 0    | 0.00 |
| *Pterocarpus lucens*        | 5.5  | 16   | 9.52 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Rhyynchosia malacaphylla*  | 5.13 | 18   | 9.06 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Sclerocarya birrea*        | 4.71 | 13   | 7.7  | 4    | 2.4  | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Senna septemtrinalis*      | 5.5  | 16   | 9.52 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Solanum nigrum*            | 5.5  | 16   | 9.52 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Tamarindus indica*         | 5.5  | 16   | 9.52 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Temanalia macropera*       | 5.5  | 16   | 9.52 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Ximenia americana*         | 5.5  | 16   | 9.52 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Ziziphus abyssinica*       | 5.5  | 16   | 9.52 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |
| *Ziziphus spinacrisztrichistri* | 5.5  | 16   | 9.52 | 8    | 4.76 | 1    | 0.60 | 1    | 0.60 | 11   | 6.55 | 16   | 9.52 |

**Table 4**: Average height (m), density (No./400m²) and percent coverage of the woody vegetation in major grazing areas of the study districts.

**Legend**
- **D**: Density of trees/shrubs (No./400m²)
- **%**

Av. H=Average height; ILG= Less grazed area of Itang; ISG= Seasonally grazed area of Itang; ICG= Communally grazed area of Itang; IRB= River basins of Itang; JLG= Less grazed area of Jikawo; JSG= Seasonally grazed area of Jikawo; JCG= Communally grazed area of Jokawo; JRB= River basins of Jikawo; D= Density of trees/shrubs (No./400m²).
Floristic composition of the herbaceous vegetation layer:-
A total of 35, 2, 2, and 6 species of grasses, legumes, sedges and non-grass herbaceous vegetation were identified in Itang district of the Nuer pastoral area (Table 1 and Table 2). Of the herbaceous species composition in the district, the grass species consisted 89.8% with the categories decreasers (highly desirable), increasers (moderately desirable) and invaders (less desirable) accounting 33.4, 48.8 and 17.8% of the total grass species composition, respectively (Table 1). In Jikawo district, a total of 40, 3, 5 and 9 species of grasses, legumes, sedges and other non-grass herbaceous vegetation were identified (Table 1 and Table 2). Out of the total herbaceous species identified in the district, 87.8% were grasses, of which 23.3, 51.3 and 25.4% were within the categories of decreasers, increasers and invaders, respectively (Table 2). The higher proportion of palatable species (decreasers and increasers) in the two districts was due to the dominance of Hyparrhenia species in the relatively less and moderately grazed areas. The same study conducted in the mid rift valley by Amsalu (2000) indicated that due to the influence of high proportion of Hyparrhenia species in the enclosure and seasonally grazed areas increasers constituted the highest composition (56%), of the total grasses. Moreover, this report agreed with the concept of Tainton (1981); accordingly under low grazing pressure, and good rainfall, different vegetation of the same species vary in their ability to extract their requirements from the environment. Furthermore, Amsalu (2000) stated that, in the competitive struggle for light, some plant species like Hyparrhenia, might be physiologically or morphologically better suited to intercept sufficient light to meet their requirements than others.

Table 5: Dominant and common grass species in the study districts

| Grazing areas | Districts | Itang | Jikawo |
|---------------|-----------|-------|--------|
|               | Scientific name | % DM | Scientific name | % DM |
| LG            | Andropogon schirensis | 5.51 | Eragrostis pillosa | 6.99 |
|               | Aristida micans | 6.20 | Eragrostis tremula | 12.00 |
|               | Brachiaria xantheoleuca | 5.27 | Digitaria adscendense | 10.64 |
|               | Eleusina indica | 5.90 | Hyparrhenia rufa | 35.92 |
|               | Hyparrhenia filipendula | 7.53 | Pennisetum clandestinum | 23.50 |
|               | Hyparrhenia rufa | 31.13 | Pennisetum glabrum | 6.35 |
|               | Panicum hochstetteri | 5.22 | Tetropogon villosa | 5.47 |
|               | Pennisetum adoense | 23.00 | Chenchrus mitis | 12.70 |
| SG            | Brachiaria xantheoleuca | 7.27 | Chloris gayana | 8.92 |
|               | Cynodon dactylon | 10.38 | Eragrostis tremula | 10.43 |
|               | Eragrostis tremula | 9.62 | Hyparrhenia hirta | 23.69 |
|               | Eleusina multiflora | 5.90 | Oryza barthi | 14.00 |
|               | Hyparrhenia filipendula | 27.24 | Rhynchelytrium repense | 7.49 |
|               | Pennisetum adoense | 15.20 | Setaria verticillata | 8.30 |
|               | Pennisetum polystachyon | 5.19 | Chenchrus mitis | 12.70 |
| CG            | Echinochloa column | 25.33 | Echinochloa pyramidelis | 7.50 |
|               | Eleusina indica | 16.85 | Eleusina jaegeri | 9.85 |
|               | Eragrostis multiplosa | 13.57 | Eragrostis tremula | 16.94 |
|               | Eriochloa nubica | 11.41 | Eriochloa procera | 45.21 |
|               | Lintonia nutans | 8.63 | Pennisetum glabrum | 7.11 |
| RB            | Cynodon dactylon | 9.04 | Cynodon dactylon | 8.14 |
|               | Echinochloa pyramidelis | 37.00 | Echinochloa pyramidelis | 15.10 |
|               | Eleusina jaegeri | 13.80 | Eriochloa procera | 9.52 |
|               | Pennisetum glabrum | 25.09 | Pennisetum glabrum | 30.00 |
|               | Setaria verticillata | 16.55 | Setaria verticillata | 22.50 |

LG= Less grazed; SG = Seasonally grazed; CG = Communally grazed; RB = River basins; Dominant (> 20% of DM); Common (<5% and > 20% of DM)
Indicators of heavy grazing such as *Pennisetum glabrum* and *Setaria verticillata* were the dominant grass species in the river basins of the districts while in the communally grazed areas of Itang. *Eleusine indica* and that of Jikawo, *Eragrostis tef* and *Pennisetum glabrum*, were common (Table 1). In the heavily grazed areas, relatively highly desirable grass species such as *Cenchrus mitis*, *Chloris gayana*, *Brachiaria semiundulata* and *Pennisetum* species were non-existent. On the other hand, these desirable species were observed and common in the less grazed and seasonally grazed areas. This vegetation community change would be attributed due to the high intensity of grazing pressure in the communally grazed and river banks. In agreement with Amsalu (2000), Amsalu and Baars (2002), Abule et al. (2005), who stated that as grazing intensity increases, the herbaceous layer changes from highly to less palatable species.

**Floristic composition of woody vegetation layer:-**
A total of 21 and 25 tree/shrub species were identified in Itang and Jikawo district, respectively. The woody vegetation layer in Itang district, composed of mainly *Accacia* species like *Accacia hecatophylla*, *Accacia hockii*; *Balanties aegyptica*; *Grewia* species such as *Grewia mollis* and *Grewia tenax*; and from *Ziziphus* species, *Ziziphus abyssinica* and *Ziziphus spinachristhrti*. While *Accacia* species mainly *Accacia hockii* and *Accacia seyal*; *Cadaba farinosa*; *Combretom species*; and *Ziziphus spinachristhrti* were constituted in the woody vegetation layer of Jikawo. The species composition of trees/shrubs of the major grazing areas in both district were with significantly (p<0.05) highest score in less grazed areas followed by moderately grazed. The river basins and communally grazed areas showed no significant difference in their woody vegetation species composition score (Table 6).

There were significant (p<0.05) differences among the major grazing areas of the districts in terms of woody vegetation density. In Itang district, the trees/shrubs density of lass grazed and moderately grazed areas were: 379 and 300 No/ha, respectively. In the stated grazing areas of Jikawo district, the density of woody vegetation were 408 and 329 No/ha, respectively. At the periphery of the open grasslands in communally grazed and river basins, the woody vegetation density recorded were significantly (p<0.05) the least with < 92 No/ha (Table 6). However, the overall woody vegetation density was not beyond the equilibrium (40% cover), according to the assumption by Roques et al. (2001), to have an imp...

**Table 6:-** LSM ±SE of woody vegetation species composition and density (No./ha) in the study districts

| Grazing areas | Distritcs | Itang | Jikawo |
|---------------|-----------|-------|--------|
|               | WSC | WD (No./ha) | WSC | WD (No./ha) |
| LG            | 6.83±0.17<sup>a</sup> | 379.17±10.48<sup>b</sup> | 7.50±0.32<sup>c</sup> | 408.33±17.72<sup>c</sup> |
| SG            | 4.75±0.21<sup>a</sup> | 300.00±12.84<sup>b</sup> | 6.17±0.32<sup>c</sup> | 329.17±17.72<sup>c</sup> |
| CG            | 0.50±0.17<sup>a</sup> | 33.33±10.48<sup>c</sup> | 0.67±0.32<sup>c</sup> | 45.83±17.72<sup>c</sup> |
| RB            | 1.00±0.17<sup>a</sup> | 79.17±10.48<sup>b</sup> | 1.17±0.32<sup>c</sup> | 91.67±17.72<sup>c</sup> |
| CV            | 13.20   | 13.62  | 20.40  | 19.85   |
| CR            | 0.53    | 33.05  | 0.95   | 52.29   |

WSC = Woody species composition; WD = Woody vegetation density; LG= Less grazed; SG = Seasonally grazed; CG = Communally grazed; RB = River basins; CV = Coefficient of variation; CR = Critical range; Means with different letters in a row are significantly different (p<0.05).

**Conclusions:-**
The present findings clearly demonstrated the floristic composition of the rangeland particularly those of communally grazed and river basins that have highly affected by over grazing and invasion of unwanted species. The grazing areas have been over grazed due to overstocking. This situation has been a threat for the livelihood of the pastoral community in the districts and should be reverted through employing proper grazing systems (grassland management practices), rehabilitation and conservation. The floristic composition analysis in this study was based on a single season data where such parameters could be influenced by both spatial and temporal variations. Therefore, further studies need to be carried out on the basis of different deriving factors so as to finally produce unbiased information on the range resources and potentials.
Acknowledgements:-
The authors are grateful the Federal Agricultural ATVET and Extension Department of Ministry of Agriculture (MoA) for funding the research project. The supports of Haramaya University, Gambella Peoples Regional State Council, Gambella Region Bureau of Agriculture and Rural Development, Gambella Agricultural Research Institute and Gambella ATVET College are also acknowledged. The authors would like to extend their appreciation to the contributions of Nuer pastoralists.

References:-
1. Abule E, Snyman, HA, Smit, GN (2005). Comparisons of pastoralists perceptions about rangeland resource utilization in the middle Awash valley of Ethiopia. J. Environ. Manage., 75: 21-35.
2. Ahmed B (2003). Soil condition and vegetation cover in human impacted rangelands of Jijiga, Somali Regional State. M.Sc. Thesis, Alemaya University, Ethiopia.
3. Alemayehu M (2004). Rangeland Biodiversity: Concepts, Approaches and the way forward. Addis Ababa University, Faculty of Science, Addis Ababa, Ethiopia. 80p.
4. Amaha K (2006). Characterization of rangeland resources and dynamics of the pastoral Production system in the Somali region of Eastern Ethiopia. Ph.D. Thesis, The Free State University, Bloemfontein, South Africa.
5. Amsalu S (2000). Herbaceous species composition, dry matter production and condition of the major grazing areas in the mid rift valley, M.Sc. Thesis, Alemaya University, Ethiopia.
6. Amsalu S, Baars R.MT (2002). Grass composition and rangeland condition of the major grazing areas in the mid rift valley, Ethiopia. Afr. J. Range & Forage Sci., 9:161-166.
7. Ayana A (1999). Range condition and traditional grazing management in Borana. M.Sc. Thesis, Alemaya University, Ethiopia.
8. Baars RMT, Chileshe EC, Kalokoni DM (1997). Technical note: range condition in cattle density areas in the western province of Zambia. Tropical Grassland, 31: 569-573.
9. Belaynesh D (2006). Floristic composition and diversity of the vegetation, soil seed bank flora and condition of the rangelands of the Jijiga Zone, Somali Regional State, Ethiopia. M.Sc. Thesis, Alemaya University, Ethiopia.
10. Beruk Y (2003). The declining pastoral environment and variability status and adaptation strategies. Pp. 155-164. Proceedings of the Challenges and Opportunities of Livestock Marketing, The 10th Annual conference of Ethiopia Society of Animal Production, Addis Ababa, Ethiopia, 22-24 August 2003.
11. Blench R, Sommer F (1999). Understanding Rangeland Biodiversity. ODI (Overseas Development Institute), Portland house, stage plane, London. Working paper 121.
12. BLPDP (Borana Lowland Pastoral Development Programme) (2004). Overview of Borana Pastoral Production Livelihood System. Extension-, PRA- and M+E- Concepts Networking and Policy Advocacy. BLPDP, Documentation on 7 years experience, Vol. I. December, 2004. Addis Ababa, Ethiopia.
13. Coppock DL (1993). Vegetation and pastoral dynamics in the southern Ethiopia rangelands: Implications for theory and management. Pp.42-61. In: Behnke RHJ, Scoones I, Kerven C (eds.). Range ecology at disequilibrium. New model of natural variability and pastoral adaptation in African Savanna. Overseas Development Institute, London, UK.
14. Coppock DL (1994). The Borana Plateau of Southern Ethiopia: Synthesis of pastoral research, development and change, 1980-1991. International Livestock Center for Africa (ILCA), Addis Ababa, Ethiopia. 393p.
15. Dyksterhuis EJ (1949). Condition and management of rangeland based on quantitative ecology. J. Range Manage., 2:104-115.
16. EARO (Ethiopia Agricultural Research Organization) (2000). Dry land Agriculture Research Strategic Planning Document. Addis Ababa, Ethiopia. 66p.
17. Friedel MH, Laycock WA, Basin GN (2000). Assessing rangeland condition and trend. Pp. 227-261. In: Mannetje LT, Jones RM (eds.). Field Laboratory Methods for Grassland and Animal Production Research. CABI, UK.
18. Gemedo-Dalle T (2004). Vegetation ecology, rangeland condition and forage resources evaluation in the Borana lowlands, Southern Ethiopia. Ph.D. Dissertation, Georg-August University, Gottingen, Germany.
19. GRS (Gambella Regional State) (2003). Gambella Regional Land-use and Land Allotment Study. Amended Draft Final Report, Vol. II. Yeshi-Ber Consult (YBC), October 2003, Addis Ababa, Ethiopia.
20. IAR (Institute of Agricultural Research) (1990). Abobo Research Center Progress Report 1988-1989. IAR, Addis Ababa, Ethiopia.
21. ILCA (International Livestock Center for Africa) (1990). Livestock Research Manual. ILCA, Addis Ababa, Ethiopia. 2:31-54.
22. **Ivy P (1969).** Veld Condition Assessments. Pp. 105-111. Proceedings of Veld Management Conference. Bulawayo, Zimbabwe, 27-31 May 1969.

23. **Kershaw KA (1973).** Quantitative and Dynamic Plant Ecology. (2nd ed.). Edward Arnold Publishers LTD. London.

24. **Oba G (2001).** Indigenous ecological knowledge of landscape change in East Africa. International Association for Landscape Ecology Bulletin, 19(3): 1-3.

25. **PADS (Pastoral Areas Development Study) (2004).** Review of the past and present trends of the pastoral areas. Pp.1-34. Livestock Resources. PADS Report Phase I. Section I, Vol. II, Techniplan, MCE, Agristudio, Addis Ababa and Rome.

26. **PFE (Pastoralist Forum Ethiopia) (2001).** Poverty Reduction Strategy and Pastoral Development. Proceedings of the Second National Conference on Pastoral Development in Ethiopia. 22-23 May 2001, Addis Ababa, Ethiopia, Pastoralists Forum Ethiopia

27. **PFE (Pastoralist Forum Ethiopia) (2004).** Pastoralism and sustainable pastoral development. Proceedings of the Third National Conference on Pastoral Development in Ethiopia. 23-24 December 2003, Addis Ababa, Ethiopia, Pastoralists Forum Ethiopia.

28. **RISC (Range Inventory Standardization Committee) (1983).** Guidelines and Terminologies for Range Inventory and Monitoring.

29. **Roques KG, O'Connor T, Watkinson AR (2001).** Dynamics of shrub encroachment in an African savannah: Relative influences of fire, herbivory, rainfall and density dependence. Journal of Applied Ecology, 91 (2): 268-280.

30. **Russell A (1984).** The environment of Ethiopia Rift Valley compared to other areas of Africa. In: Richard S (ed.). ILCA Bulletin No. 17. ILCA, Addis Ababa, Ethiopia.

31. **SAS (Statistical Analysis System) (1999).** Institute of Applied Statistics and SAS Programming Language. Cary, North Carolina.

32. **Tainton NM (1981).** The assessment of veld condition. Pp.46-55. In: Tainton NM (ed.). Veld management in South Africa. University of Natal Press, Pietermaritzburg, South South Africa. 472p.