bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

The fodder grass resources for ruminants: A indigenous treasure of local communities of Thal desert Punjab, Pakistan

Humaira Shaheen*[1,2], Rahmatuallah Qureshi[3], Mirza Faisal Qaseem[3] and Piero Bruschi[4]

COMSATS Institute of Information Technology[1]

South China Botanical Garden, Chinese Academy of Sciences, Guangzhou, PR China[2]

Pir Mehr Ali Shah Arid Agriculture University Rawalpindi[3]

University of Florence Italy[4]

humaira.shaheen@comsats.edu.pk, hshaheen@scbg.ac.cn

Abstract: Indigenous people have been using their regional grasses for rearing their animals for centuries. The present study is the first recorded traditional knowledge of grasses and feeding system for livestock from the Thal desert in Pakistan. Snowball method was used to identify key informants. Information was collected from 232 informants from six districts of Thal Desert through semi-structural questionnaire and site visits. The data was analyzed through Smith's salience index and Composite Salience using ANTHROPAC package in R software. On the whole 61 grasses were recorded from the study area and most of the species belongs to the Poaceae family (52 species). Based on palatability grasses were categorized into three major groups i.e. (A) High priority, (B) Medium priority and (C) Low priority. Species in Group A, abundantly present in the study area, highly palatable forage for all ruminants. 232(141M +91W) local informants were interviewed. Informants were grouped into three major age categories: 20–35 (48 informants), 36–50 (116 informants) and 51–67 years (68 informants). ANTHROPAC frequency analysis conformed the Smith's salience index and Composite Salience; *Cynodon dactylon* was the favorite species (6.46 SI, 0.6460 CS) followed by *Cymbopogon jwarancusa* (5.133 SI, 0.5133 CS) and *Sorghum* sp. was the third most salient species (5.121 SI, 0.5121 CS). Grasses were mostly available during the season of August and October and had also ethnoveterinary importance. This document about the traditional feeding of livestock from Thal Desert can strengthen the value of conserving our traditional knowledge, which was poorly documented before.

Keywords: Fodder, Thal Desert, livestock, pairwise comparison, ANTHROPAC

Introduction

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

In rural areas of Pakistan, agro-pastoral activities play a crucial role in the development of the local economy, accounting for more than half of the total agricultural income and 10.6% of the national GDP [1]. These activities are particularly important in the economy of the country's desert regions where land cultivation is difficult and livestock is the main and often unique survival strategy and income source for the local communities. Moreover, milk and meat production may counteract the impact of climatic unpredictability on fluctuations in food availability, especially in areas facing frequent crop shortages. According to data reported by Farooq et al. [2], in Pakistan 8.1% of buffaloes, 13.5% of cattle, 15.3% of sheep and 14.4% of goats are raised in desert districts. However, husbandry in these areas is often an uncertain and low-paid activity; shortage of fodder as a result of severe climatic conditions, high rate of diseases, limited availability of veterinary services and poor access to animal vaccination are important constraints limiting the local livestock productivity [2]. The sustainable production of livestock under harsh climatic conditions needs efficient strategies for improving fodder utilization and management [3]. From this perspective, traditional knowledge can be an important source of information on local wild forage resources and on their nutritive properties. Several studies have shown that smallholder farmers in many parts of the world have a deep practical knowledge about the importance and quality of plants used to feed animals. Ethnobotanical investigations on fodder plants have been carried out in Africa [4-6], Brazil [7], India [8, 9] and China [10-12]. Many studies throughout the world highlight the diverse and abundant use of grasses and sedges as fodder [12, 13] [7, 8]; grasses and sedges are generally reported to be palatable and highly productive resources and to have a high forage potential especially in arid and semiarid areas [7].

Previous studies have shown that Thal is rich in grasses and sedges [14]; most of the grasses used by local population as fodder [15]. However, no detailed study has carried out to analyze utilization and selection strategies of these plants by shepherds and farmers living in this zone. Extensive areas in the Thal have been overgrazed and they are now strongly threatened by desertification processes [16, 17]. Understanding the relative importance and preference of different species is crucial for a sustainable management of the local forage resources and can help animal husbandry technicians to optimize the selection of useful fodder species and to improve the livestock system efficiency.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Moreover, recording this knowledge would be a much faster and cheaper method for learning about palatability and nutritive value of these plants.

The major aims of this study were:

1) To document traditional knowledge about the use of grasses and sedges as fodder in Thal and to assess similarities and differences with the studies previously conducted in the same [15] and in neighboring areas [11, 12].
2) To evaluate the impact of socioeconomic factors on the local ethnobotanical knowledge
3) To rank, by order of preference, the different species used in the animal diet
4) To quantify the influence of seasonal variation on the availability of these plants as animal feed.

Materials and Methods

Area of study

The Thal desert is located between 31° 10' N and 71° 30' E in the Punjab province, Pakistan (Fig. 1). It is a subtropical sandy desert lying between the Indus River flood plains in the west and Jhelum and Chenab River flood plains in the east. About 50% of the Thal is under arid to hyper-arid climatic conditions (mean annual rainfall less than 200 mm) and the remaining half is characterized by semiarid climatic conditions (annual mean rainfall between 200 and 500 mm). Most of rainfall occurs between June and August. Average temperatures range between 3-8 °C in winter and 32 – 40 °C in summer. Wind erosion is a serious problem leading to the loss of topsoil and organic matter and damage to crop plants. This region is divided into six districts viz. Bhakkar, Khushab, Mianwali, Jhang, Layyah, and Muzaffargarh.

In Thal desert livestock is considered as a more secure source of income for small farmers and landless poor people. According to [18] the average herd size is 17 standard animal units. Livestock herds consist of animals of different age and sex; on average each farm has 22.8 goats, 16.7 sheep, 7 cattle, 2.51 buffaloes, 0.88 camels, 0.21 donkeys and 0.05 mules. Detailed information on grazing and stall feeding practiced in the area is given in [19].

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Ethnobotanical survey

Data were collected for two consecutive years (from March 2016 to March 2018) from Thal desert. Thal desert has six districts and we visited each district twice a year for data collection. Informants were selected by snowball-sampling technique [20] among village leaders, shepherds and both farm and domestic livestock caretakers. Formal ethical consent was obtained from all participants before the research started. Information was gathered by using different approaches i.e. group discussions with informants, individual semi-structured questionnaires and participant observation (Fig. 2) [21]. The questionnaires were drafted in the local language (*Seriki* and *Punjabi*) and included the following major questions: (i) Which grasses/sedges are used as fodder? (ii) Which grasses/sedges are the preferred feed of choice for cattle, sheep, camels, buffaloes, and goats? (iii) What is the palatability of the different used plants? (iv) Which plant part do animals consume? (v) What are the feeding habits of different animals? (vi) Which livestock feeding system does local people adopt: free grazing or cut and carry? (vii) Do the listed fodder plants have any ethnoveterinary use? (viii) What are their other indigenous uses?

In the second stage of the field research we used direct observation of livestock grazing habits to evaluate the palatability of different plants, animal preferences and the growth stages of plants at the time of grazing.

Collection and identification of plants

Plant collection was performed with the help of local informers during the field survey. Identification of the gathered species was carried out by the herbarium specialist Dr. Mushtaq Ahmed from Quaid-i-Azam University Islamabad and by the taxonomist Dr. Humaira Shaheen (Fig. 3). Botanical nomenclature of species and families complies with online Flora of Pakistan (http://www.efloras.org/flora_page.aspx?flora_id=5) [22] and the herbarium specimens were kept in to the Botany Department of Pir Mehr Ali Shah University of Arid Agriculture.

Data analysis

The most common method to measure relative abundance was visual assessment and observation of ethnobotanically important grasses in the study area[12]. Total study area

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

was almost 20,000 square kilometers. We randomly divided each district into 45-50 plots and plot size was (10X10m = 100m^2). Results were constructed by percentage of relative abundance through the following formula;

$$RA = \frac{Total\ percentage\ cover\ of\ species\ in\ all\ plots}{Number\ of plots\ estimated} \times 100$$

Based on the abundance value, grasses were categorized into the following groups i.e. Abundant, Common, Frequent, Occasional and Rare (Table 1).

Relative frequency of citation (RFC) was calculated to sort listed plants by priority order, using the following formula [23-25].

RFC = FC/N

Where FC is the number of informants that mentioned the fodder use of the species and N is the total number of informants included in the study.

Pairwise comparison (PWC) was also used to determine the priority order of the listed species [12]. Ten informants (5 key informants and 5 randomly selected) were chosen for the PWC. The participants were asked, one at a time, to select their preferred fodder plants from all possible pairs of species. Each species got a score of 1 if the participants selected it. The final score was obtained by adding the scores and ranking them.

Smith's salience index and Composite Salience [26] were used to judge species saliency by weighing the average of the inverse rank of a species across multiple free-lists where each list was weighed by the number of species in the list. ANTHROPAC [27] was used to generate Smith's salience indexes.

Pairwise ranking or comparison was used to evaluate the degree of preference or levels of importance. The values for use reports across the selected species were summed up and ranked. Ten informants (six key and four randomly taken informants) in the study area ranked grasses according to their use e.g. 1st, 2nd, 3rd, 4th and 5th respectively. Ranking can be used for evaluating the degree of preference or level of importance of selected plants [26, 28].

Socioeconomic factors

In total, 232 local informants were interviewed (Table 2); 141 were men and 91 were women. A smaller number of female informants was expected and can be partially explained with the local cultural restrictions preventing women from working outside

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

155 their homes or farms. Informants were grouped into three major age categories: 20–35
156 (48 informants), 36–50 (116 informants) and 51–67 years (68 informants). With regard to
157 the profession, 34% (36 females and 44 males) were shepherds, 26% (27 females and 33
158 males) were farmed livestock caretakers and 40% (28 females and 64 males) domestic
159 livestock caretakers. Thirty-six (16%) of the interviewed people were illiterate, 24 (10%)
160 never completed their primary education, 120 (52%) completed 5 years of primary school
161 and 52 (22%) informants had middle education level (Fig. 4) [22].
162
163 **RESULTS AND DISCUSSION**
164
165 **Use of fodder species**
166 The informants reported the use of 61 plant species that were distributed into 40 genera
167 and 3 botanical families. The most represented genus was *Cyperus* with 5 species,
168 followed by *Cenchrus* and *Eragrostis* with 4 species each. Most species belonged to
169 Poaceae family (51 species; 84% of the reported plants) while 8 species (13%) were
170 categorized into Cyperaceae family. Typhaceae were represented by only one species:
171 *Typha elephantina*. Fifty-five species (92% of the reported species) were classified as
172 native and 5 (8%) as exotic. The following exotic species were reported by informants:
173 *Chloris gayana*, *Imperata cylindrica*, *Paspalum dilatatum*, *Sorghum bicolor* and
174 *Vetiveria zizanioides.* These results seem to reflect composition and distribution patterns
175 of the local flora. In a floristic checklist of Thal desert, Shaheen et al. [22] observed that
176 Poaceae was the leading family with 52 species. Of the 52 Poaceae naturally occurring in
177 the area, 48 (94%) were reported to be used as fodder in our study; 5 were not cited by
178 informants and 4 (*Brachiaria reptans*, *Eragrostis atrovirens*, *E. cilianensis*, *Themeda*
179 *anathera*) were reported in our study but not in the floristic inventory. All the eight
180 Cyperaceae cited were included in the study conducted by Shaheen et al. [14].
181 Our comparative analysis revealed 15 species that are used as fodder in all the considered
182 studies. We found a mean similarity (Jaccard's index) rather high (36.4 ± 6.9) with
183 values ranging from 30.8 (this study vs [11]) to 50.0 ([12] vs [11]). These studies are all
184 from zones lying in the proximity of the study area that share not only similar ecological
185 factors but also the same socioeconomic and cultural history. Nevertheless, our study

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

listed 20 grasses not previously reported for this area in the fodder category. These results provide an important contribution of novelty to the knowledge on wild fodder plants in Pakistan. At the same time, they also show the importance of collecting new ethnobotanical information even in areas already studied.

Socioeconomic factors

Informants mentioned 8.27 ± 4.49 taxa (range 1 – 18). Gender ($H = 0.373$; $P > 0.05$) and education ($H = 5.29$; $P > 0.05$) had no influence on the knowledge of fodder plants. Gender influence on traditional knowledge is controversial [29] and many studies have showed that the statistical strength of this relation depends on the local cultural context and on the categories of use that the researchers focus on. A lack of differentiation between men and women, as observed in this study, could mean that there is not a clear division of labor in the area. A similar finding was observed by Aumeeruddy et al. [30] in Northern Pakistan, where women have a detailed knowledge on characteristics and properties of the different fodder species, suggesting that they fully share with men the responsibility of livestock rearing and forage collection. Khan and Khan [31] observed that most of the women of Cholistan desert have an important role in managing livestock, spending almost 8 to 13 hours a day in this activity. Differently Nunes et al. [7] and Bruschi et al. [6] showed that men prevail in the knowledge about fodder plants. The greater male knowledge found in these two studies may be explained by different gender-based experiences and skills: men spend much of their time moving with their herds while women are more frequently involved in managing food and family care. The age of informants resulted to be statistically significant ($H = 9.97$; $P < 0.05$). As also shown in many other ethnobotanical studies [32]; [33]; [34], elderly people seem to retain more traditional knowledge on the use of plants. For young people (25 – 35 years old), the average number of known fodder plants was 6.65 ± 4.12 while for middle-aged (36 – 50) and elderly informants (> 50) there was an average number of 8.25 ± 4.13 and 9.42 ± 4.74, respectively. Occupation also strongly affected the number of fodder species reported by informants ($H = 14.58$; $P < 0.01$). Domestic livestock caretakers mentioned a higher number of plants (9.50 ± 4.43) followed by farmed livestock caretakers (7.98 ± 4.02) and shepherds (7.10 ± 4.60). Domestic livestock caretakers spend much time with cattle; therefore have a better knowledge about the animals' favorite foods.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Pairwise ranking of wild palatable plants

Cymbopogon jwarancusa subsp. *jwarancusa* with 1st rank was the most preferred species among all selected grass species, followed by *Cynodon dactylon, Cenchrus ciliaris, Typha elephantina* and *Cyperus alopecuroides* which had 2nd 3rd, 4th and 5th rank respectively. *Pycreus flavidus* received the lowest score, therefore resulting as the less preferred species (Table 3). The most highly ranked species (*Cymbopogon jwarancusa* subsp. *Jwarancusa, Cynodon dactylon, Cenchrus ciliaris, Typha elephantina* and *Cyperus alopecuroides*) are also the most dominant in the area (Shaheen, unpublished data). This finding seems to support the "appearance hypothesis" under which the most abundant species are better known and mostly used Lucena et al. [35]. Plants commonly growing in given area would allow local people to have more experience of their properties and consequently would have a greater probability of being introduced into the local culture.

Co-relation used for pairwise comparison

On the basis of RFC value, pairwise comparison was used to correlate fodder grasses and the knowledge of the respondent. Ten out of 232 respondents were chosen on the basis of their profession (ethnoveterinary practitioner) but were potential respondents due to enough indigenous knowledge. Based on RFC values knowledge of respondent R1 showed a strong correlation with R4, as R2 (0.56; $p<0.001$) showed with R1 with R7 (0.55;$p<0.001$), R2 have strong correlation with R3 and R8 (0.48, 0.58; $p<0.001$) but R2 had the strongest correlation with R9 (0.71; $p<0.001$). All correlation and their distribution of RFC values are shown in Fig. 5. The positive correlation between respondents suggests that respondents report similar information about the plant, for example, R2 and R9 both were an ethnoveterinary practitioner with age more than 50 so they have similar knowledge.

Availability and Prioritizing fodder grasses on the basis of RFC and PWC

RCF values ranged from 1 to 0.51 with a mean value of 0.71. Twenty-five species had RFC values higher than average value while the remaining 35 species had RFC value lower than the average value (Fig. 6, Table 4). *Cymbopogon jwarancusa* and *Cynodon dactylon* showed the highest value (1.00) while *Imperata cylindrical* (0.52) and *Vetiveria*

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

zizanioides (0.51) had the lowest values. Based on these RFC values fodder species were included into three categories of priority: species with higher priority (group A), species with medium priority (group B) and species with low priority (group C). Twenty-eight (45.9%) species were highly preferred by the informants followed by twenty-three (37.7%) species that had medium priority while ten (16.3%) grass species were the least preferred (Fig 7). Values ranged between 1-0.69 for group A, between 0.69-0.54 for group B and between 0.54-0.51 for group C. Similar results were shown by Harun et al. [12] in their study. These results were confirmed by cluster analysis based on RFC in which the reported species were classified into three major groups compliant with the results of priority ranking analysis. Similar results were found when we performed cluster analysis using PWC data. *Cymbopogon jwarancusa* was the preferred species in both approaches (Table 5).

The species included in the Group A (high priority) is ecologically dominant and largely available in the area. Moreover, taxa included in this group have a good palatability and are also available during the dry season when other grazing resources are exhausted. .

Palatability of grasses and the method of feeding

Preferred palatability species are often leafy and without lots of stem, with a high leaf table and leaves of low tensile strength [36, 37]. Palatability analysis showed that 77% of the reported species are grazed in the study area (Table 6). In particular; grasses included in group A of the priority ranking were consumed by all ruminants locally raised. Goats are the only animals to feed on every type of grass growing in Thal desert although palatability results show a preference for 58% of the reported species. 40% of the species represented the favorite fodder for sheep and 26% the favorite fodder for buffaloes Camels are very selective animals and use only few specific grasses as fodder (Fig. 8). Different parts showed to have different edibility: for example 42% of grass species were consumed as whole plant (e.g. *Cynodon dactylon*, *Eragrostis minor*, *Cenchrus ciliaris*, *Cenchrus pennisetiformis* etc) while 38% and 19% of them were consumed as aerial parts and as leaves, respectively. The reason why so many grasses are grazed as a whole is probably related to their small size and tender herbaceous texture (e.g. *Cynodon dactylon, Lasiurus sindicus, Phalaris minor, Cyperus rotundus, Eragrostis minor* etc similer results shown in other literature [12] [13]. Due to the sandy nature of soils occurring in the study

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

area these plants have shallow root systems and can easily be pulled out from the soil. Species growing in the form of dense patch are hard to be consumed as a whole plant and animals can enjoy feeding only with the aerial parts of this grass. Beliefs on the feeding habit of the livestock are common in the area: for example, some local shepherds reported that putting the herd out to pasture in open field improves their health and milk production. According to them animals freely grazing are able to select the better grasses avoiding the toxic or less nutritious ones. They justify their belief by comparing milk production of freely grazing animals with cattle fed with forage and also by saying that during dry season, when free grazing is not possible, there is a considerable reduction in animal health and milk production. As Provenza et al describe in their study [38].

Role of the fodder species on milk production

Ten out of the 80 interviewed shepherds (based on the informant knowledge) were randomly sampled to analyze more in detail the role of fodder species on the milk production. We focused our attention on the shepherds because, during the interviews, they showed a deeper knowledge about the species influencing quantity and quality of milk. According to them, *Cynodon dactylon* was the favorite species for the milk production (6.46 SI, 0.6460 CS) followed by *Cymbopogon jwarancusa* (5.133 SI, 0.5133 CS). *Cymbopogon jwarancusa* was also reported to give a peculiar aroma, increasing the milk's value. *Sorghum* sp. was the third most salient species (5.121 SI, 0.5121 CS) (Table 7). This findings were confirmed when we extended our analysis to all the informants. According to the results of the ANTHROPAC frequency analysis, ranking the plants in the order of their citation frequency (Fig. 9), *Cynodon dactylon* had 73.21% frequency of milk production, following by *Cymbopogon jwarancusa* (70.54%) and *Sorghum* sp. (67.86%).

Relative abundance and seasonal availability

Relative abundance analysis showed that most of the cited species (55%) were abundantly present in the study area and most of them belonged to the priority Group A (Fig.10). 13.39% of the species were available in August and in October while 12.54 % were available in July. In Pakistan, July, August and October are months characterized by

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

monsoon rains fostering the grass biomass development (Fig.11).

People use Livestock for improving their economic life

Livestock production makes the main contribution to agriculture value-added services in the study area. Ten local informants were asked to rank animals from one to five on the basis of their economic value. Milk production is the major income source for people living in the Thal desert; mostly person raised cows and buffaloes more for milk production as compare to raise camels or goats (Fig. 12). Goats, sheep, buffaloes and cows are also raised for meat production. During religious celebrations (such as pilgrimages and *Eid ul Azha*) shepherds and farmers take livestock to the local market for sale and this is another major income source as also shown in [39]. Skin from sheep, buffaloes, cows and camels are also an other way of earning, people sale the animal skin for making leather goods; teeth and bones are used for making different objects (e.g. buttons, jewelry and decoration pieces) (Fig. 12). Dung of buffaloes and cows is dried and used as fuel or, fresh, as a natural fertilizer to improve the soil fertility. Ox, buffaloes and sometimes camels are used for ploughing. Camels are commonly used for transportation in desert areas.

Indigenous uses and Ethno-veterinary uses of grasses

Eighteen of the 61 reported species were locally used in ethno-veterinary practice. *Cymbopogon jwarancusa* was the most cited veterinary grass (48) and was reported to heal infertility and skin diseases in ruminants (Table 8). Other species (*Cenchrus* spp*., Arundo donax, Desmostachya bipinnata, Dichanthium annulatum, Digitaria ciliaris*, *Eleusine indica, Eragrostis* spp*., Saccharum spontaneum*) were frequently reported to treat urinary and digestive diseases in livestock. As similar results shown in different studies [12, 16, 40]. Urinary and digestive diseases were the most frequently reported disorders; this finding is probably due to the sandy nature of the soil, causing the accumulation of sand-laden feed material in the digestive apparatus and in the urinary tract of livestock.

Conclusion:

The present study is the detailed inventory of 61 indigenous grass species used for fodder and ethno veterinary in Thal district of Southern Punjab Pakistan. The data about grasses

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

was obtained from 232 local informants belonging to different age groups and professions these informants ranked *Cymbopogon jwarancusa* and *Cynodon dactylon* as most preferred grass species. The present study provides an inventory, list of plant parts and diversity in palatability and feeding behavior of these grasses. The data analysis highlighted the possible motives behind the greater acceptability ratio of high priority fodder grasses i.e. diversity in their palatability for major ruminant species, abundant availability in the study area and versatile feeding methods. This data enriched study is not only significant for the conservation of ethnobotanical knowledge but also it may help in facilitating the sustainable livestock feeding for ruminants. Subsequently, the information may play a major role in improving the livelihood of smallholder farmers. Furthermore, it is the first study, which use Smith's salience index and Composite Salience index to authenticate and validate the collected information. Blend of traditional and scientific knowledge is essentially required to produce worthwhile criterion for selecting these fodder grasses. If some of the grasses show promising nutritional and pharmacological value, then relevant policy marker should take necessary steps to conserve the area and the species. It should not only beneficial for the pharmaceuticssal companies; it will also help to boost up the economy of the country.

Declaration:

- **Acknowledgements**

We acknowledge all the informants of the study area to for their support and hospitality, We are really very grateful to Director of Camel form Dr. Asharaf and Director of Mani form Dr. Razaq for their support and giving permission to explore the area for data collection. I am very thankful to HEC Pakistan for their kind support for providing travel grant.

- **Funding**

I am thankful to Higher Education Commission of Pakistan (HEC) for travel funding to partially covering the costs of processing the data. Costs of this project were managed personally. No external funding resources were available for this particular study.

Availability of data and materials

Voucher specimens were submitted to the Herbarium of PMAS-AAUR Pakistan for forthcoming uses (Table 3).

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

373 **Authors' contributions**

374 The ethnobotanical survey and fodder grass sample collection were done by SH, QR, and
375 QFM. QFM did the statistical analysis and SH wrote the manuscript by providing a
376 critical interpretation of the outputs. QR supervised the whole study and helped in
377 identification of specimens. All authors read and approved the final manuscript.

378 **Ethics approval and consent to participate**

379 **Consent for publication**

380 Not applicable.

381 **Competing interests**

382 Authors declare that they have no competing interests.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

383

384 **Legend of figures**

397 **Legend of Tables**

410

411

412

413

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

1. Ghazali A. Analyzing the relationship between foreign direct investment domestic investment and economic growth for Pakistan. International Research Journal of Finance and Economics. 2010;47(1):123-31.
2. Farooq U, Ahmad M, Saeed I. Enhancing livestock productivity in the desert ecologies of Pakistan: setting the development priorities. Pakistan Development Review. 2009;48(4):795-823.
3. Hussain F, Durrani MJ. Seasonal availability, palatability and animal preferences of forage plants in Harboi arid range land, Kalat, Pakistan. Pakistan Journal of Botany (Pakistan). 2009.
4. Okoli I, Ebere C, Uchegbu M, Udah C, Ibeawuchi I. A survey of the diversity of plants utilized for small ruminant feeding in south-eastern Nigeria. Agriculture, ecosystems & environment. 2003;96(1-3):147-54.
5. Bahru T, Asfaw Z, Demissew S. Ethnobotanical study of forage/fodder plant species in and around the semi-arid Awash National Park, Ethiopia. Journal of forestry research. 2014;25(2):445-54.
6. Bruschi P, Urso V, Solazzo D, Tonini M, Signorini MA. Traditional knowledge on ethno-veterinary and fodder plants in South Angola: an ethnobotanic field survey in Mopane woodlands in Bibala, Namibe province. Journal of Agriculture and Environment for International Development (JAEID). 2017;111(1):105-21.
7. Nunes AT, Lucena RFP, dos Santos MVF, Albuquerque UP. Local knowledge about fodder plants in the semi-arid region of Northeastern Brazil. Journal of ethnobiology and ethnomedicine. 2015;11(1):12.
8. Singh V, Gaur R, Bohra B. A survey of fodder plants in mid-altitude Himalayan rangelands of Uttarakhand, India. Journal of Mountain Science. 2008;5(3):265-78.
9. Nautiyal S. Interactions Between Humans and Ecosystems in Himalayas of India and Its Socioeconomic and Ecological Consequences: An Ecological Modelling Approach. Ecosystem Functions and Management: Springer; 2017. p. 39-57.
10. Abdullah M, Rafay M, Hussain T, Ahmad H, Tahir U, Rasheed F, et al. NUTRITIVE POTENTIAL AND PALATABILITY PREFERENCE OF BROWSE FOLIAGE BY LIVESTOCK IN ARID RANGELANDS OF CHOLISTAN DESERT (PAKISTAN). JAPS, Journal of Animal and Plant Sciences. 2017;27(5):1656-64.
11. Zareen A, Khan Z, Ajaib M. Ethnobotanical evaluation of the shrubs of Central Punjab, Pakistan. Biologia (Pakistan). 2013;59(1):139-47.
12. Harun N, Chaudhry AS, Shaheen S, Ullah K, Khan F. Ethnobotanical studies of fodder grass resources for ruminant animals, based on the traditional knowledge of indigenous communities in Central Punjab Pakistan. Journal of ethnobiology and ethnomedicine. 2017;13(1):56.
13. Geng Y, Hu G, Ranjitkar S, Wang Y, Bu D, Pei S, et al. Prioritizing fodder species based on traditional knowledge: a case study of mithun (Bos frontalis) in Dulongjiang area, Yunnan Province, Southwest China. Journal of ethnobiology and ethnomedicine. 2017;13(1):24.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

458 14. Shaheen H, Qureshi R, Iqbal S, Qasem MF. Seasonal availability and
459 palatability of native flora of Santh Saroola Kotli Sattian, Rawalpindi, Pakistan.
460 African Journal of Plant Science. 2014;8(2):92-102.
461 15. Khalil AT, Shinwari ZK, Qaiser M, Marwat KB. Phyto-therapeutic claims about
462 euphorbeaceous plants belonging to Pakistan; an ethnomedicinal review. Pak J Bot.
463 2014;46(3):1137-44.
464 16. Abbasi AM, Khan MA, Shah MH, Shah MM, Pervez A, Ahmad M.
465 Ethnobotanical appraisal and cultural values of medicinally important wild edible
466 vegetables of Lesser Himalayas-Pakistan. J Ethnobiol Ethnomed. 2013;9(1):66. Epub
467 2013/09/17. doi: 10.1186/1746-4269-9-66. PubMed PMID: 24034131; PubMed
468 Central PMCID: PMCPMC3853161.
469 17. Khan M, Khan MA, Mujtaba G, Hussain M. Ethnobotanical study about
470 medicinal plants of Poonch valley Azad Kashmir. J animal plant Sci. 2012;22:493-
471 500.
472 18. Hussain I. Profile of Livestock Production in Thal Desert of Pakistan.
473 International Journal of Academic Research in Business and Social Sciences.
474 2017;7(3):480-94.
475 19. FARAZ A, WAHEED A, YAQOOB M, MIRZA R. Camel Production Profile in
476 Desert Ecosystem of Thal, Punjab. Sindh University Research Journal-SURJ (Science
477 Series). 2019;51(01):45-52.
478 20. Waters J. Snowball sampling: a cautionary tale involving a study of older drug
479 users. International Journal of Social Research Methodology. 2015;18(4):367-80.
480 21. Shaheen H, Qaseem MF, Amjad MS, Bruschi P. Exploration of ethno-medicinal
481 knowledge among rural communities of Pearl Valley; Rawalakot, District Poonch
482 Azad Jammu and Kashmir. PloS one. 2017;12(9):e0183956.
483 22. Shaheen H, Qureshi R, Qaseem MF, Amjad MS, Bruschi P. The cultural
484 importance of indices: A comparative analysis based on the useful wild plants of
485 Noorpur Thal Punjab, Pakistan. European Journal of Integrative Medicine.
486 2017;12:27-34.
487 23. Shaheen H, Qureshi R, Akram A, Gulfraz M. Some important medicinal flora of
488 Noorpur Thal, Khushab, Pakistan. Archives Des Sciences. 2012;65(2):57-73.
489 24. Ashfaq S, Ahmad M, Zafar M, Sultana S, Bahadur S, Abbas N. Medicinal plant
490 biodiversity used among the rural communities of arid regions of northern Punjab,
491 Pakistan. 2019.
492 25. Nadaf M, Joharchi M, Amiri MS. Ethnomedicinal uses of plants for the
493 treatment of nervous disorders at the herbal markets of Bojnord, North Khorasan
494 Province, Iran. Avicenna journal of phytomedicine. 2019;9(2):153.
495 26. Qaseem M, Qureshi R, Amjad M, Ahmed W, Masood A, Shaheen H. ETHNO-
496 BOTANICAL EVALUATION OF INDIGENOUS FLORA FROM THE COMMUNITIES OF
497 RAJH MEHAL AND GOI UNION COUNCILS OF DISTRICT KOTLI, AZAD JAMMU
498 KASHMIR PAKISTAN. APPLIED ECOLOGY AND ENVIRONMENTAL RESEARCH.
499 2019;17(2):2799-829.
500 27. Nankaya J, Nampushi J, Petenya S, Balslev H. Ethnomedicinal plants of the
501 Loita Maasai of Kenya. Environment, Development and Sustainability. 2019:1-21.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

502 28. Tounekti T, Mahdhi M, Khemira H. Ethnobotanical Study of Indigenous
503 Medicinal Plants of Jazan Region, Saudi Arabia. Evidence-Based Complementary and
504 Alternative Medicine. 2019;2019.
505 29. Torres-Avilez W, Medeiros PMd, Albuquerque UP. Effect of gender on the
506 knowledge of medicinal plants: systematic review and meta-analysis. Evidence-
507 Based Complementary and Alternative Medicine. 2016;2016.
508 30. Aumeeruddy-Thomas Y, Shinwari Z, Abdullah A, Khan A. Ethnobotany and
509 the management of fodder and fuelwood at Ayubia National Park, North West
510 Frontier Province, Pakistan. People and Plants working paper. 2004;(13).
511 31. Khan AA, Khan K. Womenâ€™ s Role in Livestock Economy of Cholistan
512 Desert, Pakistan. Global Journal of Human-Social Science Research. 2015.
513 32. Voeks RA, Leony A. Forgetting the forest: assessing medicinal plant erosion in
514 eastern Brazil. Economic Botany. 2004;58(sp1):S294-S306.
515 33. Upadhyay B, Roy S, Kumar A. Traditional uses of medicinal plants among the
516 rural communities of Churu district in the Thar Desert, India. Journal of
517 ethnopharmacology. 2007;113(3):387-99.
518 34. de Melo JG, Santos AG, de Amorim ELC, Nascimento SCd, de Albuquerque UP.
519 Medicinal plants used as antitumor agents in Brazil: an ethnobotanical approach.
520 Evidence-based complementary and alternative medicine. 2011;2011.
521 35. de Lucena RFP, de Medeiros PM, de Lima Araújo E, Alves AGC, de
522 Albuquerque UP. The ecological apparency hypothesis and the importance of useful
523 plants in rural communities from Northeastern Brazil: An assessment based on use
524 value. Journal of Environmental Management. 2012;96(1):106-15.
525 36. Albuquerque UP, Lucena RF, Monteiro JM, Florentino AT, Almeida CdFC.
526 Evaluating two quantitative ethnobotanical techniques. 2006.
527 37. Meissner H. Recent research on forage utilization by ruminant livestock in
528 South Africa. Animal Feed Science and Technology. 1997;69(1-3):103-19.
529 38. Provenza FD, Villalba JJ, Dziba L, Atwood SB, Banner RE. Linking herbivore
530 experience, varied diets, and plant biochemical diversity. Small ruminant research.
531 2003;49(3):257-74.
532 39. Haleem S. Pakistan-Culture Smart!: The Essential Guide to Customs &
533 Culture: Bravo Limited; 2013.
534 40. Moreki JC. Documentation of ethnoveterinary practices used in family
535 poultry in Botswana. Vet World. 2013;6(1):18-21.
536

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

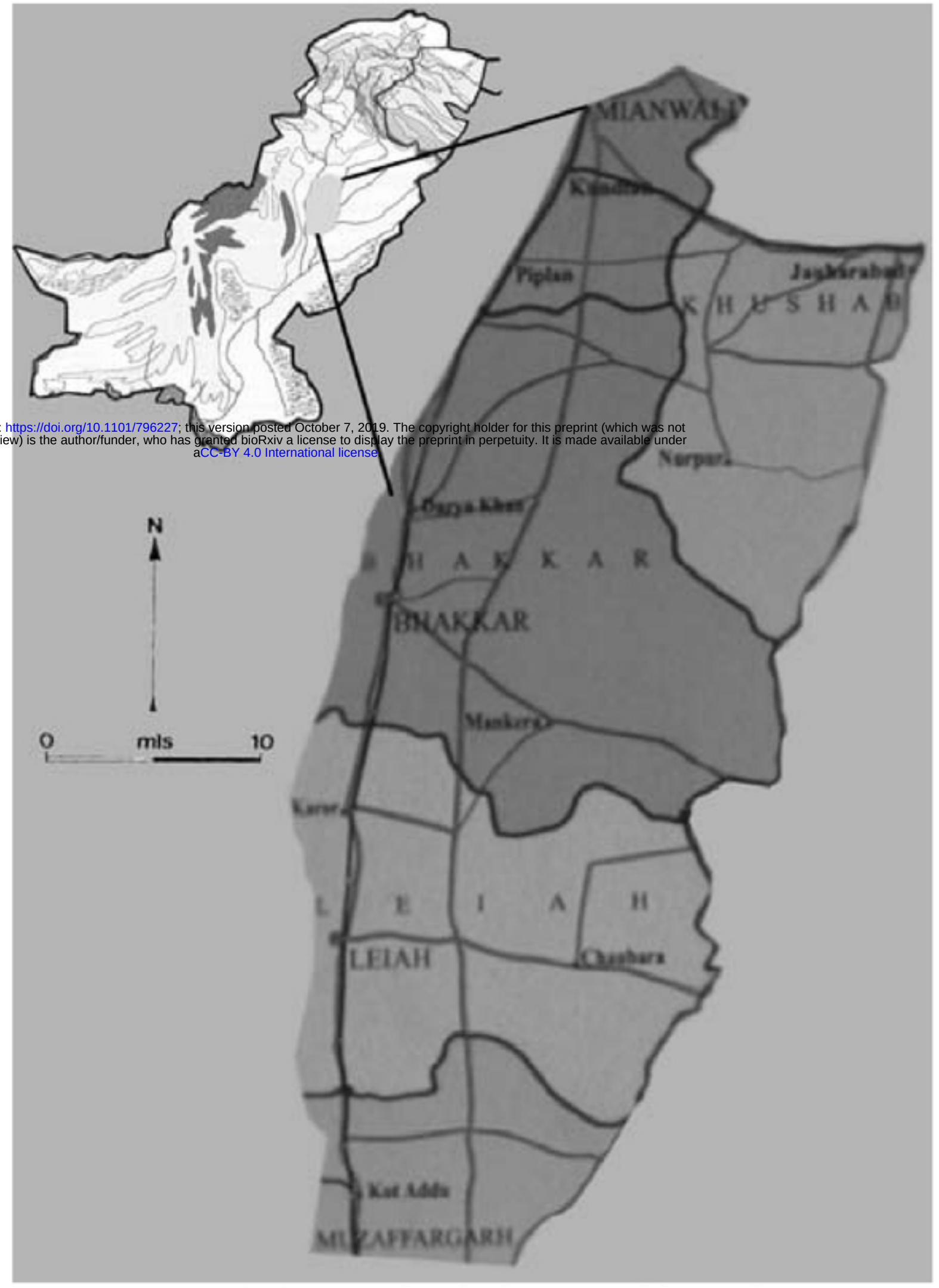
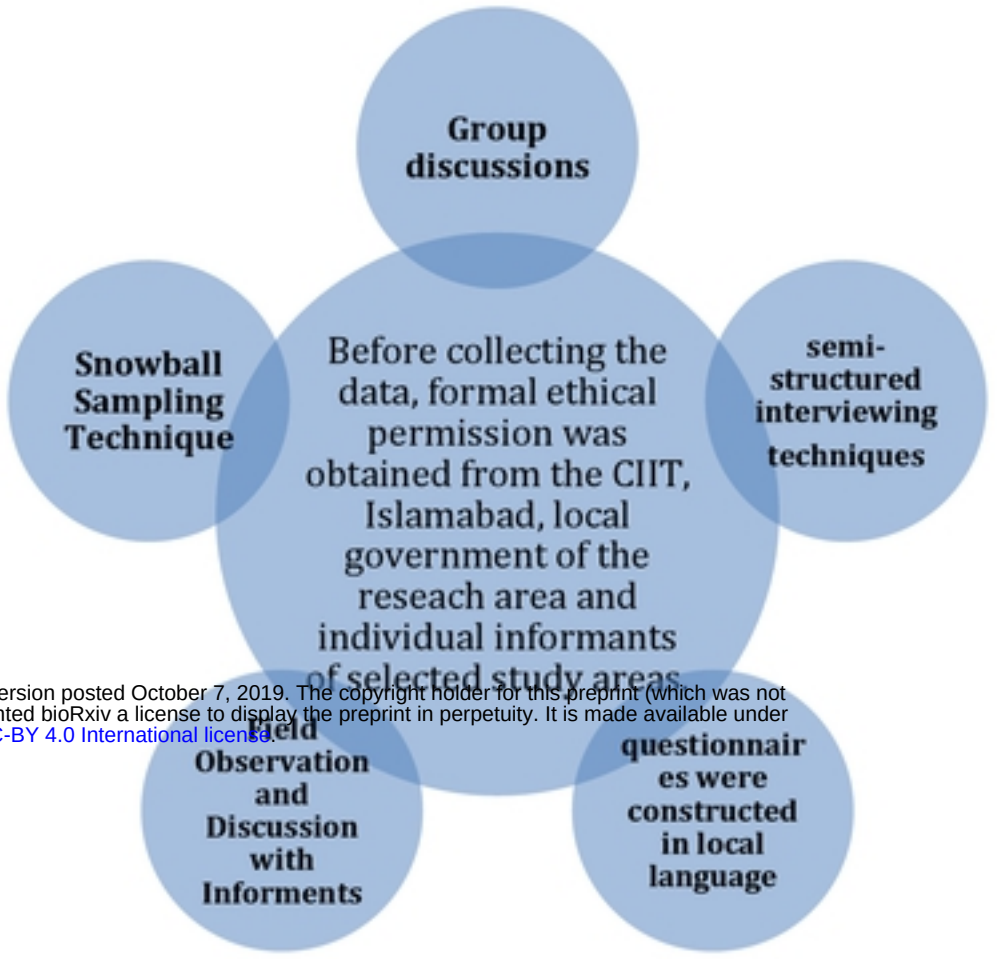


Fig. 1: Demography of informants of this study area



bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Fig. 2: Ethnobotanical survey and data collection

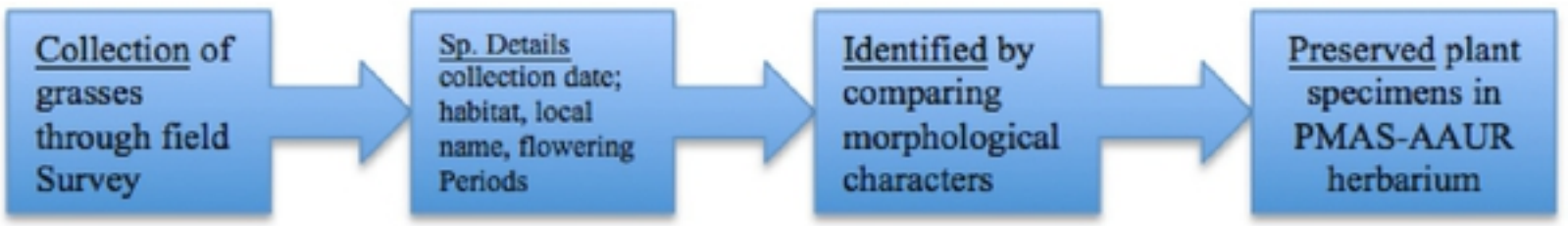


Fig. 3: Different steps for collection and identification of Grasses

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

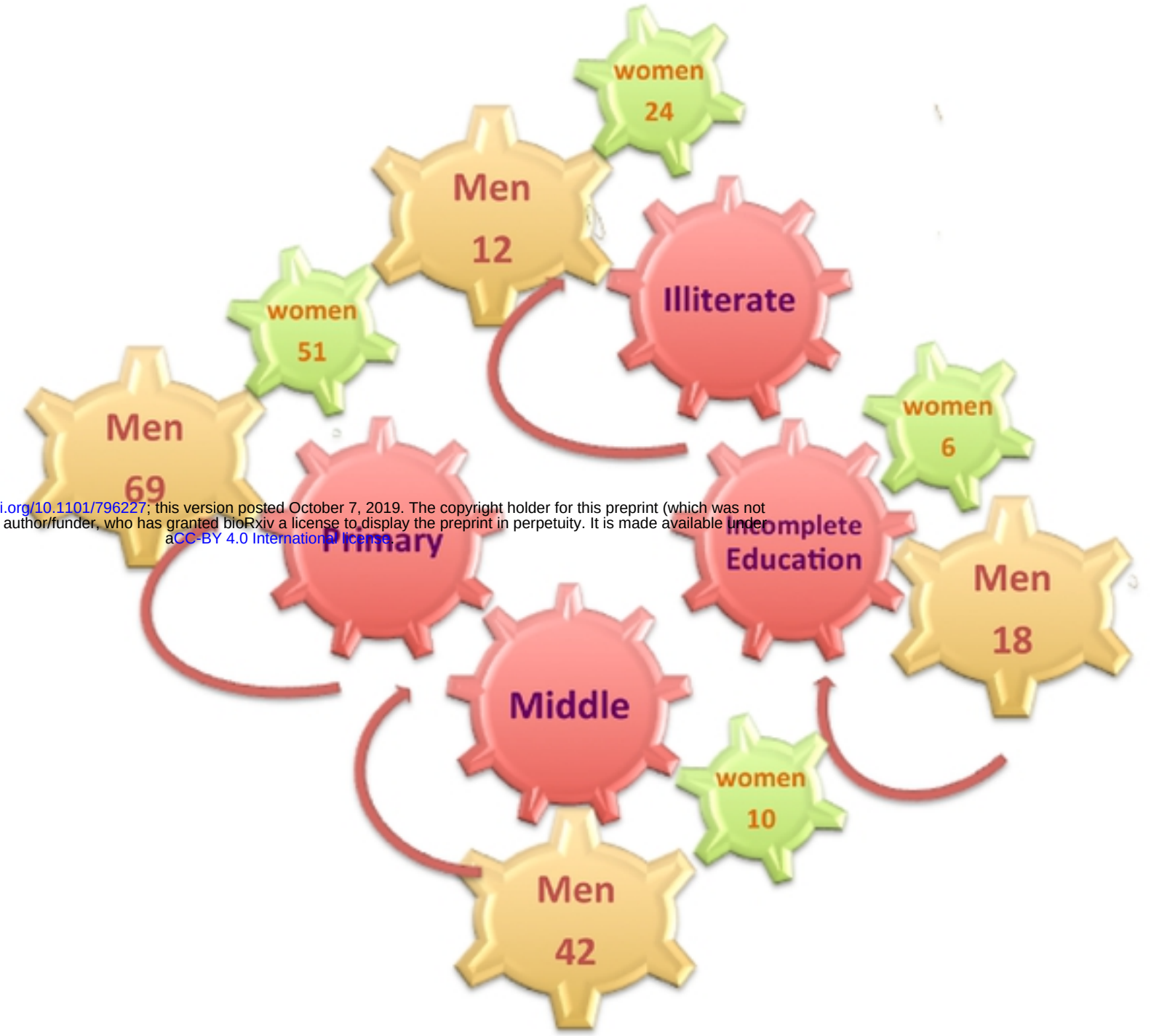


Fig. 4: Summary of education levels of informants

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

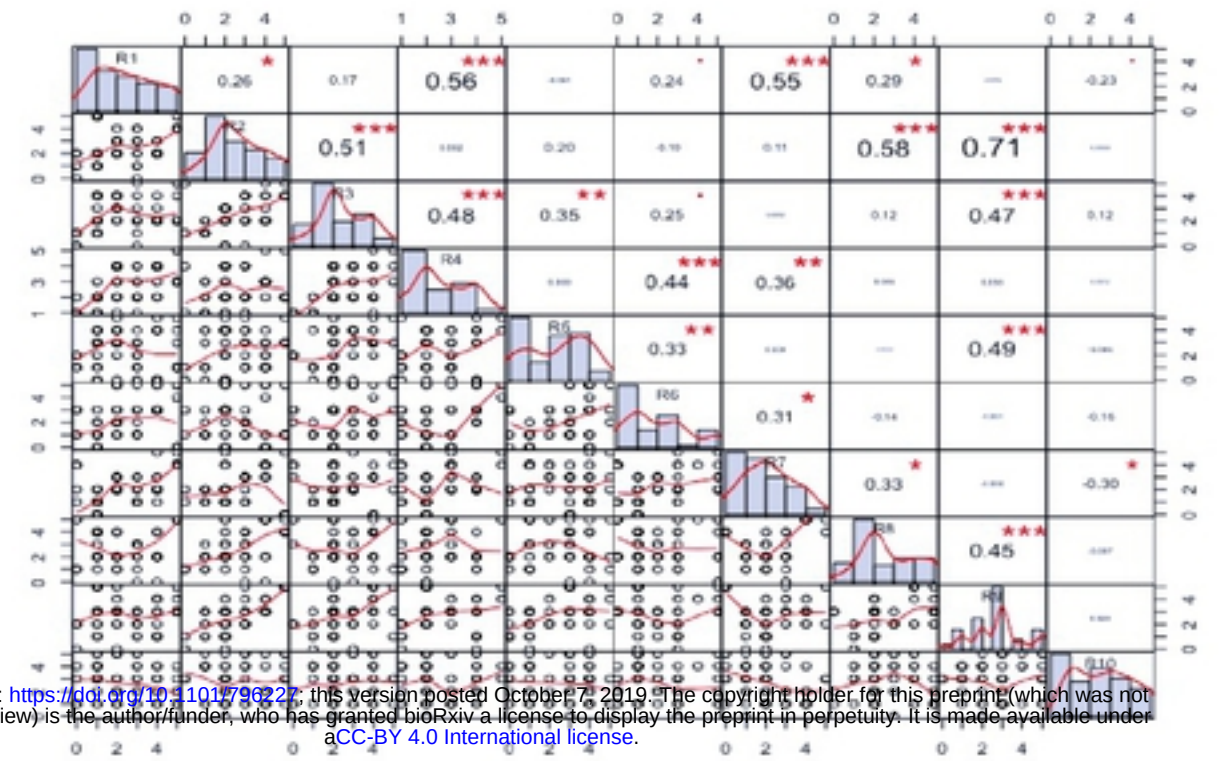


Fig. 5: Co-relation used for pairwise comparison for different grasses

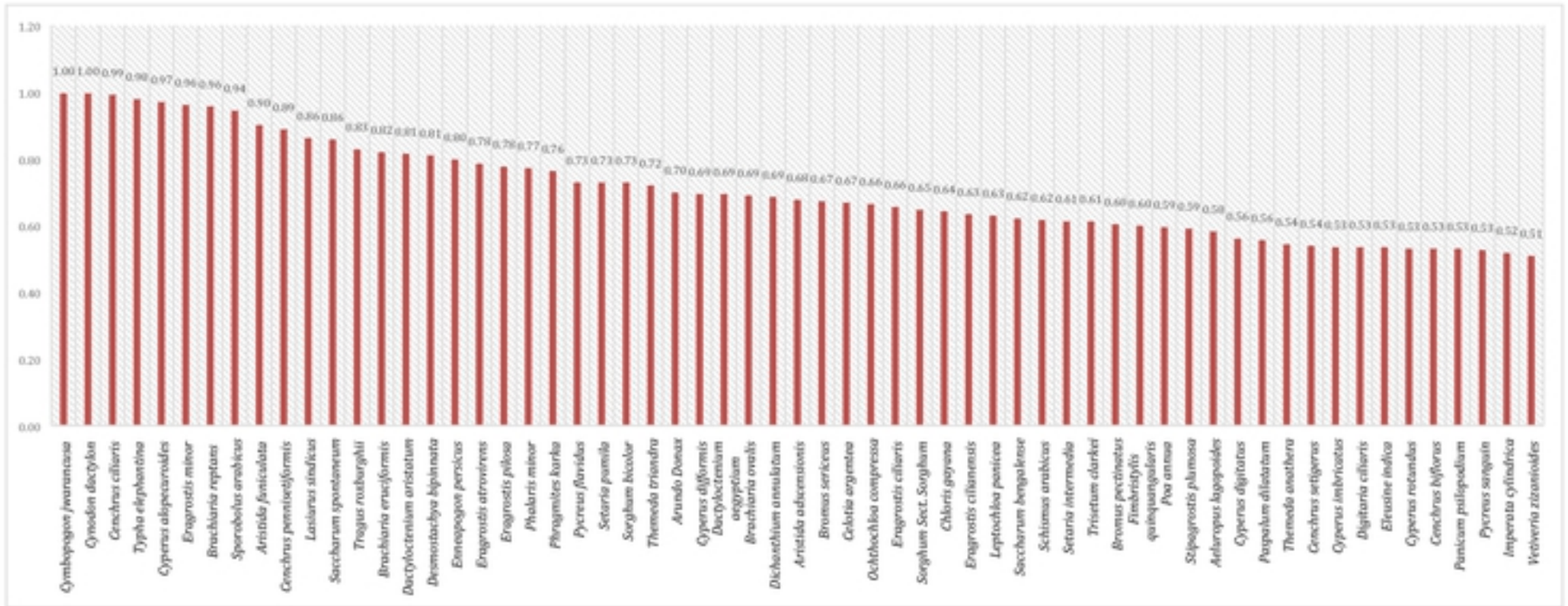


Fig. 6 Prioritizing of fodder grasses on the bases of RFC

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

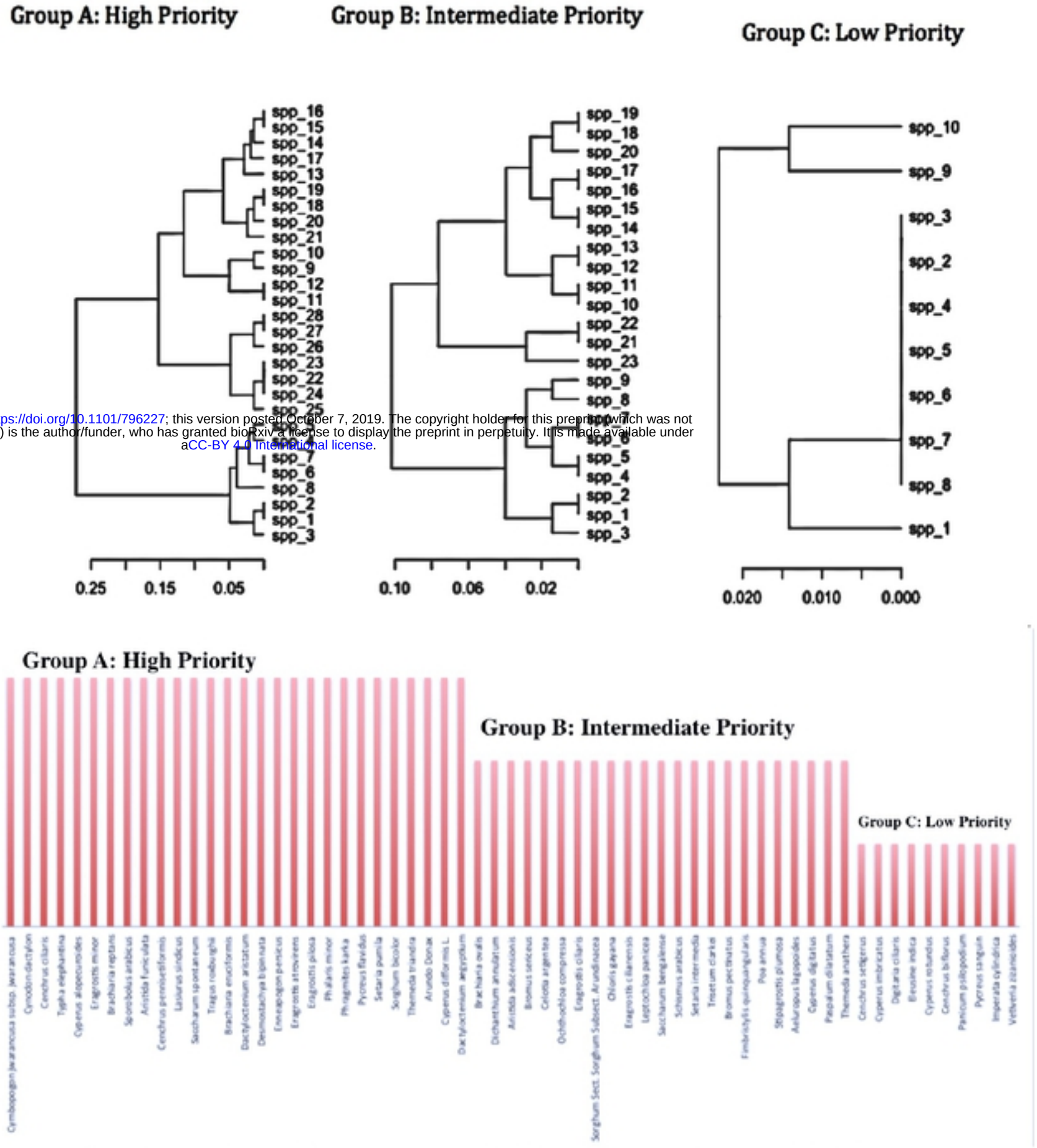


Fig. 7: Cluster analysis for grouping of ethno botanically used fodder grasses

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

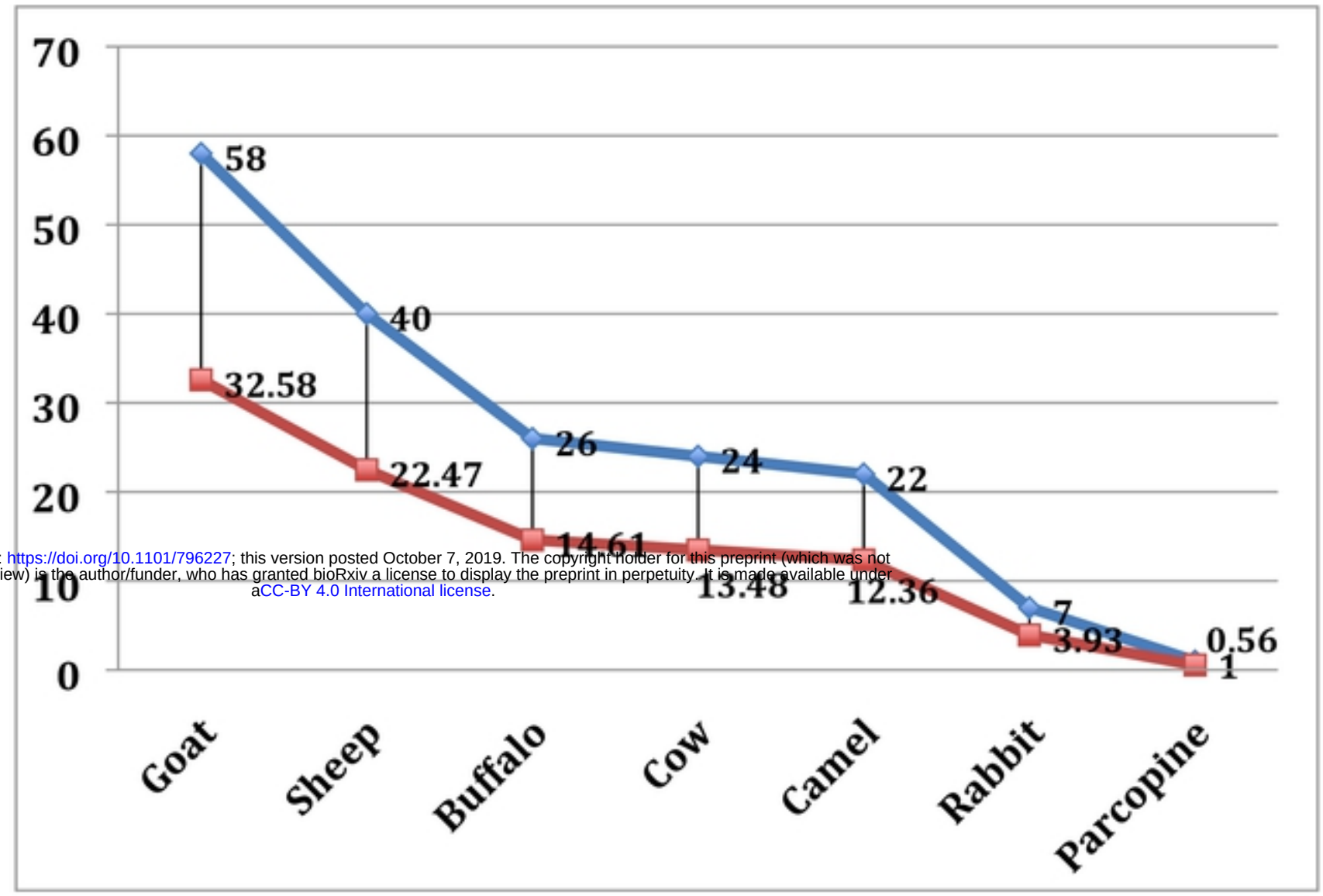


Fig. 8: Animals Preferences of grasses in the study area

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

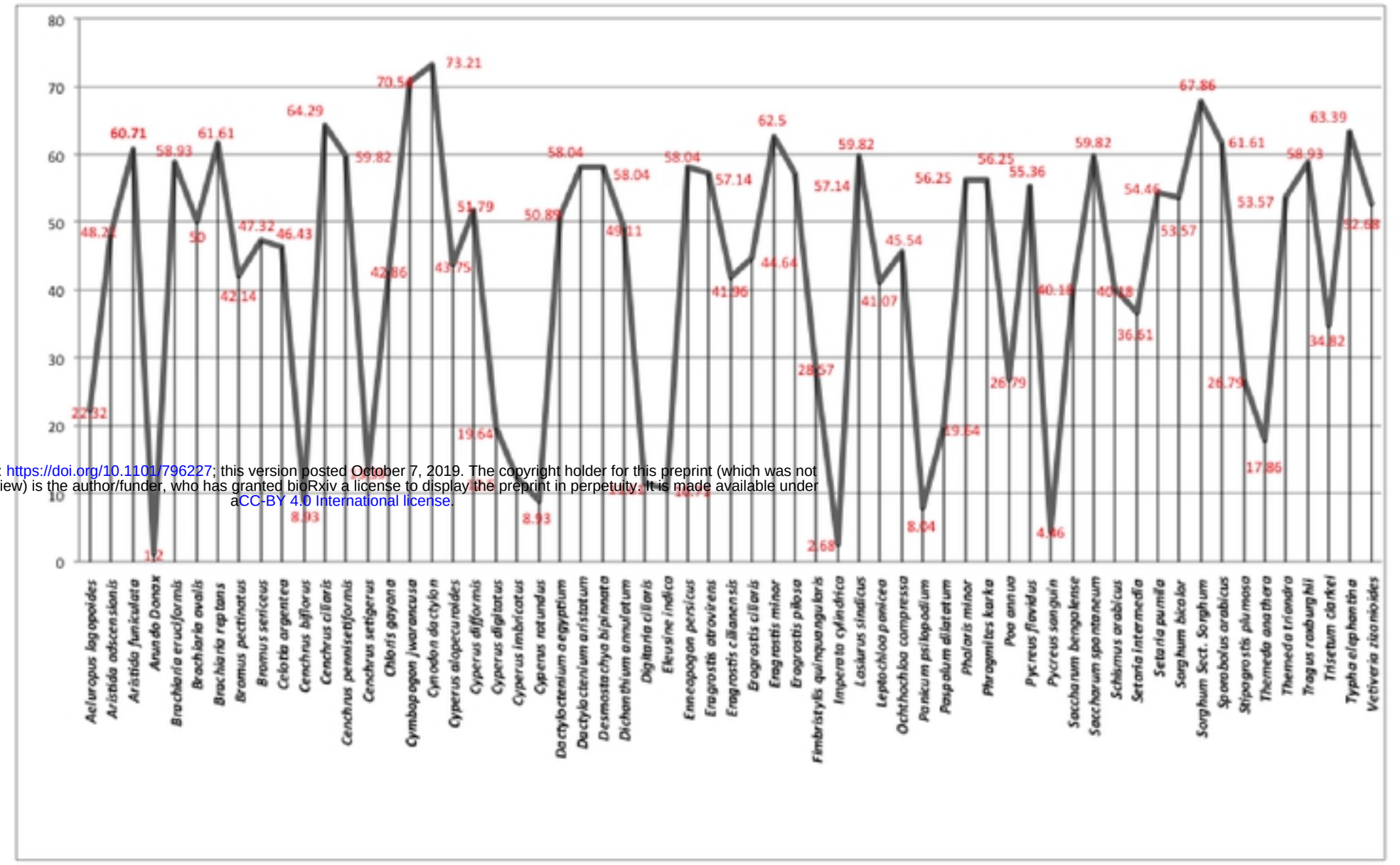
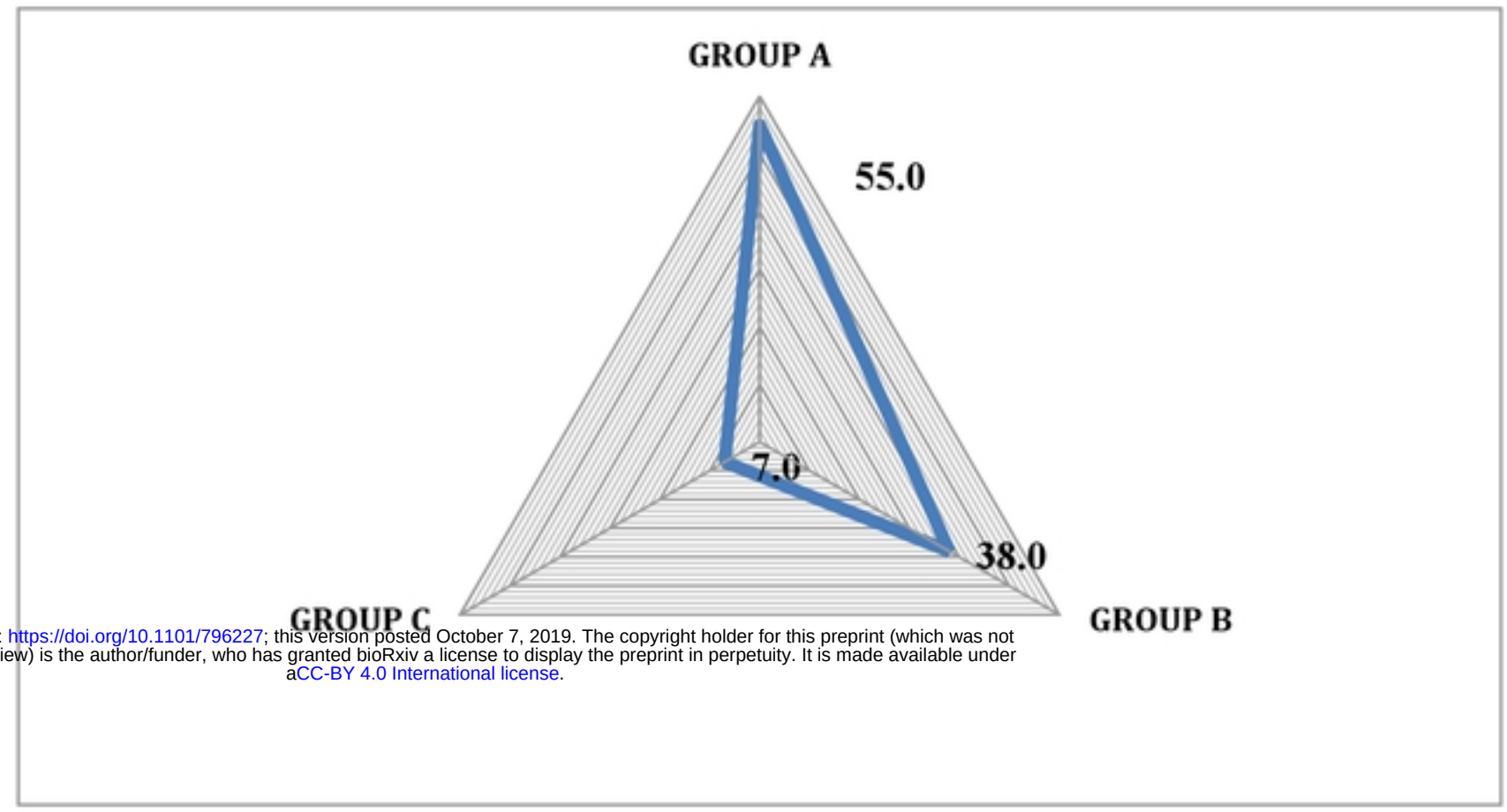
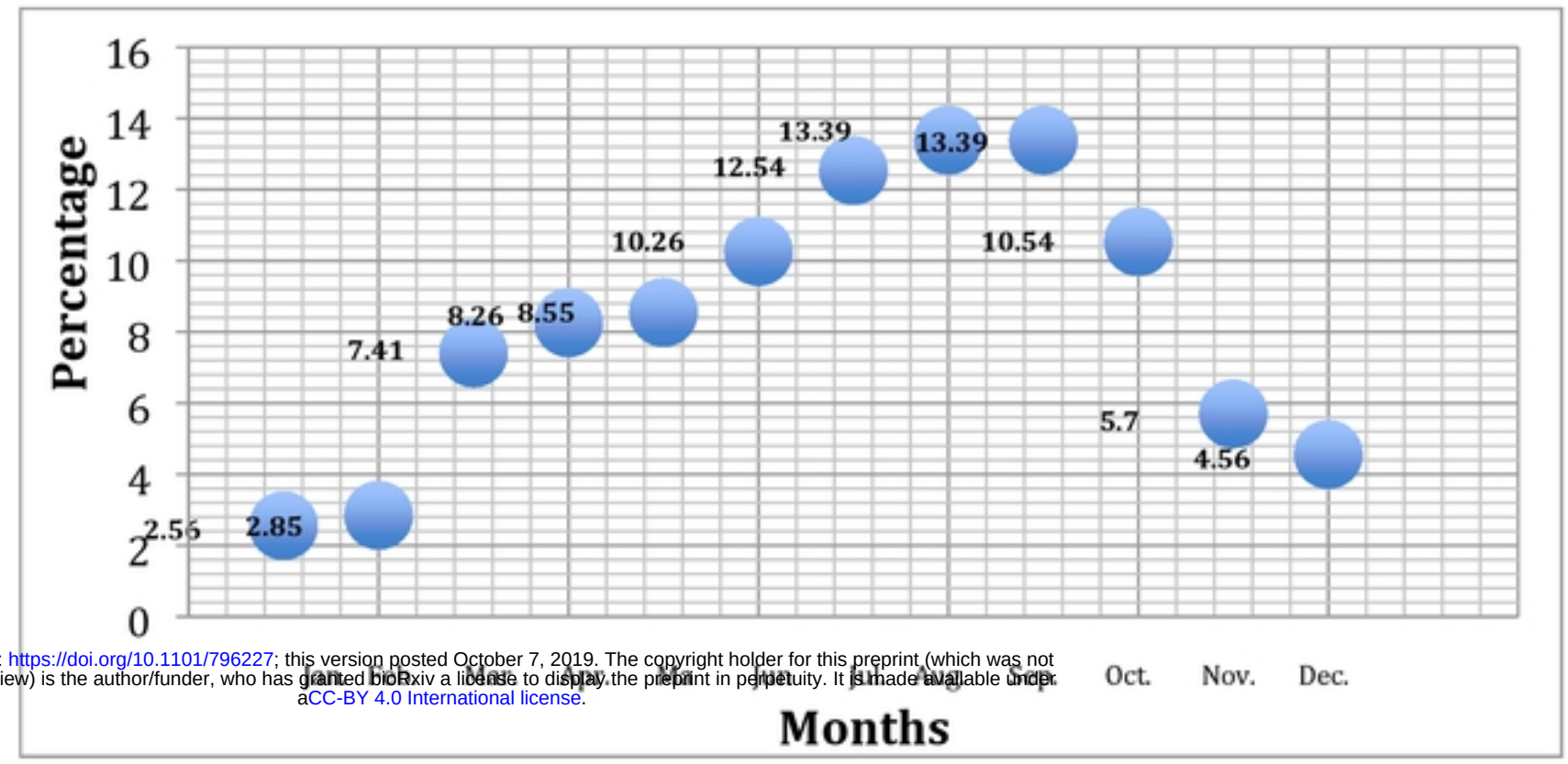


Fig. 9: Frequency of milk producing species according to informants ranking



bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Fig. 10: Percentage of species in each group



bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Fig. 11: Availability of the grasses in the study area

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

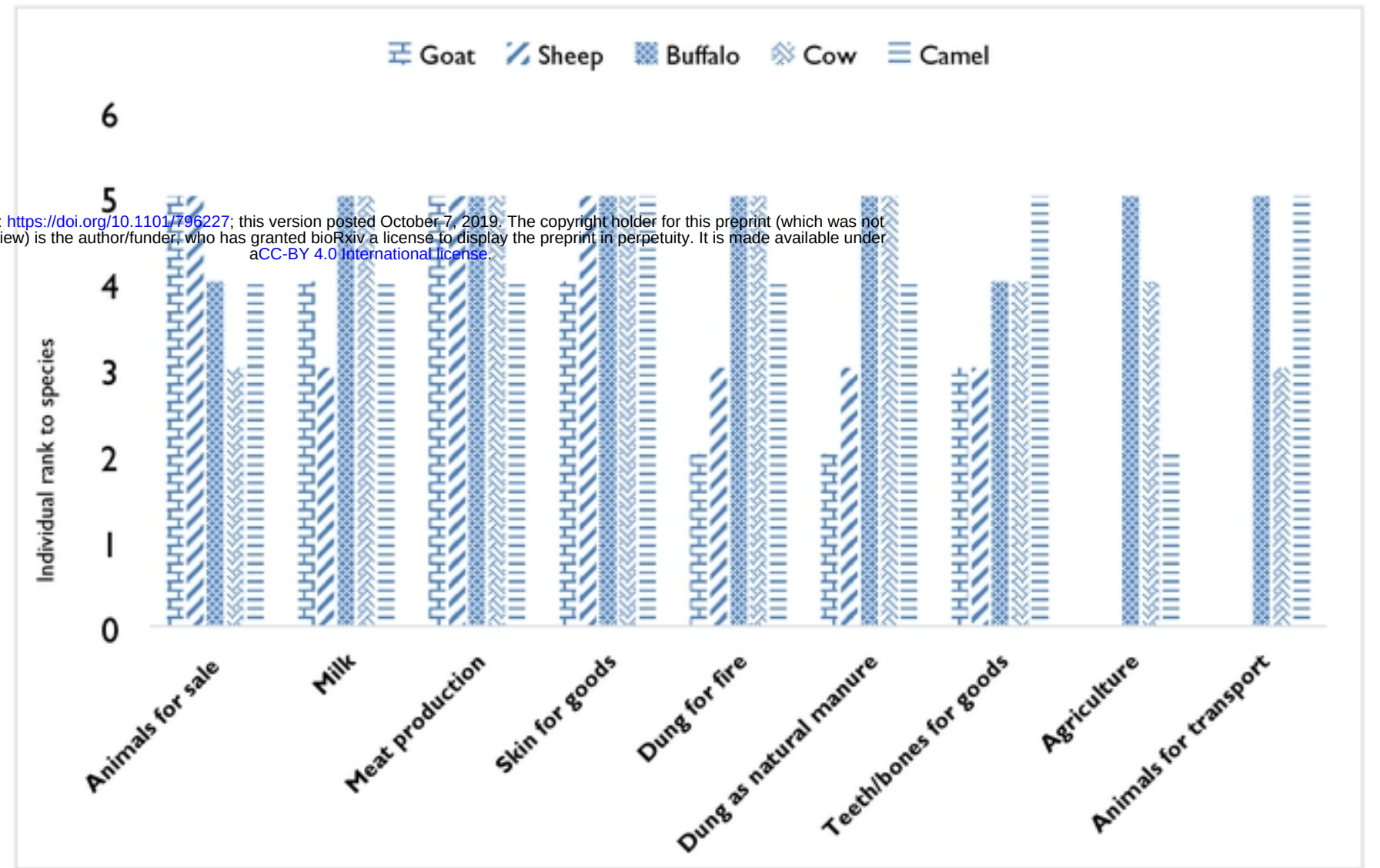


Fig. 12: People use Livestock for improving their economic life in Thal Desert

Table 1. Relative abundance categories and Coverage in the study area

Abundance scale	Abundance categories	Coverage of Grasses
	Rare (R)	<7%
1	Occasional (O)	7-10%
2	Frequent (F)	10-25%
3	Common (C)	25-55%
4	Abundant (A)	55-100%

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under a CC-BY 4.0 International license.

Table 2: Demography of informants of the study area

Type of Informants	Young aged 20-35	Middle aged 36-50	Seniors aged 51-67	Total
Local Shepherds (F)	8	19	9	36
Local Shepherds (M)	11	20	13	44
Farmed Ruminant care takers (F)	5	17	5	27
Farmed Ruminant care takers (M)	11	16	6	33
Domestic Ruminant care takers (F)	7	12	9	28
Domestic Ruminant care takers (M)	6	32	26	64
Total informants	48	116	68	232

Key: Local Shepherds (who take care cattle in the field for free grazing), Farmed Ruminant caretakers (who take care cattle in the livestock forms), Domestic Ruminant caretakers (who take care cattle in their home).

Table. 3: Pair wise ranking of wild palatable plants from all districts of Thal

S. No.	Botanical name	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	T	R
1	*Cymbopogon jwarancusa subsp. jwarancusa* (Jones) Schult.	5	5	5	5	5	5	5	5	5	3	48	1ST
2	*Cynodon dactylon* (L.) Pers.	5	4	4	5	4	4	4	5	4	4	43	2ND
3	*Cenchrus ciliaris* L.	4	3	4	4	4	5	3	4	4	4	39	3RD
4	*Typha elephantina* Roxb.	5	4	5	3	3	5	4	5	3	1	38	4TH
5	*Cyperus alopecuroides* Rottb.	4	2	3	3	4	3	5	4	2	3	33	5TH
6	*Eragrostis minor* Host	2	2	3	4	4	5	2	2	3	5	32	6TH
7	*Sporobolus arabicus* Boiss.	2	3	4	4	3	2	3	2	3	5	31	7TH
8	*Brachiaria reptans (L.) C. A. Gardner & C.E.*	1	5	4	2	3	1	0	4	5	5	30	8TH
9	*Dichanthium annulatum* (Forsk.)	1	5	4	2	3	1	0	4	5	5	30	9TH
10	*Lasiurus sindicus* Henr.	4	2	2	4	5	3	2	2	4	1	29	10TH
11	*Aristida funiculate* Trin. & Pupr.	5	4	2	3	1	0	4	5	3	2	29	10TH
12	*Cenchrus pennisetiformis* Hochst. & Steud.	1	5	4	2	3	1	0	4	5	4	29	10TH
13	*Saccharum spontaneum* L.	2	2	3	4	4	5	2	2	3	2	29	10TH
14	*Themeda triandra* Forsk.	5	4	2	3	1	0	4	5	3	2	29	10TH
15	*Pycreus flavidus* (Retz.) T. Koyama	2	3	3	2	4	1	3	2	3	5	28	11TH

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Table 4: List of the collected grasses, Ethnobotanical, Ethno veterinary data, abundance; focal persons count (FC) and relative frequency citation (RFC) of fodder grasses of area of Thal desert, Punjab Pakistan

S. No.	Family	Voucher No	Botanical name	Local name	Palatable	Fodder part	Feeding method	Ethno veterinary	Other uses	Soil ecology	RA	FC(n)	RFC
1	Cyperaceae	PMAS-AAUR-2013-320	*Cyperus alopecuroides* Rottb.				Fo	*	*	*	F	225	0.9698
2	Cyperaceae	PMAS-AAUR-2013-321	*Cyperus difformis* L.	Bhudde			Fo	*	*	*	C	161	0.6940
3	Cyperaceae	PMAS-AAUR-2013-322	*Cyperus digitatus* Roxb.	Sowe			Fo, For	*	Fuel	Soil binder	C	130	0.5603
4	Cyperaceae	PMAS-AAUR-2013-323	*Cyperus imbricatus* Retz.				Fo, For	*	*	Soil binder	F	124	0.5345
5	Cyperaceae	PMAS-AAUR-2013-324	*Cyperus rotundus* L.	Dela			Fo	* * *	* * *	Soil binder	A	123	0.5302

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

S. No.	Family	Voucher No	Botanical name	Local name	Palatable	Fodder part	Feeding method	Ethno veterinary	Other uses	Soil ecology	RA	FC(n)	RFC
													
6	Cyperaceae	PMAS-AAUR-2013-325	*Fimbristylis quinquangularis* (Vahl) Kunth	Murrakh			Fo, For	✱	✱	Soil binder	O	139	0.5991
7	Cyperaceae	PMAS-AAUR-2013-325	*Pycreus flavidus* (Retz.) T. Koyama	Sayyar Ghaah			Fo, For	✱	✱ ✱ ✱	Soil binder	O	169	0.7284
8	Cyperaceae	PMAS-AAUR-2013-327	*Pycreus sanguin* (Vahl) Nees	Ghaa			Fo	✱	✱ ✱ ✱	✱	F	122	0.5259
9	Poaceae	PMAS-AAUR-2013-328	*Aeluropus lagopoides (L.) Thwaites*	Kalar Ghaah			Fo	✱	✱ ✱ ✱	✱	A	135	0.5819
10	Poaceae	PMAS-AAUR-2013-329	*Aristida adscensionis* L	*Lamb Ghaas*			Fo, For	✱ ✱ ✱	✱	✱	A	157	0.6767
11	Poaceae	PMAS-AAUR-2013-330	*Aristida funiculata* Trin. & Pupr.	*Lamb Ghaas*			Fo, For	✱	✱	✱	A	209	0.9009
12	Poaceae	PMAS-AAUR-2013-331	*Arundo Donax* L.	Narr			Fo, For, Mf	✱ ✱ ✱	✱ ✱ ✱	✱	A	162	0.6983

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

S. No.	Family	Voucher No	Botanical name	Local name	Palatable	Fodder part	Feeding method	Ethno veterinary	Other uses	Soil ecology	RA	FC(n)	RFC
13	Poaceae	PMAS-AAUR-2013-333	*Brachiaria eruciformis* (J.E. Smith) Griseb				Fo, For	*	*	*	A	190	0.8190
14	Poaceae	PMAS-AAUR-2013-332	*Brachiaria*	Ghaah			Fo	*	* * *	*	A	160	0.6897
15	Poaceae	PMAS-AAUR-2013-334	*Brachiaria reptans* (L.) C. A. Gardner & C.E.	Ghaah			Fo, For	*	*	*	A	222	0.9569
16	Poaceae	PMAS-AAUR-2013-335	*Bromus pectinatus* Th unb.				Fo	*	* * *	*	A	140	0.6034
17	Poaceae	PMAS-AAUR-2013-336	*Bromus sericeus* Drobov				Fo	*	* * *	*	A	156	0.6724
18	Poaceae	PMAS-AAUR-2013-337	*Celotia argentea* L.	Ghaah			Fo	*	*	*		155	0.6681
19	Poaceae	PMAS-AAUR-2013-338	*Cenchrus biflorus* Roxb.	Mohabbat buti/Ludri			Fo, Mf	* * *	*	*	A	123	0.5302
20	Poaceae	PMAS-AAUR-2013-339	*Cenchrus ciliaris* L.	Drahman/ Dhaman ghaa			Fo, For	* * *	* * *	*	A	230	0.9914
21	Poaceae	PMAS-AAUR-2013-340	*Cenchrus pennisetiformis* Hochst. & Steud.	Dhamni			Fo	*	* * *	*	A	206	0.8879

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under a CC-BY 4.0 International license.

S. No.	Family	Voucher No	Botanical name	Local name	Palatable	Fodder part	Feeding method	Ethno veterinary	Other uses	Soil ecology	RA	FC(n)	RFC
22	Poaceae	PMAS-AAUR-2013-341	*Cenchrus setigerus* Vahl	Talra			Fo	* * *	* * *	Soil binder	C	125	0.5388
23	Poaceae	PMAS-AAUR-2013-342	*Chloris gayana* Kunth	Chitta ghaa			Fo	*	*	*	A	149	0.6422
24	Poaceae	PMAS-AAUR-2013-343	*Cymbopogon jwarancusa subsp. jwarancusa* (Jones) Schult.	Khavi			Fo, For, Mf	* * *	* * *	Soil binder	C	231	0.9957
25	Poaceae	PMAS-AAUR-2013-344	*Cynodon dactylon* (L.) Pers.	Talla			Fo, For	* * *	* * *	Soil binder	C	231	0.9957
26	Poaceae	PMAS-AAUR-2013-345	*Dactyloctenium aegyptium* (L.) Willd.	Madhana ghaa			Fo	* * *	*	Soil binder	C	161	0.6940
27	Poaceae	PMAS-AAUR-2013-346	*Dactyloctenium aristatum*	Madhana			Fo, For	*	*	Soil binder	A	189	0.8147
28	Poaceae	PMAS-AAUR-2013-347	*Desmostachya bipinnata* (L.) Stapf.	Dab Ghaa			Fo, Mf	* * *	* * *	Soil binder	A	188	0.8103
29	Poaceae	PMAS-AAUR-2013-348	*Dichanthium annulatum* (Forssk.) Stapf	Murgha ghaa			Fo	* * *	* * *	Soil binder	A	159	0.6853

S. No.	Family	Voucher No	Botanical name	Local name	Palatable	Fodder part	Feeding method	Ethno veterinary	Other uses	Soil ecology	RA	FC(n)	RFC
30	Poaceae	PMAS-AAUR-2013-349	*Digitaria ciliaris* (Retz.) Koel				Fo, For	*	* * *	Soil binder	F	124	0.5345
31	Poaceae	PMAS-AAUR-2013-350	*Eleusine indica* (L.) Gaertn.	Gandel ghaa			Fo	* * *	*	Soil binder	C	124	0.5345
32	Poaceae	PMAS-AAUR-2013-351	*Enneapogon persicus* Boiss.				Fo	*	*	*	A	185	0.7974
33	Poaceae	PMAS-AAUR-2013-352	*Eragrostis atrovirens* (Desf.) Trin. Ex Steud.	Ghaah			Fo, For	*	*	*	A	182	0.7845
34	Poaceae	PMAS-AAUR-2013-353	*Eragrostis cilianensis* (All.) Lut. ex F.T. Hubbard	Ghaa			Fo,F or	*	*	*	A	147	0.6336
35	Poaceae	PMAS-AAUR-2013-354	*Eragrostis ciliaris* (L.) R. Br.	Ghaa			Fo	*	*	*	A	152	0.6552
36	Poaceae	PMAS-AAUR-2013-355	*Eragrostis minor* Host	Ghaa			Fo	* * *	*	*	A	223	0.9612
37	Poaceae	PMAS-AAUR-2013-356	*Eragrostis pilosa (Linn.) P. Beauv.*				Fo, For	* * *	*	*	R	180	0.7759
38	Poaceae	PMAS-AAUR-2013-357	*Imperata cylindrica* (L.) Raeuschel.	Dab Ghaas			Fo	* * *	*	*	O	120	0.5172

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

S. No.	Family	Voucher No	Botanical name	Local name	Palatable	Fodder part	Feeding method	Ethno veterinary	Other uses	Soil ecology	RA	FC(n)	RFC
39	Poaceae	PMAS-AAUR-2013-358	*Lasiurus sindicus* Henr.	Karera			Fo, For	*	*	Soil binder	C	200	0.8621
40	Poaceae	PMAS-AAUR-2013-359	*Echinochloa panicea* (Retz.) Ohwi				Fo, Mf	*	* * *	*	C	146	0.6293
41	Poaceae	PMAS-AAUR-2013-360	*Ochthochloa compressa* (Forssk.) Hilu	Juth Madhaana/Chhimbar/Buchrighaa			Fo	*	*	Soil binder	A	154	0.6638
42	Poaceae	PMAS-AAUR-2013-361	*Panicum psilopodium* Trin.				Fo, For, Mf	*	*	Soil binder	C	123	0.5302
43	Poaceae	PMAS-AAUR-2013-362	*Paspalum dilatatum* Poir.	Ghaa			Fo	*	*	Soil binder	C	129	0.5560
44	Poaceae	PMAS-AAUR-2013-363	*Phalaris minor* Retz.	Dumbi sitti			Fo	*	*	*	F	179	0.7716
45	Poaceae	PMAS-AAUR-2013-364	*Phragmites karka* (Retz.) Trin. ex Steud.	Narr			Fo	*	* * *	*	C	177	0.7629
46	Poaceae	PMAS-AAUR-2013-365	*Poa annua* L.	Machhar ghaa			Fo	*	*	*	C	138	0.5948
47	Poaceae	PMAS-AAUR-2013-366	*Saccharum bengalense* Retz.	Saroo			Fo, For, Mf	* * *	* * *	Soil binder	O	144	0.6207

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

S. No.	Family	Voucher No	Botanical name	Local name	Palatable	Fodder part	Feeding method	Ethno veterinary	Other uses	Soil ecology	RA	FC(n)	RFC
													
48	Poaceae	PMAS-AAUR-2013-367	*Saccharum spontaneum* L.	Saroo			Fo, For, Mf	✱ ✱ ✱	✱ ✱ ✱	Soil binder	O	199	0.8578
49	Poaceae	PMAS-AAUR-2013-368	*Schismus arabicus* Nees	Ghaa			Fo	✱	✱	Soil binder	A	143	0.6164
50	Poaceae	PMAS-AAUR-2013-369	*Setaria intermedia* Roem. & Schult				Fo	✱	✱	Soil binder	A	142	0.6121
51	Poaceae	PMAS-AAUR-2013-370	*Setaria pumila* (Poir.) Roem. & Schult				Fo	✱	✱	Soil binder	F	169	0.7284
52	Poaceae	PMAS-AAUR-2013-371	*Sorghum bicolor* (Linn.) Moench.	Milo			Fo, For, Mf	✱ ✱ ✱	✱ ✱ ✱	✱	A	169	0.7284
53	Poaceae	PMAS-AAUR-2013-372	*Sorghum* Sect. *Sorghum* Subsect. *Arundinacea Moench.*	Milo			Fo, Mf	✱	✱ ✱ ✱	✱	A	150	0.6466
54	Poaceae	PMAS-AAUR-2013-373	*Sporobolus arabicus* Boiss.				Fo	✱	✱ ✱ ✱	✱	A	219	0.9440
55	Poaceae	PMAS-AAUR-2013-374	*Stipagrostis plumosa* (Linn.) Munro ex T.	Chita gah			Fo	✱	✱	Soil binder	F	137	0.5905
56	Poaceae	PMAS-AAUR-2013-375	*Themeda anathera*				Fo, For	✱	✱	✱	F	126	0.5431

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

S. No.	Family	Voucher No	Botanical name	Local name	Palatable	Fodder part	Feeding method	Ethno veterinary	Other uses	Soil ecology	RA	FC(n)	RFC
													
57	Poaceae	PMAS-AAUR-2013-376	*Themeda triandra* Forsk.				Fo, For	*	*	*	R	167	0.7198
58	Poaceae	PMAS-AAUR-2013-377	*Tragus roxburghii* Panigrahi	Ghaa			Fo	*	* * *	*	A	192	0.8276
59	Poaceae	PMAS-AAUR-2013-378	*Trisetum clarkei* (Hook. f.) R. Steudel				Fo	*	*	Soil binder	R	142	0.6121
60	Poaceae	PMAS-AAUR-2013-379	Vetiveria zizanioides (Linn.) Nash				Fo, For	*	*	*	R	118	0.5086
61	Typhaceae	PMAS-AAUR-2013-380	*Typha elephantina* Roxb.	Kundar			Fo, For, Mf	*	* * *	*	F	227	0.9784

Whole plant  **Leaves**  **Areal parts**  **Juvenile stage**  **, Cow**  **, Buffalo**  **, Goat**  **, Sheep**  **, Camel**  **, Rabbit**  **, Porcupine** 

*****
*****

Yes *****, **NA ***, Fo, Fodder, For, Forage, Mf, Mix with feed, Goat, RA Relative abundance, A Abundant, C Common, F Frequent, O Occasional, R Rare

Table 5: Pairwise comparison (PWC) base on similar RFC vales of fodder grasses

Fodder grasses	Total gained % points	Rank
GROUP A (RFC =0.9957-0.9009)		
Cymbopogon jwarancusa subsp. jwarancusa	88.2	1st
Typha elephantina	87.3	2nd
Cynodon dactylon	87.1	3rd
Cenchrus ciliaris	85.1	4th
Cyperus alopecuroides	84	5th
GROUP B (RFC =0.8879-0.8103)		
Cenchrus pennisetiformis	72.5	1st
Lasiurus sindicus	63.5	2nd
Saccharum spontaneum	62.4	3rd
Tragus roxburghii	60.9	4th
GROUP C (RFC =0.7974-0.6940)		
Enneapogon persicus	77.9	1st
Eragrostis atrovirens	76.8	2nd
Eragrostis pilosa	72.1	3rd
Phalaris minor	70.1	4th
Phragmites karka	61.1	5th
GROUP D (RFC =0.6897-0.6121)		
Brachiaria ovalis	72.1	1st
Dichanthium annulatum	60.3	2nd
Aristida adscensionis	59.9	3rd
Bromus sericeus	58.7	4th
Celotia argentea	55.9	5th
GROUP E (RFC =0.6034-0.6)		
Bromus pectinatus	92.8	1st
Fimbristylis quinquangularis	90.5	2nd
Poa annua	85.2	3rd
Stipagrostis plumosa	76.9	4th
GROUP F (RFC =0.5431-0.5086)		
Themeda anathera	59.1	1st
Cenchrus setigerus	55.6	2nd
Cyperus imbricatus	54.9	3rd
Digitaria ciliaris	52.3	4th

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Table 6: Frequency analysis for palatability, parts used for eating and feeding methods and relative abundance of fodder grasses

Studied parameters	Frequency	Valid percent	Cumulative percent
Co, Bu, Sh, Go, Ra	1	1.64	1.64
Co, Bu, Sh, Go	6	9.84	11.48
Co, Bu, Sh, Go, Ra	4	6.56	18.03
Go, Sh, Co	3	4.92	22.95
Go, Sh	20	32.79	55.74
Go, Sh, Co, Cm	1	1.64	57.38
Co, Bu, Sh, Go, Cm	11	18.03	75.41
Bu, Sh, Go	1	1.64	77.05
Co, Bu,	3	4.92	81.97
Go	9	14.75	96.72
Sh	2	3.28	100
Total	**61**	**100**	
Whole plant	42	68.85	68.85
Leaves	4	6.56	75.41
Juvenile	2	3.28	78.69
Aerial, whole plant at Juvenile	1	1.64	80.33
Aerial, Juvenile	2	3.28	83.61
Aerial and leaves	2	3.28	86.89
Aerial	8	13.11	100.00
Total	**61**	**100**	
Fo	31	50.82	50.82
Fo,For, Mf	7	11.48	62.30
Fo, Mf	21	34.43	96.72
Fo,Mf	2	3.28	100.00
Total	**61**	**100**	
Abundant	30	49.18	49.18
Common	13	21.31	70.49
Frequent	9	14.75	85.25
Occasional	5	8.20	93.44
Rare	4	6.56	100
Total	**61**	**100**	

Key: Co (Cow), Bu (Buffalo), Sh (Sheep), Go (Goat), Ra (Rabbit), Cm (Camel), Fo (Fodder), For (Forage) , Mf (Mix Fodder)

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Table 7: Results of ANTHROPAC analysis of overall salience index of milk producing species

S. No.	Botanical name	Inverted Rank/Total Listed = Smith,s Salience Index (SS1)	(SS2)	(SS3)	(SS4)	(SS5)	(SS6)	(SS7)	(SS8)	(SS9)	(SS10)	Illness Σ	Composite Salience Σ/n (n = 10)
1	*Cynodon dactylon*	1		0.96		0.9	0.883		1	0.867	0.85	6.46	0.6460
2	*Cymbopogon jwarancusa*	0.933	1		1	0.15		0.3	0.883		0.867	5.133	0.5133
3	*Sorghum* Sect. *Sorghum*	0.96	1.00		0.82	0.67	0.4	0.4	0.21	0.34	0.321	5.121	0.5121
4	*Cenchrus ciliaris*	0.933		0.75	0.933	0.42	0.51	0.51		0.4	0.15	4.606	0.4606
5	*Typha elephantina*	0.933	0.96	0.321	0.05	0.75	0.3	0.152	0.04	0.321	0.058	3.885	0.3885
6	*Eragrostis minor*	0.867		0.34		0.867	0.82		0.017	0.82		3.731	0.3731
7	*Brachiaria reptans*	0.62	0.72	0.321	0.05	0.75	0.3	0.152	0.04	0.321	0.058	3.332	0.3332
8	*Dactyloctenium aegyptium*	0.0432	0.054	0.651	0.783		0.017		0.532		0.33	3.279	0.3279
9	*Aristida funiculata*		0.82	0.67			0.083	0.768		0.083	0.833	3.257	0.3257
10	*Cenchrus pennisetiformis*	0.833		0.767	0.096	0.073		0.767	0.096	0.073	0.767	3.472	0.3472
11	*Lasiurus sindicus*	0.076	0.017	0.8	0.0764	0.0432	0.054	0.098	0.76	0.87	0.0973	2.8919	0.2892
12	*Saccharum spontaneum*	0.767	0.82	0.67		0.017			0.3	0.152	0.04	2.766	0.2766
13	*Tragus roxburghii*	0.021	0.02	0.031	0.768	0.8	0.0764	0.017	0.767	0.096	0.017	2.6154	0.2615
14	*Brachiaria eruciformis*	0.769	0.767	0.096	0.073	0.083	0.098	0.063	0.65			2.599	0.2599
15	*Dactyloctenium aristatum*		0.017	0.767	0.096	0.073	0.57	0.767	0.096	0.017		2.403	0.2403
16	*Desmostachya bipinnata*	0.733		0.82	0.67		0.017			0.083		2.323	0.2323
17	*Enneapogon persicus*			0.734	0.083	0.15	0.07	0.0631	0.023	0.421	0.51	2.0541	0.2054
18	*Eragrostis atrovirens*	0.735	0.03	0.042	0.15	0.768	0.12	0.032	0.027	0.053	0.0564	2.0154	0.2015
19	*Eragrostis pilosa*	0.0432	0.054	0.15	0.076	0.217	0.717	0.021	0.52	0.031	0.096	1.9252	0.1925
20	*Phalaris minor*	0.8	0.0764	0.017		0.083	0.033	0.05	0.032	0.083	0.7	1.8744	0.1874
21	*Phragmites karka*	0.701	0.01	0.023	0.74	0.15	0.07	0.0631	0.023		0.032	1.8161	0.1816
22	*Pycreus flavidus*			0.683	0.096	0.01	0.023	0.23	0.7	0.032	0.027	1.805	0.1805
23	*Setaria pumila*	0.65		0.15	0.07	0.0631		0.7	0.07	0.0631	0.023	1.7892	0.1789
24	*Sorghum bicolor*	0.0764	0.0432	0.054	0.651	0.217	0.15	0.07	0.0631	0.017	0.437	1.7787	0.1779
25	*Themeda triandra*					0.68	0.076	0.23	0.117	0.021	0.652	1.776	0.1776
26	*Vetiveria zizanioides*			0.617		0.15	0.07	0.0631	0.7			1.6001	0.1600
27	*Cyperus difformis*	0.6			0.0432	0.054	0.15	0.076	0.217		0.43	1.5702	0.1570
28	*Dactyloctenium aegyptium*	0.0432	0.054	0.651	0.567		0.0764	0.017		0.027	0.07	1.5056	0.1506
29	*Brachiaria ovalis*	0.13	0.51		0.0764	0.0432	0.054	0.651		0.017		1.4816	0.1482
30	*Dichanthium annulatum*	0.132	0.242	0.517	0.15	0.076	0.017	0.15	0.07	0.0631	0.023	1.4401	0.1440
31	*Aristida adscensionis*	0.5	0.142		0.251	0.217		0.01	0.023	0.23	0.017	1.394	0.1394
32	*Bromus sericeus*		0.054		0.45			0.083	0.054	0.051	0.567	1.259	0.1259
33	*Celotia argentea*	0.433				0.0432	0.054	0.051	0.567		0.0764	1.2246	0.1225
34	*Ochthochloa compressa*	0.076	0.23	0.4	0.071		0.083	0.0764		0.0432	0.054	1.0336	0.1034
35	*Eragrostis ciliaris*	0.367		0.076	0.23	0.14	0.07		0.15	0.083		1.116	0.1116
36	*Cyperus alopecuroides*		0.251		0.333	0.0432	0.054	0.051	0.05	0.025	0.142	0.9492	0.0949
37	*Chloris gayana*	0.3	0.142	0.071		0.01	0.023	0.23	0.017	0.0631	0.023	0.8831	0.0883
38	*Eragrostis cilianensis*	0.051		0.083	0.076	0.023	0.4	0.071	0.051	0.05		0.805	0.0805

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under a CC-BY 4.0 International license.

S. No.	Botanical name	Inverted Rank/Total Listed = Smith,s Salience Index (SS1)	(SS2)	(SS3)	(SS4)	(SS5)	(SS6)	(SS7)	(SS8)	(SS9)	(SS10)	Illness Σ	Composite Salience Σ/n (n = 10)
39	*Leptochloa panicea*	0.284	0.026	0.0432	0.054		0.14	0.07	0.083	0.054	0.033	0.7872	0.0787
40	*Saccharum bengalense*	0.02	0.0710	0.055	0.046	0.0532	0.064	0.25	0.01	0.083	0.054	0.7142	0.0714
41	*Schismus arabicus*	0.2			0.061		0.05	0.083	0.076	0.023	0.22	0.713	0.0713
42	*Setaria intermedia*	0.055	0.067		0.183		0.0132	0.211	0.071	0.051	0.05	0.7012	0.0701
43	*Trisetum clarkei*	0.167		0.233	0.0432	0.054	0.026	0.0432	0.054	0.011	0.04	0.6714	0.0671
44	*Bromus pectinatus*		0.14	0.15			0.017	0.117	0.15	0.076	0.017	0.667	0.0667
45	*Fimbristylis quinquangularis*	0.151		0.0432		0.046	0.0532	0.064	0.25	0.017		0.6244	0.0624
46	*Poa annua*	0.071	0.051	0.05		0.017	0.233	0.0432	0.152			0.6172	0.0617
47	*Stipagrostis plumosa*	0.117		0.017	0.071	0.051	0.05	0.017		0.233	0.0432	0.5992	0.0599
48	*Aeluropus lagopoides*	0.055	0.161	0.0432	0.054	0.011	0.033	0.055	0.026	0.0432	0.054	0.5354	0.0535
49	*Cyperus digitatus*	0.1	0.023	0.046	0.0532		0.064		0.05	0.0710	0.055	0.046	0.5082	0.0508
50	*Paspalum dilatatum* Poir.	0.032	0.042	0.217	0.102		0.046		0.046	0.017		0.502	0.0502
51	*Themeda anathera*	0.0432	0.054	0.011	0.033	0.25			0.083			0.4742	0.0474
52	*Cenchrus setigerus*	0.0432	0.054	0.017	0.0432	0.054	0.071	0.051	0.05		0.084	0.4674	0.0467
53	*Cyperus imbricatus*		0.051		0.067		0.071	0.051		0.0432	0.152	0.4352	0.0435
54	*Digitaria ciliaris*						0.067	0.233	0.0432	0.054	0.026	0.4232	0.0423
55	*Eleusine indica*	0.05	0.0432	0.233			0.026		0.054			0.4062	0.0406
56	*Cyperus rotundus*	0.01		0.05	0.017	0.071	0.011	0.033	0.055	0.0710	0.055	0.373	0.0373
57	*Cenchrus biflorus*	0.033	0.017	0.0432	0.054	0.011	0.054	0.064	0.0432	0.017	0.011	0.3474	0.0347
58	*Panicum psilopodium*	0.033	0.017	0.071	0.051	0.05		0.033	0.033	0.033		0.321	0.0321
59	*Pycreus sanguin*	0.011	0.031	0.055	0.0110	0.023	0.011	0.033	0.055	0.0710	0.017	0.318	0.0318
60	*Imperata cylindrica*	0.017		0.033		0.011		0.046	0.0532	0.064	0.055	0.2792	0.0279
61	*Arundo Donax*	0.018			0.071	0.051	0.05		0.042	0.017		0.249	0.0249

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

bioRxiv preprint doi: https://doi.org/10.1101/802227. this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Table 8: Grasses use in Ethno- veterinary and Ethnobotanical

S. No.	Botanical name	Ethnobotanical Uses	Ethno veterinary uses
1	*Aeluropus lagopoides* (L.) *Thwaites*	Fuel	---
2	*Aristida adscensionis* L	---	Controls itching
3	*Arundo Donax L.*	---	Gastrointestinal
4	*Arundo Donax L.*	Fencing, inkpot pen, hollow stem for announcement	---
5	*Brachiaria ovalis* Stapf	Fuel	---
6	*Bromus pectinatus* Thunb.	Fuel	---
7	*Bromus sericeus* Drobov	Fuel	---
8	*Cenchrus biflorus* Roxb.	---	Diuretic
9	*Cenchrus ciliaris* L.	Fuel	Diuretic
10	*Cenchrus pennisetiformis* Hochst. & Steud.	Fuel	---
11	*Cenchrus setigerus* Vahl	Fuel	Diuretic
12	*Cymbopogon jwarancusa subsp. jwarancusa* (Jones) Schult.	Fumigant for measles, matrices (Chatai) for typhoid, root extract for typhus fever and cough, Seeds for chicken pox, roof thatching, roots khass for washing domestic pots/utensils	Fumigant for skin diseases, fragrance in milk, Diuretic and improve fertility in bull
13	*Cynodon dactylon* (L.) Pers.	Remove pimples, feet burning sensation, fever	Paste of leaves controls dysentery and anti-inflammatory to wounded areas of animal's body
14	*Cyperus digitatus* Roxb.	Fuel	---
15	*Cyperus rotundus* L.	Fuel	Antidiarrheal and gur function stabilizer
16	*Dactyloctenium aegyptium* (L.) Willd.	---	Used to reduce after birth abdominal pains
17	*Desmostachya bipinnata* (L.) Stapf.	Broom making, Fuel	Digestive disorders, Dysentery
18	*Dichanthium annulatum* (Forssk.) Stapf	Fuel	Digestive disorders
19	*Digitaria ciliaris* (Retz.) Koel	Fuel	
20	*Eleusine indica* (L.) Gaertn.	---	Cure digestive disorders
21	*Eragrostis minor* Host	---	Digestive disorders

S. No.	Botanical name	Ethnobotanical Uses	Ethno veterinary uses
22	*Eragrostis pilosa (Linn.) P. Beauv.*	---	Help to cure contusion
23	*Imperata cylindrica* (L.) Raeuschel.	---	Fumigant for Piles
24	*Leptochloa panicea* (Retz.) Ohwi	Fuel	---
25	*Phragmites karka* (Retz.) Trin. ex Steud.	Writing pen (Qalam) trunk, thatching of roof, and fuel source, shoes making	---
26	*Pycreus flavidus* (Retz.) T. Koyama	Fuel	---
27	*Saccharum bengalense* Retz.	Culms used for making matrices, chairs (Morrhe), hand fan, cages (Pinjra), brooms (Jhaaru), etc. Leaves used for making matrices (Chatai). Leaf sheaths beaten to make strong ropes (Rassi)	Leaves used to treat oral problems of ruminants
28	*Saccharum spontaneum* L.	Leaves Decoction for stoppage of urination (Micturition),fuel, culm used for making cages, roof thatching (Patalan) and ornamental goods. Leaves woven to make matrices	Root help to relieve in inflammation and urinary problems
29	*Sorghum bicolor* (Linn.) Moench.	Fuel	Wounds, fever, anemia and constipation
30	*Sorghum* Sect. *Sorghum* Subsect. *Arundinacea Moench.*	Fuel	---
31	*Sporobolus arabicus* Boiss.	Fuel	---
32	*Tragus roxburghii* Panigrahi	Fuel	---
33	*Typha elephantina* Roxb.	Fuel, roof thatching, ropes, matrices, inflorecese medicinally importance and shoes making	---

bioRxiv preprint doi: https://doi.org/10.1101/796227; this version posted October 7, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.