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MINISTRY OF LIVESTOCK, FORESTRY AND RANGE

DEUTSCHE GESELLSCHAFT FÜR TECHNISCHE ZUSAMMENARBEIT

CENTRAL RANGELANDS DEVELOPMENT PROJECT

- VETERINARY COMPONENT -

A PROJECT OF SOMALI - GERMAN TECHNICAL COOPERATION

Report 29: TECHNICAL REPORT
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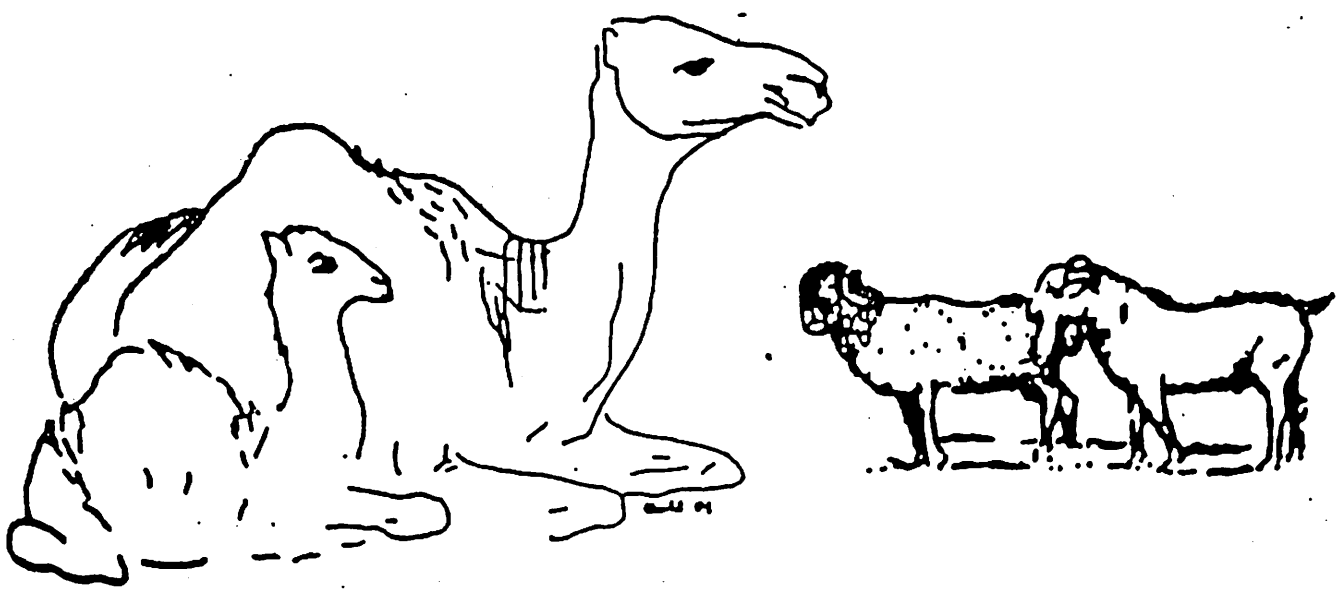
RANGE UNIT CLASSIFICATION AND FODDER RESOURCES IN THE WESTERN PARTS OF THE CENTRAL RANGELANDS OF SOMALIA.

A CONCEPT TO CALCULATE RANGE CAPACITY

January 1991



Geerida haween guud la feero iyo guursi laga qaad
(the death of a wife will cause a new marriage)

geerideydana guud lagooyiyo gablan laga qaad
(my death will cause sorrow and hair shaving)

geeridaadana gaawo maran iyo gaajo laga qaad
(your death - his female camel - will cause
empty vessels and famine)

(Somali poem)

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RANGE UNIT CLASSIFICATION AND FODDER RESOURCES IN THE WESTERN PARTS OF THE CENTRAL RANGELANDS OF SOMALIA.

A CONCEPT TO CALCULATE RANGE CAPACITY

I. INTRODUCTION

Somalia, classified as one of the "Most Seriously Affected Countries" (MSAC)[1] with a very low economic potential (GNP 1983: 250 US $ per inhabitant)[2], is located in mainly arid and vulnerable environments. The country's export volume has greater dependence upon a livestock economy than anywhere else in the world. International projects dealing with animal production and range management are upholding the important task of searching for strategies of land use, which combine the demand for balance and preservation with the need for increasing the production potential. In this conflict of interests the mothods of range evaluation are important in that they determine the framework in which acitvities can be planned, ensuring natural compatibility in the long run.

Within the context of the GTZ veterinary project in the Central Rangelands the necessity to combine both aspects of range management planning has been realized. Research on the available range resources was treated as an important component of any supporting measures, because it seemed reasonable to evaluate the land's carrying capacity in preparation for the influence of medical treatment upon herd growth parameters. The aim was to illuminate medical intervention from an environmental point of view and to define those natural constraints which limit the projects scale of effectiveness. Therefore a field study was carried out during 1989 concerning the problem of

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[1] Statistischer Länderkurzbericht 1986

[2] ibenda 1986

carrying capacity in the Central Rangelands of Somalia[3]. With respect to the actual situation in those areas used by nomads the following points were decided upon as relevant and realistically obtainable steps for calculating the areas potential for use :

1. Differentiation of environmental range units (RU), focussing on the criteria: soil type, topography, vegetation composition and vegetation cover.
2. Calculation of the potential biomass production per RU.
3. Identification of those parts of total biomass production, which are palatable and fodder available - calculated per season and RU, separately for the different species of livestock (in kg per ha-RU, or in grazing days / stock / RU).
4. Chemical analyses of the fodder plants and comparison of their nutritive value with the needs of animals.
5. Range condition survey to fit the actual (1989) situation into a temporary continuity of the last years.
6. Interviews on aspects of traditional range management and the actual household economy to search for opportunities for the improvement of marketing and management strategies.

This preliminary report deals with points 1 - 4. It is separated into two parts which are dealing with distinct, but closely connected topics. To avoid repetition, methodology and the presentation of results are described only in places where they seem to be most relevant. Therefore some variation in the style of presentation is unavoidable. In Part I the concept of "range unit classification" is defined and discussed. The spatial area of study is characterized, differentiated and mapped. In Part II the methods of data collection and the procedure of range resource calculation are introduced. For each range unit a figure is offered, which demonstrates the 1989 range potential. Finally the actual proportion of proper use is given, which stands as a

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[3] This study was financed with the generous support of the German Academic Exchange Service and the University of Freiburg.

starting point for further considerations concerning the areas carrying capacity during 1989. The role of leaf litter in the consumption of animals during the dry season is raised and discussed. The suitability and adaptation of the different kinds of livestock to the Somali thornbush savanna is shown and the evidence for the concept of calculating carrying capacity only by means of standardized " TLU " is questioned.

PART I

THE STUDY AREA AND THE RANGE UNIT CLASSIFICATION

In chapter one the unifying features and the vegetation of the study area will be presented. Chapter two offers the method of range unit differentiation, the results and a discussion. The third chapter leads over into a detailed description of the study area presented as a comparison of the defined range units.

1. DESCRIPTION OF THE STUDY AREA

The study area which coincides with the districts Dhuusamaareeb, Balan Bale and partly Mataban is located in Central Somalia from 45°30' to 46°50' E longitude, lying between 5°- 6°20' N latitude, adjacent to the Ethiopian border (map no.1).

Unifying features of the area are:

- a bimodal and unreliable rainfall (coefficient of annual variation: 60 - 70 %), ranging between 100 - 250 mm per year; The 1989 rainfall distribution is documented in figure 1
- an average annual temperature of 28°C with a small monthly range of ± 4° C, and a mean monthly windspeed of 2 - 3 km/h which increases to 4 - 5 km/h during the southwestern monsoon
- a relative humidity at 8 a.m of about 75% and of 55-65 % by 2 p.m. with a local monthly range of ± 4 % , and a level of evapotranspiration which, based on Penmans equation, is around 180 mm/mo.

(FEWSD 1988; Griffiths 1972; FAO 1977; Hunt 1951).

- the area is part of a paleoclimatic and pleistocene denuded scarp landscape, which is gently sloping from W/NW to E/SE. Today there is no distinct macro relief left. The difference in altitude decreases over the distance of 100 km from 430 to 230 m. (Merla 1979; Drechsel 1986; RMR 1982).
- With the exception of the continental Jesomma sandstones, only marine sediments of Upper Jurassic to Middle Eocene limestones, gypsum and anhydrites occur in the study region. Large areas are covered to varying degrees by consolidated red to pale sands. Often the bedrock forms outcroppings. (Drechsel 1986)
- a deciduous range plant population of 90 - 95 %.
- a use of land based exclusively upon nomadic pastoralism.

Table 1 offers a list of 200 of the most important range plants. The list is organized according to the method of "Importance value" (Whittaker 1970 & Curtis 1959, in: Mueller-Dombois Ellenberg 1974)[4]. Although anticipating the method of vegetation analyses it seems useful to offer this list here, because it demonstrates the dishomogeneity of the plant composition (Column: Frequency) before classifying the area into range units. Only 4 plants come up to the 50 % frequency, the value taken as threshold for the criteria of "constant" plants. This rate prohibits a uniform treatment of the area in terms of range resources (Comparison in chapter I. 2.3.)

In conclusion it can be said, that differences in the rangelands are primarily determined by the distribution pattern of soils and changing plant communities. A mosaic of different range units is created, which is characterized by unique combinations of dominant and subdominant species, various production potentials and changing range conditions. (Hemming 1972; RMR 1982; Drechsel 1986; Kuchar 1989)

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[4] The information about the methods of collection is presented only once in Part II. 1, to avoid too many repetitions.

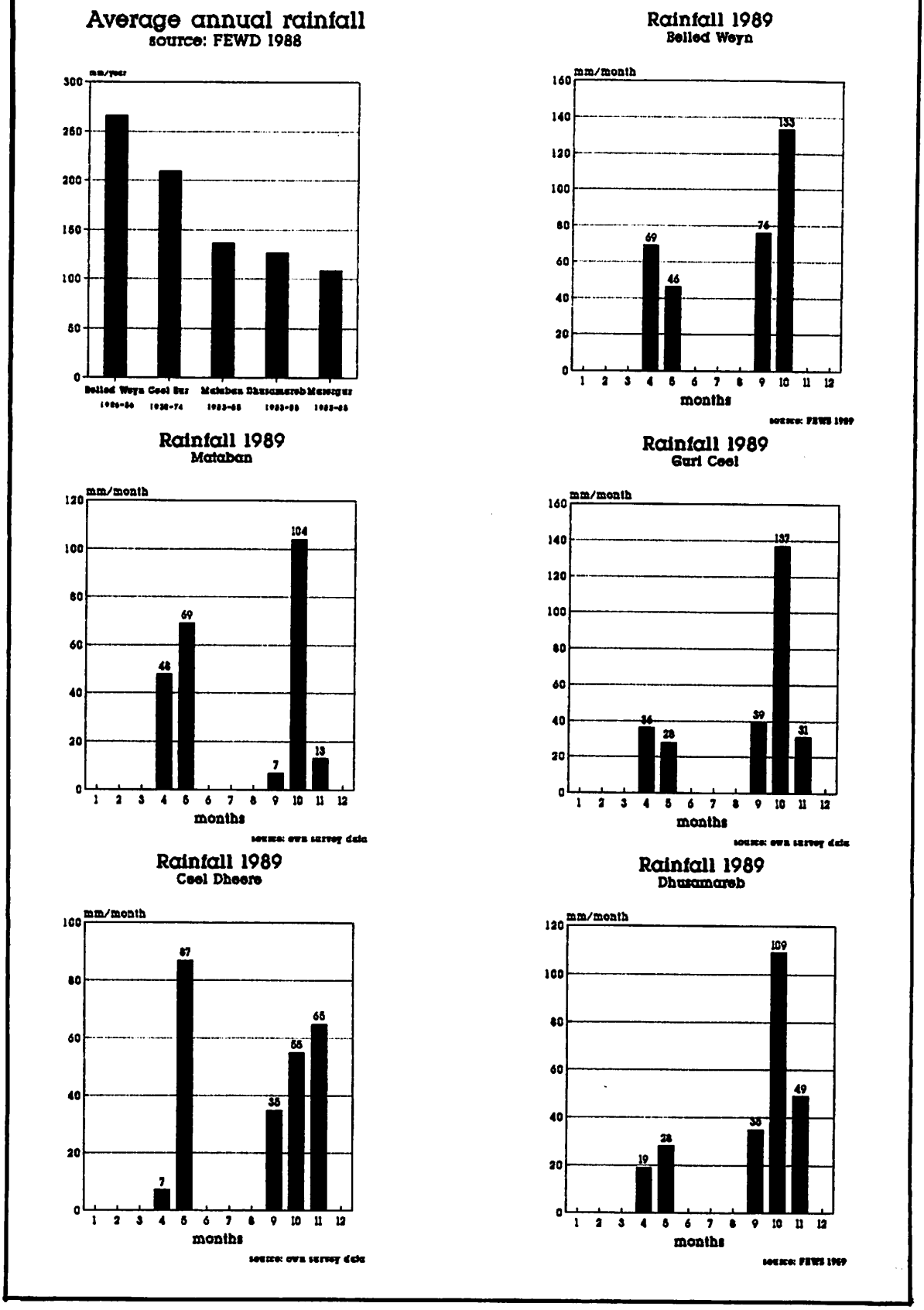

figure 1 : Average annual rainfall and 1989 rainfall data

table 1 :

Vegetation distribution and importance value

SOM. PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute frequency	Relative density	Relative dominance	Relative frequency	Importance value
JILAB	INDIGOFERA RUSPOLII	dS	3.71	63.64	12.99	8.82	3.28	25.09
KABGAL	TRIUMFETTA HETEROCARPA	dS	2.12	60.91	10.01	5.06	3.14	18.20
KURA	ACACIA TORTILIS	aT *	4.69	45.45	0.20	11.16	2.34	13.70
DHUROD	MELHANIA spp.	wF *	0.47	40.00	7.72	1.11	2.06	10.89
GO	INDIGOFERA ?INTRICATA	dS	0.68	30.00	7.32	1.63	1.55	10.49
NAGARDHEEB	PLEUROPTHERANTA REVOILII	dS	1.53	58.18	3.31	3.65	3.00	9.97
TIMOFAHIYE	PAVONIA PIROTTAE	wF	0.11	57.27	6.69	0.26	2.95	9.91
NAGARAWR / FARO YAR	INDIGOFERA SPINOSA	adS	0.55	28.18	6.83	1.30	1.45	9.58
QODAXTOOL	BLEPHARIS spp.	awF *	0.14	37.27	3.93	0.33	1.92	6.18
GABRAR	COMMIPHORA HORRIDA	adT	1.22	46.36	0.29	2.91	2.39	5.60
DHAAYODHABE	PAVONIA ARABICA	wF	0.08	31.82	3.71	0.19	1.64	5.54
NAGARXEYLEY	HIBISCUS spp.	wF	0.09	37.27	3.09	0.22	1.92	5.23
JEERIN	ACACIA EDGEWORTHII	aS	1.24	34.55	0.45	2.95	1.78	5.18
SARMAAN	ACACIA HORRIDA	aS	1.41	30.91	0.20	3.36	1.59	5.15
GOGOBO	IPHIONA ROTUNDIFOLIA	dS *	0.96	31.82	1.06	2.29	1.64	4.99
DHIRINDHIR	EUPHORBIA CUNEATA	aS	0.81	40.00	0.44	1.94	2.06	4.44
NAGARJABTO	HELIOTROPIUM spp.	wF	0.15	45.45	1.44	0.37	2.34	4.15
GUNRAY	COMMIPHORA GURREH	-cT	1.27	13.64	0.04	3.02	0.70	3.76
BUULALOOD	IPOMOEA DONALDSONII	aS	0.48	40.91	0.32	1.15	2.11	3.57
YAMAARUG / KAXAR	BLEPHARIS CILIARIS	anF	0.01	18.18	2.41	0.03	0.94	3.38
DAFURUUR	GREWIA TENAX	S	0.34	42.73	0.13	0.80	2.20	3.14
RAXANREB	COMMIPHORA INCISA	acS	0.77	20.91	0.08	1.83	1.08	2.98
NAGARCAD	SERICOCOMOPSIS spp.	dS	0.23	30.00	0.86	0.56	1.55	2.96
DHITI / CAR IQAD	COMMIPHORA LOBATO-SPATHULATA	acS	0.49	30.00	0.19	1.16	1.55	2.89
MURJAAN	BOSWELIA NEGLECTA	T	0.94	11.82	0.03	2.23	0.61	2.87
HAMBOHI	AERVA JAVANICA	wF	0.08	30.91	0.88	0.19	1.59	2.67
BOCBOCOOD	PAVONIA KOTSCHYII	wF	0.04	25.45	1.19	0.11	1.31	2.61
MIRDHIS	ANISOTES TRISULCUS	S	0.65	15.45	0.22	1.55	0.80	2.57
GUNDUD	COMMIPHORA TRUNCATA	T	0.61	20.00	0.06	1.45	1.03	2.54
QANSAX	ACACIA REFISCIENS	aS	0.73	10.91	0.15	1.74	0.56	2.45
YICIB / GUD	CORDEAUXIA EDULIS	eS *	0.72	8.18	0.20	1.71	0.42	2.33
JIRAQ	ACACIA TURNBULLIANA	aS	0.60	13.64	0.19	1.43	0.70	2.32
HOHOB	GREWIA PENICILLATA	S	0.21	32.73	0.14	0.49	1.69	2.31
CADAAD MADOW	ACACIA ZIZYPHISPINA	aS	0.49	19.09	0.07	1.18	0.98	2.23
NAGARMADOW	HIBISCUS ?SOMALENSIS	wF	0.09	15.45	1.21	0.21	0.80	2.22
DACUUL		dS	0.15	10.91	1.27	0.35	0.56	2.18
BILCIL	ACACIA CHEILANTHIFOLIA	aT	0.64	11.82	0.04	1.53	0.61	2.18
SAGARSUF		dS *	0.24	19.09	0.62	0.57	0.98	2.17
XAGAR CAD	COMMIPHORA ELLISIAE	T	0.74	7.27	0.02	1.77	0.37	2.16
REXAN	?OCIMUM BASILICUM	dS	0.23	13.64	0.90	0.54	0.70	2.15
SARIN CAD	SERICOCOMOPSIS PALLIDA	dS	0.32	15.45	0.51	0.77	0.80	2.07
WACANRI	LANNEA spp.	T	0.68	6.36	0.01	1.61	0.33	1.95
JALEELO	CASSIA spp.	dS	0.27	17.27	0.35	0.64	0.89	1.88
KAXANDO	TRIBULUS TERRESTRIS	anF	0.02	11.82	1.12	0.05	0.61	1.78
QARON	COMMIPHORA VELUTINA	-aT	0.32	17.27	0.05	0.76	0.89	1.70

Vegetation distribution and importance value (contin.)

SOM.PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute frequency	Relative density	Relative dominance	Relative frequency	Importance value
MIRACAS / DAMAG	GREWIA TEMBENSIS	S	0.14	24.55	0.09	0.32	1.26	1.68
WANIN / GEED JINI	SOLANUM ?ALBICAULE	dS	0.25	11.82	0.47	0.59	0.61	1.67
DHEER DHEERE	ACACIA BRICCHETTIANA	aS	0.46	8.18	0.11	1.09	0.42	1.63
CADAAD	ACACIA SENEGAL	adT	0.37	12.73	0.10	0.87	0.66	1.62
BAAR NIRGOOD	?SATANOCRATER spp.	edS *	0.17	16.36	0.35	0.40	0.84	1.60
MARYOTOL	JATROPHA ?DICHTAR	aS	0.29	15.45	0.04	0.70	0.80	1.54
QABO YAR YAR	EUPHORBIA INAEQUISPINA	aSK	0.40	8.18	0.10	0.96	0.42	1.48
NAGARSP.	CROTOLARIA spp.	dS	0.03	10.91	0.81	0.07	0.56	1.44
MUQLAY	BOSWELIA MICROPHYLLA	T	0.29	13.64	0.03	0.69	0.70	1.43
GEED DAJIIS / MAROLAYS	SOLANUM MACRACANTHUM	adS	0.12	15.45	0.33	0.29	0.80	1.42
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	0.21	16.36	0.07	0.50	0.84	1.41
KALMOON	?CLEOME spp.	S	0.27	8.18	0.30	0.63	0.42	1.35
BEEYA CAD	BOSWELIA RIVAE	cT	0.37	8.18	0.03	0.88	0.42	1.33
MAYGAG	BOSCIA MINIMIFOLIA	eT *2	0.29	11.82	0.03	0.69	0.61	1.32
MARKAFURE	HELIOTROPIUM spp.	wF	0.01	14.55	0.50	0.03	0.75	1.28
BEEYA MADOW	COMMIPHORA SULCATO STRIATA	T	0.29	10.91	0.03	0.68	0.56	1.27
BARANJIS	CONVOLVULUS spp.	cF	0.06	13.64	0.40	0.15	0.70	1.25
QALMO WAALIS		edS *2	0.04	13.64	0.38	0.09	0.70	1.17
DABAXAYR	TEPHROSIA UNIFLORA	wF	0.05	8.18	0.63	0.12	0.42	1.17
XODAY	COMMIPHORA HODAI	T	0.40	2.73	0.01	0.94	0.14	1.09
CADUUR	SOLANUM JUBAE	S	0.21	10.91	0.03	0.50	0.56	1.09
QALANQAL	CADABA GLANDULOSA	eS *2	0.20	10.91	0.03	0.47	0.56	1.06
DUFNOOD	?CLEOME spp.	wF	0.01	13.64	0.33	0.02	0.70	1.05
CADAAD CAD	ACACIA HAMULOSA	adT	0.10	14.55	0.04	0.24	0.75	1.03
MARER	CORDIA SINENSIS	S *	0.21	9.09	0.03	0.50	0.47	0.99
NAGAR/MADOW/BIG	HERMANNIA spp.	dS	0.13	10.91	0.11	0.31	0.56	0.98
FARADOWOCO	BARLERIA PROXIMA	awF *	0.03	12.73	0.24	0.07	0.66	0.96
SAALO WEYNE	?HERMANNIA spp.	dS	0.10	10.00	0.18	0.24	0.52	0.94
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	aT	0.16	10.00	0.03	0.38	0.52	0.92
KHUURI / QOODHI	CAESALPINIA ERIANTHERA	adT	0.21	7.27	0.04	0.49	0.37	0.91
GOWLELO	COMMIPHORA ?ELLENBECKII	T	0.12	10.91	0.03	0.29	0.56	0.88
NAGAR	CROTOLARIA ?DUMOSA	dS	0.08	5.45	0.39	0.19	0.28	0.86
FULAAY	ACACIA SENEGAL VAR.?	aT	0.13	10.00	0.03	0.31	0.52	0.85
DARAN DOWOCO	LIMONIUM CYLINDRIFOLIUM	edS *2	0.06	2.73	0.56	0.15	0.14	0.85
QABO	EUPHORBIA LONGISPINA	aSK	0.13	9.09	0.03	0.32	0.47	0.82
JAFEECO (RU 24)	IPOMOEA CITRINA	S	0.10	10.00	0.05	0.24	0.52	0.80
DUQQURON		dS	0.01	3.64	0.59	0.02	0.19	0.80
RUMASAN	LOEWIA GLUTINOSA	S	0.20	3.64	0.05	0.47	0.19	0.70
GAHAYR	BLEPHARISPERUM spp.	S	0.05	10.00	0.06	0.12	0.52	0.70
ANEXO	CUCUMELLA KELLERI	F	0.03	10.00	0.10	0.06	0.52	0.67
ONTOR	CORDYLA SOMALENSIS	T	0.22	2.73	0.01	0.53	0.14	0.67
DHARQO (MADOW)	TEPHROSIA OBBIADENSIS	dS *	0.05	6.36	0.20	0.12	0.33	0.64
SHRUB??		S	0.07	8.18	0.03	0.17	0.42	0.62
XABOW	ZYGOPHYLLUM spp.	cdS *	0.05	4.55	0.26	0.12	0.23	0.62
JALEELO WEYNE/J.GEEL	CASSIA ELLISEA	S	0.21	1.82	0.02	0.50	0.09	0.61

Vegetation distribution and importance value (conti.)

SOM.PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute frequency	Relative density	Relative dominance	Relative frequency	Importance value
CADUUR DHEGA WEYNE	SOLANUM ?BIFURCUM	wF	0.02	0.91	0.52	0.04	0.05	0.61
ARANBOWDO	COMMIPHORA spp.	aS	0.10	6.36	0.03	0.25	0.33	0.60
DUL WEYN / QAASHAQORON	COMMIPHORA CILIATA	T	0.15	4.55	0.01	0.35	0.23	0.59
CALOOLYAAY	?OCHNA spp.	eS	0.07	7.27	0.02	0.18	0.37	0.57
DHUROD similar	MELHANIA ?PHILLIPSIAE	wF	0.01	6.36	0.18	0.02	0.33	0.53
JOWDHER	?GYROCARPUS ANGUSTIFOLIUS	T	0.17	1.82	0.01	0.41	0.09	0.51
SARIN		S	0.06	5.45	0.07	0.15	0.28	0.50
DHUMOOD	?CLERODENDRUM MICROPHYLLUM	dT *	0.03	7.27	0.01	0.08	0.37	0.47
JIIC MADOW	CADABA spp.	T *2	0.07	5.45	0.01	0.16	0.28	0.45
CANYO	PORTULACA OLERACEA	anF	0.00	4.55	0.19	0.00	0.23	0.43
LEBIYARO	?SESBANIA spp.	dS	0.03	0.91	0.31	0.07	0.05	0.42
HAJIIN	INDIGOFERA SPARTEOLA	wF	0.01	6.36	0.07	0.02	0.33	0.42
KABGAL SIMILAR	TRIUMFETTA spp.	dS	0.03	4.55	0.11	0.06	0.23	0.41
DHIGTAR / CIGAN	DICHROSTACHYS CINERA	aS	0.10	2.73	0.03	0.24	0.14	0.40
GARRAS	DOBRA GLABRA	eT *2	0.06	4.55	0.01	0.15	0.23	0.40
RIYOXIR		dS	0.04	3.64	0.10	0.09	0.19	0.38
GEEL REEB	CAESALPINIA TROTHAE	aS	0.10	1.82	0.04	0.25	0.09	0.38
AFGUB	COMMIPHORA ODDURENSIS	adT	0.02	5.45	0.01	0.06	0.28	0.35
DIIQLAY	JATROPHA MICROPHYLLA	S	0.02	5.45	0.01	0.04	0.28	0.34
DABAKAR	DALBERGIA MICROPHYLLA	S	0.01	5.45	0.01	0.03	0.28	0.32
ARGEG	ASPARAGUS AFRICANUS	adS	0.01	4.55	0.04	0.02	0.23	0.30
BALAMBAL	ABUTILON HIRTUM	wF	0.01	4.55	0.04	0.02	0.23	0.29
DS??SALT1		dS	0.00	1.82	0.18	0.01	0.09	0.29
QANSOLE	RYNCHOSIS GANSOLE	dS	0.04	2.73	0.04	0.10	0.14	0.28
SARIN CAD II		dS	0.02	3.64	0.04	0.04	0.19	0.27
LEBI	DELONIX ELATA	T	0.09	0.91	0.00	0.21	0.05	0.26
JINOW	COMMIPHORA ROSTRATA VAR.ROS	S	0.01	4.55	0.01	0.02	0.23	0.26
IBOCAROOR	CROTOLARIA spp.	wF	0.00	0.91	0.19	0.01	0.05	0.25
XABNOXAS		wF	0.03	0.91	0.13	0.07	0.05	0.25
BOOGA DHAYE	?CHRYZOPHORA spp.	dS	0.02	2.73	0.04	0.05	0.14	0.23
DABIB / UUSQAABE	?ACALYPHA spp.	aS	0.03	2.73	0.02	0.07	0.14	0.23
DHEGAYAR	BOSCIA CORIACEA	eS *2	0.03	2.73	0.01	0.07	0.14	0.22
DARAN BIYOOD		skF *2	0.02	1.82	0.08	0.04	0.09	0.21
DABLEF	COMMICARPUS CF.BOISSIERI	wF	0.01	2.73	0.06	0.02	0.14	0.21
MADAX BUSHI	MORMODICA SPINOSA	V	0.02	2.73	0.01	0.06	0.14	0.21
LAMALOOJI	?MAERUA ANGOLENSIS	eT	0.00	3.64	0.01	0.01	0.19	0.21
HIGLO	CADABA MIRABILIS	eT *2	0.06	0.91	0.00	0.15	0.05	0.20
GEEDKURRUS	LIPPIA CARVIODORA	dS	0.01	1.82	0.07	0.02	0.09	0.19
CIIN	SACROSTEMMA VIMINALE	V	0.05	0.91	0.01	0.12	0.05	0.18
GEED GABAL		dS	0.04	0.91	0.02	0.11	0.05	0.18
GEED GABOY	?LEPTODENIA PYROTECHNICA	eS	0.01	2.73	0.00	0.03	0.14	0.17
GUMER	ACACIA NUBICA	aS	0.01	2.73	0.02	0.02	0.14	0.17
MAL MAL	COMMIPHORA ?SENNII	aS	0.01	2.73	0.01	0.02	0.14	0.17
XAMUR	ZIZIPHUS HAMUR	eaS *	0.03	1.82	0.00	0.07	0.09	0.16
JAJABOOD	?PREMNA spp.	dS	0.02	0.91	0.08	0.04	0.05	0.16

Vegetation distribution and importance value (conti.)

SOM.PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute frequency	Relative density	Relative dominance	Relative frequency	Importance value
JIIC RUGUNBAY	CADABA LONGIFOLIA	T *2	0.01	2.73	0.01	0.02	0.14	0.16
QUDDE / JABSI	CORDIA SUCKERTII	S	0.02	1.82	0.00	0.06	0.09	0.16
MANDHERA QUBE	CYPHOSTEMMA spp.	V	0.02	1.82	0.01	0.05	0.09	0.15
DOOBOGOY	HELIOTROPIUM LONGIFLORUM	dS	0.01	1.82	0.02	0.02	0.09	0.14
SARARO CADAYS	?TEPHROSIA spp.	dS	0.01	0.91	0.07	0.02	0.05	0.13
OWRADHAYE	COMBRETRUM ?RETIFLORA	S	0.03	0.91	0.02	0.07	0.05	0.13
XAJIIN DALUUG	INDIGOFERA OGADENSI	dS	0.01	0.91	0.06	0.03	0.05	0.13
XAYEY	COMMIPHORA ERYTHRAEA	T	0.01	1.82	0.00	0.02	0.09	0.12
DS??SALT2	?AMMOCHARIS spp.	dS	0.00	1.82	0.02	0.00	0.09	0.11
MISARA JABIS	?TERMINALIA PARVULA	S	0.00	1.82	0.00	0.01	0.09	0.11
JIIC TIF	CADABA BACCARINII	T *2	0.00	1.82	0.00	0.01	0.09	0.11
DHEEB YAXAAS	COMMIPHORA ?ALATICAULIS	S	0.00	1.82	0.00	0.01	0.09	0.11
DARAN	?SALSOLA spp.	cdS *	0.01	0.91	0.04	0.02	0.05	0.11
RAYDAB	ALBIZIA ANTHELMINTICA	T	0.00	1.82	0.00	0.00	0.09	0.10
SAYNSAAB	?ADENIUM OBESCUM	dS	0.01	0.91	0.03	0.02	0.05	0.10
HAJIINCAD		dS	0.00	0.91	0.04	0.01	0.05	0.10
QUNLE SIRIQ	ACACIA WALWALENSIS	aT	0.01	0.91	0.01	0.03	0.05	0.09
GULAN	?SALSOLA FOETIDA	dS	0.00	0.91	0.03	0.01	0.05	0.09
GEEDHARAQ		dS	0.00	0.91	0.02	0.01	0.05	0.07
CARMO	CISSUS ELLENBECKII	V	0.01	0.91	0.00	0.02	0.05	0.07
DS??SALT3		dS	0.00	0.91	0.02	0.00	0.05	0.06
UNKNOWN DS	TRIUMFETTA spp.	dS	0.00	0.91	0.02	0.00	0.05	0.06
KOBOSH	GREWIA VILLOSA	S	0.00	0.91	0.00	0.01	0.05	0.06
BUR BUR	?MELHANIA MURICATA	dS	0.00	0.91	0.01	0.00	0.05	0.06
DARJO (CAD)	INDIGOFERA TRITA	dS	0.00	0.91	0.01	0.00	0.05	0.06
KIDI		eS *2	0.00	0.91	0.00	0.01	0.05	0.06
CADAY	COMMIPHORA ?BRUCEA	S	0.00	0.91	0.00	0.01	0.05	0.06
CADANOOD	?ASPARAGUS spp.	S	0.00	0.91	0.00	0.01	0.05	0.06
BULACAYOOD	COMMIPHORA AFF.SULCATOSTRIATA	S	0.00	0.91	0.00	0.01	0.05	0.06
XERKOOD / XARIG	?MERREMIA spp.	dS	0.00	0.91	0.01	0.00	0.05	0.06
GARUNJO	GLOSSONEMA REVOLLII	wF	0.00	0.91	0.01	0.00	0.05	0.06
CAYO	CLEOME spp.	dS	0.00	0.91	0.00	0.00	0.05	0.05
XAGAR	COMMIPHORA ?KUA	T	0.00	0.91	0.00	0.00	0.05	0.05
QANRAR / QARANRO	STERCULIA ?RYNCHOCARPA	T	0.00	0.00	0.00	0.00		0.03
SHILLAN	BALANITES ROTUNDIFOLIA	eaS *2	0.00	0.00	0.00	0.00	0.00	0.01
HALOPHIL sp.??		cdS	0.00	0.00	0.00	0.00	0.00	0.01
MEREFED / MIRAFUR	BOSWELIA spp.	T	0.00	0.00	0.00	0.00	0.00	0.01
KULLAN	BALANITES AEGYPTICA	eaS *2	0.00	0.00	0.00	0.00	0.00	0.01
JEERIN II	ACACIA LEUCOSPIRA	aS	0.00	0.00	0.00	0.00	0.00	0.01
XAYO	?WRIGHTIA DEMARTINIANA	T	0.00	0.00	0.00	0.00	0.00	0.00
WASHAQAR/CAANOXAYR	?PLUCHEA SACROPHYLLA	cdS *	0.00	0.00	0.00	0.00	0.00	0.00
UNKNOWN PLOT 24	COMMIPHORA spp.	T	0.00	0.00	0.00	0.00	0.00	0.00
UNKNOWN PICTURE 5/28		S	0.00	0.00	0.00	0.00	0.00	0.00
UNKNOWN BILD 7/22	?MARSDENIA SCHIMPERII ??	wF	0.00	0.00	0.00	0.00	0.00	0.00
UNKNOWN BILD 7/11		wF	0.00	0.00	0.00	0.00	0.00	0.00

Vegetation distribution and importance value (conti.)

SOM.PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute frequency	Relative density	Relative dominance	Relative frequency	Importance value
UNKNOWN BILD 6/19		wF	0.00	0.00	0.00	0.00	0.00	0.00
UNKNOWN	PAVONIA spp.	wF	0.00	0.00	0.00	0.00	0.00	0.00
UNKNOWN	MALVA spp.	wF	0.00	0.00	0.00	0.00	0.00	0.00
SABAN SABDHO	PLATYCELYPHIUM spp.	dT	0.00	0.00	0.00	0.00	0.00	0.00
QADI	PLICOSEPALIS CURVIFLORUS	P	0.00	0.00	0.00	0.00	0.00	0.00
KABXAN	THESPESIAS DANIS	S *	0.00	0.00	0.00	0.00	0.00	0.00
JIIQ	ACACIA SEYAL VAR.FISTULA	aT	0.00	0.00	0.00	0.00	0.00	0.00
JAC JAC		S	0.00	0.00	0.00	0.00	0.00	0.00
HIIRAN	?HILDEBRANDTIA SOMALENSIS	S	0.00	0.00	0.00	0.00	0.00	0.00
HAREERI	TERMINALIA ?POLYCARPA	T *	0.00	0.00	0.00	0.00	0.00	0.00
GOOSAY	COMMIPHORA spp.	S	0.00	0.00	0.00	0.00	0.00	0.00
GEESA RIYOOD	PENTATROPIS SPIRALIS	V	0.00	0.00	0.00	0.00	0.00	0.00
GEED ABOODI	?TRIBULUS CISTOIDES	caF	0.00	0.00	0.00	0.00	0.00	0.00
FARADOWOCO II	BARLERIA TRISPINOSA	awF	0.00	0.00	0.00	0.00	0.00	0.00
ELLAN	LAWSONIA INERMIS	S	0.00	0.00	0.00	0.00	0.00	0.00
DHISAQ	TERMINALIA ORBICULARIS	T	0.00	0.00	0.00	0.00	0.00	0.00
DHEBI	GREWIA MOLLIS	S	0.00	0.00	0.00	0.00	0.00	0.00
DACUUL II	?TRIANTHEMA spp.	S	0.00	0.00	0.00	0.00	0.00	0.00
CAABEEY	?JATROPHA TROPAEOLIFOLIA	SK	0.00	0.00	0.00	0.00	0.00	0.00
BOOC	CALOTROPIS PROCERA	S	0.00	0.00	0.00	0.00	0.00	0.00
BALANBALIS	SENRA INCANA	dS	0.00	0.00	0.00	0.00	0.00	0.00
BACAROOR / XINTIR	COMMIPHORA SP. AFF. SULCATA	T	0.00	0.00	0.00	0.00	0.00	0.00

Growth-form symbols:

- F : forb
- G : grass
- P : parasite
- S : shrub
- SK : succulent
- T : tree
- V : vine

- a : armed
- an : annual
- c : creeping
- d : dwarf
- e : evergreen
- sk : succulent
- w : woody
- - : more or less
- *2 : dry season fodder available
- * : partly dry season available

2. THE DIVISION OF RANGE UNITS

2.1. Material and methods

The first step in determining range units (RU) and range site boundaries was done through interpretation of enhanced MSS Landsat imagery (1 : 250000 and 1 : 500000). Concerning the eastern parts of the survey area the results of the RMR study (1979) were used for orientation. The western part of the area was mapped completely new.

The second step was to collect field data. A network of randomly selected plots[5] was established in the study area. This task had to be submitted to the given infrastructure of the dense and thorny bushland[6]. In addition, as a result of the security situation, the regularity of plot distribution was influenced by :

1. Mine fields, as a relict of the Somali Ethiopian conflict, which blocked access to several roads in the NW parts of the survey area. Exact information about the accessability of streets was prerequisite to their use.
2. Armed conflicts and shootings between rivaling nomadic clans prohibited field activities in the SO parts of the study area for the first eight months.
3. Because of these conflicts we were ordered by the authorities to stay overnight only at police or military controlled permanent settlements and to inform them of our travelroutes. Consequently we were forced to arrange the distances between the plots based on the obligation to reach a save place by night.

In spite of these difficulties, a randomly selected network was arrived at by defining the intervals between the plots every morning before starting a tour and without knowledge of the specific appearances of these places. The distances, 3, 5 or 10

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[5] further discribtions on the survey method and the criteria of data collection at the plots are given in chapter III.1.

[6] The risk of tire punctures caused by the extrem strong thorns of the vegetation was to high to leave the dirt roads even there were the vegetation cover wasn't too dense.

km were measured by the car tachometer. The survey method at the plots is described in chapter II.1.

The final step for the range unit classification was to analyse the collected data and to proof and actualize the provisionally defined range site boundaries with emphasize on floristic similarities. The scale of study was 1 : 250000. The level of accuracy was, for the purpose of a biomass calculation, submitted to this scale.

The floristical differentiation was established by following the method of "Braun-Blanquet's Floristic Association System"[7] . The summarized range units were taken as research units for the calculation of the fodder resources.

2.2. Results and discussion

Map number 1 shows the distribution of the survey plots and gives the first impression of range unit differentiation on the basis of satellite image interpretation (dotted lines).

The primary criteria for the division of range units on the basis of the field data was the physiognomic vegetation structure, which clearly distinguished between bushland areas, shrub land areas and dwarfshrub areas. In 1989[8] the range units 16 and 24 were classified as bushland, in the units 47 and 31 shrubs were dominant and the units 44 and 45 were found to be dwarfshrub - shrubland.

A closer view following in detail to floristical criteria is given in table 2. It offers the "Differentiated Table"[9] of the study areas vegetation. Because of limited space only the Somali plant names are used in this list[10]. The horizontal head line

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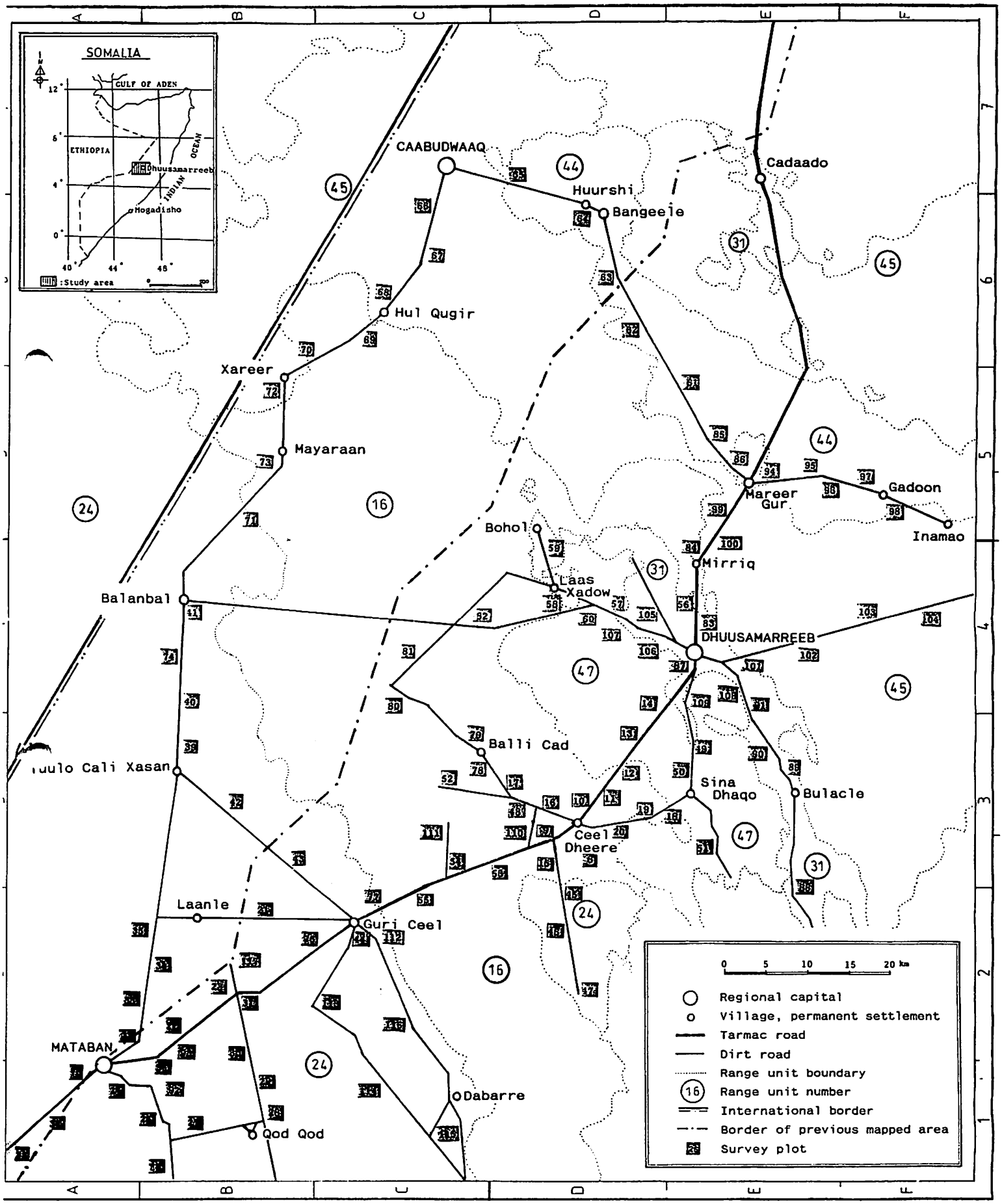
[7] Mueller-Dombois & Ellenberg 1974 p. 175 ff

[8] The situation was probably not always like it is now

[9] The quotation marks used in this passage are signalizing Braun Blanquet's terms

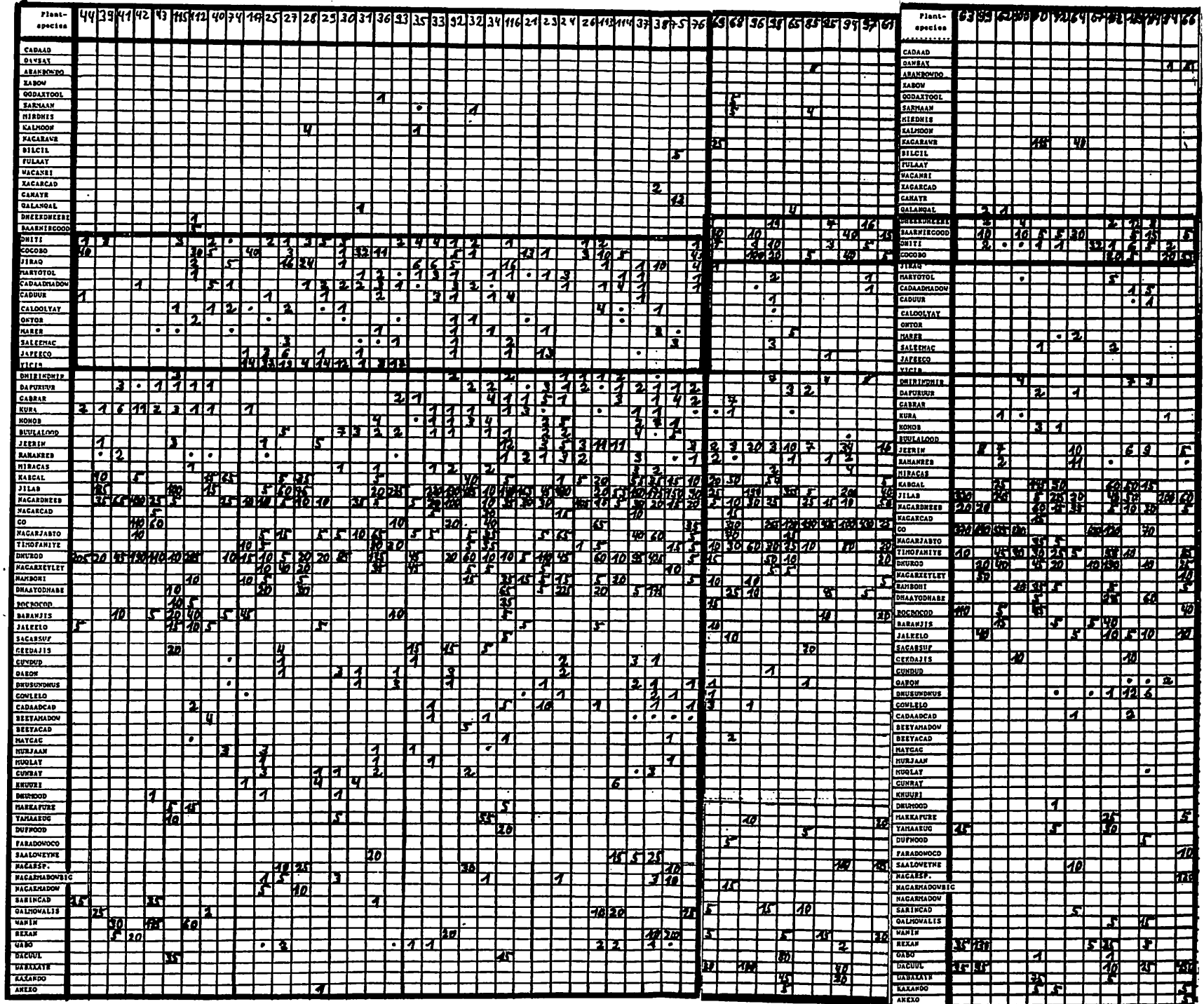
[10] The botanical names of the different plant species were given in table one. The continuation of the list, concerning the plants of low frequencies, is added as "Appendix 1".

BASS GRAPH
P. 7-1



map 1 : The study area and the distribution of sample plots

Tab. 2 : Floristical Range Unit differentiation



Tab. 2 : Floristical Range Unit differentiation

RU 16

Plant-species	77	71	58	8	17	48	15	119	73	53	54	52	55	78	80	62	111	81	30	45	46	79	11	12	9	16	42	10	14	18
	29	32	17	18	25	29	27	33	32	33	29	27	29	22	30	25	30	23	27	25	28	28	20	20	19	31	28	22	34	28
CADAAD																										1		3	2	3
QANSAX															2															
ARANBONDO						1					1		2				2					•								
XAROW																														
QODAXTOOL	20				20	50	45	5	20	50	5		50		50	80	5	5	50	45	20	5		100	50	35	20		25	15
SARMAAN	1				2	2	1	2				2	3	4		1	2	•	4		1	2	2	4	2	1		1	1	13
MIRDHIS			3		17		8					6										11					6	4		
KALMOON																										1	15			
MACARAWR			35	10	150	95	20	105	25	35	5	60	20				45	125	5					40		10	10			100
BILCIL						2			1			1	5			3							1		1	1		1		•
FULAAY			•			3	1			2						2					1			3		1			3	1
MACANBI																		1	•	•	1	1		1	1	•			1	2
XAGARCAD			•			1	1		1	4		1		•	•	•	1	•					1							
CANAYR	•										3	1	3	1	3	2	1	1												
QALANQAL	1								•	2	•	1	2		1	1	•													
DHEERDHEERE																														
BAARNIRCOOD	5								5																					
DHITI	1																													
COCOBO													20														5			
JIRAQ	1																													
MARYOTOL	1																													
CADAADMADOW		3																												
CADUUR																														
CALOOLYAY																														
ONTOR																														
MAREER		1		1																										
SALEEMAC																														1
JAFEECO																														
YICIB																														
DHIRINDHIR	•	•		1		2	1	32	4	15	12	1	6	12	1	1	5	5	•	11	27	5	2	3		4	10	1	10	3
DAFURUUR		1		2	4	5		1	1	1	1	2			1	1	3	7	2	1	1	1			1	2			1	
CABRAR	6	3		5	1	2	5	6	•	3	2		2	6	5	4	3	6	1	5	4		4	1	6	4	4	1	1	8
KURA			•	3	2	•	2	5			1	1	4	1		1	4	1	•	2	1	8	1		2	1		7	1	
HONOB	1	4	•		4	3	1		5	4	1	1	1	2	1	1		2	4		1	2			1	1	5		2	1
BUULALOOD	6			3		3	1	8		5	9		8	5	2	4	4	5	1	16	4	6	2	5		5	15	•	12	10
JEERIN	•	2											21											5			5			
RAHANREB							1			1				1												1				
MIRACAS		1			1		1		•	3	1			1	2	3	1	2	1			•					1		2	
KABGAL	275		215		130	65	45	35	20	25	185	5	40	30		85	75	10	35	185	45	5	125	80		30	650		85	220
JILAB	135	190	125	25	95		60	35	10	210	30	215		120	40		85				25		45		115	15	35		5	
NACARDHEEB	15	20				5		45	25				5							5			5		5	15		9		
NACARCAD		5			5		30	40	25	10	50	10	10			10			10	10	25	5	10	20	15	5	40	15	20	20
CO	15	600						45	20						45	85	55					20								
NACARJABTO		15	5		5			10		20	25			10	3	10	5		30	5		5	30			5		5	5	
TIMOFANIYE	140	15	25				80	10	35	25	20	15	10		15	5	60				5	105					50	5		
DHUROD	15	5						65	5				5		5				25	125	15		300	210	175	5	35	35	5	20
NACARXEYLEY		5	40		53		30					5					3		50	25	5		10	30	10	125		110	10	30
HAMBONI		5									40				5													5		
DHAAYODHABE		65			45	25		15		30	30	35					45		20							15			35	30
BOCBOCOD	65	55	25						15				10	10	70	20	5	10				30		10						
BARANJIS																														
JALEELO								5				5																		
SACARSUF		40							5					5	40							5			21				1	3
CEEDAJIS			1		1	40	1												25		60				10		5		4	
GUNDUD	•	2			1	1	1			2	2		1	•	3	•	3	1	1	•	2	•				2		•	3	
QARON					1	3				1	2									1	3						1	1	3	
DHUSUNDHUS										1																	1			
GONLELO																				•										
CADAADCAD					1																1		2		2		2			
BEEYAMADOW		1			•	2	1	1				1	3		•							•		1		2				
BEEYACAD		2	3					1	•	1	1	1	•		1						•	2							•	
MAYCAC		•			1	1		2		1	1				•		1		2			•								
MURJAAN		•								1			1	•				1	1	2	•		2			•		1	1	2
MUQLAY	•					1	•	3	•	2	3	1			1		1	1	1	1						1		•		
GUNRAY	1							•	•	1			1		1			•				•	1		1		3		•	4
KHUURI																1														
DHUMOOD										1																				
MARKAFURE						10		18			5																			
YAMAARUG		25					5	35	100		115				80	40	80									35				
DUFNOOD								5						5		10	10	5								•				
FARADOWOCO	5								10	10			5	5																
SAALOWEYNE					11				10																	6		5		5
NACARSP.										20		20									15	10								
NACARMADOWBIS		5						15		5												5								
NACARMADOW					45	10	50												25	10	10			45			30		45	60
SABINCAD		5	5			30			5			10			10	15		10				15								
QALMOVALIS																														
WANIN			1														5											2		
REXAN																											50			
QABO						1		1							1						1									1
DACUUL									5					10																
DARAXAYR	40	20																												
KAXANDO		10						225																						
ANEXO	5					5				10				10					20			5	1		5					

Plant-species	RU 47											RU 31										
	43	44	49	50	106	57	51	105	60	108	109	101	88	85	87	116	83	56	53	91	86	[illegible]
CADAAD										1	1	3	1	5	3	5				15	•	4
QANSAX								10		•	3	2	1	22	15	1	1	12				
ARANBONDO											•	•	3	8						1		
XAROW												20		10		25				10	30	
QODAXTOOL	20	35	30	60	30	35		45	60	35	100		200		200			20	100	25	5	
SARMAAN	1	3	4		20	8	3		1	1								4			10	3
MIRDHIS			4	29	23	5		3		1	8				8		8				13	
KALMOON		5	8	140					9	5											•	
MACARAWR			125	100	5	40			35	125							250	50			5	
BILCIL							1										1					
FULAAY	1		1																			
MACANBI							1															
XAGARCAD																						
CANAYR					4																	2
GALANQAL	1		•						1								1					
DHEERDHEERE																						1
BAARNIRCOOD										30							5					1
DHITI										•												
COCOBO	3	4								25	30		45		10						5	10
JIRAQ																						
MARYOTOL																						
CADAADMADOW																						
CADUUR																						
CALOOLYAY																						1
ONTOR																						
MAREER																						1
SALEEMAC		1																				1
JAFEECO																				2		
YICIB																						
DHIRINDHIR		2	8	20					2	3		2								10		
DAFURUUR	1		4	2		2	•	•	1	6							2					1
CABRAR	2	2	13	8	1		3	•	2		4		2	2			4			1	1	
KURA			1		3	16	1	1	1	3	1		1	2	1			1		•	1	
HONOB				2	2																	
BUULALOOD	1		2	8	1		•		2	1	2	1	1				•					
JEERIN	3	10	1						10	19	1						8	•			5	
RAHANREB					2	2			•	•			•							•	3	
MIRACAS			4	4									6	•					3			
KABGAL	200	315	160	300	90	90	5	45	285	100	105				25		20	60	90			3
JILAB	230	40	30	20		35			105	50			40		5		25	35			280	
NACARDHEEB	40		10				5		5	45							5	30				
NACARCAD	30	35	45		10						45									•		
CO					45			30		85	55		50		150	30	45					
NACARJABTO		5				5		40			25		10		45	25	40	20		5		
TIMOFANIYE		80	250	150	60	150		200	5	25	80		25		300	45	25	55	60		40	
DHUROD	110	150	30																		5	
NACARXEYLEY	10	145	25		5	35		40	5	40	25							40	20			
HAMBONI	15	10	30		10	5							85		20			10		35	5	
DHAAYODHABE			45	45	90			45	5	5	10											
BOCBOCOD					40			45	5	25	20				20		10				30	
BARANJIS	/								5													
JALEELO	1				45										25							
SACARSUF.	20	12			10			36	10	25	55	10					3	25		10		
CEEDAJIS																						
GUNDUD			3										1				•			•		
QARON							•															
DHUSUNDHUS	1	1	1							1											1	
GONLELO									1	1	2	1		•					2	5	2	
CADAADCAD									1													
BEEYAMADOW											1											
BEEYACAD																						
MAYCAC			•			•							1					1				
MURJAAN	1						•															
MUQLAY																						
GUNRAY																	1					
KHUURI										4			3			1	•					
DHUMOOD																						
MARKAFURE			5		15			25				10			18	5		5		5		
YAMAARUC						20		20	10													
DUFNOOD					35			20		10	35							25				
FARADOWOCO					20	5		10			25							20			5	
SAALONEYNE																5						
NACARSP.																	20					
NACAR/MADOW/			15																			
NACARMADOW	25	140					5															
SABINCAD						5		20					5									
QALMOVALIS										5	5				65		15					
WANIN					5				10			-										
REXAN																						
QABO		4		2										1						1	5	
DACUUL										10							10					
DARAXAYR										45	40											
KAXANDO					10			10	5			135				110			10			
ANEXO																						

contains the plot numbers and the added number of species per plot. All numbers are expressed in the order of magnitude of 200 squaremeter plots. The upper 29 species represent the area's "differentiating" species. The next are the "constant" species, arranged, as the following plants, by the criteria of decreasing frequency. Some of the plots, for example plot number 77, are located exactly on the border of two range units. These places posess vegetation of an atypical composi-tion. Nevertheless they are not taken as independant units, because of the described scale of study. The summed total units, used for the following steps of biomass calculation, are framed. They are drawn and illustrated in different hatchures in map 2.

The proposed range unit classification is considered to be more suitable for detailed range analyses than the descriptive division offered by Mascott. Local place names, identical to leading dominants in the vegetation composition were suggested as criteria for differentiation.

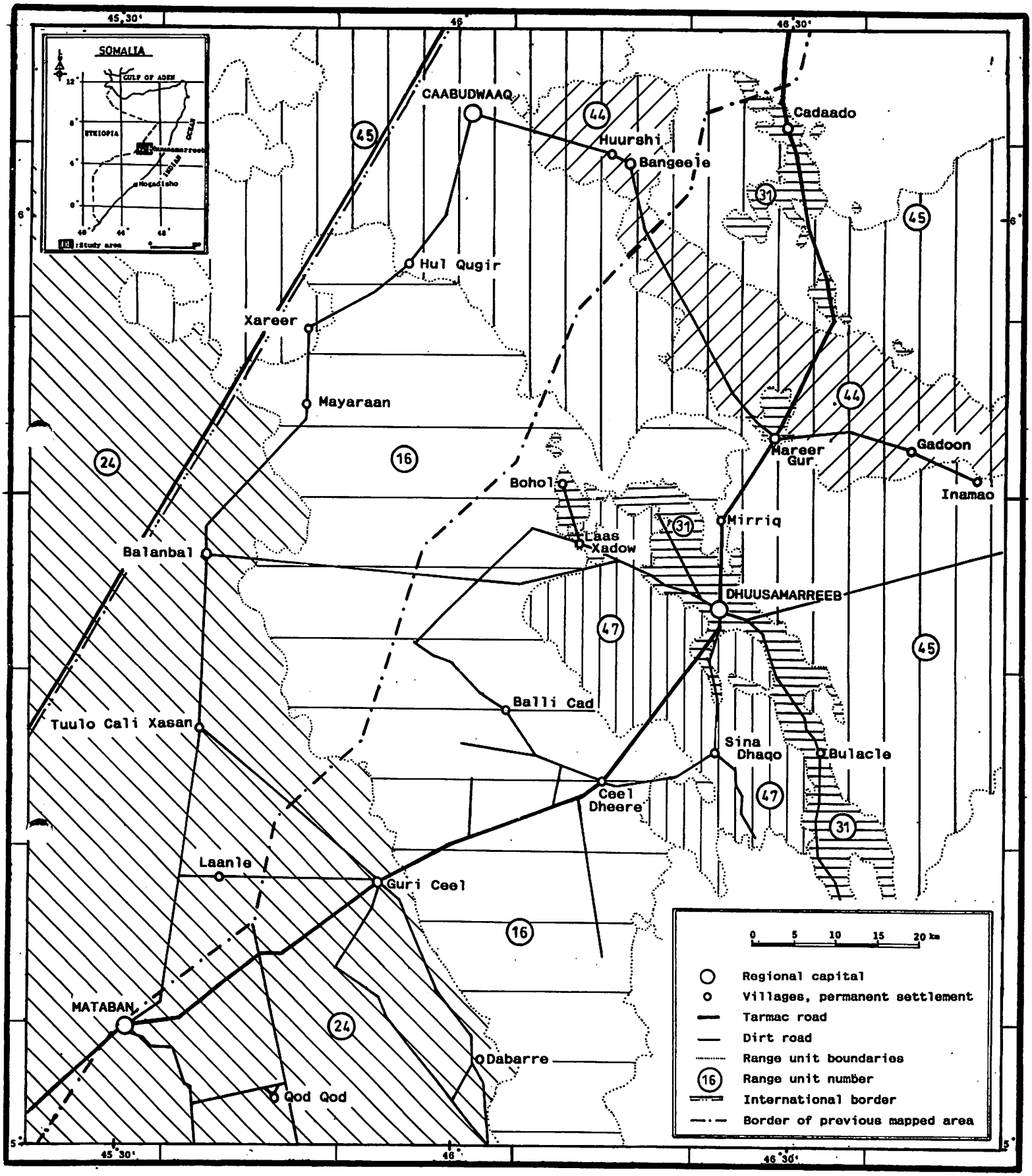
In Comparison with the RMR study there were found to be two distinct differences:

1. Following the floristical criteria and interests of range management the RMR "Land System Units" (LSU) 44 and 45 were more or less identical. The obvious differences visible on the satellite imagery are probably the result of a differen-ce in soil depth. The sand cover over the limestone seemed to be deeper in LSU 45. The two areas were taken as one research unit for this study.
2. The RMR study characterized a small area south of Ceel Dheere as LSU 24 (map 1). This could not be confirmed in the present field survey. The area was related to RU 16.

All other boundaries, which were discribed in the RMR study, were found to be still valid and of a very high exactness, after a time of ten years.

3. The characteristics of the different range units

Table 3 offers a summary of the physical features of the envi-ronment and describes and compares the defined range units.



map 2 : The range unit division

Table 3 : The physical features of environment compared for the different range units.

	RU 24 "Hawd or red sand area"	RU 45/44 "sand over lime-stone area"	RU 47 "limestone series"	RU 16 "limestone series"	RU 31 "gypsum area"
RU - Size : (in sqkm)	survey area : 2500 total area : 5544 representative for approxim. : 9456	survey area : 1600 total area : 6120 representative for approxim. :16840	survey area : 976 total area : 976 representative for approxim. : 3452	survey area : 2000 total area : 2544 representative for approxim. : 5308	survey area : 250 total area : 830 representative for approxim. : 1678
Geology :	Jesomma sandstone nubic series continental sediment Cretaceous-Eocene	Taleh limestone-formation marine sediment Eocene	Taleh limestone formation marine sediment Eocene	Auradu / Taleh lime-stone formations marine sediments Cretaceous / Eocene	Taleh limestone / Southern Gypsum marine / continental sediments: Eocene
Altitude :	450 - 300 m	280 - 240 m	290 - 230 m	300 - 250 m	270 - 190 m
Topography : and micro relief	gentle W to E slopes with no micro relief	Flat with very gentle W-E slopes. Some slight undulating patterns associated with limestone bands	gentle NW/SE slope. ancient peneplain in the south of the RU with numerous small depressions. Well developed micro relief associated with wavy bands.	gentle NW/SE slope, numerous small depressions and hills (5-10 m) in the SE part forming a micro relief	Flat with a gentle N to S slope. A section across the narrow "shoe - string" zone reveals a shallow channel with a floor 10 m below the surrounding limestones.
Soils and : rocks	Limestone exposures cover 1-2 % of the RU.The rest is covered with deep red sand: eutric Regosol	Stony limestone surfaces cover 5-10 % of the RU. The rest is covered with allochthon red - orange sands, mainly calcaric Regosols, Arenosols.	Parallel wavy wide bands of limestone and orange toned sands. Sands cover 40 % of the area. A few gypsum exposures in small depressions calceric Regosols, Lithosols, Arenosols	Appr. 60% of the area is covered by limestone some fragmented & mantled. The limestone is speckled with pale orange termitaria patches and medium to narrow wavy bands of pale orange sand: calcaric Regosols, Lithosols	gypsum/anhydrite exposures in massiv plates,small secondary fragments and stones cover 85 % . pale pink gypseous fine sandy silt and limestone fragments make up 15 % of the surfaces. Lithosols, Regosols, Yermosols.
Physiogno-mic : vegetation structure	deciduous bushland / medium dense wooded shrubland & dwarf-shrub understory	deciduous dwarf-shrubland with few shrubs and nearly no trees	deciduous shrubland. Medium to low densities in the tree and dwarf shrub layers.	deciduous bushland / medium dense wooded shrubland & dwarf-shrub understory.	deciduous bushland/ shrubland. Low densities in all layers of vegetation.
Drainage- : system feature	high water infiltration rate - little drainage development	very high water infiltration rate, very little drainage development	a few drainage chanels, but generally sandy bands acting as drainage zones.	narrow sandy bands form the drainage zones , channel development is poor.	an ancestral drainge zone with typical "shoe string" form. current drainage is not developed on the surface, but some fossil channels and sink holes can be found.
sources : RMR 1979; Drechsel 1986; Baas 1990					

The tables 4.1 - 4.5 offer the respective characteristic vegetation pattern, which grow on the introduced range units. They are, like table 1, prepared in accordance with the method of "Importance Value" (Whittaker 1970 & Curtis 1959, in: Mueller-Dombois & Ellenberg 1974). A comparison with table 1 demonstrates that distinct frequencies of leading species can now be found, the number of plant species per range unit with a frequency value higher than 50 % averages around 12. The order of the calculated importance value of the plant species is equivalent to the first visual impression one receives, while passing through the regions. The number of occuring species per range unit is much less than in table 1, which takes into consideration the total area. 121 different species were recorded on the plots in range unit 16, while only 72 species were found in range unit 31. The other numbers were lying somewhere in between. The higest variation of growing species in range unit 16 can be explained by the occurance of both sandy and stony sites.
The proposed Range unit concept is considered to be a solid basis for a spatial pattern, which is essential for the following analysis concerning the range resources. It offers a proper range unit characterization, which allows interregional comparison of rangelands and eventually the transference of the results that follow. The methods of vegetation analyses and the mode of calculation will be discribed in the following section.

table 4.1. :R U 1 6 : Vegetation distribution and importance value

PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
KABGAL	TRIUMFETTA HETEROCARPA	dS	2.81	90.00	13.41	5.92	3.60	22.93	61.42
JILAB	INDIGOFERA RUSPOLII	dS	2.84	73.33	10.91	6.00	2.93	19.84	71.78
KURA	ACACIA TORTILIS	aT	6.47	63.33	0.26	13.66	2.53	16.44	195.03
NAGARAWR	INDIGOFERA SPINOSA	adS	1.07	63.33	10.61	2.25	2.53	15.39	24.19
DHUROD	MELHANIA ?INCANA	wF	0.59	56.67	6.77	1.24	2.26	10.27	12.95
TIMOFAHIYE	PAVONIA PIROTTAE	wF	0.14	56.67	7.45	0.30	2.26	10.02	7.33
GABRAR	COMMIPHORA HORRIDA	adT	2.56	86.67	0.52	5.40	3.46	9.38	80.39
NAGARXEYLEY	HIBISCUS spp.	wF	0.16	53.33	6.49	0.33	2.13	8.95	6.61
SARMAAN	ACACIA HORRIDA	aS	2.84	63.33	0.26	5.99	2.53	8.78	54.89
DHIRINDHIR	EUPHORBIA CUNEATA	aS	1.75	80.00	0.94	3.68	3.20	7.82	50.08
YAMAARUG	BLEPHARIS CILIARIS	anF	0.03	30.00	6.54	0.06	1.20	7.80	5.88
DHAAYODHABE	PAVONIA ARABICA	wF	0.07	43.33	5.71	0.15	1.73	7.59	5.34
GO	INDIGOFERA ?INTRICATA	dS	0.28	33.33	5.20	0.59	1.33	7.13	8.33
QODAXTOOL	BLEPHARIS spp.	awF	0.13	76.67	3.44	0.27	3.06	6.77	3.82
BUULALOOD	IPOMOEA DONALDSONII	aS	1.13	76.67	0.73	2.39	3.06	6.18	39.42
NAGARCAD	SERICOCOMOPSIS spp.	dS	0.48	70.00	1.72	1.02	2.80	5.54	12.19
WACANRI	LANNEA spp.	T	2.16	20.00	0.04	4.56	0.80	5.39	36.90
BILCIL	ACACIA CHEILANTHIFOLIA	aT	1.87	33.33	0.09	3.95	1.33	5.37	50.93
GUNDUD	COMMIPHORA TRUNCATA	T	1.50	50.00	0.14	3.17	2.00	5.31	37.56
XAGARCAD	COMMIPHORA ELLISIAE	T	1.93	23.33	0.05	4.07	0.93	5.05	65.79
MURJAAN	BOSWELIA NEGLECTA	T	1.78	26.67	0.06	3.75	1.07	4.88	47.76
NAGARMADOW	HIBISCUS ?SOMALENSIS	wF	0.14	36.67	2.80	0.30	1.46	4.57	3.48
GUNRAY	COMMIPHORA GURREH	-cT	1.49	26.67	0.06	3.14	1.07	4.27	27.62
HOHOB	GREWIA PENICILLATA	S	0.42	73.33	0.24	0.88	2.93	4.05	8.12
NAGARJABTO	HELIOTROPIUM spp.	wF	0.20	56.67	1.31	0.43	2.26	4.01	3.79
QARON	COMMIPHORA VELUTINA	-aT	1.09	30.00	0.08	2.29	1.20	3.57	24.55
DAFURUUR	GREWIA TENAX	S	0.34	66.67	0.17	0.72	2.66	3.55	6.44
NAGARDHEEB	PLEUROPTHERANTA REVOILII	dS	0.51	36.67	0.75	1.07	1.46	3.29	11.73
BEEYACAD	BOSWELIA RIVAE	-cT	1.02	26.67	0.06	2.15	1.07	3.27	21.58
MIRDHIS	ANISOTES TRISULCUS	S	0.95	23.33	0.29	2.01	0.93	3.23	19.85
BOCBOCOOD	PAVONIA KOTSCHYII	wF	0.04	40.00	1.41	0.09	1.60	3.10	1.50
SARINCAD	SERICOCOMOPSIS PALLIDA	dS	0.28	30.00	0.93	0.59	1.20	2.72	6.99
MAYGAG	BOSCIA MINIMIFOLIA	eT	0.64	30.00	0.05	1.35	1.20	2.59	91.07
MUQLAY	BOSWELIA MICROPHYLLA	T	0.56	30.00	0.08	1.19	1.20	2.46	13.01
MIRACAS	GREWIA TEMBENSIS	S	0.23	43.33	0.10	0.49	1.73	2.32	4.44
GEEDDAJIS	SOLANUM MACRANTHUM	adS	0.24	30.00	0.59	0.51	1.20	2.30	8.63
BEEYAMADOW	COMMIPHORA SULCATO STRIATA	T	0.52	26.67	0.06	1.10	1.07	2.22	13.22
FULAAY	ACACIA SENEGAL VAR.?	aT	0.42	30.00	0.08	0.88	1.20	2.16	6.95
SAGARSUF		dS	0.25	26.67	0.47	0.53	1.07	2.07	8.23
DS??		dS	0.14	26.67	0.68	0.29	1.07	2.04	3.55

R U 1 6 : Vegetation distribution and importance value (contin.)

PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
NAGAR	CROTOLARIA ?DUMOSA	dS	0.10	13.33	1.01	0.22	0.53	1.76	1.93
QALANQAL	CADABA GLANDULOSA	eS	0.36	20.00	0.04	0.76	0.80	1.60	21.52
DHARQO	TEPHROSIA OBBIADENSIS	dS	0.18	16.67	0.54	0.39	0.67	1.59	6.82
ANEXO	CUCUMELLA KELLERI	F	0.08	26.67	0.26	0.16	1.07	1.49	1.62
KAXANDO	TRIBULUS TERRESTRIS	anF	0.01	6.67	1.19	0.02	0.27	1.47	1.09
GAHAYR	BLEPHARISPERUM spp.	S	0.10	26.67	0.10	0.22	1.07	1.38	2.79
DUQQURON		dS	0.02	3.33	1.14	0.05	0.13	1.32	1.12
DULWEYN	COMMIPHORA CILIATA	T	0.41	10.00	0.02	0.86	0.40	1.27	6.91
GEELREB	CAESALPINIA TROTHAE	aS	0.38	6.67	0.12	0.80	0.27	1.19	7.98
ARANBOWDO	COMMIPHORA spp.	aS	0.22	16.67	0.05	0.46	0.67	1.17	3.44
FARADOWOCO	BARLERIA PROXIMA	awF	0.05	20.00	0.25	0.11	0.80	1.16	0.93
QABOYARYAR	EUPHORBIA INAEQUISPINA	aSK	0.13	20.00	0.05	0.28	0.80	1.12	0.00
SAALOWEYN	?HERMANNIA spp.	dS	0.11	16.67	0.18	0.23	0.67	1.08	3.35
CADAAD	ACACIA SENEGAL	adT	0.22	13.33	0.05	0.46	0.53	1.03	4.10
NAGAR/MADOW/BIG	HERMANNIA spp.	dS	0.16	13.33	0.15	0.34	0.53	1.02	9.62
DUFNOOD	?CLEOME spp.	wF	0.01	20.00	0.20	0.01	0.80	1.01	0.21
CADAADCAD	ACACIA HAMULOSA	adT	0.15	16.67	0.04	0.31	0.67	1.01	2.11
HAMBOHI	AERVA JAVANICA	wF	0.03	13.33	0.28	0.07	0.53	0.88	0.58
ARGEG	ASPARAGUS AFRICANUS	adS	0.04	16.67	0.13	0.08	0.67	0.88	1.10
JEERIN	ACACIA EDGEWORTHII	aS	0.09	13.33	0.12	0.18	0.53	0.83	6.30
RAHANREB	COMMIPHORA INCISA	acS	0.10	13.33	0.02	0.20	0.53	0.76	6.81
JIICMADOW	CADABA spp.	eT	0.14	10.00	0.02	0.29	0.40	0.71	7.53
JIRAQ	ACACIA TURNBULLIANA	aS	0.25	3.33	0.04	0.53	0.13	0.70	4.25
CIIN	SAVROSTEMMA VIMINALE	V	0.19	6.67	0.03	0.40	0.27	0.69	0.00
H??		wF	0.01	10.00	0.28	0.02	0.40	0.69	0.28
NAGARSP.	CROTOLARIA spp.	dS	0.01	10.00	0.25	0.02	0.40	0.68	0.30
DABAXAYR	TEPHROSIA UNIFLORA	wF	0.03	6.67	0.30	0.06	0.27	0.63	0.54
JOWDHER	?GYROCARPUS ANGUSTIFOLIUS	T	0.16	6.67	0.02	0.33	0.27	0.62	3.54
DHIGTAR	DICHROSTACHYS CINERA	aS	0.21	3.33	0.05	0.43	0.13	0.61	2.99
SARINCAD2		dS	0.05	10.00	0.10	0.10	0.40	0.60	1.07
DABAKAR	DALBERGIA MICROPHYLLA	S	0.02	13.33	0.02	0.04	0.53	0.59	0.47
AFGUB	COMMIPHORA ODDURENSIS	adT	0.07	10.00	0.02	0.16	0.40	0.58	1.24
REXAN	?OCINUM BASILICUM	dS	0.08	3.33	0.25	0.16	0.13	0.55	1.59
MARKAFURE	HELIOTROPIUM spp.	wF	0.01	10.00	0.13	0.01	0.40	0.54	0.16
KALMOON	?CLEOME spp.	S	0.08	6.67	0.08	0.17	0.27	0.52	4.11
GOGOBO	IPHIONA ROTUNDIFOLIA	dS	0.05	6.67	0.13	0.10	0.27	0.49	1.24
WANIN	SOLANUM ?ALBICAULE	dS	0.03	10.00	0.04	0.05	0.40	0.49	0.69
MARER	CORDIA SINENSIS	S	0.09	6.67	0.01	0.20	0.27	0.48	1.81
LAMALOOJI	?MAERUA ANGOLENSIS	eT	0.01	10.00	0.03	0.02	0.40	0.45	0.59
JALEELO	CASSIA spp.	dS	0.05	6.67	0.05	0.10	0.27	0.42	1.28

R U 1 6 : Vegetation distribution and importance value (con .)

PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
XODAY	COMMIPHORA HODAI	T	0.13	3.33	0.00	0.28	0.13	0.41	2.46
GARRAS	DOBRA GLABRA	eT	0.12	3.33	0.02	0.25	0.13	0.40	15.51
BAARNIRGOOD	?SATANOCRATER spp.	edS	0.03	6.67	0.05	0.06	0.27	0.38	0.68
DHUMOOD	?CLERODENDRUM MICROPHYLLUM	dT	0.05	6.67	0.01	0.10	0.27	0.38	0.81
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	0.05	6.67	0.01	0.10	0.27	0.37	1.63
QUDDE/JABSI	CORDIA SUCKERTII	S	0.04	6.67	0.02	0.08	0.27	0.36	0.85
DACUUL		dS	0.01	6.67	0.08	0.02	0.27	0.36	0.32
CADAADMADOW	ACACIA ZIZIPHISPINA	aS	0.10	3.33	0.02	0.21	0.13	0.36	2.86
SHRUB??		S	0.03	6.67	0.02	0.07	0.27	0.35	1.00
BALAMBAL	ABUTILON HIRTUM	wF	0.01	6.67	0.05	0.02	0.27	0.34	0.33
DHEGAYAR	BOSCIA CORIACEA	eS	0.03	6.67	0.01	0.05	0.27	0.33	1.20
JIICTIF	CADABA BACCARINII	eT	0.03	6.66	0.01	0.05	0.27	0.33	1.21
DIIQLAY	JATROPHA MICROPHYLLA	S	0.02	6.67	0.01	0.05	0.27	0.32	0.49
HAJIIN	INDIGOFERA SPARTEOLA	wF	0.00	6.67	0.03	0.01	0.27	0.31	0.09
DHEEBYAXAAS	COMMIPHORA ?ALATICAULIS	S	0.00	6.67	0.01	0.01	0.27	0.29	0.09
SAYNSAAB	?ADENIUM OBESCUM	dS	0.02	3.33	0.10	0.05	0.13	0.28	0.44
DABIB	?ACALYPHA spp.	aS	0.04	3.33	0.02	0.09	0.13	0.24	1.09
DHURODSIMILAR	MELHANIA ?PHILLIPSIAE	wF	0.00	3.33	0.08	0.01	0.13	0.22	0.10
XAMUR	ZIZIPHUS HAMUR	aS	0.04	3.33	0.00	0.07	0.13	0.21	0.73
KOBOSH	GREWIA VILLOSA	S	0.03	3.33	0.01	0.05	0.13	0.20	1.08
CARMO	CISSUS ELLENBECKII	V	0.02	3.33	0.01	0.04	0.13	0.19	0.50
KABGALSIMILAR	TRIUMFETTA spp.	dS	0.01	3.33	0.03	0.01	0.13	0.17	0.14
SARIN		S	0.01	3.33	0.01	0.02	0.13	0.17	0.36
DARJO	INDIGOFERA TRITA	dS	0.00	3.33	0.03	0.01	0.13	0.16	0.05
DHITI	COMMIPHORA LOBATO-SPATHULATA	acS	0.01	3.33	0.00	0.01	0.13	0.15	0.09
MANDHERAQUBE	CYPHOSTEMMA spp.	V	0.00	3.33	0.00	0.01	0.13	0.15	0.05
MADAXBUSHI	MORMODICA SPINOSA	V	0.00	3.33	0.00	0.01	0.13	0.15	0.00
CADANOOD	?ASPARAGUS spp.	S	0.00	3.33	0.00	0.01	0.13	0.15	0.22
BULAAYOOD	COMMIPHORA AFF. SULCATO STRIATA	S	0.00	3.33	0.00	0.01	0.13	0.15	0.19
MISARAJABIS	?TERMINALIA PARVULA	S	0.00	3.33	0.00	0.00	0.13	0.14	0.09
JINOW	COMMIPHORA ROSTRATA	S	0.00	3.33	0.00	0.00	0.13	0.14	0.05
CAYO	CLEOME spp.	dS	0.00	3.33	0.00	0.00	0.13	0.14	0.03
JIICRUGUNBAY	CADABA LONGIFOLIA	eT	0.00	3.33	0.00	0.00	0.13	0.14	0.10
QANSAX	ACACIA REFISCIENS	aS	0.00	3.33	0.00	0.00	0.13	0.14	0.01
XAGAR	COMMIPHORA ?KUA	T	0.00	3.33	0.00	0.00	0.13	0.14	2.63
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	aT	0.00	3.33	0.00	0.00	0.13	0.14	0.33
MARYOTOL	JATROPHA ?DICHTAR	aS	0.00	3.33	0.00	0.00	0.13	0.14	0.39
KHUURI	CAESALPINIA ERIANTHERA	adT	0.00	3.33	0.00	0.00	0.13	0.14	0.48
GOWLELO	COMMIPHORA ?ELLENBECKII	T	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RUMASAN	LEOWIA GLUTINOSA	S	0.00	0.00	0.00	0.00	0.00	0.00	0.01

table 4.2. :

R U 2 4 : Vegetation distribution and importance value

PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom kg/ha
DHUROD	MELHANIA ?INCANA	wF	1.08	82.35	29.80	2.39	4.71	36.91	27.52
JILAB	INDIGOFERA RUSPOLII	dS	4.98	64.71	22.14	10.99	3.70	36.83	126.93
NAGARDHEEB	PLEUROPTHERANTA REVOILII	dS	3.01	85.29	10.70	6.65	4.88	22.24	111.34
KURA	ACACIA TORTILIS	aT	6.66	44.12	0.26	14.69	2.53	17.48	255.31
GOGOBO	IPHIONA ROTUNDIFOLIA	dS	1.37	50.00	1.80	3.03	2.86	7.69	38.22
GUNRAY	COMMIPHORA GURREH	-cT	2.87	17.65	0.09	6.34	1.01	7.44	58.58
KABGAL	TRIUMFETTA HETEROCARPA	dS	0.80	47.06	2.61	1.76	2.69	7.06	14.76
YICIB	CORDEAUXIA EDULIS	eS	1.94	26.47	0.79	4.28	1.52	6.58	98.86
JIRAQ	ACACIA TURNBULLIANA	aS	1.69	35.29	0.70	3.74	2.02	6.46	48.90
CADAADMADOW	ACACIA ZIZIPHISPINA	aS	1.46	50.00	0.24	3.23	2.86	6.33	31.34
DHAAYODHABE	PAVONIA ARABICA	wF	0.08	26.47	3.99	0.18	1.52	5.69	2.70
NAGARJABTO	HELIOTROPIUM spp.	wF	0.14	50.00	2.49	0.31	2.86	5.67	2.68
WANIN	SOLANUM ?ALBICAULE	dS	0.65	23.53	2.02	1.42	1.35	4.79	18.01
DHITI	COMMIPHORA LOBATO-SPATHULATA	acS	0.51	55.88	0.32	1.13	3.20	4.65	7.15
GABRAR	COMMIPHORA HORRIDA	adT	0.88	32.35	0.18	1.94	1.85	3.97	22.35
GO	INDIGOFERA ?INTRICATA	dS	0.21	20.59	2.27	0.46	1.18	3.91	5.64
JEERIN	ACACIA EDGEWORTHII	aS	0.73	32.35	0.43	1.60	1.85	3.88	38.51
TIMOFAHIYE	PAVONIA PIROTTAE	wF	0.03	35.29	1.77	0.06	2.02	3.84	1.09
MARYOTOL	JATROPHA ?DICHTAR	aS	0.68	38.24	0.13	1.50	2.19	3.82	15.42
DAFURUUR	GREWIA TENAX	S	0.42	44.12	0.18	0.93	2.53	3.64	7.60
MURJAAN	BOSWELIA NEGLECTA	T	1.29	11.76	0.06	2.84	0.67	3.57	24.96
REXAN	?OCINUM BASILICUM	dS	0.34	14.71	1.94	0.75	0.84	3.54	7.42
BUULALOOD	IPOMOEA DONALDSONII	aS	0.42	38.24	0.27	0.92	2.19	3.38	9.71
HAMBOHI	AERVA JAVANICA	wF	0.05	38.24	1.03	0.12	2.19	3.33	1.29
NAGARXEYLEY	HIBISCUS spp.	wF	0.09	29.41	1.25	0.20	1.68	3.13	2.78
CADUUR	SOLANUM JUBAE	S	0.55	29.41	0.12	1.22	1.68	3.02	10.62
RAHANREB	COMMIPHORA INCISA	acS	0.53	26.47	0.12	1.16	1.52	2.80	17.49
HOHOB	GREWIA PENICILLATA	S	0.33	29.41	0.22	0.73	1.68	2.63	5.98
BARANJIS	CONVOLVULUS spp.	cF	0.11	23.53	1.03	0.24	1.35	2.61	2.03
XODAY	COMMIPHORA HODAI	T	0.96	5.88	0.02	2.12	0.34	2.47	16.28
JAFEECO	IPOMOEA CITRINA	S	0.31	26.47	0.21	0.67	1.52	2.40	7.12
KHUURI	CAESALPINIA ERIANTHERA	adT	0.65	11.76	0.11	1.43	0.67	2.21	25.78
ONTOR	CORDYLA SOMALENSIS	T	0.71	8.82	0.03	1.58	0.51	2.11	16.16
JALEELO	CASSIA spp.	dS	0.23	20.59	0.37	0.51	1.18	2.05	6.08
SARINCAD	SERICOCOMOPSIS PALLIDA	dS	0.50	8.82	0.45	1.10	0.51	2.05	12.56

R U 2 4 : Vegetation distribution and importance value (contin.)

PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
JALEELOWEYNE	CASSIA ELLISEA	S	0.72	5.88	0.08	1.58	0.34	2.00	14.63
DHIRINDHIR	EUPHORBIA CUNEATA	aS	0.33	20.59	0.09	0.72	1.18	1.99	5.91
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	0.21	23.53	0.09	0.47	1.35	1.90	8.63
NAGAR/MADOW/BIG	HERMANNIA spp.	dS	0.24	20.59	0.18	0.54	1.18	1.89	5.41
CALOOLYAAY	?OCHNA spp.	eS	0.24	20.59	0.09	0.52	1.18	1.79	11.46
GUNDUD	COMMIPHORA TRUNCATA	T	0.38	14.71	0.06	0.83	0.84	1.74	10.25
XAGARCAD	COMMIPHORA ELLISIAE	T	0.69	2.94	0.01	1.51	0.17	1.70	11.65
MIRACAS	GREWIA TEMBENSIS	S	0.11	23.53	0.10	0.24	1.35	1.68	2.01
H??		wF	0.02	8.82	1.14	0.04	0.51	1.68	0.70
NAGARCAD	SERICOCOMOPSIS spp.	dS	0.15	14.71	0.48	0.34	0.84	1.65	4.11
NAGARSP.	CROTOLARIA spp.	dS	0.02	14.71	0.70	0.04	0.84	1.58	0.50
QALMOWALIS		edS	0.05	14.71	0.60	0.11	0.84	1.55	1.51
SAALOWEYN	?HERMANNIA spp.	dS	0.18	11.76	0.48	0.40	0.67	1.55	5.52
GEEDDAJIS	SOLANUM MACRANTHUM	adS	0.10	14.71	0.40	0.22	0.84	1.46	3.51
QABO	EUPHORBIA LONGISPINA	aSK	0.17	17.65	0.07	0.38	1.01	1.45	3.44
QARON	COMMIPHORA VELUTINA	-aT	0.15	17.65	0.08	0.34	1.01	1.43	9.56
MARER	CORDIA SINENSIS	S	0.21	14.71	0.04	0.46	0.84	1.35	4.80
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	aT	0.18	14.71	0.07	0.40	0.84	1.32	7.29
CADAADCAD	ACACIA HAMULOSA	adT	0.10	17.65	0.09	0.21	1.01	1.31	2.79
BEEYAMADOW	COMMIPHORA SULCATO STRIATA	T	0.34	8.82	0.04	0.75	0.51	1.30	8.69
SHRUB??		S	0.10	14.71	0.11	0.23	0.84	1.18	2.78
BOCBOCOOD	PAVONIA KOTSCHYII	wF	0.03	8.82	0.59	0.07	0.51	1.16	0.58
SARIN		S	0.17	8.82	0.26	0.37	0.51	1.13	5.49
HAJIIN	INDIGOFERA SPARTEOLA	wF	0.02	14.71	0.23	0.05	0.84	1.12	0.62
MUQLAY	BOSWELIA MICROPHYLLA	T	0.19	11.76	0.03	0.42	0.67	1.12	4.24
LEBI	DELONIX ELATA	T	0.42	2.94	0.01	0.92	0.17	1.09	7.06
RIYOXIR		dS	0.27	2.94	0.26	0.60	0.17	1.02	7.50
YAMAARUG	BLEPHARIS CILIARIS	anF	0.00	8.82	0.51	0.00	0.51	1.02	0.28
DS??		dS	0.06	8.82	0.34	0.13	0.51	0.97	1.40
CADAAD	ACACIA SENEGAL	adT	0.29	2.94	0.07	0.64	0.17	0.88	4.23
BEEYACAD	BOSWELIA RIVAE	-cT	0.30	2.94	0.04	0.66	0.17	0.87	7.93
DACUUL		dS	0.03	5.88	0.37	0.07	0.34	0.77	0.94
MAYGAG	BOSCIA MINIMIFOLIA	eT	0.19	5.88	0.01	0.41	0.34	0.77	3.18
GOWLELO	COMMIPHORA ?ELLENBECKII	T	0.09	8.82	0.03	0.19	0.51	0.73	2.75
BILCIL	ACACIA CHEILANTHIFOLIA	aT	0.22	2.94	0.04	0.50	0.17	0.70	8.94

R U 2 4 : Vegetation distribution and importance value (contin.)

SOMALI PLANT NAME	BOTANICAL NAME	TYPE of VEGETATION	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
MARKAFURE	HELIOTROPIUM spp.	wF	0.01	8.82	0.18	0.01	0.51	0.70	0.14
KABGALSIMILAR	TRIUMFETTA spp.	dS	0.04	5.88	0.22	0.08	0.34	0.63	0.76
DHUMOOD	?CLERODENDRUM MICROPHYLLUM	dT	0.04	8.82	0.02	0.09	0.51	0.62	1.09
BOOGADHAYE	?CHRYZOPHORA spp.	dS	0.05	5.88	0.14	0.12	0.34	0.60	1.35
GEEDGABAL		dS	0.14	2.94	0.11	0.32	0.17	0.59	2.63
GEEDGABOY	?LEPTODENIA PYROTECHNICA	eS	0.02	8.82	0.01	0.06	0.51	0.57	1.15
SARMAAN	ACACIA HORRIDA	aS	0.10	5.88	0.01	0.22	0.34	0.57	1.49
DOOBOGOY	HELIOTROPIUM LONGIFLORUM	dS	0.03	5.88	0.11	0.06	0.34	0.51	0.69
NAGARMADOW	HIBISCUS ?SOMALENSIS	wF	0.01	5.88	0.11	0.01	0.34	0.46	0.11
OWRADHAYE	COMBRETRUM ?RETIFLORA	S	0.09	2.94	0.09	0.20	0.17	0.45	2.10
CANYO	PORTULACA OLERACEA	anF	0.00	5.88	0.11	0.00	0.34	0.45	0.06
DULWEYN	COMMIPHORA CILIATA	T	0.12	2.94	0.01	0.26	0.17	0.44	2.03
KALMOON	?CLEOME spp.	S	0.03	5.88	0.04	0.06	0.34	0.43	1.12
RAYDAB	ALBIZIA ANTHELMINTICA	T	0.10	2.94	0.01	0.23	0.17	0.41	1.65
XAYEY	COMMIPHORA ERYTHREA	T	0.03	5.88	0.01	0.06	0.34	0.40	0.51
GAHAYR	BLEPHARISPERUM spp.	S	0.06	2.94	0.10	0.13	0.17	0.39	1.69
BALAMBAL	ABUTILON HIRTUM	wF	0.01	5.88	0.04	0.01	0.34	0.38	0.15
HAJIINCAD		dS	0.01	2.94	0.18	0.01	0.17	0.37	0.15
JINOW	COMMIPHORA ROSTRATA	S	0.00	5.88	0.01	0.01	0.34	0.36	0.23
DUFNOOD	?CLEOME spp.	wF	0.00	2.94	0.15	0.01	0.17	0.32	0.09
DABLEF	COMMICARPUS CF. BOISSIERI	wF	0.01	2.94	0.11	0.02	0.17	0.30	0.24
QUNLESIRIQ	ACACIA WALWALENSIS	aT	0.04	2.94	0.03	0.10	0.17	0.29	0.72
DHURODSIMILAR	MELHANIA ?PHILLIPSIAE	wF	0.00	2.94	0.11	0.01	0.17	0.29	0.09
DHEERDHEERE	ACACIA BRICCHETTIANA	aS	0.05	2.94	0.01	0.11	0.17	0.28	0.73
BAARNIRGOOD	?SATANOCRATER spp.	edS	0.01	2.94	0.04	0.03	0.17	0.23	0.28
SAGARSUF		dS	0.01	2.94	0.04	0.02	0.17	0.23	0.30
GARUNJO	GLOSSONEMA REVOLLII	wF	0.00	2.94	0.04	0.00	0.17	0.21	0.03
QODAXTOOL	BLEPHARIS spp.	awF	0.00	2.94	0.04	0.00	0.17	0.21	0.03
JIICMADOW	CADABA spp.	eT	0.01	2.94	0.01	0.03	0.17	0.20	0.53
AFGUB	COMMIPHORA ODDURENSIS	adT	0.01	2.94	0.01	0.02	0.17	0.20	0.28
GUMER	ACACIA NUBICA	aS	0.01	2.94	0.01	0.02	0.17	0.19	0.17
DABAKAR	DALBERGIA MICROPHYLLA	S	0.01	2.94	0.01	0.01	0.17	0.19	0.16
MISARAJABIS	?TERMINALIA PARVULA	S	0.00	2.94	0.01	0.01	0.17	0.18	0.18
ANEXO	CUCUMELLA KELLERI	F	0.00	2.94	0.01	0.00	0.17	0.18	0.03
GARRAS	DOBRA GLABRA	eT	0.05	0.00	0.01	0.11	0.00	0.12	3.42
DIIQLAY	JATROPHA MICROPHYLLA	S	0.01	0.00	0.01	0.02	0.00	0.03	0.22
CARMO	CISSUS ELLENBECKII	V	0.01	0.00	0.01	0.01	0.00	0.02	0.26

table 4.3. : R U 4 5 : Vegetation distribution and importance value

SOMALI PLANT NAME	BOTANICAL NAME	TYPE of VEGETATION	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
GO	INDIGOFERA INTRICATA	dS	4.33	28.57	32.46	12.03	1.80	46.29	114.21
JILAB	INDIGOFERA RUSPOLII	dS	4.71	64.28	13.25	13.09	4.05	30.40	117.89
KABGAL	TRIUMFETTA HETEROCARPA	dS	2.42	50.00	4.53	6.73	3.15	14.41	44.89
DACUUL		dS	0.98	35.71	7.05	2.72	2.25	12.02	28.86
NAGARDHEEB	PLEUROPTHERANTA REVOILII	dS	1.42	71.42	2.41	3.94	4.50	10.85	39.93
RAHANREB	COMMIPHORA INCISA	acS	3.39	14.28	0.15	9.43	0.90	10.47	62.41
DHITI	COMMIPHORA LOBATO=SPATHULATA	acS	1.98	57.14	0.57	5.50	3.60	9.68	30.05
JEERIN	ACACIA EDGEWORTHII	aS	2.02	50.00	0.55	5.61	3.15	9.32	77.21
TIMOFAHIYE	PAVONIA PIROTTAE	wF	0.07	71.42	3.73	0.21	4.50	8.44	3.46
DHUROD	MELHANIA ?INCANA	wF	0.24	57.14	3.44	0.66	3.60	7.71	4.93
REXAN	?OCINUM BASILICUM	dS	0.57	35.71	2.41	1.57	2.25	6.23	13.25
DHAAYODHABE	PAVONIA ARABICA	wF	0.13	28.57	3.84	0.36	1.80	6.01	4.03
BAARNIRGOOD	?SATANOCRATER spp.	edS	0.46	57.14	0.98	1.28	3.60	5.86	11.58
DHEERDHEERE	ACACIA BRICCHETTIANA	aS	1.08	35.71	0.32	2.99	2.25	5.56	49.86
JALEELO	CASSIA spp.	dS	0.66	42.85	0.92	1.82	2.70	5.44	21.32
GOGOBO	IPHIONA ROTUNDIFOLIA	dS	0.74	28.57	1.15	2.04	1.80	4.99	18.15
BOCBOCOOD	PAVONIA KOTSCHYII	wF	0.25	28.57	2.29	0.69	1.80	4.78	4.49
RUMASAN	LEOWIA GLUTINOSA	S	1.15	14.28	0.25	3.21	0.90	4.36	26.38
DHIRINDHIR	EUPHORBIA CUNEATA	aS	0.90	21.42	0.16	2.49	1.35	4.01	22.06
KURA	ACACIA TORTILIS	aT	0.92	21.42	0.04	2.54	1.35	3.93	40.22
QANSAX	ACACIA REFISCIENS	aS	0.93	14.28	0.07	2.59	0.90	3.55	20.82
NAGARAWR	INDIGOFERA SPINOSA	adS	0.27	14.28	1.78	0.76	0.90	3.44	5.30
LEBIYARO	?SESBIANA spp.	dS	0.20	7.14	2.24	0.55	0.45	3.23	3.73
HAMBOHI	AERVA JAVANICA	wF	0.07	35.71	0.69	0.21	2.25	3.15	1.35
BARANJIS	CONVOLVULUS spp.	cF	0.15	28.57	0.92	0.42	1.80	3.14	2.82
NAGARJABTO	HELIOTROPIUM spp.	wF	0.12	21.42	1.26	0.34	1.35	2.96	4.49
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	0.48	21.42	0.24	1.32	1.35	2.92	28.72
YAMAARUG	BLEPHARIS CILIARIS	anF	0.00	21.42	0.80	0.01	1.35	2.17	0.69
NAGARSP.	CROTOLARIA spp.	dS	0.11	7.14	1.38	0.30	0.45	2.13	2.13
DABAXAYR	TEPHROSIA UNIFLORA	wF	0.08	14.28	0.92	0.23	0.90	2.04	1.53
QANSOLE	RYNCHOSIS GANSOLE	dS	0.31	14.28	0.25	0.87	0.90	2.02	5.45
IBOLAROOR	CROTOLARIA spp.	wF	0.03	7.14	1.38	0.09	0.45	1.92	1.32
NAGARXEYLEY	HIBISCUS spp.	wF	0.10	14.28	0.69	0.27	0.90	1.86	1.72
SARMAAN	ACACIA HORRIDA	aS	0.45	7.14	0.06	1.24	0.45	1.74	10.82
NAGARCAD	SERICOCOMOPSIS spp.	dS	0.17	14.28	0.34	0.47	0.90	1.72	4.60
QALANQAL	CADABA GLANDULOSA	eS	0.28	14.28	0.04	0.78	0.90	1.71	16.23
RIYOXIR		dS	0.36	7.14	0.23	0.99	0.45	1.67	9.88
GABRAR	COMMIPHORA HORRIDA	adT	0.41	7.14	0.08	1.14	0.45	1.67	11.57

R U 4 5 : Vegetation distribution and importance value (contin.)

SOMALI PLANT NAME	BOTANICAL NAME	TYPE of VEGETATION	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
DIIQLAY	JATROPHA MICROPHYLLA	S	0.07	21.42	0.06	0.21	1.35	1.62	2.71
GEEDKURRUS	LIPPIA CARVIODORA	dS	0.07	14.28	0.52	0.19	0.90	1.60	2.95
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	aT	0.22	14.28	0.04	0.62	0.90	1.55	5.58
KAXANDO	TRIBULUS TERRESTRIS	anF	0.00	21.42	0.17	0.00	1.35	1.53	0.15
CADAADMADOW	ACACIA ZIZIPHISPINA	aS	0.19	14.28	0.07	0.54	0.90	1.51	5.85
MARYOTOL	JATROPHA ?DICHTAR	aS	0.34	7.14	0.06	0.94	0.45	1.45	10.49
MADAXBUSHI	MORMODICA SPINOSA	V	0.16	14.28	0.07	0.46	0.90	1.43	3.87
QARON	COMMIPHORA VELUTINA	-aT	0.02	21.42	0.00	0.05	1.35	1.40	0.29
JAJABOOD	?PREMNA spp.	dS	0.13	7.14	0.57	0.35	0.45	1.38	3.18
DAFURUUR	GREWIA TENAX	S	0.16	14.28	0.04	0.44	0.90	1.37	2.67
GEEDDAJIS	SOLANUM MACRANTHUM	adS	0.06	14.28	0.23	0.17	0.90	1.30	1.99
MARKAFURE	HELIOTROPIUM spp.	wF	0.02	14.28	0.34	0.05	0.90	1.29	0.40
QALMOWALIS		edS	0.03	14.28	0.23	0.09	0.90	1.22	0.89
CADAADCAD	ACACIA HAMULOSA	adT	0.08	14.28	0.04	0.22	0.90	1.16	1.80
FARADOWOCO	BARLERIA PROXIMA	awF	0.02	14.28	0.17	0.06	0.90	1.14	0.65
DHURODSIMILAR	MELHANIA ?PHILLIPSIAE	wF	0.01	14.28	0.17	0.03	0.90	1.10	0.22
HOHOB	GREWIA PENICILLATA	S	0.04	14.28	0.04	0.12	0.90	1.06	1.42
MAYGAG	BOSCIA MINIMIFOLIA	eT	0.20	7.14	0.02	0.57	0.45	1.04	27.66
DABAKAR	DALBERGIA MICROPHYLLA	S	0.03	14.28	0.02	0.07	0.90	0.99	0.66
MUQLAY	BOSWELIA MICROPHYLLA	T	0.17	7.14	0.01	0.47	0.45	0.94	2.89
SAALOWEYN	?HERMANNIA spp.	dS	0.07	7.14	0.12	0.19	0.45	0.75	2.08
CADUUR	SOLANUM JUBAE	S	0.10	7.14	0.01	0.28	0.45	0.75	1.95
MAREER	CORDIA SINENSIS	S	0.08	7.14	0.02	0.23	0.45	0.70	1.67
JIICMADOW	CADABA spp.	eT	0.08	7.14	0.01	0.22	0.45	0.69	4.30
NAGARMADOW	HIBISCUS ?SOMALENSIS	wF	0.01	7.14	0.17	0.04	0.45	0.66	0.27
SAGARSUF		dS	0.03	7.14	0.12	0.08	0.45	0.64	1.49
QABO	EUPHORBIA LONGISPINA	aSK	0.06	7.14	0.01	0.16	0.45	0.62	1.13
SARINCAD	SERICOCOMOPSIS PALLIDA	dS	0.04	7.14	0.06	0.11	0.45	0.62	1.10
DHIGTAR	DICHROSTACHYS CINERA	aS	0.05	7.14	0.01	0.15	0.45	0.62	0.80
DABLEF	COMMICARPUS CF. BOISSIERI	wF	0.01	7.14	0.12	0.04	0.45	0.61	0.39
GEEDGABOY	?LEPTODENIA PYROTECHNICA	eS	0.03	7.14	0.01	0.09	0.45	0.56	1.56
ANEXO	CUCUMELLA KELLERI	F	0.02	7.14	0.06	0.05	0.45	0.55	0.36
XERKOOD	?MERREMIA spp.	dS	0.01	7.14	0.06	0.04	0.45	0.54	0.33
HAJIIN	INDIGOFERA SPARTEOLA	wF	0.01	7.14	0.06	0.02	0.45	0.53	0.16
QODAXTOOL	BLEPHARIS spp.	awF	0.00	7.14	0.06	0.01	0.45	0.51	0.06
DUFNOOD	?CLEOME spp.	wF	0.00	7.14	0.06	0.00	0.45	0.51	0.06
GARRAS	DOBRA GLABRA	eT	0.00	7.14	0.01	0.00	0.45	0.46	9.31
DHUMOOD	?CLERODENDRUM MICROPHYLLUM	dT	0.00	7.14	0.01	0.00	0.45	0.46	0.99

R U 4 4 : Vegetation distribution and importance value

SOMALI PLANT NAME	BOTANICAL NAME	TYPE of VEGETATION	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
GO	INDIGOFERA INTRICATA	dS	3.68	80.00	29.78	8.80	4.67	43.25	97.84
JILAB	INDIGOFERA RUSPOLII	dS	5.58	70.00	17.73	13.25	4.17	35.15	145.04
JEERIN	ACACIA EDGEWORTHII	aS	6.46	80.00	1.69	15.35	4.76	21.81	218.99
NAGARDHEEB	PLEUROPTHERANTA REVOILII	dS	1.65	80.00	2.97	3.93	4.76	11.66	45.25
GOGOBO	IPHIONA ROTUNDIFOLIA	dS	1.72	60.00	3.84	4.08	3.57	11.49	55.92
DHEERDHEERE	ACACIA BRICCHETTIANA	aS	3.36	30.00	0.73	7.99	1.79	10.51	104.71
TIMOFAHIYE	PAVONIA PIROTTAE	wF	0.09	80.00	4.98	0.22	4.76	9.96	4.25
RAHANREB	COMMIPHORA INCISA	acS	2.46	50.00	0.17	5.84	2.98	8.99	85.38
KABGAL	TRIUMFETTA HETEROCARPA	dS	1.40	40.00	2.88	3.33	2.38	8.59	26.25
XABNOCAS		wF	1.64	10.00	1.48	3.88	0.60	5.96	33.00
BAARNIRGOOD	?SATANOCRATER spp.	edS	0.61	50.00	1.48	1.44	2.98	5.91	16.19
NAGARSP.	CROTOLARIA spp.	dS	0.22	20.00	3.93	0.53	1.19	5.65	5.58
DHIRINDHIR	EUPHORBIA CUNEATA	aS	1.40	30.00	0.33	3.33	1.79	5.45	41.91
DABAXAYR	TEPHROSIA UNIFLORA	wF	0.23	30.00	2.97	0.54	1.79	5.29	4.55
DHITI	COMMIPHORA LOBATO-SPATHULATA	acS	0.77	50.00	0.45	1.84	2.98	5.27	14.36
SARMAAN	ACACIA HORRIDA	aS	1.42	20.00	0.16	3.36	1.19	4.71	27.04
QANSAX	ACACIA REFISCIENS	aS	1.66	10.00	0.14	3.95	0.60	4.68	39.65
DHUROD	MELHANIA ?INCANA	wF	0.11	40.00	1.66	0.26	2.38	4.30	2.19
REXAN	?OCINUM BASILICUM	dS	0.13	40.00	0.79	0.31	2.38	3.48	3.97
QALMOWALIS		edS	0.10	40.00	0.79	0.24	2.38	3.41	2.82
CANYO	PORTULACA OLERACEA	anF	0.01	20.00	1.75	0.02	1.19	2.96	1.37
RUMASAN	LEOWIA GLUTINOSA	S	0.68	20.00	0.14	1.61	1.19	2.94	13.36
DAFURUUR	GREWIA TENAX	S	0.43	30.00	0.10	1.02	1.79	2.91	7.29
DHAAYODHABE	PAVONIA ARABICA	wF	0.03	30.00	1.05	0.07	1.79	2.91	1.01
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	aT	0.63	20.00	0.07	1.51	1.19	2.77	10.15
KAXANDO	TRIBULUS TERRESTRIS	anF	0.01	20.00	1.31	0.03	1.19	2.53	1.04
DHURODSIMILAR	MELHANIA ?PHILLIPSIAE	wF	0.05	20.00	1.14	0.12	1.19	2.44	1.30
DACUUL		dS	0.17	10.00	1.40	0.40	0.60	2.40	5.26
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	0.23	30.00	0.07	0.54	1.79	2.39	7.66
SABINCAD	SERICOCOMOPSIS PALLIDA	dS	0.44	10.00	0.70	1.05	0.60	2.34	12.22
MARYOTOL	JATROPHA ?DICHTAR	aS	0.46	20.00	0.05	1.10	1.19	2.34	8.74
HAMBOHI	AERVA JAVANICA	wF	0.04	30.00	0.44	0.10	1.79	2.33	0.79
MABER	CORDIA SINENSIS	S	0.41	20.00	0.12	0.97	1.19	2.28	8.36

table 4.4. : R U 4 4 : Vegetation distribution and importance value (contin.)

SOMALI PLANT NAME	BOTANICAL NAME	TYPE of VEGETATION	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
NAGARXEYLEY	HIBISCUS spp.	wF	0.05	30.00	0.35	0.11	1.79	2.24	0.81
JIRAQ	ACACIA TURNBULLIANA	aS	0.34	20.00	0.24	0.80	1.19	2.23	23.12
GOWLELO	COMMIPHORA ?ELLENBECKII	T	0.30	20.00	0.03	0.70	1.19	1.93	4.68
BARANJIS	CONVOLVULUS spp.	cF	0.08	20.00	0.52	0.19	1.19	1.90	1.48
QALANQAL	CADABA GLANDULOSA	eS	0.51	10.00	0.07	1.21	0.60	1.87	29.51
YAMAARUG	BLEPHARIS CILIARIS	anF	0.00	20.00	0.61	0.01	1.19	1.81	0.48
CADAADCAD	ACACIA HAMULOSA	adT	0.23	20.00	0.07	0.54	1.19	1.80	3.27
NAGARJABTO	HELIOTROPIUM spp.	wF	0.03	20.00	0.35	0.07	1.19	1.61	1.14
MIRACAS	GREWIA TEMBENSIS	S	0.12	20.00	0.10	0.30	1.19	1.59	3.15
XAJIINDALUG	INDIGOFERA OGADENSI	dS	0.12	10.00	0.61	0.29	0.60	1.50	2.24
DUFNOOD	?CLEOME spp.	wF	0.01	20.00	0.26	0.02	1.19	1.47	0.24
KABGALSIMILAR	TRIUMFETTA spp.	dS	0.12	10.00	0.52	0.29	0.60	1.41	2.49
CADAAD	ACACIA SENEGAL	adT	0.29	10.00	0.07	0.70	0.60	1.36	5.76
SAGARSUF		dS	0.15	10.00	0.35	0.36	0.60	1.31	4.15
NAGARAWR	INDIGOFERA SPINOSA	adS	0.06	10.00	0.44	0.15	0.60	1.18	1.20
GEEDDAJIS	SOLANUM MACRANTHUM	adS	0.09	10.00	0.35	0.20	0.60	1.15	2.80
JALEELO	CASSIA spp.	dS	0.14	10.00	0.17	0.34	0.60	1.11	3.73
QABO	EUPHORBIA LONGISPINA	aSK	0.14	10.00	0.03	0.33	0.60	0.97	2.82
BOCBOCOOD	PAVONIA KOTSCHYII	wF	0.03	10.00	0.26	0.06	0.60	0.92	0.47
CADUUR	SOLANUM JUBAE	S	0.13	10.00	0.02	0.30	0.60	0.91	2.43
DABLEF	COMMICARPUS CF. BOISSIERI	wF	0.02	10.00	0.17	0.05	0.60	0.82	0.54
BOOGADHAYE	?CHRYZOPHORA spp.	dS	0.05	10.00	0.09	0.12	0.60	0.80	1.21
CADAADMADOW	ACACIA ZIZIPHISPINA	aS	0.07	10.00	0.02	0.16	0.60	0.78	1.39
ANEXO	CUCUMELLA KELLERI	F	0.02	10.00	0.09	0.05	0.60	0.74	0.50
GAHAYR	BLEPHARISPERUM spp.	S	0.02	10.00	0.03	0.04	0.60	0.67	0.88
QANSOLE	RYNCHOSIS GANSOLE	dS	0.02	10.00	0.02	0.05	0.60	0.66	0.35
CADAY	COMMIPHORA ?BRUCEA	S	0.01	10.00	0.02	0.03	0.60	0.65	0.40
QARON	COMMIPHORA VELUTINA	-aT	0.02	10.00	0.00	0.04	0.60	0.64	0.29
KUBA	ACACIA TORTILIS	aT	0.00	10.00	0.02	0.00	0.60	0.61	18.28
JAFEECO	IPOMOEA CITRINA	S	0.04	10.00	0.02	0.05	0.60	0.61	0.85
DHUMOOD	?CLERODENDRUM MICROPHYLLUM	dT	0.00	10.00	0.02	0.00	0.60	0.61	1.24
CALOOLYAAY	?OCHNA spp.	eS	0.00	10.00	0.02	0.00	0.60	0.61	3.25
SHILLAN	BALANITES ROTUNDIFOLIA	eaS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUULALOOD	IPOMOEA DONALDSONII	aS	0.00	0.00	0.00	0.00	0.00	0.00	0.00

table 4.5. : R U 4 7 : Vegetation distribution and importance value

SOMALI PLANT NAME	BOTANICAL NAME	TYPE of VEGETATION	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
KABGAL	TRIUMFETTA HETEROCARPA	dS	5.63	100.00	21.67	12.68	4.09	38.44	138.17
NAGARAWR	INDIGOFERA SPINOSA	adS	2.28	54.54	15.83	5.13	2.23	23.19	50.27
TIMOFAHIYE	PAVONIA PIROTTAE	wF	0.36	81.81	12.87	0.82	3.35	17.03	17.62
JILAB	INDIGOFERA RUSPOLII	dS	2.10	63.63	5.84	4.73	2.60	13.17	53.48
SARMAAN	ACACIA HORRIDA	aS	4.05	72.72	0.42	9.12	2.97	12.51	120.97
KURA	ACACIA TORTILIS	aT	3.71	72.72	0.26	8.35	2.97	11.58	126.44
QODAXTOOL	BLEPHARIS spp.	awF	0.33	90.90	6.78	0.75	3.72	11.25	10.49
KALMOON	?CLEOME spp.	S	2.34	45.45	1.64	5.28	1.86	8.78	115.15
SAGARSUF		dS	1.59	63.63	2.21	3.57	2.60	8.38	53.27
GABRAR	COMMIPHORA HORRIDA	adT	2.16	72.72	0.40	4.86	2.97	8.23	85.22
NAGARXEYLEY	HIBISCUS spp.	wF	0.13	81.81	3.81	0.29	3.35	7.45	5.40
MIRDHIS	ANISOTES TRISULCUS	S	1.77	63.63	0.47	4.00	2.60	7.07	45.56
DHUROD	MELHANIA ?INCANA	wF	0.56	27.27	3.96	1.25	1.12	6.33	10.54
JEERIN	ACACIA EDGEWORTHII	aS	1.56	54.54	0.44	3.51	2.23	6.18	49.87
DHAAYODHABE	PAVONIA ARABICA	wF	0.04	63.63	2.67	0.09	2.60	5.37	3.48
QANSAX	ACACIA REFISCIENS	aS	1.67	18.18	0.20	3.75	0.74	4.69	44.93
NAGARDHEEB	PLEUROPTHERANTA REVOILII	dS	0.70	45.45	0.74	1.57	1.86	4.17	17.03
GO	INDIGOFERA ?INTRICATA	dS	0.15	36.36	2.28	0.34	1.49	4.11	3.14
NAGARCAD	SERICOCOMOPSIS spp.	dS	0.41	45.45	1.04	0.92	1.86	3.82	10.26
BUULALOOD	IPOMOEA DONALDSONII	aS	0.41	63.63	0.17	0.93	2.60	3.70	12.65
NAGARJABTO	HELIOTROPIUM spp.	wF	0.20	54.54	0.89	0.45	2.23	3.57	5.25
DAFURUUR	GREWIA TENAX	S	0.48	54.54	0.16	1.09	2.23	3.47	8.55
DHIRINDHIR	EUPHORBIA CUNEATA	aS	0.51	45.45	0.35	1.15	1.86	3.36	25.55
NAGARMADOW	HIBISCUS ?SOMALENSIS	wF	0.13	27.27	1.78	0.28	1.12	3.18	3.08
H??		wF	0.03	36.36	1.48	0.08	1.49	3.05	1.98
BOCBOCOOD	PAVONIA KOTSCHYII	wF	0.04	45.45	1.04	0.10	1.86	2.99	1.53
HAMBOHI	AERVA JAVANICA	wF	0.11	45.45	0.69	0.25	1.86	2.80	2.00
GOGOBO	IPHIONA ROTUNDIFOLIA	dS	0.32	36.36	0.47	0.71	1.49	2.67	6.46
DUFNOOD	?CLEOME spp.	wF	0.06	36.36	0.99	0.14	1.49	2.61	1.62
WACANRI	LANNEA spp.	T	0.93	9.09	0.01	2.10	0.37	2.48	15.82

R U 4 7 : Vegetation distribution and importance value (contin.)

SOMALI PLANT NAME	BOTANICAL NAME	TYPE of VEGETATION	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
FARADOWOCO	BARLERIA PROXIMA	awF	0.17	36.36	0.59	0.38	1.49	2.46	4.16
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	0.41	36.36	0.04	0.91	1.49	2.44	8.81
JALEELO	CASSIA spp.	dS	0.53	18.18	0.46	1.18	0.74	2.38	15.58
MURJAAN	BOSWELIA NEGLECTA	T	0.77	9.09	0.01	1.73	0.37	2.11	13.03
QABOYARYAR	EUPHORBIA INAEQUISPINA	aSK	0.45	9.09	0.49	1.00	0.37	1.87	14.49
DABAXAYR	TEPHROSIA UNIFLORA	wF	0.11	18.18	0.84	0.25	0.74	1.83	2.07
HIGLO	CADABA MIRABILIS	eT	0.64	9.09	0.00	1.43	0.37	1.81	12.70
NAGAR	CROTOLARIA ?DUMOSA	dS	0.26	18.18	0.45	0.58	0.74	1.77	5.28
MARKAFURE	HELIOTROPIUM spp.	wF	0.08	27.27	0.45	0.17	1.12	1.73	1.52
BILCIL	ACACIA CHEILANTHIFOLIA	aT	0.56	9.09	0.01	1.27	0.37	1.65	8.99
YAMAARUG	BLEPHARIS CILIARIS	anF	0.00	27.27	0.49	0.01	1.12	1.62	0.62
GARRAS	DOBRA GLABRA	eT	0.32	18.18	0.03	0.72	0.74	1.49	32.57
GOWLELO	COMMIPHORA ?ELLENBECKII	T	0.15	27.27	0.04	0.33	1.12	1.49	8.43
MIRACAS	GREWIA TEMBENSIS	S	0.29	18.18	0.08	0.66	0.74	1.48	4.79
DUQQURON		dS	0.02	18.18	0.64	0.04	0.74	1.43	0.88
ANN.H??			0.01	9.09	0.99	0.02	0.37	1.38	1.25
KAXANDO	TRIBULUS TERRESTRIS	anF	0.00	27.27	0.25	0.01	1.12	1.37	0.32
GUNDUD	COMMIPHORA TRUNCATA	T	0.43	9.09	0.03	0.96	0.37	1.37	11.27
KHUURI	CAESALPINIA ERIANTHERA	adT	0.41	9.09	0.04	0.92	0.37	1.34	13.01
QALANQAL	CADABA GLANDULOSA	eS	0.23	18.18	0.02	0.52	0.74	1.28	13.28
DHIGTAR	DICHROSTACHYS CINERA	aS	0.37	9.09	0.06	0.83	0.37	1.26	5.38
NAGAR/MADOW/BIG	HERMANNIA spp.	dS	0.32	9.09	0.15	0.73	0.37	1.25	7.79
SARINCAD	SERICOCOMOPSIS PALLIDA	dS	0.10	18.18	0.25	0.23	0.74	1.22	2.59
BAARNIRGOOD	?SATANOCRATER spp.	edS	0.24	9.09	0.30	0.53	0.37	1.20	5.53
WANIN	SOLANUM ?ALBICAULE	dS	0.13	18.18	0.15	0.29	0.74	1.18	3.53
DHEGAYAR	BOSCIA CORIACEA	eS	0.34	9.09	0.03	0.76	0.37	1.16	19.13
FULAAY	ACACIA SENEGAL VAR.?	aT	0.15	18.10	0.02	0.34	0.74	1.10	2.35
SHRUB??		S	0.13	18.18	0.03	0.30	0.74	1.07	2.79
XAMUR	ZIZIPHUS HAMUR	aS	0.30	9.09	0.01	0.67	0.37	1.05	5.49
SARIN		S	0.10	18.18	0.07	0.23	0.74	1.04	3.41
AFGUB	COMMIPHORA ODDURENSIS	adT	0.10	18.18	0.02	0.23	0.74	0.99	1.70
QABO	EUPHORBIA LONGISPINA	aSK	0.25	9.09	0.04	0.57	0.37	0.98	5.08

R U 4 7 : Vegetation distribution and importance value (contin.)

SOMALI PLANT NAME	BOTANICAL NAME	TYPE of VEGETATION	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
JIICRUGUNBAY	CADABA LONGIFOLIA	eT	0.07	18.18	0.03	0.16	0.74	0.93	5.07
HOHOB	GREWIA PENICILLATA	S	0.05	18.18	0.04	0.12	0.74	0.90	1.83
GUMER	ACACIA NUBICA	aS	0.03	18.18	0.09	0.06	0.74	0.89	1.49
QALMOWALIS		edS	0.01	18.18	0.10	0.02	0.74	0.86	0.56
BEEYAMADOW	COMMIPHORA SULCATO STRIATA	T	0.20	9.09	0.01	0.44	0.37	0.82	3.30
DACUUL		dS	0.06	9.09	0.30	0.13	0.37	0.80	1.74
RAHANREB	COMMIPHORA INCISA	acS	0.00	18.18	0.04	0.00	0.74	0.78	18.37
DHARQO	TEPHROSIA OBBIADENSIS	dS	0.11	9.09	0.15	0.25	0.37	0.77	3.13
CADAAD	ACACIA SENEGAL	adT	0.00	18.18	0.02	0.00	0.74	0.76	2.46
MAYGAG	BOSCIA MINIMIFOLIA	eT	0.00	18.18	0.00	0.00	0.74	0.74	0.00
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	aT	0.16	9.09	0.01	0.36	0.37	0.74	2.54
RIYOXIR		dS	0.12	9.09	0.05	0.26	0.37	0.68	3.20
DS??		dS	0.04	9.09	0.15	0.09	0.37	0.61	1.05
JIICMADOW	CADABA spp.	eT	0.10	9.09	0.01	0.23	0.37	0.61	5.38
MANDHERAQUBE	CYPHOSTEMMA spp.	V	0.07	9.09	0.05	0.15	0.37	0.57	1.08
DHUMOOD	?CLERODENDRUM MICROPHYLLUM	dT	0.07	9.09	0.02	0.16	0.37	0.55	2.23
GAHAYR	BLEPHARISPERUM spp.	S	0.03	9.09	0.04	0.07	0.37	0.48	1.59
DIIQLAY	JATROPHA MICROPHYLLA	S	0.03	9.09	0.02	0.08	0.37	0.47	1.36
BURBUR	?MELHANIA MURICATA	dS	0.02	9.09	0.05	0.04	0.37	0.47	0.45
KABCALSIMILAR	TRIUMFETTA spp.	dS	0.02	9.09	0.05	0.04	0.37	0.46	0.38
BARANJIS	CONVOLVULUS spp.	cF	0.01	9.09	0.05	0.03	0.37	0.45	0.23
DHURODSIMILAR	MELHANIA ?PHILLIPSIAE	wF	0.00	9.09	0.05	0.01	0.37	0.43	0.09
DABAKAR	DALBERGIA MICROPHYLLA	S	0.02	9.09	0.01	0.04	0.37	0.42	0.47
JINOW	COMMIPHORA ROSTRATA	S	0.01	9.09	0.02	0.03	0.37	0.42	0.71
LAMALOOJI	?MAERUA ANGOLENSIS	eT	0.02	9.09	0.01	0.04	0.37	0.42	0.27
CADAADCAD	ACACIA HAMULOSA	adT	0.00	9.09	0.01	0.00	0.37	0.38	0.73

table 4.6. : R U 3 1 : Vegetation distribution and importance value

PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
QODAXTOOL	BLEPHARIS spp.	awF	0.73	60.00	16.84	3.31	3.17	23.32	20.70
QANSAX	ACACIA REFISCIENS	aS	3.21	70.00	0.89	14.44	3.70	19.03	153.20
KABGAL	TRIUMFETTA HETEROCARPA	dS	1.16	40.00	8.34	5.25	2.12	15.71	29.24
TIMOFAHIYE	PAVONIA PIROTTAE	wF	0.12	70.00	9.03	0.56	3.70	13.29	8.80
MIRDHIS	ANISOTES TRISULCUS	S	2.43	30.00	0.54	10.95	1.59	13.08	51.41
CADAAD	ACACIA SENEGAL	adT	2.06	60.00	0.55	9.27	3.17	13.00	51.83
GO	INDIGOFERA ?INTRICATA	dS	0.05	40.00	8.96	0.25	2.12	11.32	2.92
DARANDOWOCO	LIMONIUM CYLINDRIFOLIUM	edS	0.29	60.00	5.43	1.29	3.17	9.90	7.11
JILAB	INDIGOFERA RUSPOLII	dS	0.75	50.00	3.75	3.40	2.65	9.79	17.81
KURA	ACACIA TORTILIS	aT	1.44	50.00	0.11	6.48	2.65	9.23	80.31
NAGARAWR	INDIGOFERA SPINOSA	adS	0.24	30.00	6.51	1.07	1.59	9.16	8.28
XABOW	ZYGOPHYLLUM spp.	cdS	0.57	50.00	2.53	2.55	2.65	7.72	13.85
HAMBOHI	AERVA JAVANICA	wF	0.35	50.00	3.14	1.60	2.65	7.38	6.44
KAXANDO	TRIBULUS TERRESTRIS	anF	0.04	30.00	5.43	0.20	1.59	7.22	4.94
CADUURDHEGAWEYN	SOLANUM ?BIFURCUM	wF	0.29	10.00	4.98	1.29	0.53	6.79	8.06
H??		wF	0.06	30.00	3.90	0.29	1.59	5.78	3.70
MARKAFURE	HELIOTROPIUM spp.	wF	0.03	50.00	2.91	0.13	2.65	5.68	2.83
NAGARJABTO	HELIOTROPIUM spp.	wF	0.09	60.00	1.30	0.38	3.17	4.86	4.28
GABRAR	COMMIPHORA HORRIDA	adT	0.44	50.00	0.15	1.99	2.65	4.79	12.72
SARMAAN	ACACIA HORRIDA	aS	0.77	20.00	0.26	3.47	1.06	4.79	38.73
ARANBOWDO	COMMIPHORA spp.	aS	0.49	30.00	0.12	2.20	1.59	3.91	9.18
GOWLELO	COMMIPHORA ?ELLENBECKII	T	0.34	40.00	0.15	1.55	2.12	3.82	12.30
DS??SALT4		dS	0.01	60.00	0.15	0.03	3.17	3.36	0.49
RAHANREB	COMMIPHORA INCISA	acS	0.60	10.00	0.03	2.71	0.53	3.27	10.21
DS??SALT1		dS	0.09	20.00	1.76	0.40	1.06	3.22	5.67
DARANBIYOOD		skF	0.19	30.00	0.77	0.85	1.59	3.20	3.24
KHUURI	CAESALPINIA ERIANTHERA	adT	0.46	20.00	0.06	2.05	1.06	3.17	14.45
DS??		dS	0.04	40.00	0.84	0.19	2.12	3.15	2.71
SAGARSUF		dS	0.16	30.00	0.58	0.73	1.59	2.90	4.09
DS??SALT3		dS	0.01	50.00	0.15	0.03	2.65	2.83	0.49
BILCIL	ACACIA CHEILANTHIFOLIA	aT	0.51	10.00	0.02	2.28	0.53	2.82	8.06
BOCBOCOOD	PAVONIA KOTSCHYII	wF	0.03	30.00	1.07	0.15	1.59	2.81	1.13
GOGOBO	IPHIONA ROTUNDIFOLIA	dS	0.15	30.00	0.46	0.65	1.59	2.70	4.45
QALMOWALIS		edS	0.09	20.00	1.22	0.41	1.06	2.69	5.01
NAGARDHEEB	PLEUROPTHERANTA REVOILII	dS	0.26	20.00	0.38	1.15	1.06	2.59	6.24
DHIRINDHIR	EUPHORBIA CUNEATA	aS	0.30	20.00	0.18	1.34	1.06	2.58	5.35
JALEELO	CASSIA spp.	dS	0.35	10.00	0.38	1.59	0.53	2.50	9.32
GUNRAY	COMMIPHORA GURREH	-cT	0.41	10.00	0.02	1.83	0.53	2.38	6.91

R U 3 1 : Vegetation distribution and importance value (contin.)

PLANT NAME	BOTANICAL NAME	VEGETATION TYPE	Abs. dominance %/ha	Absolute Frequency	Relative density	Relative dominance	Relative frequency	Importance value	Pot.biom. kg/ha
DULWEYN	COMMIPHORA CILIATA	T	0.41	10.00	0.02	1.83	0.53	2.38	6.91
DS??SALT2		dS	0.01	40.00	0.15	0.03	2.12	2.30	0.49
MAYGAG	BOSCIA MINIMIFOLIA	eT	0.26	20.00	0.03	1.15	1.06	2.24	39.51
QABO	EUPHORBIA LONGISPINA	aSK	0.35	10.00	0.08	1.59	0.53	2.19	7.06
MIRACAS	GREWIA TEMBENSIS	S	0.22	20.00	0.14	0.98	1.06	2.18	4.73
MALMAL	COMMIPHORA ?SENNII	aS	0.11	30.00	0.06	0.48	1.59	2.13	3.12
DABIB	?ACALYPHA spp.	aS	0.20	20.00	0.11	0.88	1.06	2.04	5.09
JEERIN	ACACIA EDGEWORTHII	aS	0.15	20.00	0.20	0.68	1.06	1.94	10.68
DUQQURON		dS	0.03	10.00	1.22	0.11	0.53	1.87	1.19
NAGARXEYLEY	HIBISCUS spp.	wF	0.01	20.00	0.46	0.05	1.06	1.57	0.46
FARADOWOCO	BARLERIA PROXIMA	awF	0.01	20.00	0.38	0.04	1.06	1.49	1.14
BUULALOOD	IPOMOEA DONALDSONII	aS	0.08	20.00	0.03	0.34	1.06	1.43	1.64
DARAN	?SALSOLA spp.	cdS	0.09	10.00	0.38	0.40	0.53	1.31	1.66
SALT??		dS	0.00	10.00	0.69	0.02	0.53	1.24	2.01
QABOYARYAR	EUPHORBIA INAEQUISPINA	aSK	0.03	20.00	0.05	0.13	1.06	1.24	0.96
GULAN	?SALSOLA FOETIDA	dS	0.07	10.00	0.31	0.32	0.53	1.15	1.84
QALANQAL	CADABA GLANDULOSA	eS	0.13	10.00	0.02	0.57	0.53	1.12	7.38
DAFURUUR	GREWIA TENAX	S	0.10	10.00	0.03	0.43	0.53	0.99	1.54
DUFNOOD	?CLEOME spp.	wF	0.01	10.00	0.38	0.05	0.53	0.97	0.40
NAGARSP.	CROTOLARIA spp.	dS	0.03	10.00	0.31	0.11	0.53	0.95	0.50
GEEDHARAQ		dS	0.04	10.00	0.15	0.16	0.53	0.84	1.08
SAALOWEYN	?HERMANNIA spp.	dS	0.05	10.00	0.08	0.21	0.53	0.82	1.44
BAARNIRGOOD	?SATANOCRATER spp.	edS	0.04	10.00	0.08	0.20	0.53	0.80	1.02
DHARQO	TEPHROSIA OBBIADENSIS	dS	0.04	10.00	0.08	0.19	0.53	0.79	1.15
DACUUL		dS	0.02	10.00	0.15	0.09	0.53	0.78	0.64
JAFEECO	IPOMOEA CITRINA	S	0.04	10.00	0.03	0.18	0.53	0.74	1.70
SARINCAD2		dS	0.02	10.00	0.08	0.10	0.53	0.71	0.57
SARINCAD	SERICOCOMOPSIS PALLIDA	dS	0.02	10.00	0.08	0.10	0.53	0.71	0.57
BALAMBAL	ABUTILON HIRTUM	wF	0.02	10.00	0.08	0.08	0.53	0.69	0.50
DHUROD	MELHANIA ?INCANA	wF	0.01	10.00	0.08	0.03	0.53	0.63	0.12
KIDI		eS	0.01	10.00	0.02	0.06	0.53	0.61	0.91
JINOW	COMMIPHORA ROSTRATA	S	0.01	10.00	0.02	0.06	0.53	0.61	0.40
CANYO	PORTULACA OLERACEA	anF	0.00	10.00	0.08	0.00	0.53	0.61	0.07
RAYDAB	ALBIZIA ANTHELMINTICA	T	0.00	10.00	0.03	0.00	0.53	0.56	11.24
GUNDUD	COMMIPHORA TRUNCATA	T	0.00	10.00	0.02	0.00	0.53	0.54	4.02
GARRAS	DOBRA GLABRA	eT	0.00	10.00	0.02	0.00	0.53	0.54	11.63
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	0.00	10.00	0.02	0.00	0.53	0.54	2.45
HOHOB	GREWIA PENICILLATA	S	0.00	0.00	0.00	0.00	0.00	0.00	0.10

The following pictures show the various soil types and illustrate the physical features of environment as they occur in the study area:

picture 1 : Eutric Regosol

picture 2 : Cambic Arenosol

picture 3 : Chromic Vertisol

picture 4 : Calceric Regosol, lithic phase

picture 5 : Lithosol

picture 6 : Haplic Xerosol

picture 7 : Aerial photo Range Unit 24

picture 8 : Physical feature Range Unit 24

picture 9 : Physical feature Range Unit 16

picture 10 : Physical feature Range Unit 47

picture 11 : Physical feature Range Unit 44/45

picture 12 : Physical feature Range Unit 31

The photos 1 - 6 were taken by Drechsel (1986), picture 7 by Watson (RMR 1979) and 8 - 12 were taken by the authors.

PART II

VEGETATION ANALYSES AND FODDER RESOURCE CALCULATION

I. MATERIAL AND METHODS

Although this topic is very complex, it seems nesseccary to deal with it as a whole, because all the components are so closely related to each other that it is impossible to separate them out. The presentation is ordered according to the activities which were carried out in the field and during the time of analyses. The following steps are described:

- the method of collection of vegetation data, which offers the means to calculate the vegetation's occurence in number and size.
- the analyses of the fodder priorities of animals, which enables one to identify unpalatable plant species and to exclude them from the following steps.
- the collection of biomass data, which serves as a basis for the calculation of leaf biomass(weight), as a function of the vegetation structure.
- the mode of calculation of the fodder resources and the manner in which the condition of "proper use" is included.
- the methods to determine the nutrition quality of fodder and the seasonal variations in nutritive value.

Before introducing in more detail the method of range resource calculation, it should be emphasized that a study of this kind cannot be more than an approximation. The demand upon this study is not one of one hundred percent precision, but is an attempt to model as closly as possible, reality.

1. Vegetation analyses

1. 1. Demands on the plot sampling method

The demands on the sampling method were determined by the Somali environment and the living conditions : it had to combine all vegetation layers in single survey, it had to be practicable with as little means as was available and it had to be economical in terms of time spent under the hot sun. The

primary interest was first, to derive a randomly selected data basis for the floristical range unit division and second, to offer, in reference to the important range plants, sufficient information for the statistical analyses of the parameters: density, dominance and frequency as well as plant size and population structure.

1.2. The collection of the vegetation data

The vegetation survey concentrated principally on the vegetation periods during the rainy seasons and the following three weeks. Plant identification and the regeneration studies were most effective and evident during this time.

All plots were taken at a distance of 200 m from the roads. This distance was neccessary, because even the nomads with their herds prefer the roads for moving around and therefore the adjacent meters to the roads were not representative as grazing areas. The survey method was designed on the basis of the "line intercept method" and a "count plot method" (Mueller-Dombois & Ellenberg 1974). The direction of the 100 m straight "plot line" was determined by throwing a pen and following the direction indicated always leading away from the road. The line was constructed with help of 50 m tapes[11]. In the plots the following data were collected :

1. The number of individual plants. Always on the left side of the 100 m line the adjacent 2 meter space was surveyed with the help of a 2 m yard stick. Trees and shrubs were counted on 200 msq, dwarfshrubs and woody forbs on 40 msq, grass tufts and annual herbs on 10 msq. The dwarfshrub plots were taken besides the first and the last 10 m of the line respectively. The grass layer was recorded in 1 msq plots each ten meters (from the meters 9 - 10, 19 - 20 etc. along the tape). Young regenerating plants were counted separately. Additionally plants were noted, which were covering the plot while rooting outside. This information was used as supplementary source of values for the method of Braun-Blanquet (marked as points in table 2). For all other statistical

[11] Sometimes it was a very time consuming and harmful task, to wind the tape through the thorny trees and bushes

analyses only the plants rooting in the plot areas were taken as data.

2. Size parameters and cover of individual plants. Plant height, crown diameter, crown height and the coverage area (projected) on the 100 m straight line were measurements taken from those plants, which contacted a hypothetical, vertical plane projected above the tape (--> randomly).

1.3. Animals fodder selection

On the range not all plants are suitable as fodder. Some plants are avoided completely by one or perhaps every variety of stock, other plants are used seasonally only, while some selected every occasion. The nomads are the only people who have an excellent knowledge on these fodder priorities. To derive a figure on the fodder suitability of plants a series of interviews with the nomads was carried out. In addition the fodder priorities of grazing / browsing animals, observed during the field survey were recorded. To avoid misunderstandings concerning the plant names, the interviews were conducted either in the bush at the plantsites or with the help of branch cuttings. The interviews centered upon the following two questions:

1. Which plants are selected or accepted by which stock ?
2. What are the seasonal priorities ?

The following rating key was used and explained to the nomads.

High	Palatable :	first priority rainy season
Medium	Palatable :	second priority rainy season
Dry season	HP :	dry season priority
Low	Palatable :	end of rainy season and beginning of dry season when HP and MP plants are finished
Dry season	LP :	when nothing else is left
Un-	Palatable :	never eaten

All data were collected and classified for all range animals seperately. The results are presented in tables 6.1 - 6.5. Several single ratings (min.: n $\geq$ 5) were added to make one final rating per plant and stock.

One aim of the first two steps concerning the mode of field activity planning was to identify the 50 most common and palatable fodder plants consumed during the rainy or the dry season. This knowledge made it possible to exclude unpalatable and rare plants from the time consuming and in case of thorny species even harmful activity of clipping.

1.4. Biomass sampling

The collection of biomass samples was done by clipping and subjected to the following criteria:

1. The clipping activities were restricted to the 50 most common and palatable fodder plants (HP, MP, LP, DHP, DLP), which represented approximately 90 % of the total consumable plant biomass.
2. All plant samples were collected close to the places where rain gauges had been installed; the samples included within this presentation received between 80 and 120 mm of rain per season.
3. Samples were not taken from protected areas, as they should represent the "normal" plant condition in a "normally" used range. But the condition was, that the selected plants showed no signs of damage, caused by browse during the respectively present season.
4. Deciduous plants and grasses were cut at the end of a rainy period to obtain the peak biomass production. Evergreen dry season fodder plants were collected during the dry season.
5. All samples were cut and sacked completely except for large shrubs and trees (CD > 2 m). These were, in dependance upon their shape, divided into equal halves or quarters. One part was randomly selected and clipped. Perennial grasses were clipped according to their growing habit, as single grass tufts, annual grasses per square meter - both to the height of three cm above ground.
6. To determine the consumable biomass the samples were air dried first, then the leaves and if relevant the consumable green twigs were taken off, oven dried (105° C) and weighed.
7. All samples were taken for chemical analyses.

In the case of herbs and woody forbs, several individuals / species of an average size were taken together to form one average biomass sample. Dwarfshrubs, perennial grasses, shrubs and trees were cut off in different sizes.

The intention was to establish a data basis, which enabled the calculation of regression functions for the ratio: increase of shape to the increase of biomass.

2. The mode of calculation

2.1. The correlation of biomass increase and plant size parameters

For the described ratio the highest correlations were found. The fundamental assumption was that the increase in biomass is basically determined by plant size and plant shape. In this context the measured parameters of growth and several geometric figures were taken as representative of the different plant shapes and used to calculate the increase in biomass as a linear function of:

x	x^2	x^3	log
1. plant Height	3. CD * H	volume of:	9. CD
2. CrownDiameter	4. $\pi/4*CD^2$	5. sphere	10. $\pi/4*CD^2$
		6. sphere sector	11. volume: sphere
		7. cylinder	
		8. rot.ellipsoid	

Correlations were calculated separately per plant species and/or for combined plant groups of similar shapes. The highest correlations per plant or plant group and the corresponding regression functions for the described ratio are shown in table 6. An example for a regression function is given in figure 2.

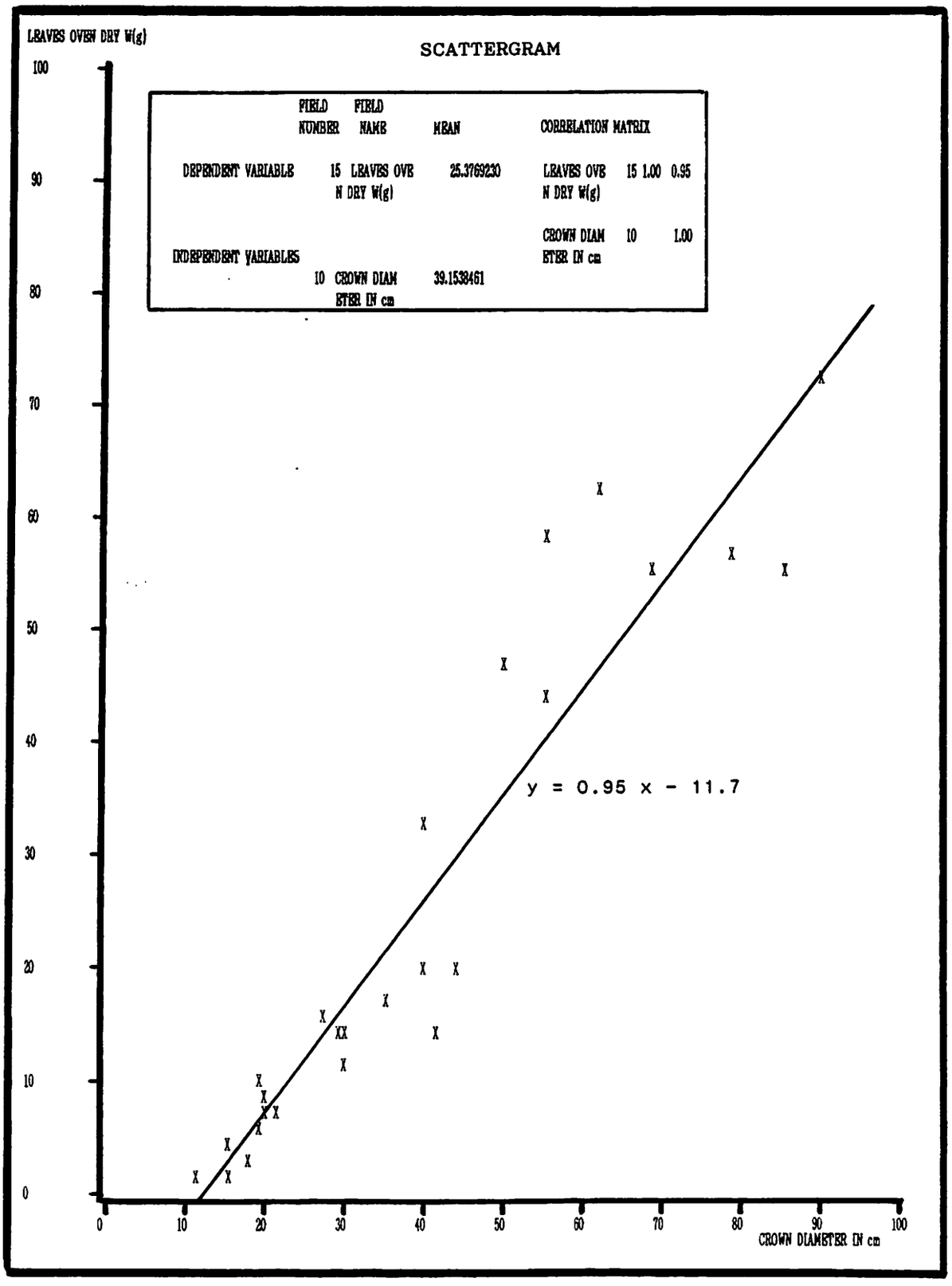


Figure 2 : The regression function for the ratio : increase of crown diameter to increase of biomass production (Indigofera ruspolii).

line, where the size data were measured. They are too small in size to touch a 100 m line representatively.

[13] Kreeb 1983 p. 80 ff, Mueller-Dombois & Ellenberg 1974 p.118 ff

2.2. The calculation of the Vegetation data

The method of data collection was introduced in chapter II.1.2. As already mentioned the following criteria were of interest:

1. density, which deals with the absolute number of plants per area.
2. frequency, which deals with the distribution and abundance of plants (% of all plots where a plant species grows).
3. dominance which deals with the coverage (% coverage per plant species / layer and area).
4. growing parameters of plants (crown diameter, height and crown volume).

Densities and frequencies were established as average values on the basis of the plot counting results. Dominances were calculated as a function of average crown surface (πr^2) per plant species multiplied by the number of plants per area. In the case of trees and shrubs the proportion of young regenerating plants was excluded from the multication[12]. The results were compared with those of the line intercept method, which offered slightly lower ratings concerning the tree and the dwarf shrub layer. The results for the shrub layer were nearly identical. The method previously mentioned was given preference to the second, because the biomass data was calculated on the basis of the same numerical data (number of plants per ha, except small regenerating ones). The comparability of the two components was considered as most important.

To compare the collected data on the different range plants according to their appearances in the different range units, the method of "Importance value" (Whittaker 1970, Curtis 1959)[13] was used. The tables 4.1 - 4.5 contain the single parameters.

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[12] They didn't fulful the criteria of average size, because the were not represented proportional to their occurence on the line, where the size data were measured. They are too small in size to touch a 100 m line representatively.

[13] Kreeb 1983 p. 80 ff, Mueller-Dombois & Ellenberg 1974 p.118 ff

2.3. The combination of the vegetation data with the biomass data

The data was fit into one another by multiplying: dry weight biomass per plant or plant group, taken from the regression analyses, x average plant numbers per ha (plot counting). The calculation took the distribution of plant sizes per species into account (growth parameters measured along the 100 m line). For all species the criteria of plant distribution per classes

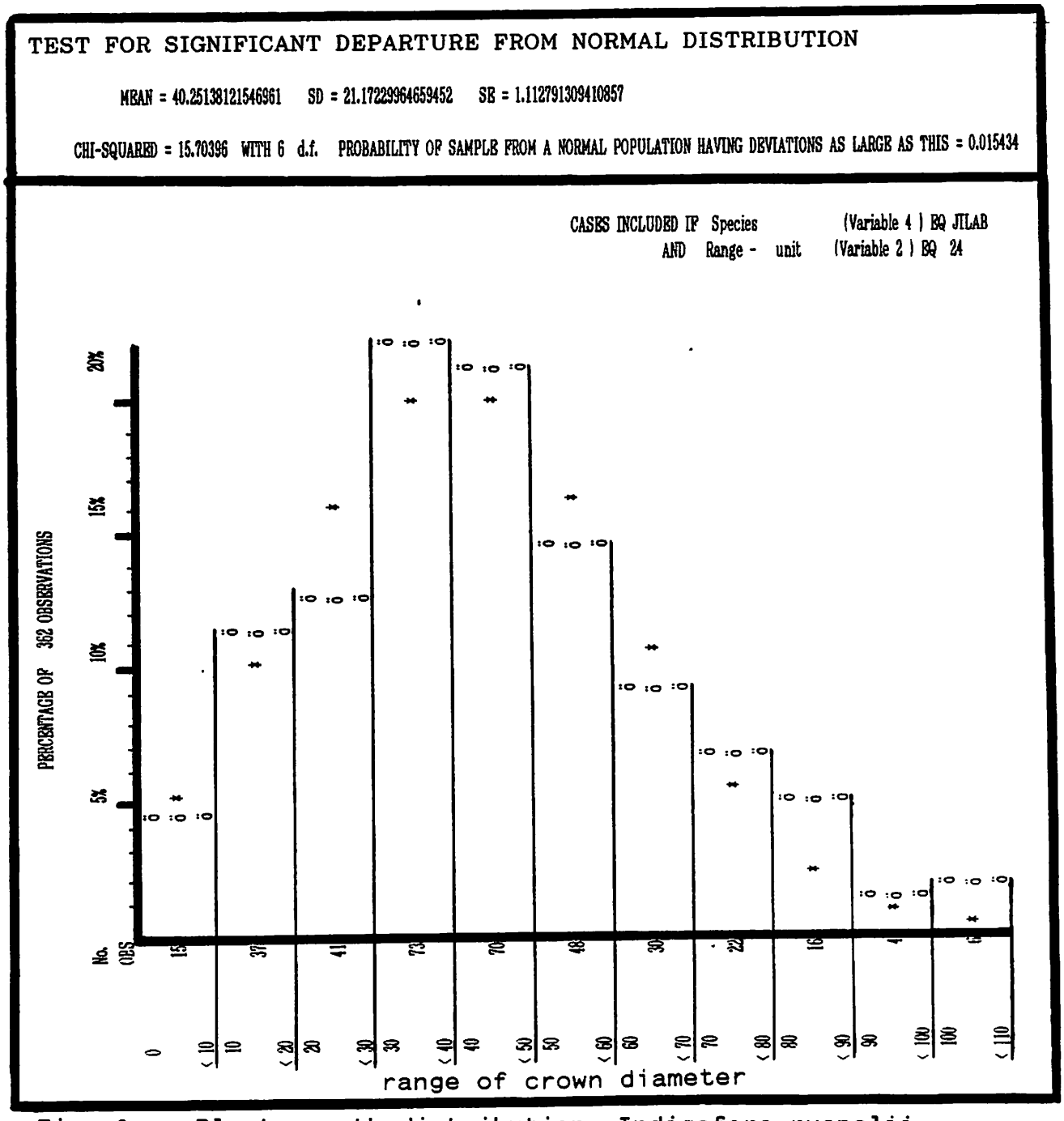

Fig. 3 : Plant growth distribution: Indigofera ruspolii (Jilab)

of size was checked according to the statistic normal distribution (% density per size class compared to the normal distribution of coverage per size class: figure 2). If there was coincidence, the parameters of an "average plant" were used. If there was no coincidence with the normal distribution different size classes were built up and calculated separately. The biomass production of unpalatable or rare species, which were not clipped, was estimated by transferring the equations, valid for the palatable species, in accordance to their growing shapes.

The mode of calculation established for each RU, the seasonal amount of fodder available biomass per plant species or plant family and ha. The rainy season value, taken at a level of peak production, represents the starting point for the calculation of the fodder resource development until the next rainy season and is the basis for the calculation of the "proper use factor". It is expressed in grazing days per animal and ha (table 7.2).

Evergreen plant species form the main fodder resource during the dry season. Their biomass was determined for the dry season situation only because they remain untouched during the rainy season. The last column in the tables 4.1- 4.5 offers the calculated biomass potential per plant species and ha.

2.4. The proper use factor

Under the conditions of natural compatibility and fodder availability it is not possible to accept the total potential biomass production as a consumable resource. The established proper use factor (table 7.1) added the following aspects. The proportion of young regenerating vegetation was excluded from the resource calculation as well as those parts of individual plants, which were out of reach for the animals. Refered to the browsing capacity of camels, plants were rated as relevant, which were higher or, in case of dense Acacia shrubs, broader than 4 m. Concerning the fodder potential of sheep and goat the maximum range of reach was assumed to be 1,75 m respectively.

The calculated evergreen plant biomass was adjusted with an estimated factor, which reduced 70 % of the calculated potential, as in the case of evergreen plants only the seasonal increase of biomass can be accepted as a basis for fodder. The

collected biomass samples, which served as data for the calculation of the regression function were taken from the total plants.

3. The fodder quality and its influence upon range capacity

This step was taken to compare directly the energy and protein contents of the fodder with the animals needs. The usual step[14] is to compare the supply (kg biomass dry weight) with the demand (mainly energy and protein) in terms of the figure: 6,25 kg fodder dry wheigt per Tropical Livestock Unit. It was intended to proof the accuracy of the second method, and to compare the results of both methods.

For this reason the collected plant material was analysed for its chemical composition and nutritive values accoring to the "Weender analyse" (Naumann & Brassler 1976). In addition the water solubility was testet (Rutagwenda 1989). The net energy content was calculated in compliance with Boudet 1978. Concerning those samples, which were available in fresh condition and in form of litter, the "Hohenheimer Futterwert Test" (Menke 1987) was conducted additionally, to support the evidence of the comparison. Mn, Mg, Cu, Zn and Ca were determined by atomic absorption spectrophotometry (AAS), P using molybdenum blue method. Levels of toxicity were proofed (Zech, 1981; Rappenhöhner, 1989; McDowell 1986). The results are offered in tables 8 and 11. Table 9 offers the quality ratings calculated according to Boudet 1978 and by the Range Management Handbook of Kenya. The requirement assumptions are compared at the levels of maintenance and moderate production. The fodder resources calculated as energy supply and presented separately per range unit and vegetation layer, are given in table 10.

3.1. The seasonal fodder potential and the aspect of leaf litter consumption

The seasonal development of fodder and its quality are strictly determined by the bimodal rainfall pattern. While there is plenty of good quality fodder available during the rainy periods

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[14] this is much easier in terms of working efforts

there is severe shortage of fresh fodder arising during the dry seasons. 90 to 95 percent of the vegetation are deciduous and undergo defoliation three weeks after the last rains. As a source of nutritional fodder only evergreen plant species and to a small degree Acacia tortilis and Cordia sinensis, remain. The nutritive values can be found in table 8. This point of view, which cares about the supply of fresh leaves only, reflects the usual limit of studies.

But another aspect has to be considered : the role of litter in animals consumption during the dry season, and its nutritive value (Kuchar 1989). In the deciduous thornbush savanna of Somalia all the leaves, which were not consumed during a rainy season, turn into fodder available in form of litter during the following dry season. Those parts of vegetation, which are out of reach for the livestock, because of height or size are also concerned. This means, that the total potential biomass production, about one third more than the actual use capacity, which is limited by the accessibility (proper use), is the starting point for this resource. Two known facts justify the interests in litter: the first is that litter is consumed during the dry season and the second is, that litter can be fermented in the digestive system of ruminants together with a proportion of fresh fodder (evergreen species).

For that reason litter was collected after defoliation, as it lay under the plants at the beginning of the dry season. The chemical analyses and interpretations were done as previously described. The calculation basis for the dry season fodder potential was assumed as: available green plant biomass + amount of litter. The amount of available litter was hypothetically estimated as the difference between total foliage production and animals intake during the rainy season, which was dependant upon the stocking rates during that time. Figures on the available amount of litter are presented in table 7.2. Different assumptions about stocking rates are taken into account. Unfortunately there was no opportunity to collect comparable samples at the end of the dry season to check the continuing development of nutritive values during that time. Therefore only the starting point of the dry season can be offered here.

II. RESULTS

In the previous chapters on methodology the order of presentation was similar to the order of fieldwork and the sequence of calculations and analyses. In this section two points must first be highlighted, which form some kind of intermediate result: The presentation of the regression functions and the study on palatability. These components make up the basis from which to calculate the range resources and to arrange them in accordance with the animals selection of fodder and consumption habits. The results are given in tables 5, 6.1 - 6.5 and in figure 4.1. The other results are added in the same order, as in the previous section. Chapter 2.1 contains some general results from the vegetation studies. The total range capacity is presented in chapter 2.2. The potential of fodder and the proportion of "proper use" of the total supply is given in chapter 2.3 (table 7.1 and 7.2). The component of litter consumption is included. Taking range unit 16 as an example, the fodder supply in kg biomass per animal and vegetation layer is compared in table 7.3. Figure 4.2 gives an impression on the total consumable biomass for camels as compared to cattle in a bushland area. The difference of range capacity, fodder potential and fodder capacity is demonstrated in the figures 5.1 - 6.2b. The results on the chemical analyses and the nutritional values of the plants are presented in chapter 3. The figures are compared to the palatability ratings and correlated with the level of animal needs as well as to the toxity level with reference to mineral contents.

1.1. The regression functions for the biomass calculation

Table 5 gives those basic regression functions which allow the calculation of biomass production in the range of 80 - 120 mm of seasonal rain. The groups which are summed up here were determined according to the growing shapes of plants. The numbers in column 2 refer to the criteria of shape as they were introduced in the methodology section (II.2.1). About 400 single plants, distributed across the different groups of shapes served as the data basis for these calculations.

Table 5 : Regression functions for biomass calculation
ratio : increase of size - increase of leaf biomass
(in : cm/cm²/cm) (in : g)

plant or plant group	criteria (chap.II.2.1.)	formula for biomass calculation	correlation coefficient
Indigofera ruspolii	2.	y = 0.95 x - 11.7	0.95
All Indigofera spp.	4.	y = 0.015 x + 2.2	0.92
Triumfetta heterocarpa	6.	y = 0.00063 x + 7.5	0.96
Other dwarfshrubs with average cd < 20 cm	5.	y = 0.00074 x + 2.7	0.97
average cd > 20 cm	6.	y = 0.00067 x + 8.9	0.96
umbrella shaped Acacia shrubs	4.	y = 0.015 x - 6.1	0.94
umbrella shaped spp. except Acacia spp.	4.	y = 0.018 x - 63.7	0.98
Grewia Shrubs	5.	y = 0.00015 x + 49.8	0.95
Other deciduous shrubs	4.	y = 0.018 x + 28.5	0.95
Evergreen shrub spp.	5.	y = 0.00044 x + 132	0.97
Trees except Acacia spp	4.	y = 0.017 x - 2.9	0.93
Acacia trees	4.	y = 0.016 x - 7.06	0.92
Perennial grass tufts	4.	y = 0.144 x - 0.39	0.98

1.2. The palatability of the range plants

Tables 6.1. - 6.5. present the results from the interview series on the palatability of plants, which were conducted with the nomads. They are grouped in the order of the vegetation layers. The explanations for the abbreviations used, have already been given in chapter II.1.3. The legend for the column "Vegetation Type" is added subsequent to table 6.5.

Table 6.1. : Palatability rating : trees

SOM.PLANT NAME	BOTANICAL NAME	BOTANICAL FAMILY	VEGETATION TYPE	FINAL RATING CAMEL	FINAL RATING GOATS	FINAL RATING SHEEP	FINAL RATING CATTLE
AFGUB	COMMIPHORA ODDURENSIS	BURSERACEAE	adT	M	M	U	U
BACAROOR / XINTIR	COMMIPHORA SP. AFF. SULCATA	BURSERACEAE	T	M	M	U	U
BEEYA CAD	BOSWELIA RIVAE	BURSERACEAE	cT	H	H	M	U
BEEYA MADOW	COMMIPHORA SULCATO STRIATA	BURSERACEAE	T	H	H	U	U
BILCIL	ACACIA CHEILANTHIFOLIA	MIMOSACEAE	aT	M	M	U	U
CADAAD	ACACIA SENEGAL	MIMOSACEAE	adT	L	L	U	U
CADAAD CAD	ACACIA HAMULOSA	MIMOSACEAE	adT	M	M	L	U
CADAAD FULAY	ACACIA SENEGAL VAR.?	MIMOSACEAE	adT	L	L	U	U
DHISAQ	TERMINALIA ORBICULARIS	COMBRETACEAE	T	H	M	L	U
DHUMOOD	?CLERODENDRUM MICROPHYLLUM	?VERBENACEAE	dT *	DL	DL	U	U
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	BURSERACEAE	T	H	H	H	U
DUL WEYN / QAASHAQORON	COMMIPHORA CILIATA	ANACARDIACEAE	T	L	L	U	U
FULAAY	ACACIA SENEGAL VAR.?	MIMOSACEAE	aT	U	U	U	U
GABRAR	COMMIPHORA HORRIDA	BURSERACEAE	adT	H	H	M	U
GARRAS	DOBRA GLABRA	SALVADORACEAE	eT *2	DH	DH	U	U
GOWLELO	COMMIPHORA ?ELLENBECKII	BURSERACEAE	T	M	L	U	U
GUNDUD	COMMIPHORA TRUNCATA	BURSERACEAE	T	H	H	L	U
GUNRAY	COMMIPHORA GURREH	BURSERACEAE	-cT	H	H	L	U
HAREERI	TERMINALIA ?POLYCARPA	COMBRETECEAE	T *	H	H	U	U
HIGLO	CADABA MIRABILIS	CAPPARACEAE	eT *2	DH	DH	U	U
HIIRAN	?HILDEBRANTIA SOMALENSIS	CONVOLVULACEAE	T	H	H	L	U
JIIC MADOW	CADABA spp.	CAPPARACEAE	T *2	DH	DH	U	U
JIIC RUGUNBAY	CADABA LONGIFOLIA	CAPPARACEAE	T *2	DH	DH	U	U
JIIC TIF	CADABA BACCARINII	CAPPARACEAE	T *2	DH	DH	DL	U
JIIQ	ACACIA SEYAL VAR.FISTULA	MIMOSACEAE	aT	L	L	U	U
JOWDHER	?GYROCARPUS ANGUSTIFOLIUS	?HERNANDIACEAE	T	M	M	U	U
KHUURI / QOODHI	CAESALPINIA ERIANTHERA	CAESALPINIACEAE	adT	H	H	U	U
LEBI	DELONIX ELATA	CAESALPINIACEAE	T	M	L	U	U
MAYGAG	BOSCIA MINIMIFOLIA	CAPPARACEAE	eT *2	DH	DH	DH	U
MEREFED / MIRAFUR	BOSWELIA spp.	BURSERACEAE	T	M	M	L	U
MUQLAY	BOSWELIA MICROPHYLLA	BURSERACEAE	T	H	H	U	U
MURJAAN	BOSWELIA NEGLECTA	BURSERACEAE	T	L	L	L	U
ONTOR	CORDYLA SOMALENSIS	CAESALPINIACEAE	T	U	U	U	U
QANBAR / QARANRO	STERCULIA ?RYNCHOCARPA	STERCULIACEAE	T	M	M	U	U
QARON	COMMIPHORA VELUTINA	BURSERACEAE	-aT	H	H	L	U
QUNLE SIRIQ	ACACIA WALWALENSIS	MIMOSACEAE	aT	M	M	L	U
KUBA	ACACIA TORTILIS	MIMOSACEAE	aT *	H	H	L	U
RAYDAB	ALBIZIA ANTHELMINTICA	MIMOSACEAE	T	L	M	/	U
SABAN SABDHO	PLATYCELYPHIUM spp.	PAPILIONACEAE	T	U	L	U	U
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	PEDALIACEAE	aT	H	H	U	U
UNKNOWN (PLOT 24)	COMMIPHORA spp.	BURSERACEAE	T	?	?	?	?
WACANRI	LANNEA spp.	ANACARDIACEAE	T	L	L	U	U
XAGAR	COMMIPHORA ?KUA	BURSERACEAE	T	H	M	L	U
XAGAR CAD	COMMIPHORA ELLISIAE	BURSERACEAE	T	H	H	L	U
XAYEY	COMMIPHORA ERYTHRAEA	BURSERACEAE	T	M	M	U	U
XAYO	?WRIGHTIA DEMARTINIANA	APOCYNACEAE	T	H	H	L	U
XODAY	COMMIPHORA HODAI	BURSERACEAE	T	U	L	U	U
YOOC	ERYTHRINA MELANACANTHA	PAPILIONACEAE	adT	H	H	U	U

Table 6.2. : Palatability rating : shrubs

SOM.PLANT NAME	BOTANICAL NAME	BOTANICAL FAMILY	VEGETATION TYPE	FINAL RATING CAMEL	FINAL RATING GOATS	FINAL RATING SHEEP	FINAL RATING CATTLE
ARANBOWDO	COMMIPHORA spp.	BURSERACEAE	aS	M	M	U	U
BOOC	CALOTROPIS PROCERA	ASCLEPIADACEAE	S	U	U	U	U
BULACAYOOD	COMMIPHORA AFF.SULCATOSTRIATA	BURSERACEAE	S	L	M	U	L
BUULALOOD	IPOMOEA DONALDSONII	CONVOLVULACEAE	aS	M	H	L	L
BUULAAYOOD II	COMMIPHORA ?CHIOVENDANA	BURSERACEAE	S	?	?	?	?
CADUUR	SOLANUM JUBAE	SOLANACEAE	S	M	M	U	U
CADAAD MADOW	ACACIA ZIZYPHISPINA	MIMOSACEAE	aS	M	M	U	U
CADANOOD	?ASPARAGUS spp.	?LILIACEAE	S	L	L	U	U
CADAY	COMMIPHORA ?BRUCEA	BURSERACEAE	S	L	L	U	U
CALOOLYAAY	?OCHNA spp.	OCHNACEAE	eS	U	U	U	U
DABAKAR	DALBERGIA MICROPHYLLA	PAPILIONACEAE	S	H	H	L	U
DABIB / UUSQAABE	ACALYPHA spp.	EUPHORBIACEAE	aS	U	U	U	U
DACUUL II	?TRIANTHEMA spp.	?AIZOACEAE	S	H	H	H	H
DAFURUUR	GREWIA TENAX	TILIACEAE	S	H	H	U	U
DHEBI	GREWIA MOLLIS	TILIACEAE	S	?	?	?	?
DHEEB YAXAAS	COMMIPHORA ?ALATICAULIS	BURSERACEAE	S	U	U	U	U
DHEER DHEERE	ACACIA BRICCHETTIANA	MIMOSACEAE	aS	L	L	U	U
DHEGAYAR	BOSCIA CORIACEA	CAPPARACEAE	eS *2	DH	DH	U	U
DHIGTAR / CIGAN	DICHROSTACHYS CINERA	MIMOSACEAE	aS	M	M	U	U
DHIRINDHIR	EUPHORBIA CUNEATA	EUPHORBIACEAE	aS	M	M	L	U
DHITI / CAR IQAD	COMMIPHORA LOBATO-SPATHULATA	BURSERACEAE	acS	M	M	L	L
DIIQLAY	JATROPHA MICROPHYLLA	EUPHORBIACEAE	S	U	U	U	U
ELLAN	LAWSONIA INERMIS	LYTHRACEAE	S	/	/	/	/
GAHAYR	BLEPHARISPERUM spp.	COMPOSITAE	S	H	H	U	U
GEED GABOY	?LEPTODENIA PYROTECHNICA	?ASCLEPIADACEAE	eS	U	U	U	U
GEEL REEB	CAESALPINIA TROTHAE	CAESALPINIACEAE	aS	M	M	U	U
GOOSAY	COMMIPHORA spp.	BURSERACEAE	S	H	M	L	U
GUMER	ACACIA NUBICA	MIMOSACEAE	aS	M	L	L	L
HOHOB	GREWIA PENICILLATA	TILIACEAE	S	H	H	M	U
JAC JAC		CAPPARACEAE	S	H	M	U	U
JAFEECO (EU 24)	IPOMOEA CITRINA	CONVOLVULACEAE	S	L	H	L	U
JALEELO WEYNE/J.GEEL	CASSIA ELLISEA	CAESALPINIACEAE	S	H	M	U	U
JEERIN	ACACIA EDGEWORTHII	MIMOSACEAE	aS	H	H	U	U
JEERIN II	ACACIA LEUCOSPIRA	MIMOSACEAE	aS	?	?	?	?
JINOW	COMMIPHORA ROSTRATA VAR.ROS	BURSERACEAE	S	L	M	U	U
JIRAQ	ACACIA TURNBULLIANA	MIMOSACEAE	aS	M	M	U	U
KABXAN	THESPESIAS DANIS	MALVACEAE	S *	L	L	U	U
KALMOON	?CLEOME spp.	?CAPPARACEAE	S	H	H	H	U
KOBOSH	GREWIA VILLOSA	TILIACEAE	S	?	?	?	?
KULLAN	BALANITES AEGYPTICA	BALANITACEAE	eaS *2	/	/	/	/
MAL MAL	COMMIPHORA ?SENNII	BURSERACEAE	aS	M	M	L	U
MARER	CORDIA SINENSIS	BORAGINACEAE	S *	DH	DH	DH	DL
MARYOTOL	JATROPHA ?DICHTAR	EUPHORBIACEAE	aS	U	L	U	U
MIRACAS / DAMAG	GREWIA TEMBENSIS	TILIACEAE	S	H	H	H	L
MIRDHIS	ANISOTES TRISULCUS	ACANTHACEAE	S	U	L	U	U
MISARA JABIS	?TERMINALIA PARVULA	?COMBRETACEAE	S	L	L	U	U
OWRADHAYE	COMBRETRUM ?RETIFLORA	COMBRETACEAE	S	H	H	/	/
QALANQAL	CADABA GLANDULOSA	CAPPARACEAE	eS *2	DH	DH	DH	DH
QANSAX	ACACIA REFISCIENS	MIMOSACEAE	aS	M	M	U	U
QUDDE / JABSI	CORDIA SUCKERTII	BORAGINACEAE	S	M	M	L	U
RAXANREB	COMMIPHORA INCISA	BURSERACEAE	acS	L	L	U	U
RUMASAN	LOEWIA GLUTINOSA	TURNERACEAE	S	U	L	U	U
SARIN		?STERCULIACEAE	S	H	H	L	L
SARMAAN	ACACIA HORRIDA	MIMOSACEAE	aS	H	M	U	U
SHILLAN	BALANITES ROTUNDIFOLIA	BALANITACEAE	eaS *2	DH	DH	U	U
UNKNOWN PICTURE 5/28		?CONVOLVULACEAE	S	?	?	?	?
XAMUR	ZIZIPHUS HAMUR	RHAMNACEAE	eaS *	DH	DH	U	U
YICIB / GUD	CORDEAUXIA EDULIS	CAESALPINIACEAE	eS *2	DH	DH	DH	DH

Table 6.3. : Palatability rating : dwarf shrubs

SOM.PLANT NAME	BOTANICAL NAME	BOTANICAL FAMILY	VEGETATION TYPE	FINAL RATING CAMEL	FINAL RATING GOATS	FINAL RATING SHEEP	FINAL RATING CATTLE
ANJALEELO	CASSIA ?TRUNCATA	CAESALPINACEAE	dS	U	U	U	U
ARGEG	ASPARAGUS AFRICANUS	LILIACEAE	adS	U	U	U	U
BAAR NIRGOOD	?SATANOCRATER spp.	ACANTHACEAE	edS *	H	H	M	L
BALANBALIS	SENRA INCANA	MALVACEAE	dS	/	/	/	/
BOOGA DHAYE	?CHRYZOPHORA spp.	?EUPHORBIACEAE	dS	U	L	U	U
BUR BUR	?MELHANIA MURICATA	TILIACEAE	dS	?	?	?	?
CAYO	CLEOME spp.	CAPPARACEAE	dS	H	H	M	M
DACUUL			dS	H	H	M	M
DARAN	?SALSOLA spp.	?CHENOPODIACEAE	cdS *	DH	DH	DH	DH
DARAN DOWOCO	LIMONIUM CYLINDRIFOLIUM	PLUMBAGINACEAE	edS *2	DH	DH	DH	M
DARJO (CAD)	INDIGOFERA TRITA	PAPILIONACEAE	dS	M	M	/	/
DHARQO (MADOW)	TEPHROSIA OBBIADENSIS	PAPILIONACEAE	dS *	U	L	L	U
DOOBOGOY	HELIOTROPIUM LONGIFLORUM	BORAGINACEAE	dS	H	H	M	U
GEED GABAL			dS	H	H	M	L
GEEDKURRUS	LIPPIA CARVIODORA	VERBENACEAE	dS	M	M	U	U
GO	INDIGOFERA ?INTRICATA	PAPILIONACEAE	dS	H	H	M	L
GOGOBO	IPHIONA ROTUNDIFOLIA	COMPOSITAE	dS *	L	L	L	L
JAJABOOD	PREMNA spp.	VERBENACEAE	dS	H	M	L	L
JALEELO SALAMUKO	CASSIA spp.	CAESALPINACEAE	dS	U	L	U	U
JILAB	INDIGOFERA RUSPOLII	PAPILIONACEAE	dS	H	H	H	H
KABGAL SIMILAR	TRIUMFETTA spp.	TILIACEAE	dS	?	?	?	?
KABGAL	TRIUMFETTA HETEROCARPA	TILIACEAE	dS	H	H	H	H
GEED DAJIIS / MAROLAYS	SOLANUM MACRACANTHUM	SOLANACEAE	adS	M	M	U	U
NAGAR	CROTOLARIA ?DUMOSA	PAPILIONACEAE	dS	H	H	M	?
NAGARAWR / FARO YAR	INDIGOFERA SPINOSA	PAPILIONACEAE	adS	H	H	L	U
NAGARCAD	?SERICOCOMOPSIS spp.	AMARANTHCEAE	dS	H	H	H	H
NAGARDHEEB	PLEUROPTHERANTA REVOILII	AMARANTHACEAE	dS	H	H	H	H
NAGAR/MADOW/BIG	HERMANNIA spp.	STERCULIACEAE	dS	H	H	L	L
QALMO WAALIS		?CRUCIFERACEAE	edS *2	H	M	/	/
QANSOLE	RYNCHOSIS GANSOLE	PAPILIONACEAE	dS	?	?	?	?
REXAN	?OCIMUM BASILICUM	LABIATAE	dS	H	M	L	L
RIYOXIR			dS	H	M	M	L
SAALO WEYNE	?HERMANNIA spp.	?STERCULIACEAE	dS	L	M	L	L
SAGARSUF		MALVACEAE	dS *	L	M	L	U
SARARO CADAYS	?TEPHROSIA spp.	PAPILIONACEAE	dS	M	H	L	U
SARIN CAD	SERICOCOMOPSIS PALLIDA	AMARANTHACEAE	dS	H	H	L	L
SARIN CAD II		AMARANTHACEAE	dS	?	?	?	?
UNKNOWN	TRIUMFETTA spp.	TILIACEAE	dS	?	?	?	?
UNKNOWN (PICTURE 13/32)		MALVACEAE	dS	?	?	?	?
UNKNOWN (PICTURE 5/10)	?AMMOCHARIS spp.		dS	?	?	?	?
UNKNOWN (PICTURE 5/32)			dS	?	?	?	?
WANIN / GEED JINI	SOLANUM ?ALBICAULE	SOLANACEAE	dS	U	U	U	U
WASHAQAR/CAANOXAYR	?PLUCHEA SACROPHYLLA	?COMPOSITAE	cdS *	DL	DL	DL	DL
XABOW	ZYGOPHYLLUM spp.	ZYGOPHYLLACEAE	cdS *	L	/	/	/
XAJIIN DALUUG	INDIGOFERA OGADENSI	PAPILIONACEAE	dS	H	H	M	L
XERKOOD / XARIG	?MERREMIA spp.	CONVOLVULACEAE	dS	H	H	H	H

Table 6.4. : Palatability rating : herbs and forbs

SOM.PLANT NAME	BOTANICAL NAME	BOTANICAL FAMILY	VEGETATION TYPE	FINAL RATING CAMEL	FINAL RATING GOATS	FINAL RATING SHEEP	FINAL RATING CATTLE
ANEXO	CUCUMELLA KELLERI	CUCURBITACEAE	F	H	H	H	H
BALAMBAL	ABUTILON HIRTUM	MALVACEAE	wF	U	L	U	U
BARANJIS	CONVOLVULUS spp.	CONVOLVULACEAE	cF	M	H	H	H
BOCBOCOOD	PAVONIA KOTSCHYII	MALVACEAE	wF	L	H	M	M
CADUUR DHEGA WEYNE	SOLANUM ?BIFURCUM	SOLANACEAE	wF	U	L	U	U
CANYO	PORTULACA OLERACEA	PORTULACACEAE	anF	/	/	/	/
DABLEF	COMMICARPUS CF.BOISSIERI	NYCTAGINACEAE	wF	/	/	/	/
DABAXAYR	TEPHROSIA UNIFLORA	PAPILIONACEAE	wF	H	H	H	H
DARAN BIYOOD		PORTULACACEAE	skF *2	DH	DH	DH	DH
DHAAYODHABE	PAVONIA ARABICA	MALVACEAE	wF	U	M	M	M
DHUROD	MELHANIA spp.	STERCULIACEAE	wF *	U	DL	DL	DL
DHUROD similar	MELHANIA ?PHILLIPSIAE	STERCULIACEAE	wF	?	?	?	?
DUFNOOD	?CLEOME spp.	?CAPPARACEAE	wF	L	M	H	L
FARADOWOCO	BARLERIA PROXIMA	ACANTHACEAE	awF *	H	H	M	U
FARADOWOCO II	BARLERIA TRISPINOSA	ACANTHACEAE	awF	H	H	M	U
GARUNJO	GLOSSONEMA REVOLLII	ASCLEPIADACEAE	wF	/	/	/	/
HAMBOHI	AERVA JAVANICA	AMARANTHACEAE	wF	U	L	U	U
IBOCAROOR	CROTOLARIA spp.	PAPILIONACEAE	wF	/	/	/	/
KAXANDO	TRIBULUS TERRESTRIS	ZYGOPHYLLACEAE	anF	H	H	M	L
MARKAFURE	HELIOTROPIUM spp.	BORAGINACEAE	wF	H	H	M	L
NAGARXEYLEY	HIBISCUS spp.	MALVACEAE	wF	H	H	M	M
NAGARJABTO	HELIOTROPIUM spp.	BORAGINACEAE	wF	H	H	M	M
NAGARMADOW	HIBISCUS ?SOMALENSIS	MALVACEAE	wF	H	H	L	U
QODAXTOOL	BLEPHARIS spp.	ACANTHACEAE	awF *	H	M	U	U
TIMOFAHIYE	PAVONIA PIROTTAE	MALVACEAE	wF	M	H	H	H
UNKNOWN	MALVA spp.	MALVACEAE	wF	?	?	?	?
UNKNOWN	PAVONIA spp.	MALVACEAE	wF	?	?	?	?
UNKNOWN BILD 6/19			wF	?	?	?	?
UNKNOWN BILD 7/11		BRASSICACEAE	wF	?	?	?	?
UNKNOWN BILD 7/22	?MARSDENIA SCHIMPERII ??		wF	?	?	?	?
XABNOXAS			wF	?	?	?	?
HAJIIN	INDIGOFERA SPARTEOLA	PAPILIONACEAE	wF	M	M	M	M
YAMAARUG / KAXAR	BLEPHARIS CILIARIS	ACANTHACEAE	anF	H	H	M	L

Table 6.5. : Palatability rating : vines, grasses and succulents

SOM.PLANT NAME	BOTANICAL NAME	BOTANICAL FAMILY	VEGETATION TYPE	FINAL RATING CAMEL	FINAL RATING GOATS	FINAL RATING SHEEP	FINAL RATING CATTLE
CARMO	CISSUS ELLENBECKII	VITACEAE	V	U	U	U	U
CIIN	SACROSTEMMA VIMINALE	ASCLEPIADACEAE	V	U	U	U	U
GEESA RIYOOD	PENTATROPIS SPIRALIS	ASCLEPIADACEAE	V	H	H	M	U
MADAX BUSHI	MORMODICA SPINOSA	CUCURBITACEAE	V	L	L	U	U
MANDHERA QUBE	CYPHOSTEMMA sp.	VITACEAE	V	L	L	U	U
AWS MULAAX	HETEROPOGON CONTORTUS	GRAMINEAE	pG	?	?	?	?
BARIYAR / BARI GAABO		GRAMINEAE	pG	H	H	H	H
CAWIR/AWSBALLI/SALBI	CYPERUS sp.	CYPERACEAE	pG	L	L	M	M
DAREMO	CHRYSOPOGON AUCHERI	GRAMINEAE	pG	H	H	H	H
DIDIBO CADDO/ADIMO CASSO	BOTHRIOCHLOA INSCULPTA	GRAMINEAE	pG	H	H	H	H
DOOYO	DACTYLOTENIUM SCINDICUM	GRAMINEAE	pG	H	H	H	H
FAYFAY	ARISTIDA KELLERI	GRAMINEAE	pG	M	H	H	H
GANROW	CHENCHRUS CILIARIS	GRAMINEAE	pG	H	H	H	H
GOCOSO /MAAR	CYRERUS ESCULENTUS	CYPERACEAE	baG	L	H	H	H
JARBO	SPOROBULUS ?NERVOSUS	GRAMINEAE	pG	H	H	H	H
MAYRO		GRAMINEAE	pG	M	M	M	M
MUDMUD		GRAMINEAE	pG	?	?	?	?
QABO QABOOD		GRAMINEAE	pG	H	H	H	H
RARMEY / MAKORE	LATIPES SENEGALENSIS	GRAMINEAE	pG	H	H	H	H
XALEEMA DHEER / XAAR		GRAMINEAE	pG	H	H	H	H
QABO	EUPHORBIA LONGISPINA	EUPHORBIACEAE	aSK	U	U	U	U
QABO YAR YAR	EUPHORBIA INAEQUISPINA	EUPHORBIACEAE	aSK	U	U	U	U

F : forb
G : grass
P : parasite
S : shrub
SK : succulent
T : tree
V : vine

a : armed
an : annual
c : creeping
d : dwarf
e : evergreen
sk : succulent
w : woody
- : more or less

*2 : dry season fodder available
* : partly dry season available

/ : unknown
? : information not sufficient

The vast majority of vegetation was rated as having high or medium palatability with regards to camels and goats, but unpalatable or low palatability in reference to cattle or sheep. This is most evident concerning the tree layer. There are two ideas which explain the different grades of animal adaptation to the thornbush savanna: the first is that cattle and sheep are mainly grazing and not browsing animals like camels and goats are, and the second is, that a considerable part of the vegetation is thorny, which disallows cattle from feeding upon them. The same problem would apply to sheep except for the fact that they can browse as well as goats in between the thorns[15], due to the dimensions of their mouths. Nevertheless it is striking that a fairly high percentage of vegetation was rated as low- or even unpalatable for sheep. Our impression was that the nomads often included the criteria of reach within their ratings.

Figure 4.1. illustrates and compares the numbers of woody plant species, as rated palatable for the different types of animals. The dark segments make up the consumable fodder resources, while the white sections represent the unpalatable proportion of vegetation for the different types of animals. It is obvious that camels and goats are well adapted, while cattle are not. The part of vegetation rated as "low palatable" is presented separately, because it demonstrates the moderate degree of adaptation of sheep to the environment.

The shortage in the supply of fresh fodder during the dry season is outlined by the small amount of consumable evergreen plant species (summed up as Dry season high and low Palatable : DP in figure 4.1.[16]), and the potential role of leaf litter consumption during the dry season can be infered (see discussion on litter consumption and table 7.2). The amounts of actual biomass production per single plant species were given in the tables 4.1 - 4.6 .

The bushland area of range unit 16 was selected to demonstrate the amount of consumable resources per type of animal and vege-

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[15] except the thorns are growing extremely dense

[16] The evergreen plant species and those, which are availabe during some times of the dry season, are signed with : "* and *²" in the tables 4 and 6 .

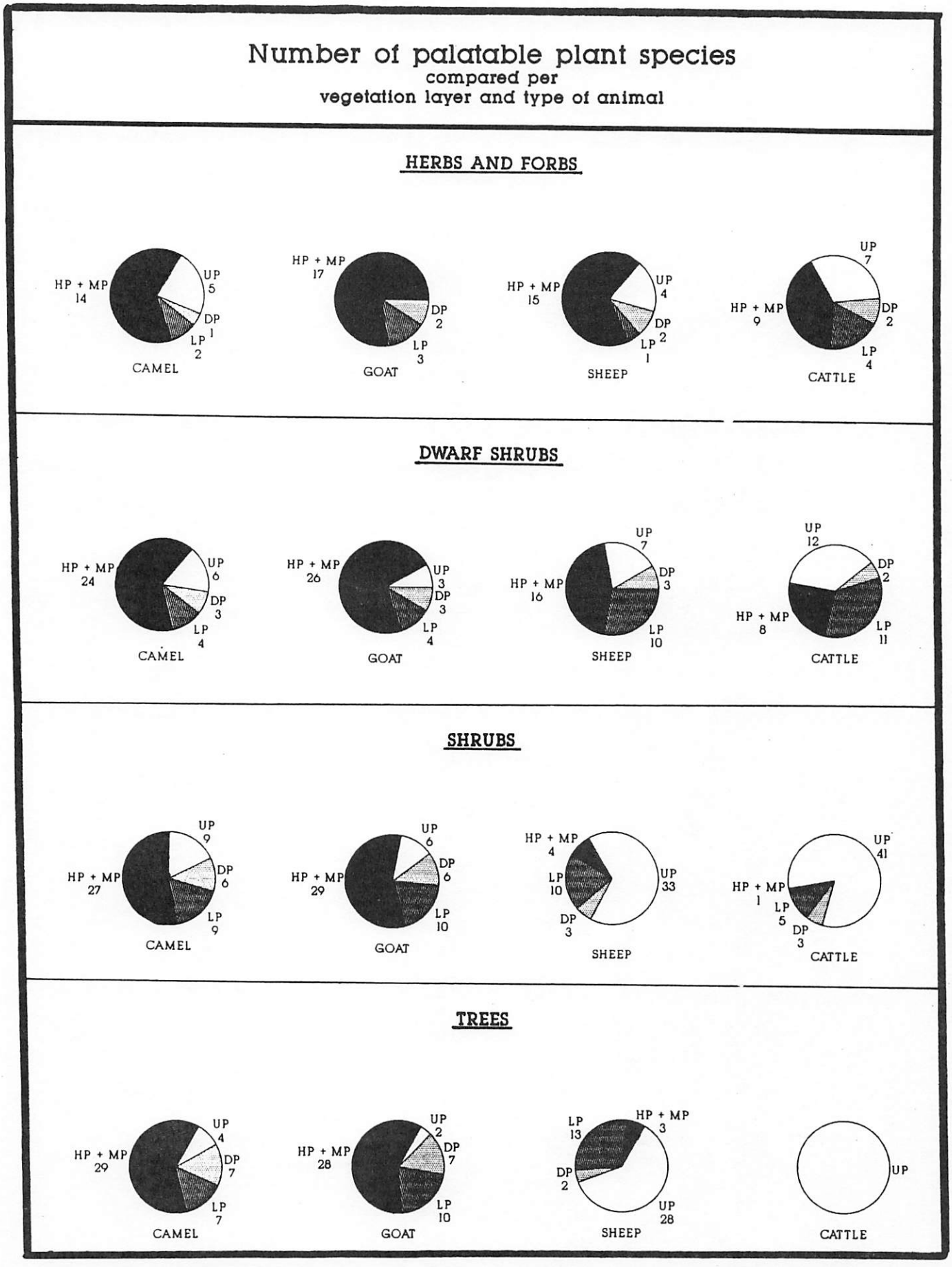

Figure 4.1. The palatability of plants seperately considered per plant layer

tation layer. The actual amounts of fodder ordered to the vegetation layers and in dependance upon the ratings of palatability are presented in table 7.3 (chap. 2.3). The preferences of the animals in their selection of browsing and grasing is evident.

A comparison between the palatability ratings and the results of the chemical analyses and nutritive values is given and discussed in chapter II. 2.1.

2.1. General results on the vegetation study

In addition to the tables 4.1. - 4.6., which have already been discussed, a summary of the vegetation structures which were characteristic for those RUs studied, is presentd in table 4.7. The patterns of dominant and subdominant species, based on their density per layer, are shown and the figures for the total potential of biomass production per ha and range unit are presented. These patterns were usually interrupted within a radius of approximately 2 km around locations with a permanent water supply[17], where an accumulation of invader plants occurred.

A clear correspondence was found between the criteria of plant density, regarded per single vegetation layers, and the order, calculated on the basis of the "Importance value".

In the study area, where the rate of precipitation is usually low, it was found that the biomass production was determined more by the continuity of raining days than by the absolute amount of rain.

The variations in the soils of the different RUs had an influence upon the absolute sizes of plants, but not upon the biomass production, correlated to the plants sizes. Concerning the woody vegetation, a very close correlation between dominance (% coverage) and biomass production was evident . In case that the vegetation cover was low (RU 31), there was no basis to transfer the water supply, which was the same as anywhere else,

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[17] These areas made up less than 3 % of the total area. They were neglected for this presentation, but they are an important aspect in terms of the range condition classification (point no. 5 mentioned in the introduction), which will be presented at an other opportunity.

into biomass production. Quickly growing species like annual grasses and annual herbs did not replace the lower rate of woody vegetation in terms of biomass production. Their part in production as compared to the total production of biomass, was very small (table 4.7.). A more detailed discussion takes place in section III.

2.2. The range resources

A seasonal biomass production ranging between 840 kg/ha and 1400 kg/ha was found in the bushland areas. The dwarfshrub areas produced about 1100 kg/ha. The range potential of the dry season in terms of green leaves - composed of evergreen plants (mainly Capparidaceae and Cordeauxia edulis) and Acacia tortilis - ranged between 56 kg/ha in the dwarfshrub area and 380 kg/ha in the bushland areas.

The highest yields of total biomass production were found in the bushland areas of the range units 16 and 24. The range potentials were highly similar, although the vegetation compositions of these regions were very different. The significant correlation, found between biomass production and coverage has already been mentioned.

The lowest capacity was found in range unit 31, resulting out of a high degree of use, practiced for several years. The edaphic situation and some blocking strata in the ground favoured the water supply in these areas. Watson had already described the gypsum areas, in the RMR study 1979, as those with the highest frequency of wells and seasonal water reserves. Up today several permanent settlements have been founded and so the areas must be rated as degraded and ecologically threatened.

The dwarf shrub areas of range units 45 and 44 are, in accordance with the information of some of the old nomads, the remains of a bushland vegetation, which covered the total region in former times. The vegetation patterns, found on the two peripheral plots 103 and 104 (table 2) support this assumption. The time of degradation is still in the mind of the nomads and described as: "long ago, when most of the trees died". Some of the nomads dated the period as the "Dhabaadheere" drought 1973 - 74.

The patterns of drought influence were in accordance with the spatial distribution of rain showers small in scale and speckled. In comparison with Watsons descriptions and aerial photos, no further degradation took place since 1979, with the exception of one intensively, used area[18]. The condition of the plants in the dwarf shrub layer was generally good and the coverage of the dwarf shrub layer was highest in comparison with the other units. These areas were those where some cattle were kept.

Table 4.7 offers the figures on the potential biomass production of leaves given in the order of the vegetation layers and range units. The correlation between coverage and biomass production is striking.

VEGETATION LAYER	NUMBER of PLANT SP.	% COVERAGE per RU	Kg TOTAL BIOMASS/HA	DOMINANT SPECIES	% DENSITY / LAYER	SUBDOMINANT SP.	% DENSITY / LAYER
RU 16							
DWARFSHRUBS	30	9.9	250	TRIUMFETTA ?HETEROCARPA	27.03	INDIGOFERA INTRICATA	10.49
				INDIGOFERA RUSPOLII	21.99	SERICOCOMOPSIS SP.	3.46
				INDIGOFERA SPINOSA	21.38		
WOODY FORBS (and HERBS)	19	1.7	56	PAVONIA PIROTTAE	16.59	HIBISCUS SOMALENSIS	14.45
				MELHANIA ?INCANA	15.07	PAVONIA ARABICA	12.71
				BLEPHARIS CILIARIS	14.56	BARLERIA SP.	7.65
SHRUBS	34	9.9	256	EUPHORBIA CUNEATA	26.95	ACACIA HORRIDA	7.49
				IPOMOEA DONALDSONII	20.75	GREWIA PENICILLATA	6.92
				ANISOTES TRISULCUS [2]	8.21	GREWIA TENAX	4.76
TREES	33	25.5	764	COMMIPHORA HORRIDA	25.58	COMMIPHORA SP.	5.45
				ACACIA TORTILIS	15.18	BOSWELIA MICROPHYLLA	4.62
				COMMIPHORA TRUNCATA	7.59	ACACIA SENEGAL VAR.	3.80
PER.GRASSES		<.5	20	ARISTIDA KELLERI		LATIPES SENEGALENSIS	
BIANN.GRASS			14	CYPERUS ESCULENTUS			
RU 24							
DWARFSHRUBS	25	13.5	378	INDIGOFERA RUSPOLII	45.26	TRIUMFETTA ?HETEROCARPA	5.34
				PLEUROPTHERANTA REVOILII	21.88	INDIGOFERA INTRICATA	4.56
						SOLANUM ?ALBICAULE	4.12
WOODY FORBS	21	1.7	43	MELHANIA ?INCANA	66.66	PAVONIA ARABICA	8.94
						HELIOTROPIUM SP.	5.58
						PAVONIA PIROTTAE	3.95
SHRUBS	30	11.8	355	CORDEAUXIA EDULIS	15.59	COMMIPHORA UNIFOLIOLATA	6.79
				ACACIA TURNBULLIANA	14.81	ACACIA ZIZYPHISPINA	5.47
				ACACIA EDGEWORTHII	8.95	IPOMOEA DONALDSONII	5.26
TREES	29	18.2	527	ACACIA TORTILIS	17.60	ACACIA HAMULOSA	5.57
				COMMIPHORA HORRIDA	10.00	BOSWELIA NEGLECTA	5.28
				CAESALPINIA ERIANTHERA	7.04	COMMIPHORA GURREH	5.28
PER.GRASSES		1.0	82	ARISTIDA KELLERI		LATIPES SENEGALENSIS	
BIANN.GRASS			15	CYPERUS ESCULENTUS			

Table 4.7. : The total biomass production and the dominant and the subdominant species per layer and range unit.

[18] in the intensively used region around Gadoon a serious overpopulation of Loewia glutinosa was found, which is poisonous to small stock and unpalatable for camel and cattle.

Table 4.7. : The total biomass production and the dominant and the subdominant species per layer and range unit. (contin.)

VEGETATION LAYER	NUMBER of PLANT SP.	% COVERAGE per RU	Kg TOTAL BIOMASS/HA	DOMINANT SPECIES	% DENSITY / LAYER	SUBDOMI-NANT SP.	% DENSITY / LAYER
RU 47							
DWARFSHRUBS	22	15.1	384	TRIUMFETTA ?HETEROCARPA	40.65	INDIGOFERA INTRICATA	4.27
				INDIGOFERA SPINOSA	29.70	MALVACEAE ?	4.14
				INDIGOFERA RUSPOLII	10.95	SERICOCOMOPSIS SP.	1.95
WOODY FORBS	19	2.4	73	PAVONIA PIROTTAE	31.63	HIBISCUS SP.	9.37
				BLEPHARIS SP.	16.67	PAVONIA ARABICA	6.57
				MELHANIA ?INCANA	9.73	HIBISCUS SOMALENSIS	4.38
SHRUBS	24	14.7	502	KALMOON: CLEOME SP.	33.05	ACACIA HORRIDA	9.50
				ANISOTES TRISULCUS	10.86	EUPHORBIA CUNEATA	7.92
				ACACIA EDGEWORTHII	9.95	ACACIA REFISCIENS	4.52
TREES	24	11.4	362	COMMIPHORA HORRIDA	35.46	DOBRA GLABRA	3.55
				ACACIA TORTILIS	24.11	BOSWELIA NEGLECTA	2.84
						LANNEA SP.	2.84
PER.GRASSES		0.2	21	NOT DETERMINED			
BIANN.GRASS			14	CYPERUS ESCULENTUS			
RU 31							
DWARFSHRUBS	30	4.7	131	INDIGOFERA INTRICATA	20.69	INDIGOFERA RUSPOLII	8.66
				TRIUMFETTA ?HETEROCARPA	19.27	LIMONIUM CYLINDRIFOLIUM	6.90
				INDIGOFERA SPINOSA	15.03	ZYGOPHYLLUM SP.	5.83
WOODY FORBS	16	2.0	68	BLEPHARIS SP.	31.93	SOLANUM SP.	9.43
				PAVONIA PIROTTAE	17.12	AERVA JAVANICA	5.95
				TRIBULUS TERRESTRIS	10.30	HELIOTROPIUM SP.	5.51
SHRUBS	16	8.8	305	ACACIA REFISCIENS	32.65	ACACIA EDGEWORTHII	7.76
				ANISOTES TRISULCUS	19.18	EUPHORBIA CUNEATA	7.76
				ACACIA HORRIDA	11.84	GREWIA TEMBENSIS	4.08
TREES	14	6.3	263	ACACIA SENEGAL VAR.	45.70	ACACIA TORTILIS	10.48
				COMMIPHORA SP. ?GOWLELO	11.43	CAESALPINIA ERIANTHERA	6.67
				COMMIPHORA HORRIDA	11.43	BOSCIA MINIMIFOLIA	2.86
PER.GRASSES		0.4	59	LATIPES SENEGALENSIS		ARISTIDA KELLERI	
BIANN.GRASS			14				
RU 45/44							
DWARFSHRUBS	28	18.4	476	INDIGOFERA INTRICATA	42.08	TRIUMFETTA ?HETEROCARPA	5.33
				INDIGOFERA RUSPOLII	20.66	NOT IDENTIFIED SP.	5.03
						PLEUROPTHERANTA REVOILII	3.62
WOODY FORBS	24	1.2	31	PAVONIA PIROTTAE	18.86	TEPHROSIA UNIFLORA	7.73
				MELHANIA ?INCANA	12.21	PAVONIA KOTSCHYII	6.65
				PAVONIA ARABICA	12.21	HELIOTROPIUM SP.	4.02
SHRUBS	27	16.8	474	ACACIA EDGEWORTHII	28.22	LOEWIA GLUTINOSA	7.16
				COMMIPHORA UNIFOLIOLATA	15.20	EUPHORBIA CUNEATA	6.58
				ACACIA BRICCHETTIANA	13.60	COMMIPHORA INCISA	5.85
TREES	14	2.3	63	COMMIPHORA ANCISTROPHA	36.79	SESAMOTHAMNUS BUSSEANUS	8.49
				ACACIA HAMULOSA	16.04	COMMIPHORA HORRIDA	7.55
				ACACIA TORTILIS	9.43	ACACIA SENEGAL	6.60
PER.GRASSES		0.4	52	ARISTIDA KELLERI		CENCHRUS ?CILIARIS	
BIANN.GRASS			20	CYPERUS ESCULENTUS			

[2]Anisotes Trisulcus is limited to 4 stands very close to permanent watersources where it is absolutely dominant.

2.3. The fodder capacity for the different livestock

The following figures and tables give an impression of the different fodder resources per animal type, based on the information on supply and palatability of fodder. Table 7.1. presents the basic data on biomass production per ha and range unit, separated in accordance with the palatability ratings. The figures on potential biomass production and on proper use are shown together. The question marks in the column "palatability rating" are used to subsume those species, about which the data, collected was insufficient.

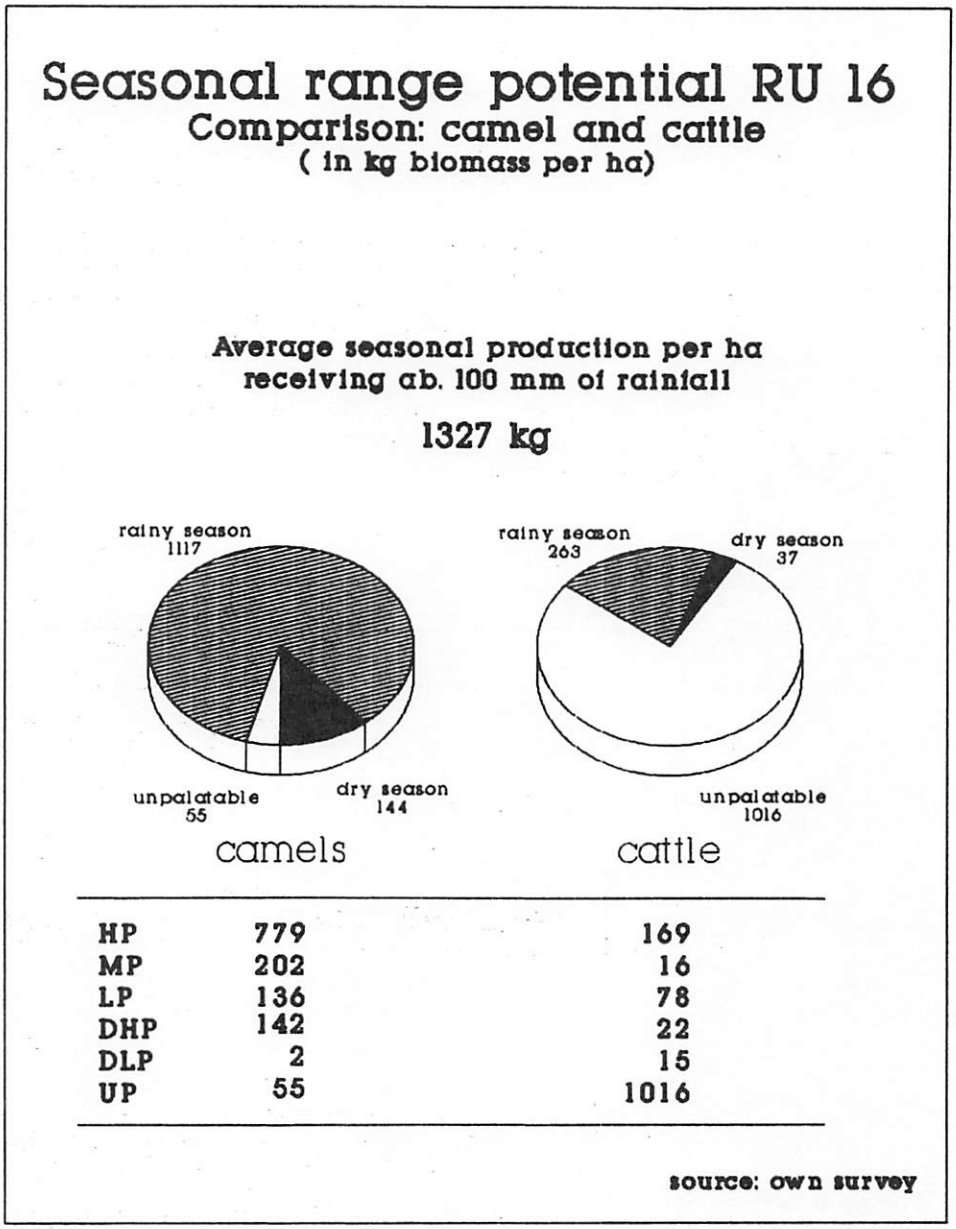
Table 7.1 : The range resources in accordance to their palatability (woody plant species only)

	DESCRIBED AS :	R U 16 NUMBER of PLANT SP.	R U 16 AVERAGE Kg BIOMASS/HA	R U 16 PROPER USE Kg / ha	R U 24 NUMBER of PLANT SP.	R U 24 AVERAGE Kg BIOMASS/HA	R U 24 PROPER USE Kg / ha	R U 45/44 NUMBER of PLANT SP.	R U 45/44 AVERAGE Kg BIOMASS/HA	R U 45/44 PROPER USE Kg / ha
CAMEL	HP	41	779	480	46	821	540	37	582	486
	MP	20	202	116	15	141	111	12	77	54
	LP	20	136	92	14	103	86	13	230	147
	DHP	9	142	40	6	112	33	8	51	18
	DLP	2	2	1	1	1	1	1	1	0
	UP	17	55	0	15	122	0	11	58	0
	??	12	11	0	10	7	0	13	39	0
GOAT	HP	43	793	326	44	807	434	36	552	426
	MP	23	213	128	22	163	112	19	116	70
	LP	19	120	50	13	117	80	11	240	124
	DHP	8	135	23	6	112	33	8	51	18
	DLP	6	45	12	3	29	23	2	5	4
	UP	10	11	0	9	72	0	6	36	0
	??	12	10	0	10	7	0	13	39	0
SHEEP	HP	12	178	167	12	272	203	13	256	214
	MP	16	151	67	15	63	46	13	148	129
	LP	23	505	208	22	479	229	17	147	81
	DHP	2	22	7	4	108	32	4	44	17
	DLP	4	121	21	1	28	22	1	4	4
	UP	50	339	0	41	345	0	34	401	0
	??	14	10	0	12	11	0	13	39	0
CATTLE	HP	9	169	160	8	261	198	9	234	207
	MP	6	16	16	6	10	10	6	29	28
	LP	15	78	58	15	110	100	15	188	160
	DHP	1	22	7	2	100	22	2	24	8
	DLP	3	15	5	2	32	25	2	8	8
	UP	73	1016	0	63	784	0	48	516	0
	??	14	11	0	11	9	0	13	39	0

	DESCRIBED AS :	RU 31 NUMBER of PLANT SP.	RU 31 AVERAGE Kg BIOMASS/HA	RU 31 PROPER USE Kg / ha	RU 47 NUMBER of PLANT SP.	RU 47 AVERAGE KG BIOMASS/HA	RU 47 PROPER USE KG / HA
CAMEL	HP	27	288	183	42	905	682
	MP	6	40	37	8	62	40
	LP	12	247	125	12	160	134
	DHP	10	77	20	9	94	23
	DLP	0	0	0	1	2	2
	UP	1	90	0	11	187	0
	??	13	24	0	9	14	0
GOAT	HP	28	233	144	40	783	596
	MP	11	103	63	14	234	129
	LP	11	315	167	13	178	127
	DHP	10	77	17	7	62	14
	DLP	2	1	1	4	44	19
	UP	3	13	0	5	27	0
	??	13	34	0	9	14	0
SHEEP	HP	9	72	64	14	376	329
	MP	10	31	31	12	117	69
	LP	13	123	55	18	322	223
	DHP	8	64	17	3	14	4
	DLP	1	0	0	1	11	10
	UP	23	440	0	35	490	0
	??	14	45	0	9	14	0
CATTLE	HP	6	64	60	9	245	220
	MP	4	7	7	5	17	16
	LP	9	24	19	13	48	45
	DHP	7	24	6	2	14	4
	DLP	1	0	0	1	11	10
	UP	38	622	0	53	994	0
	??	13	34	0	9	14	0

As a first impression it can be noted, that for camels an average of 79 % of the range units fodder potential (in kg/ha) is HP, MP or DHP and only 6 % are completely UP. For goats the ratio is 80 % to 3 % ; for sheep 34 % to 30 % ; for cattle it is 24 % to 63 %. The remaining parts are LP respectively. The adaptation of the different kinds of animals to the Central rangelands, as indicated on the basis of the number of palatable plant species, is confirmed by the calculated amount of actual biomass production. The different suitabilities of animals can be most effectively demonstrated, by comparing the range potentials in a bushland area with regards to the fodder priorities of camels and cattle. Figure 4.2 gives an illustration. Nearly the same amount of range production, which is palatable to camel is unpalatable to cattle. Concerning the dry season potential the resources for camel are four times higher than they are for cattle. It is evident, that cattle is not suited to bushland

Figure 4.2 : The seasonal range potential of range unit 16, as compared for camel and cattle.



areas. The information on this huge difference in the suitability of animals to the range is lost when the range capacity is assessed, only in terms of Tropical Livestock Units (TLU). In that case a dramatically misleading recommendation might result for the range management planning. If the range capacity is calculated as a direct result of the potential biomass production (in terms of TLU), one could get the impression, that the fodder basis for cattle is higher (one cattle is 1.0 TLU) than that for

camels (one camel is usually calculated as 1.2 TLU)[19]. In fact it is just the contrary.

For the purpose of proper range management, the proportion of proper use of the potential fodder supply has to be taken account of. The following figures illustrate the differences both, between and within range potential, fodder potential and fodder capacity, as a seasonal comparison between the bushland area of range unit 16 and the dwarfshrub - shrub land areas of the range units 45/44. The figures on the other range units are summed up in table 7.2.

Within this context, "range potential" is defined as the total biomass production in terms of leaves. The "fodder potential" describes the range capacity minus the unpalatable part of vegetation, rated per type of animal respectively. The "fodder capacity" is the actual consumable part of fodder supply, described as proportion of proper use.

Figure 5 deals with the situation of the rainy season and that part of vegetation which is defoliating. The differences in range potential, fodder poptential and actual fodder capacity are clear, as are the different supplies for the different animals. What is surpising is, that although there is a smaller potential for range production in the dwarfshrub land, than it is in the bushland area, there is a higher fodder capacity for a mixed herd. Even cattle can find sufficient fodder during the rainy season. It can be explained by the fact that the difference between fodder potential and fodder capacity is less in the dwarf shrub area than it is in the bushland area. There are no parts of vegetation which are out of reach for the animals. This means from another point of view, that in the case of over stokking the dwarf shrub areas are more vulnerable to degradation than are the bushland areas (footnote 19).

In map 3 the data on peak biomass production during a season with 100 mm of rainfall are completed for all range units.

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[19] independant of any static correction factor, which might reduce the total calculation basis for 50 or 60 % .

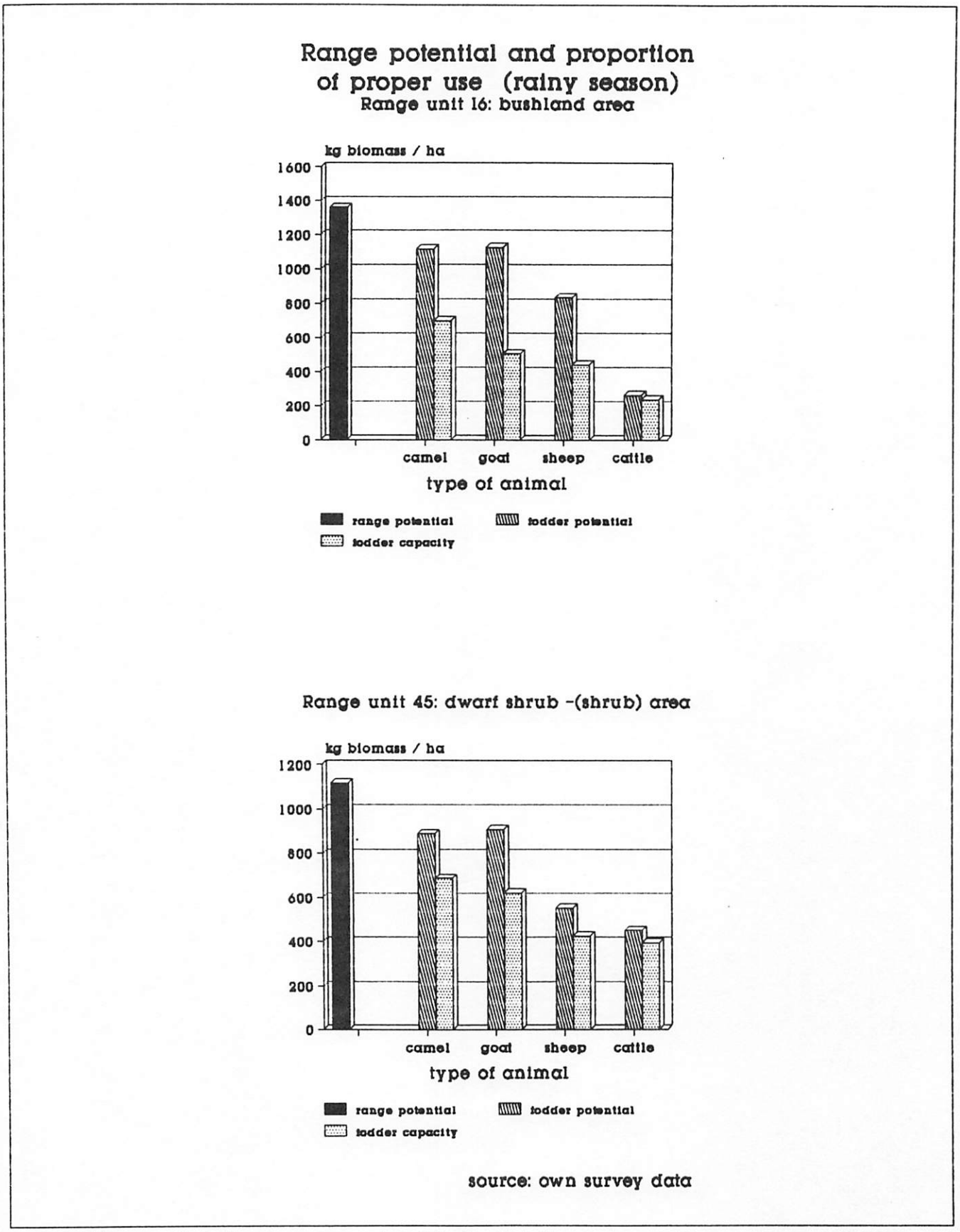
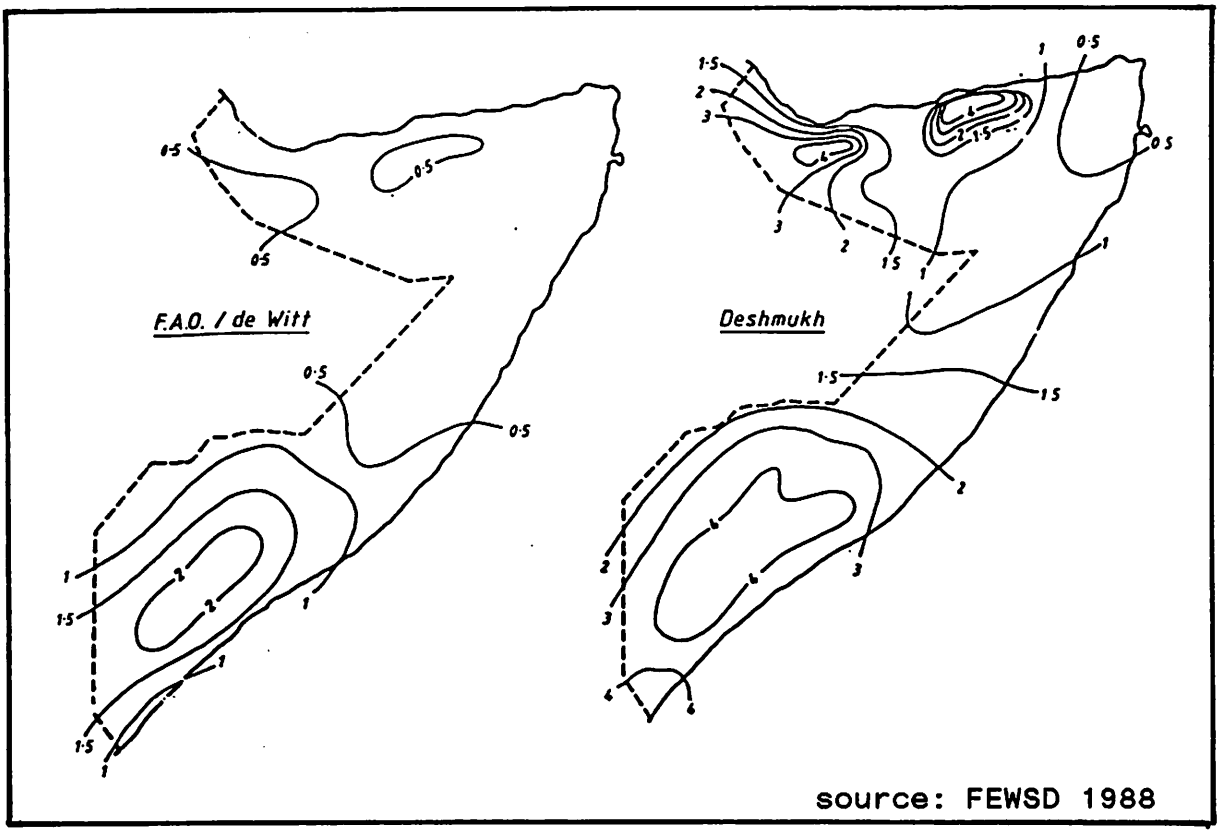


Figure 5 The range potential and the proportion of proper use. A comparison between the range units 16 and 45/44

Map 4 is taken from FEWSD (1988, p.: 140ff) and illustrates with regard to Somalia the application of two equations, given by F.A.O./de Witt and Deshmukh[20]. It is presented here to offer a comparison between different modes of calculation and to rise the question: which scale of presentation, is suitable for proper range management planning?



Map 4: Estimated annual forage production (t/ha)

Compared to each other the figures differ considerably, and compared to those established in this study, they vary both in the scale of presentation and in the calculated potentials. It is obvious that the modes of calculation as presented in map 4 can only offer very rough approximations in a macro scale, without concern of varying environments on a meso or micro scale. The evidence of results, received at such a scale of study, is discussed in more detail in Section III.

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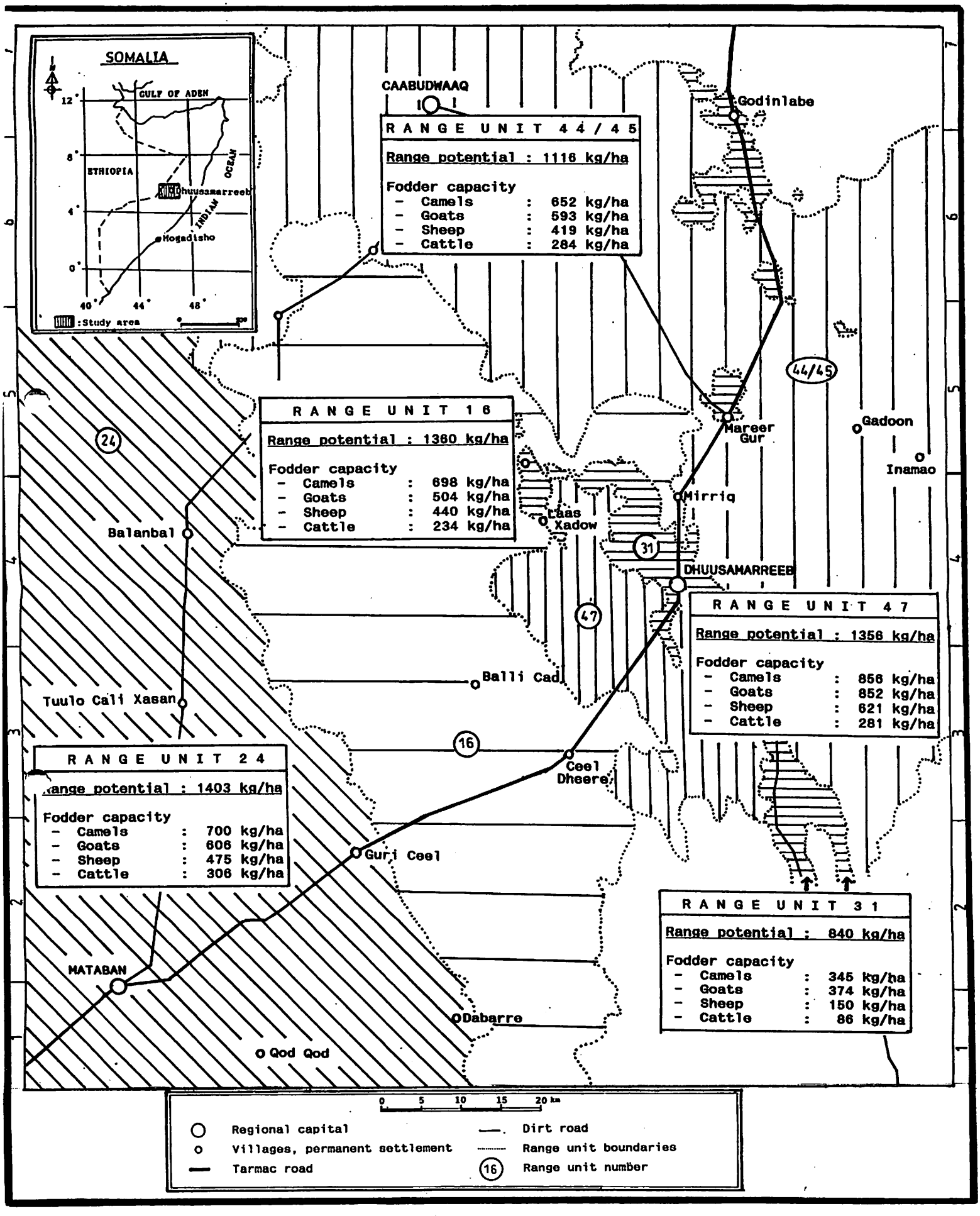
[20] The equations, and the explanations / comments of F.E.W.S.D. on them are added in Appendix 2.

THE STUDY AREA

33-1

Peak biomass production and fodder capacity in the different range units after a season with 100 mm of rainfall



The figures 6.1 and 6.2 continue with the dry season situations in the two range units selected for comparison.

The connection between the rainy and the dry season situation derives from the differences in fodder potential and fodder capacity. This difference constitutes, independant of the stocking rate during a prior rainy season, the amount of leaf litter, which builts, in addition to the evergreen plants, a potential fodder resource during the dry season.

The upper figures demonstrate the amount of fresh fodder, while those, offered below deal with the potential amount of leaf litter, which is calculated as a function of different, estimated stocking rates during a prior rainy season. The evergreen and semi- evergreen plant species, which are only selected as fodder during the time of shortage, form the basis for nutrition during the dry season. Acacia tortilis is, in terms of biomass production, the only remarkable plant which is both availabe and consumed for most of the time of both seasons. For this reason it is added separately. As the basis for the calculation of the litter potential, the amount of palatable biomass was taken and the feeding priorities of goats were assumed[21].

The first and not surprising result is, that the range potential of the dry season in terms of green leaves is much less than it is for the rainy season. The second result is, that the condition of fodder supply has obiously changed. The dry season capacity of range unit 44/45 is half as high as it is in range unit 16. The bushland areas are better suited for year round use than the dwarf shrub areas. The extremely low amount of fodder capacity in range unit 44/45, puts to question its effectivness of use during a dry season. The energy, which the animals must expend in moving from plant to plant is probably higher than the energy that might be obtained through feeding. The neccessity for seasonal mobility between the different environments becomes evident. But also on a local scale the practice of mobility is

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[21] goats have the smallest grade of avoidance

Fig.: 6.1 Range potential and proportion of proper use (dry season)

Range unit 16: Bushland area

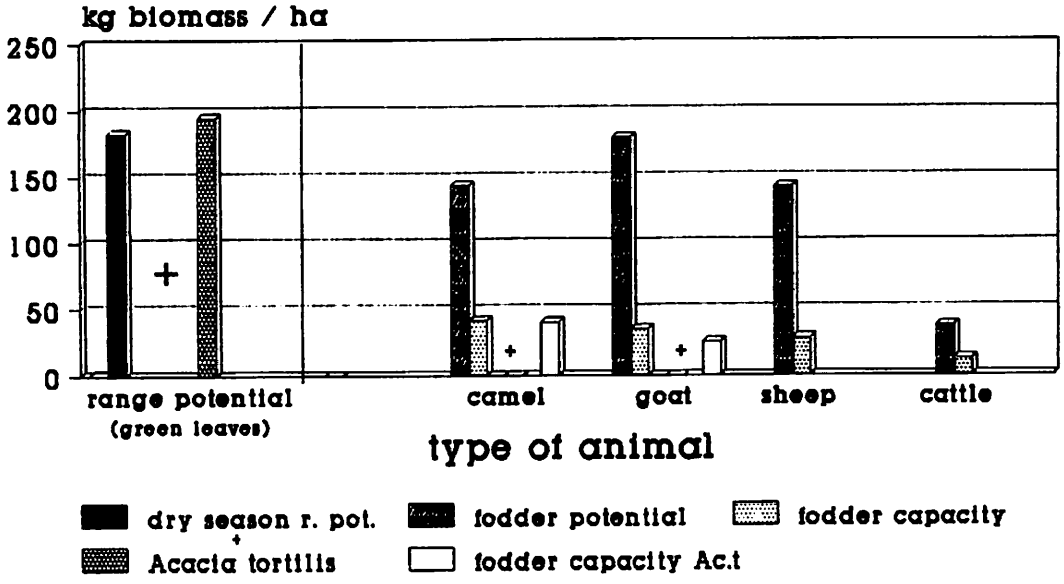


Fig.: 6.1b Potential of leaf litter

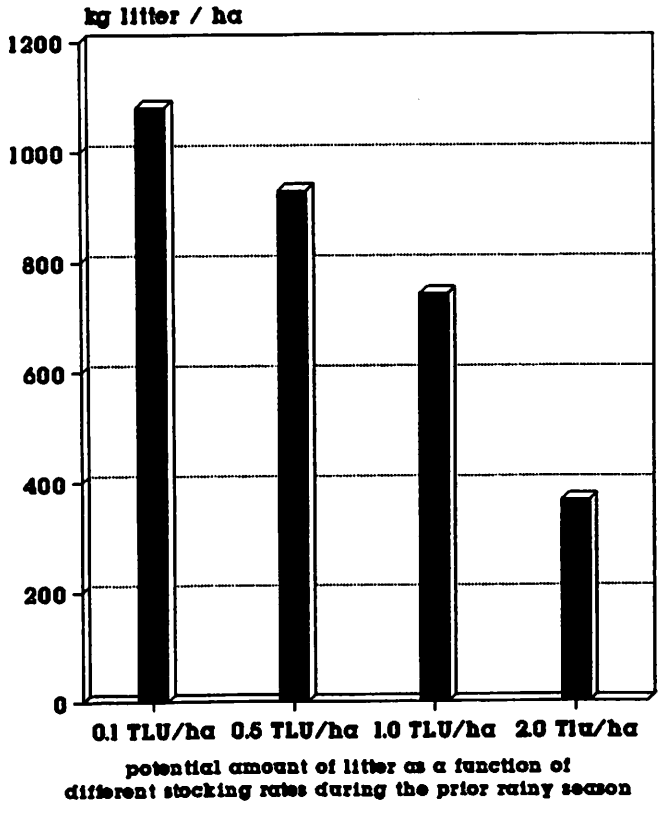


Fig.: 6.2 Range potential and proportion of proper use (dry season)

Range unit 45: dwarf shrub -(shrub) area

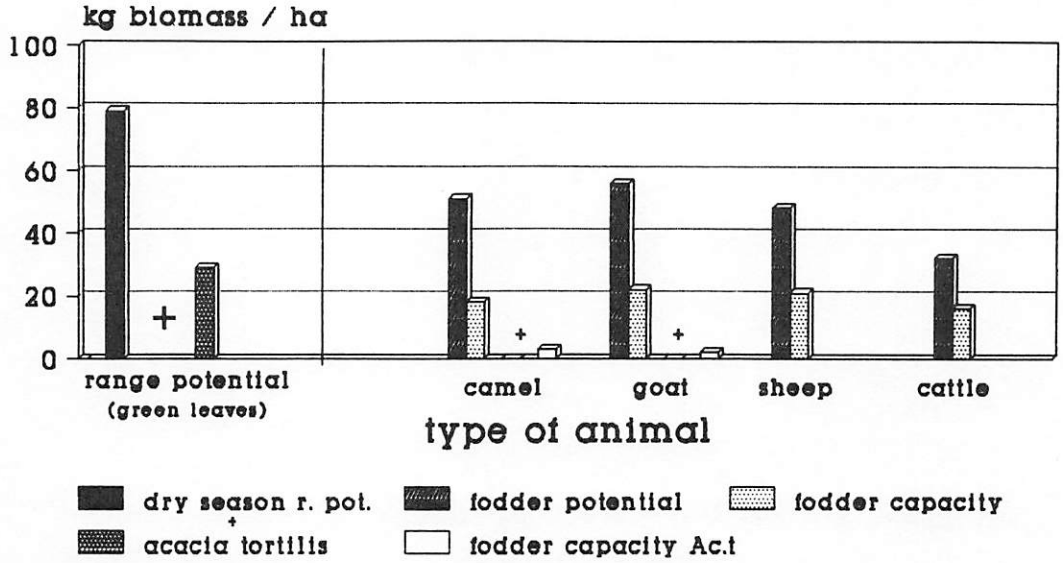
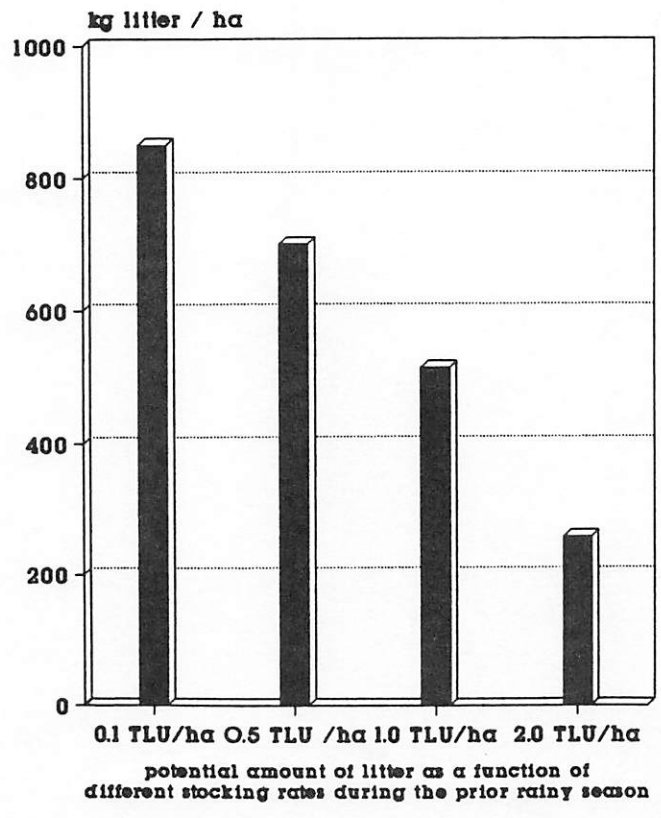


Fig.: 6.2b Potential of leaf litter



urgently important. There is, concerning the evergreen plant species, a large difference between fodder potential and fodder capacity. This difference derives from the fact that in concern of evergreen species only the seasonal increase of biomass can be rated as fodder basis. In the case of overuse the plants are severely threatend with death. Consequently it is a question of management to avoid overuse on these species by moving on time.

The additional potential of leaf litter as presented in figures 6.1b and 6.2b is impressive in its amount, but it must be conceded that the actual capacity for use is much lower. A definite value cannot be offered, because the grade of use[22], especially with regards to the differences between the different types of animals, is not exactly known. It is claer however that it is a considerable resource. No doubt exists about the use of litter, which is, at the beginnings of the dry seasons available in plenty, while at their ends there is hardly any to be found. According to the nomads even several common plants, which are unpalatable in their fresh condition (Anisotes trisulcus or Commiphora hodai) are eaten as litter. As observed during the field survey, although litter is consumed by sheep and goats, there remains some doubt about the consumption habits of cattle and camels. However, the results on the nutritive status of the litter (presented in chapter 3.1) supports its significance as a dry season fodder resource. Further reseach on this topic is urgently needed.

Table 7.2 completes the results on all range units and presents the range capacity calculated in grazing days per ha and range unit and type of animal. All calculations are done on the basis of "proper use" and the biomass production of grasses is included. With regard to leaf litter, a rating in terms of grazing days was impossible, because of the aforementioned reasons.

A range capacity lying between 25 and 75 grazing days/ha/TLU (0.8 - 2,4 ha/TLU) for cattle and 67 - 143 grazing days /ha/TLU

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[22] The size of the defoliated leaves seems to have a great influence on its availability to the animals

Table 7.2. : The fodder capacity per range unit, expressed in grazing per TLU/type of animal

	DESCRIBED AS :	CAMEL Kg LITTER per ha	CAMEL GRAZ. DAYS (TLU /ha)	GOAT Kg LITTER per ha	GOAT GRAZ. DAYS (TLU/ha)	SHEEP Kg LITTER per ha	SHEEP GRAZ. DAYS (TLU/ha)	CATTLE Kg LITTER per ha	CATTLE GRAZ. DAYS (TLU/ha)
RANGE CAPACITY:	RU 16								
1. RAINY SEASON	HP+MP+LP		117		86		76		43
2. DRY SEASON - EG.PLANTS	DHP + DLP		6		6		4		2
- LITTER									
ESTIMATED LIVE-	0.1 TLU/HA	1081	??	1087	??	797	??	225	??
STOCK DENSITIES	0.2 TLU/HA	1043	??	1050	??	759	??	188	??
DURING THE PRIOR	0.5 TLU/HA	930	??	938	??	646	??	74	??
RAINY SEASON OF	1 TLU/HA	743	??	750	??	459	??	0	
60 DAYS :	2 TLU/HA	368	??	375	??	84	??	0	
ACACIA TORTILIS	DRY SEASON		6		4				
RANGE CAPACITY:	RU 24								
1. RAINY SEASON	HP+MP+LP		131		116		93		66
2. DRY SEASON - EG.PLANTS	DHP + DLP		5		9		9		7
- LITTER									
ESTIMATED LIVE-	0.1 TLU/HA	1027	??	1049	??	776	??	342	??
STOCK DENSITIES	0.2 TLU/HA	990	??	1012	??	739	??	306	??
DURING THE PRIOR	0.5 TLU/HA	877	??	899	??	626	??	193	??
RAINY SEASON OF	1 TLU/HA	690	??	712	??	439	??	6	??
60 DAYS	2 TLU/HA	315	??	337	??	64	??	0	??
ACACIA TORTILIS	DRY SEASON		5		3				
RANGE CAPACITY:	RU 45/44								
1. RAINY SEASON	HP+MP+LP		118		111		79		75
2. DRY SEASON - EG. PLANTS	DHP + DLP		4		3		3		3
- LITTER									
ESTIMATED LIVE-	0.1 TLU/HA	851	??	870	??	513	??	413	??
STOCK DENSITIES	0.2 TLU/HA	814	??	833	??	476	??	376	??
DURING THE PRIOR	0.5 TLU/HA	701	??	720	??	363	??	263	??
RAINY SEASON OF	1 TLU/HA	514	??	533	??	176	??	76	??
60 DAYS	2 TLU/HA	139	??	159	??	0	??	0	??
RANGE CAPACITY:	RU 31								
1. RAINY SEASON	HP+MP+LP		67		72		36		25
2. DRY SEASON - EG.PLANTS	DHP + DLP		3		3		3		1
- LITTER									
ESTIMATED LIVE-	0.1 TLU/HA	537	??	613	??	188	??	57	??
STOCK DENSITIES	0.2 TLU/HA	500	??	576	??	151	??	20	??
DURING THE PRIOR	0.5 TLU/HA	387	??	463	??	38	??	0	??
RAINY SEASON OF	1 TLU/HA	200	??	276	??	0	??	0	??
60 DAYS	2 TLU/HA	0	??	0	??	0	??	0	??
ACACIA TORTILIS	DRY SEASON		2		1				
RANGE CAPACITY:	RU 47								
1. RAINY SEASON	HP+MP+LP		143		142		105		51
2. DRY SEASON - EG.PLANTS	DHP + DLP		4		5		2		2
- LITTER									
ESTIMATED LIVE-	0.1 TLU/HA	1089	??	1157	??	777	??	272	??
STOCK DENSITIES	0.2 TLU/HA	1052	??	1120	??	740	??	235	??
DURING THE PRIOR	0.5 TLU/HA	939	??	1007	??	627	??	122	??
RAINY SEASON OF	1 TLU/HA	752	??	820	??	440	??	0	??
60 DAYS	2 TLU/HA	377	??	445	??	65	??	0	??
ACACIA TORTILIS	DRY SEASON		2		1				

Table 7.3. : Fodder suitability per layers of vegetation in the bushland area of RU 16

available amount of fodder for :

	DESCRIBED AS :	CAMEL NUMBER of PLANT SP.	CAMEL % COVERAGE per RU	CAMEL AVERAGE Kg BIOMASS/HA	GOAT NUMBER of PLANT SP.	GOAT % COVERAGE per RU	GOAT AVERAGE Kg BIOMASS/HA	SHEEP NUMBER of PLANT SP.	SHEEP % COVERAGE per RU	SHEEP AVERAGE KG BIOMASS/HA	CATTLE NUMBER of PLANT SP.	CATTLE % COVERAGE per RU	CATTLE AVERAGE Kg BIOMASS/HA
	??	6	0.30	7.40	6	0.30	7.40	7	0.30	7.50	7	0.30	7.50
	HP	12	8.50	208.90	12	8.50	208.90	5	6.72	158.20	5	6.70	158.20
Dw.- shrubs	MP	2	0.10	1.60	4	0.40	13.20	5	0.60	16.90	2	0.05	0.30
(n = 30)	DHP	1	0.05	0.70	1	0.05	0.70	1	0.05	0.70	0	0.00	0.00
	LP	4	0.70	21.40	40	0.50	17.00	7	1.90	55.00	6	0.70	25.30
	DLP	1	0.10	1.10	1	0.05	1.10	0	0.00	0.00	1	0.05	0.70
	UP	4	0.30	9.19	2	0.10	2.00	5	0.40	12.00	9	2.10	58.30
	??	2	0.10	0.40	2	0.05	0.40	2	0.05	0.40	2	0.05	0.40
	HP	9	0.70	24.10	11	0.90	32.90	4	0.30	9.70	4	0.30	11.00
Woody forbs	MP	2	0.10	7.40	3	0.10	5.60	8	0.50	24.50	4	0.40	15.80
and herbs	DHP	1	0.10	3.80	1	0.10	3.80	0	0.00	0.00	0	0.00	0.00
(n = 19)	LP	3	0.10	7.10	1	0.05	0.60	2	0.20	4.40	5	0.10	8.30
	DLP	0	0.00	0.00	1	0.60	13.00	1	0.60	13.00	1	0.60	13.00
	UP	2	0.60	13.50	0	0.00	0.00	2	0.20	4.40	3	0.30	7.90
	??	2	0.10	2.10	2	0.10	2.10	2	0.10	2.10	2	0.10	2.10
	HP	9	4.10	87.90	8	2.30	69.70	2	0.30	8.50	0	0.00	0.00
	MP	9	4.10	112.00	10	5.90	130.20	1	0.40	8.10	0	0.00	0.00
Shrubs	DHP	3	0.50	24.10	3	0.50	24.10	1	0.40	21.50	1	0.40	21.50
(n = 34)	LP	5	0.10	8.30	6	0.10	8.00	5	1.20	41.20	4	1.40	44.30
	DLP	0	0.00	0.00	1	1.00	19.90	1	0.10	1.80	1	0.05	1.80
	UP	6	1.00	21.90	4	0.10	1.70	22	7.50	173.00	26	8.00	186.50
	??	2	0.10	0.80	2	0.05	0.80	2	0.05	0.80	2	0.05	0.80
	HP	11	16.10	458.30	12	17.20	481.20	1	0.05	1.60	0	0.00	0.00
	MP	7	3.20	81.00	6	2.50	63.80	2	3.60	102.00	0	0.00	0.00
Trees	DHP	4	0.90	114.20	3	0.80	106.70	0	0.00	0.00	0	0.00	0.00
(n = 33)	LP	6	4.70	99.30	6	4.40	93.60	9	14.40	404.30	0	0.00	0.00
	DLP	1	0.10	0.80	3	0.30	10.80	2	0.80	106.60	0	0.00	0.00
	UP	2	0.50	9.40	1	0.40	7.00	17	6.70	148.60	31	25.50	763.00

(0.4 - 1 ha/TLU) for camels was calculated for the rainy season situation (assumption of 60 day periods). The dry season values (assumption of 120 day periods) varied for cattle between 7 grazing days/ha/TLU (= 17 ha /TLU - for the Cordeauxia edulis area in RU 24), and 1 to 3 days/ha and TLU (120 - 40 ha /TLU) in the remaining areas. The values for camels were 4 - 12 grazing days/ha/TLU (30 - 10 ha/TLU). Those concerning smallstock lye somewhere in between.

The best fodder basis during the rainy season was, for camels and goats, located in range unit 47 (0.4 ha/TLU, followed by range unit 24 (0.46 ha/TLU for camels and 0.52 ha/TLU for goats). In terms of cattle it was the dwarf shrub area of range unit 44/45 (0.8 ha/TLU) first and range unit 24 (1.1 ha/TLU) second. For sheep, range unit 47 represented the best grazing area (0.57 ha/TLU) and range unit 24 the second best (0.65 ha/TLU) area. The lowest capacity, concerning the rainy season, was found for all kinds of animals in range unit 31 (camel: 1.1 ha/TLU; goat: 1.2 ha/TLU; sheep: 1.7 ha/TLU; cattle: 2.4ha/TLU).

The dry season situation was as follos: for camels the richest fodder basis was available in the bushland areas of range unit 16 (10 ha/TLU). There the role of Acacia tortilis was as important as were the evergreen species Cadaba glandulosa and Boscia minimifola. Concerning sheep, goats and cattle, range unit 24 which contained Cordeauxia edulis, was found to be the most suitable dry season area (goat: 10 ha/TLU; sheep: 13.3 ha/TLU; cattle: 17 ha/TLU). The lowest capacity for all animals with the exception of cattle was found in range unit 45/44. The spatial demand for the needs of camels was 30 ha/TLU, while for goats, sheep and cattle, it was an even 40 ha/TLU. The lowest capacities for cattle were found in the bushland areas of the range units 16, 47: 60 ha/TLU and 31: 120 ha/TLU. In these areas cattle could not survive during the dry seasons.

All values presented above, do not include the potential for leaf litter consumption and they are based on the standard as-

sumption of the need for 6,25 kg of fodder per day and TLU. They will be compared in chapter 3.3 with the direct correlation of nutritive values of the plants and the needs of animals in terms of calories.

Concluding this chapter it seems, from the point of view of methodology, very important to emphazise that the accuracy of information as it was given, cannot be reached when only data derived from satellite is available or used. From satellite information only the range potential can be estimated. Also the use of equations, which are based upon the criteria of rainfall data only, cannot offer more than a rough orientation.

3. Results on the nutrition analyses of fodder plants

The basic data from the nutrition analyses are presented in table 8. The samples are arranged in the order of vegetation layers. The different conditions of the plants are added to the Somali names (for example: Miracas drying or Jilab litter). The samples, which were collected during the dry season are marked with a black point.

Table number 9 adds the element of quality rating. In the last three columns, different quality ratings are given. The column "quality index" gives the estimation of forage quality, with respect to net energy and digestible protein, in accordance to Boudet 1978 . The rating "4" is equivalent to excellent, "3" stands for good, "2" means fair and "1" stands for poor quality.

Quality	Net Energy (Kcal/kg DM)	Digestible Prot. g/kg DM	Nutri. Ratio in g DP/(NE/1650)/kg DM
poor	< 742	< 25	< 55
fair	742 - 825	25 - 34	55 - 68
good	825 - 990	34 - 53	68 - 78
excellent	> 990	> 53	> 88

Estimation of forage quality with respect to NE and DP (Boudet)

Table 8 : Nutritive composition of fodder plants

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	DATE OF COLLECTION	% WS (WS / TS)	C.-PROTEIN (CP / TS)	ASH 600 (ASH / TS)	CRUDEFIBRE (CF / TS)	FAT (FAT / TS)
BAARNIRGOOD	SATANOCRATER SP.??	D	14/6/89	33.36	15.88	15.50	19.57	
DARQO	INDIGOFERA TRITA	D	13/11/89	34.28	16.84	20.90	13.88	
DARQO	INDIGOFERA TRITA	D	13/11/89	31.72	15.13	19.53	18.87	
GEED DAJIS	SOLANUM MACRACANTHUM	D	13/6/89	26.41	27.76	14.66	18.17	
GO	INDIGOFERA INTRICATA	D	2/11/89	32.96	16.37	15.23	17.75	
GOGOBO	IPHIONIA ROTUNDIFOLIA	D	11/6/89	31.85	13.81	16.65	21.55	
GOGOBO DRYING	IPHIONIA ROTUNDIFOLIA	D	14/6/89	32.91	13.75	15.48	21.81	
GOGOBO	IPHIONIA ROTUNDIFOLIA	D	2/11/89	30.20	18.24	16.12	15.28	
JILAB	INDIGOFERA RUSPOLII	D	10/6/89	20.83	13.66	22.55	20.68	0.89
JILAB	INDIGOFERA RUSPOLII	D	30/10/89	25.57	18.45	11.44	17.44	
JILAB	INDIGOFERA RUSPOLII	D	10/11/89	28.49	19.01	13.37	17.71	
JILAB LITTER*	INDIGOFERA RUSPOLII	D	10/11/89	7.03	7.69	22.40	17.39	1.36
KABGAL	TRIUMFETTA HETEROCARPA	D	16/6/89	23.49	12.23	9.38	16.66	
KABGAL	TRIUMFETTA HETEROCARPA	D	19/10/89	18.91	19.34	12.67	22.14	1.62
KABGAL	TRIUMFETTA HETEROCARPA	D	28/10/89	18.51	14.35	11.42	25.74	
NAGARAWR	INDIGOFERA SPINOSA	D	16/6/89	27.22	15.44	14.86	21.91	
NAGARAWR	INDIGOFERA SPINOSA	D	30/10/89	30.32	17.53	24.64	16.59	
NAGARDHEEB	PLEUROPTHERANTA REVOILII	D	1/6/89	26.04	16.91	13.35	28.29	
NAGARDHEEB DRY	PLEUROPTHERANTA REVOILII	D	14/6/89	22.12	14.74	10.39	35.23	
NAGARDHEEB	PLEUROPTHERANTA REVOILII	D	3/11/89	24.73	19.66	13.54	25.09	
REXAN	?OCINUM BASILIKUM	D	1/6/89	22.70	12.30	10.27	21.72	
REXAN	?OCINUM BASILIKUM	D	10/11/89	23.07	10.31	15.82	21.13	
SAGARSUF	MALVACEAE	D	29/10/89	27.90	18.35	17.80	13.51	
SARINCAD	SERICOCOMOPSIS PALLIDA	D	2/11/89	26.37	13.14	20.32	23.01	
SARINCAD DRYING	SERICOCOMOPSIS PALLIDA	D	14/6/89	26.64	14.37	15.26	17.97	
FAYFAY	ARISTIDA KELLERI	G	10/6/89	15.03	12.06	8.98	33.92	1.10
GOCOSO	CYPERUS ESCULENTUS	G	31/5/89	16.17	9.59	8.23	35.07	
GOCOSO	CYPERUS ESCULENTUS	G	10/6/89	18.32	9.86	7.64	33.03	
GOCOSO-LITTER	CYPERUS ESCULENTUS	G	14/6/89	28.24	12.51	13.07	24.03	
JARBO - FRESH	SPOROBULUS ?NERVOSUS.	G	13/11/89	16.21	8.14	12.06	36.95	
JARBO DRY SEAS.	SPOROBULUS ?NERVOSUS.	G	10/8/89	11.31	4.46	9.69	37.01	
JARBO DRY SEAS.	SPOROBULUS ?NERVOSUS.	G	10/8/89	11.73	4.76	9.20	35.44	

Table 8 : Nutritive composition of fodder plants

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	DATE OF COLLECTION	% WS (WS / TS)	C.-PROTEIN (CP / TS)	ASH 600 (ASH / TS)	CRUDEFIBRE (CF / TS)	FAT (FAT / TS)
RARMEY/FAYFAY	GRAMINEAE	G	2/11/89	15.67	11.81	8.81	35.56	
SAYR DRY-SEASON	GRAMINEAE ●	G	10/8/89	16.40	4.83	12.19	32.48	
BOCBOCOOD	PAVONIA KOTSCHYI	F	2/11/89	24.37	14.80	13.45	23.39	
DHUROD	MELHANIA ?INCANA	F	16/6/89	25.41	12.00	9.00	21.70	
DHUROD	MELHANIA ?INCANA	F	2/11/89	25.40	12.76	8.12	18.94	
DUFNOOD	CLEOME SP.??	F	16/6/89	24.14	13.46	13.91	28.00	
GEESO BIYOOD	PENTATROPIS SPIRALIS	F	10/8/89	42.45	9.05	21.28	18.67	
MARKAFURE	HELIOTROPIUM SP.	F	29/10/89	36.38	23.61	25.90	22.04	
NAGARJABTO[2]	HELIOTROPIUM SP.	F	30/10/89	21.09	18.20	16.96	19.42	
NAGARXEYLEY	HIBISCUS SOMALENSIS	F	29/5/89	31.01	16.12	18.27	24.12	
NAGARXEYLEY	HIBISCUS SOMALENSIS	F	29/10/89	30.85	16.77	18.41	18.79	
QODAXTOOL[2]*	BLEPHARIS SP.	F	29/5/89	30.32	13.42	20.07	18.01	
QODAXTOOL[2]*	BLEPHARIS SP.	F	16/6/89		11.15	20.80	15.86	
TIMOFAHIYE	PAVONIA PIROTTAE	F	2/11/89	23.59	14.18	19.79	28.82	
BUULALOOD	IPOMEA DONALDSONII	S	26/10/89	27.21	19.38	9.76	16.93	
BUULALOOD	IPOMEA DONALDSONII	S	30/10/89	30.47	11.24	8.90	22.02	
BUULALOOD*LIT.[2]	IPOMEA DONALDSONII	S	10/11/89	16.37	7.54	12.00	19.94	
CADAADMADOW	ACACIA ZIZYPHISPINA	S	1/6/89	37.93	17.31	8.74	10.25	
CADAADMADOW	ACACIA ZIZYPHISPINA	S	4/11/89	30.40	17.63	10.66	12.52	
CADAADMADOW*LIT	ACACIA ZIZYPHISPINA	S	10/11/89	21.22	6.82	11.51	16.31	
DABAKAR	DALBERGIA MICROPHYLLA	S	13/6/89	25.59	14.91	8.66	21.34	
DAFURUUR	GREWIA TENAX	S	1/6/89		13.88	12.90	27.83	
DAFURUUR	GREWIA TENAX	S	13/6/89	22.09	15.18	10.16	25.24	
DAFURUUR DRYING	GREWIA TENAX	S	16/6/89	26.10	15.50	12.71	21.25	
DAFURUUR	GREWIA TENAX	S	30/10/89	18.79	18.08	8.16	28.73	
DHIRINDHIR	EUPHORBIA CUNEATA	S	13/6/89	51.72	12.40	7.45	10.12	
DHIRINDHIR	EUPHORBIA CUNEATA	S	19/10/89	31.21	15.54	8.89	15.42	2.19
DHIRINDHIR	EUPHORBIA CUNEATA	S	30/10/89	48.35	11.43	5.64	9.84	
DHIRINDHIR*LIT.	EUPHORBIA CUNEATA	S	10/11/89	35.06	4.85	10.95	15.06	2.88
DHITI	COMMIPHORA LOBATO-SPATHULATA	S	4/11/89	19.44	12.37	5.52	29.99	
DHITI	COMMIPHORA LOBATO-SPATHULATA	S	10/11/89	21.92	14.49	7.28	25.76	
DHITI LITTER[2]*	COMMIPHORA LOBATO-SPATHULATA	S	10/11/89	10.64	4.20	9.00	33.23	

Table 8 : Nutritive composition of fodder plants

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	DATE OF COLLECTION	% WS (WS / TS)	C.-PROTEIN (CP / TS)	ASH 600 (ASH / TS)	CRUDEFIBRE (CF / TS)	FAT (FAT / TS)
EYRAB	TERMINALIA SPINOSA	S	10/8/89	37.75	19.83	12.53	13.32	
GAHAYR	BLEPHARISPERUM SP.	S	2/6/89	32.71	14.73	11.65	15.32	
GAHAYR	BLEPHARISPERUM SP.	S	16/6/89	29.23	12.56	12.89	17.72	
HOHOB	GREWIA PENICILLATA	S	16/6/89	21.66	12.79	12.99	24.85	
HOHOB	GREWIA PENICILLATA	S	4/11/89	20.94	15.39	10.36	24.10	
HOHOB	GREWIA PENICILLATA	S	10/11/89	19.16	14.98	10.83	25.25	
JAFEECO	IPOMEA CITRINA	S	1/6/89	23.26	13.06	9.78	26.43	
JAFEECO	IPOMEA CITRINA	S	4/11/89	19.11	14.91	8.66	30.30	
JALEELOWEYNE	CASSIA ELLISAE	S	3/11/89	27.29	15.10	6.73	28.24	
JEERIN	ACACIA EDGEWORTHII	S	30/5/89	29.90	16.99	12.62	17.24	
JEERIN	ACACIA EDGEWORTHII	S	16/6/89	34.28	15.23	15.58	16.77	4.36
JEERIN	ACACIA EDGEWORTHII	S	3/11/89	29.44	17.32	12.05	15.61	
JEERIN	ACACIA EDGEWORTHII	S	10/11/89	35.95	19.14	16.94	14.21	
JIRAQ	ACACIA TURNBULLIANA	S	18/10/89	30.29	19.66	5.68	19.14	1.36
JIRAQ LITTER*	ACACIA TURNBULLIANA	S	10/11/89	9.54	6.16	8.00	28.33	0.65
JIRAQ-DEERDEERE	ACACIA BRICCHETTIANA	S	13/6/89	23.30	16.14	7.19	18.43	
KABXAN	THESPESIAS DANIS	S	10/8/89	44.32	8.23	22.64	12.21	
MARER	CORDIA SINENSIS	S	30/10/89	19.22	21.44	12.24	25.50	
MARER	CORDIA SINENSIS	S	4/11/89	13.91	19.73	13.78	24.23	
MARER	CORDIA SINENSIS	S	10/11/89		19.95	14.27	21.96	
MIRACAS	GREWIA TEMBENSIS	S	18/10/89	18.74	20.73	9.00	26.62	
MIRACAS DRYING	GREWIA TEMBENSIS	S	2/6/89	21.36	14.09	8.77	28.85	
QALANQAL	CADABA GLANDULOSA	S	19/9/89	60.00	15.22	29.44	14.48	0.71
QALANQAL	CADABA GLANDULOSA	S	19/9/89	56.22	16.10	21.32	17.69	
SARMAAN	ACACIA HORRIDA	S	16/6/89	31.34	16.32	7.13	16.79	4.24
SARMAAN	ACACIA HORRIDA	S	10/11/89	33.04	16.46	10.07	14.86	
SARMAAN	ACACIA HORRIDA	S	28/10/89	23.31	17.41	8.00	15.07	
YICIB	CORDEUAXIA EDULIS	S	18/9/89	21.40	7.49	8.06	34.26	2.24
YICIB	CORDEUAXIA EDULIS	S	19/9/89	22.26	9.23	6.39	33.90	
BEEYACAD	BOSWELIA RIVAE	T	29/5/89	27.59	13.06	8.92	15.96	
BEEYACAD DRY	BOSWELIA RIVAE	T	29/5/89	28.91	3.59	11.84	16.14	3.13
BEEYACAD	BOSWELIA RIVAE	T	19/10/89	24.20	16.87	7.10	16.19	

Table 8 : Nutritive composition of fodder plants

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	DATE OF COLLECTION	% WS (WS / TS)	C.-PROTEIN (CP / TS)	ASH 600 (ASH / TS)	CRUDEFIBRE (CF / TS)	FAT (FAT / TS)
BEEYACAD	BOSWELIA RIVAE	T	10/11/89	24.69	15.30	8.84	13.18	
BEEYAMADOW	BOSWELIA SULCATO STRIATA	T	1/6/89	23.08	18.46	11.94	12.85	
BEEYAMADOW LIT.	BOSWELIA SULCATO STRIATA	T	29/5/89		5.85	15.17	14.19	
BILCIL	ACACIA CHEILANTHIFOLIA	T	19/10/89	20.72	21.96	8.97	18.44	
COMM.LITTER[2]	DIFFERENT COMMIPHORAS	T	2/6/89	24.55	6.28	12.16	19.15	3.49
DHEEN	PHYLLOGEITON DISCOLOR	T	19/9/89	23.81	10.95	15.29	16.51	
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	18/10/89	18.20	19.31	9.87	11.35	1.48
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	4/11/89	19.70	13.49	10.49	14.94	
DHUSUNDHUS*LIT[2]	COMMIPHORA ANCISTROPHORA	T	10/11/89	17.15	5.71	11.00	18.15	2.21
GABRAR	COMMIPHORA HORRIDA	T	18/10/89	19.52	12.85	9.13	19.27	
GABRAR	COMMIPHORA HORRIDA	T	29/10/89	26.25	13.56	9.75	13.57	
GABRAR	COMMIPHORA HORRIDA	T	30/10/89	20.97	8.93	10.48	19.09	
GABRAR	COMMIPHORA HORRIDA	T	10/11/89	20.88	13.33	10.82	14.49	
GABRAR LITTER[2]	COMMIPHORA HORRIDA	T	10/11/89	17.37	4.01	12.60	20.21	
GABRAR LITTER	COMMIPHORA HORRIDA	T	29/5/89	14.21	5.72	20.18	16.91	
GARRAS ●	DOBRA GLABRA	T	19/9/89	33.02	11.92	19.54	28.42	0.83
GUNDUD	COMMIPHORA TRUNCATA	T	19/10/89	27.74	14.55	6.61	19.08	
GUNDUD	COMMIPHORA TRUNCATA	T	26/10/89	30.80	12.25	5.76	13.90	
GUNDUD	COMMIPHORA TRUNCATA	T	30/10/89	30.12	9.91	9.04	13.27	
GUNDUD DRYING	COMMIPHORA TRUNCATA	T	10/11/89	32.78	10.23	8.09	17.63	
GUNRAY	COMMIPHORA GURREH	T	18/10/89	23.98	14.89	7.77	14.90	1.58
JIIQ	ACACIA SEYAL VAR.FISTULA	T	15/6/89	28.58	10.81	10.88	13.89	
KHUURI	CAESALPINA ERIANTHERA	T	18/10/89	38.56	19.85	10.61	14.37	
KHUURI LITTER[2]*	CAESALPINA ERIANTHERA	T	10/11/89	18.83	8.00	13.00	22.79	2.33
KURA	ACACIA TORTILIS	T	19/10/89	13.94	19.80	8.03	21.31	1.90
KURA	ACACIA TORTILIS	T	4/11/89	18.69	18.38	9.05	19.59	
MAYGAG ●	BOSCIA MINIMIFOLIA	T	19/09/89	35.47	23.37	9.27	24.96	2.08
MUQLAY LIT.[2]	BOSWELIA MICROPHYLLA	T	10/11/89	30.22	3.24	15.13	9.79	1.44
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	T	18/10/89	26.77	26.55	10.97	16.69	
SALEEMAC LITTER	SESAMOTHAMNUS BUSSEANUS	T	10/11/89	21.48	5.52	15.84	17.42	
XAGARCAD	COMMIPHORA ELLISIAEE	T	9/6/89	24.75	15.94	10.02	13.47	3.29
XAGARCAD LIT.[2]	COMMIPHORA ELLISIAEE	T	29/5/89	26.52	3.78	23.99	20.94	
XAGARCAD LIT.[2]*	COMMIPHORA ELLISIAEE	T	10/11/89	28.33	4.52	12.68	22.01	0.97

[2]: SAMPLE CONTAINED SOME SAND ● : DRY SEASON VALUE

*: CORRECTED VALUES (SAND)

Table 9 : Fodder quality

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	DATE OF COLLECTION	C.-PROTEIN (CP / TS)	DIG. PROT. .929CP-3.5	ASH 600 (ASH / TS)	CRUDEFIBRE (CF / TS)	PAL. INDEX CM,G,S,CT	M-ENERGY Kcal / Kg	DIGPROT*10 / UF/100	QUALITY INDEX	MET-ENERGY PROT.INDEX INDEX:EMBB EMBB KENYA	
BAARNIRGOOD	?SATANOCRATER SP.??	D	14/6/89	15.88	11.25	15.50	19.57	H,H,M,L	1382.70	134.27	4	2	2
DARQO	INDIGOFERA TRITA	D	13/11/89	16.84	12.14	20.90	13.88	M,M,/,/	1404.15	142.71	4	2	2
DARQO	INDIGOFERA TRITA	D	13/11/89	15.13	10.56	19.53	18.87	M,M,/,/	1320.00	131.95	4	2	2
GEED DAJIS	SOLANUM MACRACANTHUM	D	13/6/89	27.76	22.29	14.66	18.17	M,M,U,U	1476.75	249.04	4	2	2
GO	INDIGOFERA INTRICATA	D	2/11/89	16.37	11.71	15.23	17.75	H,H,M,L	1470.15	131.42	4	2	2
GOGOBO	IPHIONIA ROTUNDIFOLIA	D	11/6/89	13.81	9.33	16.65	21.55	L,L,L,L	1295.25	118.85	4	2	2
GOGOBO DRYING	IPHIONIA ROTUNDIFOLIA	D	14/6/89	13.75	9.27	15.48	21.81	L,L,L,L	1303.50	117.39	4	2	2
GOGOBO	IPHIONIA ROTUNDIFOLIA	D	2/11/89	18.24	13.44	16.12	15.28	L,L,L,L	1536.15	144.40	4	2	2
JILAB	INDIGOFERA RUSPOLII	D	10/6/89	13.66	9.19	22.55	20.68	H,H,H,H	1196.25	126.80	4	2	2
JILAB	INDIGOFERA RUSPOLII	D	30/10/89	18.45	13.64	11.44	17.44	H,H,H,H	1580.70	142.38	4	2	2
JILAB	INDIGOFERA RUSPOLII	D	10/11/89	19.01	14.16	13.37	17.71	H,H,H,H	1514.70	154.21	4	2	2
JILAB LITTER*	INDIGOFERA RUSPOLII	D	10/11/89	7.69	3.64	22.40	17.39	?,Y,Y,?	1338.15	44.93	1	2	0
KABGAL	TRIUMFETTA HETEROCARPA	D	16/6/89	12.23	7.86	9.38	16.66	H,H,H,H	1646.70	78.78	3	2	2
KABGAL	TRIUMFETTA HETEROCARPA	D	19/10/89	19.34	14.46	12.67	22.14	H,H,H,H	1361.25	175.31	4	2	2
KABGAL	TRIUMFETTA HETEROCARPA	D	28/10/89	14.35	9.83	11.42	25.74	H,H,H,H	1316.70	123.20	4	2	2
NAGARAWR	INDIGOFERA SPINOSA	D	16/6/89	15.44	10.84	14.86	21.91	H,H,L,U	1316.70	135.86	4	2	2
NAGARAWR	INDIGOFERA SPINOSA	D	30/10/89	17.53	12.79	24.64	16.59	H,H,L,U	1272.15	165.83	4	2	2
NAGARDHEEB	PLEUROPTHERANTA REVOILII	D	1/6/89	16.91	12.21	13.35	28.29	H,H,H,H	1097.25	183.60	4	1	2
NAGARDHEEB DRY	PLEUROPTHERANTA REVOILII	D	14/6/89	14.74	10.19	10.39	35.23	H,H,H,H	877.80	191.63	4	0	2
NAGARDHEEB	PLEUROPTHERANTA REVOILII	D	3/11/89	19.66	14.76	13.54	25.09	H,H,H,H	1229.25	198.12	4	2	2
REXAN	?OCINUM BASILIKUM	D	1/6/89	12.30	7.93	10.27	21.72	H,M,L,L	1470.15	88.97	4	2	2
REXAN	?OCINUM BASILIKUM	D	10/11/89	10.31	6.08	15.82	21.13	H,M,L,L	1338.15	74.94	3	2	2
SAGARSUF	MALVACEAE	D	29/10/89	18.35	13.55	17.80	13.51	L,M,L,U	1470.15	152.04	4	2	2
SARINCAD	SERICOCOMOPSIS PALLIDA	D	2/11/89	13.14	8.71	20.32	23.01	H,H,L,L	1163.25	123.50	4	2	2
SARINCAD DRYING	SERICOCOMOPSIS PALLIDA	D	14/6/89	14.37	9.85	15.26	17.97	H,H,L,L	1470.15	110.56	4	2	2
FAYFAY	ARISTIDA KELLERI	G	10/6/89	12.06	7.70	8.98	33.92	H,H,H,H	970.20	130.97	4	1	2
GOCOSO	CYPERUS ESCULENTUS	G	31/5/89	9.59	5.41	8.23	35.07	H,H,H,H	922.35	98.70	4	1	1
GOCOSO	CYPERUS ESCULENTUS	G	10/6/89	9.86	5.66	7.64	33.03	H,H,H,H	1031.25	90.57	4	1	1
GOCOSO-LITTER	CYPERUS ESCULENTUS	G	14/6/89	12.51	8.12	13.07	24.03	Y,Y,Y,Y	1295.25	103.45	4	2	2
JARBO - FRESH	SPOROBULUS ?NERVOSUS.	G	13/11/89	8.14	4.06	12.06	36.95	H,H,H,H	702.90	95.29	4	0	1
JARBO DRY SEAS.	SPOROBULUS ?NERVOSUS.	G	10/8/89	4.46	0.64	9.69	37.01	Y,Y,Y,Y,	790.35	13.43	1	0	0
JARBO DRY SEAS.	SPOROBULUS ?NERVOSUS.	G	10/8/89	4.76	0.92	9.20	35.44	Y,Y,Y,Y,	877.80	17.33	1	0	0
RARMEY/FAYFAY	GRAMINEAE	G	2/11/89	11.81	7.47	8.81	35.56	H,H,H,H	877.80	140.36	4	0	2
SAYR DRY-SEASON	GRAMINEAE	G	10/8/89	4.83	0.99	12.19	32.48	Y,Y,Y,Y	943.80	17.24	1	1	0
BOCBOCOOD	PAVONIA KOTSCHYI	H	2/11/89	14.80	10.25	13.45	23.39	L,H,M,M	1316.70	128.49	4	2	2
DHUROD	MELHANIA ?INCANA	H	16/6/89	12.00	7.65	9.00	21.70	U,DL,DL,DL	1491.60	84.64	3	2	2
DHUROD	MELHANIA ?INCANA	H	2/11/89	12.76	8.35	8.12	18.94	U,DL,DL,DL	1602.15	86.04	3	2	2
DUFNOOD	CLEOME SP.??	H	16/6/89	13.46	9.00	13.91	28.00	L,M,H,L	1097.25	135.40	4	1	2
GEESO RIYOOD	PENTATROPIS SPIRALIS	H	10/8/89	9.05	4.91	21.28	18.67	H,H,M,U	1295.25	62.52	2	2	1
MARKAFURE	HELIOTROPIUM SP.	H	29/10/89	23.61	18.43	25.80	22.04	H,H,M,L	1052.70	288.93	4	1	2
NAGARJABTO[2]	HELIOTROPIUM SP.	H	30/10/89	18.20	13.41	16.96	19.42	H,H,M,M	1361.25	162.52	4	2	2
NAGARXEYLEY	HIBISCUS SOMALENSIS	H	29/5/89	16.12	11.47	18.27	24.12	H,H,M,M	1163.25	162.71	4	2	2
NAGARXEYLEY	HIBISCUS SOMALENSIS	H	29/10/89	16.77	12.08	18.41	18.79	H,H,M,M	1361.25	146.42	4	2	2
QODAXTOOL[2]*	BLEPHARIS SP.	H	29/5/89	13.42	8.97	20.07	18.01	H,M,U,U	1338.15	110.57	4	2	2
QODAXTOOL[2]*	BLEPHARIS SP.	H	16/6/89	11.15	6.86	20.80	15.86	H,M,U,U	1404.15	80.59	3	2	2
TIMOFAHIYE	PAVONIA PIROTTAE	H	2/11/89	14.18	9.67	19.79	28.82	M,H,H,H	943.80	169.11	4	1	2

Table 9 : Fodder quality (contin.)

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	DATE OF COLLECTION	C.-PROTEIN (CP / TS)	DIG. PROT. .92*CP-3.5	ASH 600 (ASH / TS)	CRUDEFIBRE (CF / TS)	PAL. INDEX CM,C,S,CT	M-ENERGY Kcal / Kg	DIGPROT*10 UF/100	QUALITY INDEX	MET-ENERGY INDEX:EMHB	PROT.INDEX EMHB KENYA
BUULALOOD	IPOMEA DONALDSONII	S	26/10/89	19.38	14.50	9.76	16.93	M,H,L,L	1603.75	149.22	4	2	2
BUULALOOD	IPOMEA DONALDSONII	S	30/10/89	11.24	6.94	8.80	22.02	M,H,L,L	1470.15	77.87	3	2	2
BUULALOOD*LIT.[2]	IPOMEA DONALDSONII	● S	10/11/89	7.54	3.50	12.00	19.94	?,Y,Y,?	1470.15	39.33	1	2	0
CADAADMADOW	ACACIA ZIZYPHISPINA	S	1/6/89	17.31	12.58	6.74	10.25	H,H,U,U	1689.60	122.85	4	2	2
CADAADMADOW	ACACIA ZIZYPHISPINA	S	4/11/89	17.63	12.88	10.66	12.52	M,M,U,U	1650.00	128.78	4	2	2
CADAADMADOW*LIT	ACACIA ZIZYPHISPINA	● S	10/11/89	6.82	2.84	11.51	16.31	?,Y,Y,U	1580.70	29.60	1	2	0
DABAKAR	DALBERGIA MICROPHYLLA	S	13/6/89	14.91	10.35	5.86	21.34	H,H,L,U	1491.60	114.46	4	2	2
DAFURUUR	GREWIA TENAX	S	1/6/89	13.88	9.39	12.90	27.83	H,H,U,U	1163.25	133.26	4	2	2
DAFURUUR	GREWIA TENAX	S	13/6/89	15.18	10.60	10.16	25.24	H,H,U,U	1338.15	130.67	4	2	2
DAFURUUR	GREWIA TENAX	S	16/6/89	15.50	10.90	12.71	21.25	H,H,U,U	1382.70	130.10	4	2	2
DAFURUUR	GREWIA TENAX	S	30/10/89	18.08	13.29	8.16	28.73	H,H,U,U	1229.25	178.43	4	2	2
DHIRINDHIR	EUPHORBIA CUNEATA	S	13/6/89	12.40	8.02	7.45	10.12	M,M,L,U	1732.50	76.38	3	2	2
DHIRINDHIR	EUPHORBIA CUNEATA	S	19/10/89	15.54	10.94	8.89	15.42	M,M,L,U	1668.15	108.18	4	2	2
DHIRINDHIR	EUPHORBIA CUNEATA	S	30/10/89	11.43	7.11	5.64	9.84	M,M,L,U	1777.05	66.06	2	2	2
DHIRINDHIR*LIT.	EUPHORBIA CUNEATA	● S	10/11/89	4.85	1.01	10.95	15.06	?,Y,Y,?	1646.70	10.08	1	2	0
DHITI	COMMIPHORA LOBATO-SPATHULATA	S	4/11/89	12.37	7.99	5.52	29.99	M,M,L,L	1229.25	107.22	4	2	2
DHITI	COMMIPHORA LOBATO-SPATHULATA	S	10/11/89	14.49	9.96	7.28	25.76	M,M,L,L	1361.25	120.74	4	2	2
DHITI LITTER[2]*	COMMIPHORA LOBATO-SPATHULATA	● S	10/11/89	4.20	0.40	9.00	33.23	?,Y,Y,Y	856.35	7.74	1	0	0
EYRAB	TERMINALIA SPINOSA	S	10/8/89	19.83	14.92	12.53	13.32	/,/,/,/	1605.62	153.35	4	2	2
GAHAYR	BLEPHARISPERUM SP.	S	2/6/89	14.73	10.18	11.65	15.32	H,H,U,U	1602.15	104.88	4	2	2
GAHAYR	BLEPHARISPERUM SP.	S	16/6/89	12.56	8.17	12.89	17.72	H,H,U,U	1514.70	88.98	4	2	2
HOHOB	GREWIA PENICILLATA	S	16/6/89	12.79	8.38	12.99	24.85	H,H,M,U	1250.70	110.58	4	2	2
HOHOB	GREWIA PENICILLATA	S	4/11/89	15.39	10.80	10.36	24.10	H,H,M,U	1361.25	130.87	4	2	2
HOHOB	GREWIA PENICILLATA	S	10/11/89	14.98	10.41	10.83	25.25	H,H,M,U	1295.25	132.65	4	2	2
JAFEECO	IPOMEA CITRINA	S	1/6/89	13.06	8.63	9.78	26.43	L,H,L,U	1272.15	111.97	4	2	2
JAFEECO	IPOMEA CITRINA	S	4/11/89	14.91	10.35	8.66	30.30	L,H,L,U	1118.70	152.66	4	2	2
JALEELOWEYNE	CASSIA ELLISAE	S	3/11/89	15.10	10.53	6.73	28.24	H,H,U,U	1295.25	134.09	4	2	2
JEERIN	ACACIA EDGEWORTHII	S	30/5/89	16.99	12.28	12.62	17.24	H,H,U,U	1536.15	131.94	4	2	2
JEERIN	ACACIA EDGEWORTHII	S	16/6/89	15.23	10.65	15.58	16.77	H,H,U,U	1470.15	119.47	4	2	2
JEERIN	ACACIA EDGEWORTHII	S	3/11/89	17.32	12.59	12.05	15.61	H,H,U,U	1602.15	129.70	4	2	2
JEERIN	ACACIA EDGEWORTHII	S	10/11/89	19.14	14.28	16.94	14.21	H,H,U,U	1491.60	157.98	4	2	2
JIRAQ	ACACIA TURNBULLIANA	S	18/10/89	19.66	14.77	5.68	19.14	M,M,U,U	1646.70	147.95	4	2	2
JIRAQ LITTER*	ACACIA TURNBULLIANA	● S	10/11/89	6.16	2.22	8.00	28.33	?,?,?,?	1229.25	29.83	1	2	0
JIRAQ-DEERDEERE	ACACIA BRICCHETTIANA	S	13/6/89	16.14	11.50	7.19	18.43	L,L,U,U	1623.60	116.83	4	2	2
KABXAN	THESPESIAS DANIS	S	10/8/89	8.23	4.15	22.64	12.21	L,L,U,U	1361.25	50.25	1	2	0
MARER	CORDIA SINENSIS	S	30/10/89	21.44	16.42	12.24	25.50	DH,DH,DH,DL	1272.15	212.99	4	2	2
MARER	CORDIA SINENSIS	S	4/11/89	19.73	14.83	13.78	24.23	DH,DH,DH,DL	1272.15	192.37	4	2	2
MARER	CORDIA SINENSIS	S	10/11/89	19.95	15.03	14.27	21.96	DH,DH,DH,DL	1338.15	185.37	4	2	2
MIRACAS	GREWIA TEMBENSIS	S	18/10/89	20.73	15.76	9.00	26.62	H,H,H,L	1295.25	200.74	4	2	2
MIRACAS DRYING	GREWIA TEMBENSIS	S	2/6/89	14.09	9.59	8.77	28.85	H,H,H,L	1184.70	133.52	4	2	2
QALANQAL	CADABA GLANDULOSA	S	19/9/89	15.22	10.64	29.44	14.48	DH,DH,DH,DH	1316.70	133.35	4	2	2
QALANQAL	CADABA GLANDULOSA	● S	19/9/89	16.10	11.46	21.32	17.69	DH,DH,DH,DH	1338.15	141.27	4	2	2
SARMAAN	ACACIA HORRIDA	S	16/6/89	16.32	11.66	7.13	16.79	H,M,U,U	1646.70	116.85	4	2	2
SARMAAN	ACACIA HORRIDA	S	10/11/89	16.46	11.79	10.07	14.86	H,M,U,U	1668.15	116.63	4	2	2
SARMAAN	ACACIA HORRIDA	S	28/10/89	17.41	12.67	8.00	15.07	H,M,U,U	1711.05	122.22	4	2	2
YICIB	CORDEUAXIA EDULIS	S	18/9/89	7.49	3.46	8.06	34.26	DH,DH,DH,DH	988.35	57.75	1	1	0
YICIB	CORDEUAXIA EDULIS	● S	19/9/89	9.23	5.07	6.39	33.90	DH,DH,DH,DH	1031.25	81.15	3	1	1

Table 9 : Fodder quality (contin.)

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	DATE OF COLLECTION	C.-PROTEIN (CP / TS)	DIG. PROT. .929CP-3.5	ASH 600 (ASH / TS)	CRUDEFIBRE (CF / TS)	PAL. INDEX CM,C,S,CT	M-ENERGY Kcal / Kg	DIGPROT*10 / UF/100	QUALITY INDEX	MET-ENERGY INDEX:EMHB	PROT.INDEX EMHB KENYA
BEEYACAD	BOSWELIA RIVAE	T	29/5/89	13.06	8.63	8.92	15.96	H,H,M,U	1668.15	85.39	3	2	2
BEEYACAD DRY	BOSWELIA RIVAE ●	T	29/5/89	3.59	0.00	11.84	16.14	H,H,M,U	1602.15	-1.67	1	2	0
BEEYACAD	BOSWELIA RIVAE	T	19/10/89	16.87	12.18	7.10	16.19	H,H,M,U	1711.05	117.41	4	2	2
BEEYACAD	BOSWELIA RIVAE	T	10/11/89	15.30	10.71	8.84	13.18	H,H,M,U	1689.60	104.63	4	2	2
BEEYAMADOW	BOSWELIA SULCATO STRIATA	T	1/6/89	18.46	13.65	11.94	12.85	H,H,U,U	1623.60	138.71	4	2	2
BEEYAMADOW LIT.	BOSWELIA SULCATO STRIATA ●	T	29/5/89	5.85	1.93	15.17	14.19	?,?,?,?	1557.60	20.48	1	2	0
BILCIL	ACACIA CHEILANTHIFOLIA	T	19/10/89	21.96	16.90	8.97	18.44	M,H,U,U	1580.70	176.45	4	2	2
COMM.LITTER[2]	DIFFERENT COMMIPHORAS ●	T	2/6/89	6.28	2.34	12.16	19.15	?,Y,Y,?	1491.60	25.84	1	2	0
DHEEN	PHYLLOGEITON DISCOLOR	T	19/9/89	10.95	6.67	15.29	16.51	/,/,/,/	1514.70	72.64	3	2	2
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	18/10/89	19.31	14.44	9.67	11.35	H,H,H,U	1651.65	144.22	4	2	2
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	4/11/89	13.49	9.03	10.49	14.94	H,H,H,U	1668.15	89.34	4	2	2
DHUSUNDHUS=LIT[2]	COMMIPHORA ANCISTROPHORA ●	T	10/11/89	5.71	1.80	11.00	18.15	?,Y,Y,?	1557.60	19.12	1	2	0
GABRAR	COMMIPHORA HORRIDA	T	18/10/89	12.85	8.44	9.13	19.27	H,H,M,U	1557.60	89.38	4	2	2
GABRAR	COMMIPHORA HORRIDA	T	29/10/89	13.56	9.09	9.75	13.57	H,H,M,U	1668.15	89.95	4	2	2
GABRAR	COMMIPHORA HORRIDA	T	30/10/89	8.93	4.79	10.48	19.09	H,H,M,U	1557.60	50.79	1	2	1
GABRAR	COMMIPHORA HORRIDA	T	10/11/89	13.33	8.88	10.82	14.49	H,H,M,U	1646.70	89.01	4	2	2
GABRAR LITTER[2]	COMMIPHORA HORRIDA ●	T	10/11/89	4.01	0.23	12.60	20.21	?,Y,Y,?	1448.70	2.57	1	2	0
GABRAR LITTER	COMMIPHORA HORRIDA	T	29/5/89	5.72	1.81	20.18	16.91	?,Y,Y,?	1382.70	21.61	1	2	0
GARRAS	DOBRA GLABRA ●	T	19/9/89	11.92	7.58	19.54	28.42	DH,DH,U,U	899.25	139.02	4	1	2
GUNDUD	COMMIPHORA TRUNCATA	T	19/10/89	14.55	10.02	6.61	19.08	H,H,L,U	1623.60	101.80	4	2	2
GUNDUD	COMMIPHORA TRUNCATA	T	26/10/89	12.25	7.88	5.76	13.90	H,H,L,U	1755.60	74.03	3	2	2
GUNDUD	COMMIPHORA TRUNCATA	T	30/10/89	9.91	5.71	9.04	13.27	H,H,L,U	1689.60	55.72	2	2	1
GUNDUD DRYING	COMMIPHORA TRUNCATA	T	10/11/89	10.23	6.60	8.09	17.63	H,H,L,U	1646.70	60.16	2	2	2
GUNRAY	COMMIPHORA GURREH	T	18/10/89	14.89	10.33	7.77	14.80	H,H,L,U	1711.05	99.63	4	2	2
JIIQ	ACACIA SEYAL VAR.FISTULA	T	15/6/89	10.81	6.54	10.88	13.89	L,L,U,U	1646.70	65.56	2	2	2
KHUURI	CAESALPINA ERIANTHERA	T	18/10/89	19.85	14.94	10.61	14.37	H,H,U,U	1668.15	147.81	4	2	2
KHUURI LITTER[2]=	CAESALPINA ERIANTHERA ●	T	10/11/89	8.00	3.93	13.00	22.79	?,?,?,?	1338.15	48.48	1	2	0
KURA	ACACIA TORTILIS	T	19/10/89	19.80	14.90	8.03	21.31	H,H,L,U	1536.15	159.99	4	2	2
KURA	ACACIA TORTILIS	T	4/11/89	18.98	13.58	9.05	19.59	H,H,L,U	1557.60	143.80	4	2	2
MAYGAG	BOSCIA MINIMIPOLIA ●	T	19/ 9/89	23.37	18.21	9.27	24.96	DH,DH,DH,U	1361.25	220.77	4	2	2
MUQLAY LIT.[2]	BOSWELIA MICROPHYLLA ●	T	10/11/89	3.24	0.49	15.13	9.79	?,Y,Y,?	0.00		0	0	0
SALEEMAC	SESAMOTHAMNUS BUSSEANUS	T	18/10/89	26.55	21.16	10.97	16.69	H,H,U,U	1602.15	217.93	4	2	2
SALEEMAC LITTER	SESAMOTHAMNUS BUSSEANUS ●	T	10/11/89	5.52	1.63	15.84	17.42	?,Y,Y,Y	1448.70	18.54	1	2	0
XAGARCAD	COMMIPHORA ELLISIAEE	T	9/6/89	15.94	11.31	10.02	13.47	H,H,L,U	1668.15	111.84	4	2	2
XAGARCAD LIT.[2]	COMMIPHORA ELLISIAEE	T	29/5/89	3.78	0.01	23.99	20.94	?,Y,Y,?	1118.70	0.17	1	2	0
XAGARCAD LIT.[2]=	COMMIPHORA ELLISIAEE ●	T	10/11/89	4.52	0.70	12.68	22.01	?,Y,Y,?	1361.25	8.47	1	2	0
	[2]: SAMPLE CONTAINED SOME SAND =: CORRECTED VALUES (SAND)							?: NO INFORM. Y: EATEN					

● DRY SEASON VALUE

It is obvious that nearly all fodder resources are of good or excellent quality, if collected as green leaves. All results concerning the dry season situation, with the exception of evergreen species must be rated as poor quality, and a transitional stage seems to be absent. The impression is that the rating index itself is not sufficient differentiated. The cause for that can be seen in the high degree of influence which is attributed to the criteria of protein content in this method.
Looking at a single criteria (net energy or digestible protein) the results are rather different. Concerning the the Net Energy all samples, with the exception of some grasses, but including the samples of litter, received the rating of good or excellent. The percentage of digestible protein shows a wide variation. Nearly all samples of litter have a very low amount.

The quality index, presented in the Range Management Handbook of Kenya (Schwartz et al. in print) treats the contents of energy and protein separately and offers no combined rating. Requirement assumptions are compared at the levels of maintenance and moderate production. The thresholds of production levels per kg of consumed fodder are assumed as 1800 kcal of metabolizable energy for maintenance and 2200 kcal at the level of moderate production. Concerning the protein index

1)) *Net Energy* (NE): this represents about 50% of metabolisable energy (ME); in the case of barley grain, for instance
Gross Energy (GE) = 17.5 MJ/kg DM
Metabolisable Energy = 14.0 MJ/kg DM
Net Energy = 6.9 MJ/kg DM
Net energy is a function of the crude fibre and ash contents; it is computed from Dijkstra's regressions; the values are found in tables (see Boudet et Rivière, 1968; Boudet, 1975; Rivière, 1977; Jarrige et al 1978). These tables are expressed either in Starch Equivalents (SE) or in Feed Units (FU). However, in order to comply with the recommendations of IBP, ICSU and other international scientific bodies, the results are given here in megajoules (MJ) per kg of DM. One MJ = 239 Kcal = 0.145 FU = 0.101 SE;

2) *Digestible protein* (DP): as a function of crude protein, DP has been computed from Demarquilly and Weiss's (1970) regression: DP = 0.929 CP – 3.52 DP is expressed in % of DM.

3) *Nutritional ratio:* this is an index of dietetic value of the forage; it is the quotient of DP (in g per kg of DM, or in %) over NE, expressed in FU/kg DM. (One FU (for ruminants consuming roughage) = 6.9 MJ = 1650 Kcal = 0.7 SE);

4) *Minimum maintenance requirements:* for adult cattle these correspond to a net energy content of 3.10 MJ (0.45 FU) per kg of DM having 2.5% DP, and thus to a ratio of $\frac{25}{0.45} = 55$

The above estimates of animal needs in energy, protein and minerals are based on the assumption of a daily intake of 2.5 kg of DM per 100 kg of liveweight

(Boudet et Rivière, 1968; Boudet, 1975).

the thresholds are 40 and 60 g / kg DM (Table 10.2). The numbers in the last two columns of table 9 are related to these figures. The rating "2" stands for values higher than the threshold level for moderate production , the rating "1" is representative for values which are lying in between the two limits, and "0" is used for contents which are below the level of maintenance. According to these figures, a result, comparable to the single ratings of Boudets system occur. Both enegry and protein contents are, with the exception of some grasses, very high during the rainy season. Consequently there is plenty of fodder of excellent quality available during the rainy seasons.

Of course the more important question deals with the nutritive status in the dry season and especially of leaf litter. The answer is given in greater detail in figures 7.1 and 7.2. in a comparison of the data of the rainy season with the collected samples of leaf litter of the dry season. The four important and most productive evergreen species, Cordeauxia edulis, Boscia minimifolia, Cadaba glandulosa and Dobra glabra are included. The results from other plants, which are available during parts of the dry season only, can be read from the tables.

The evergreen species offer, even at the end of the dry season, fodder of a quality, which is higher than the maintenance level. Concerning leaf litter the energy content after defoliation stays fairly high, while protein content falls drastically. This means, that there is a high nutritive value in litter although the degree of protein is insufficient. Together with a proportion of fresh fodder received from evergreen species, litter can be fermented in the rumen of ruminants (Schwartz 1990: personal information) and has to be treated as a potential of fodder resource during the dry season, even if it is of poor quality in terms of protein. The result that there is only a small difference between the nutritional value of samples of fresh fodder and litter was confirmed by the results in the

Figure 7.1 :

Seasonal supply of metabolizable energy in leaves

A comparison of fresh leaves and litter

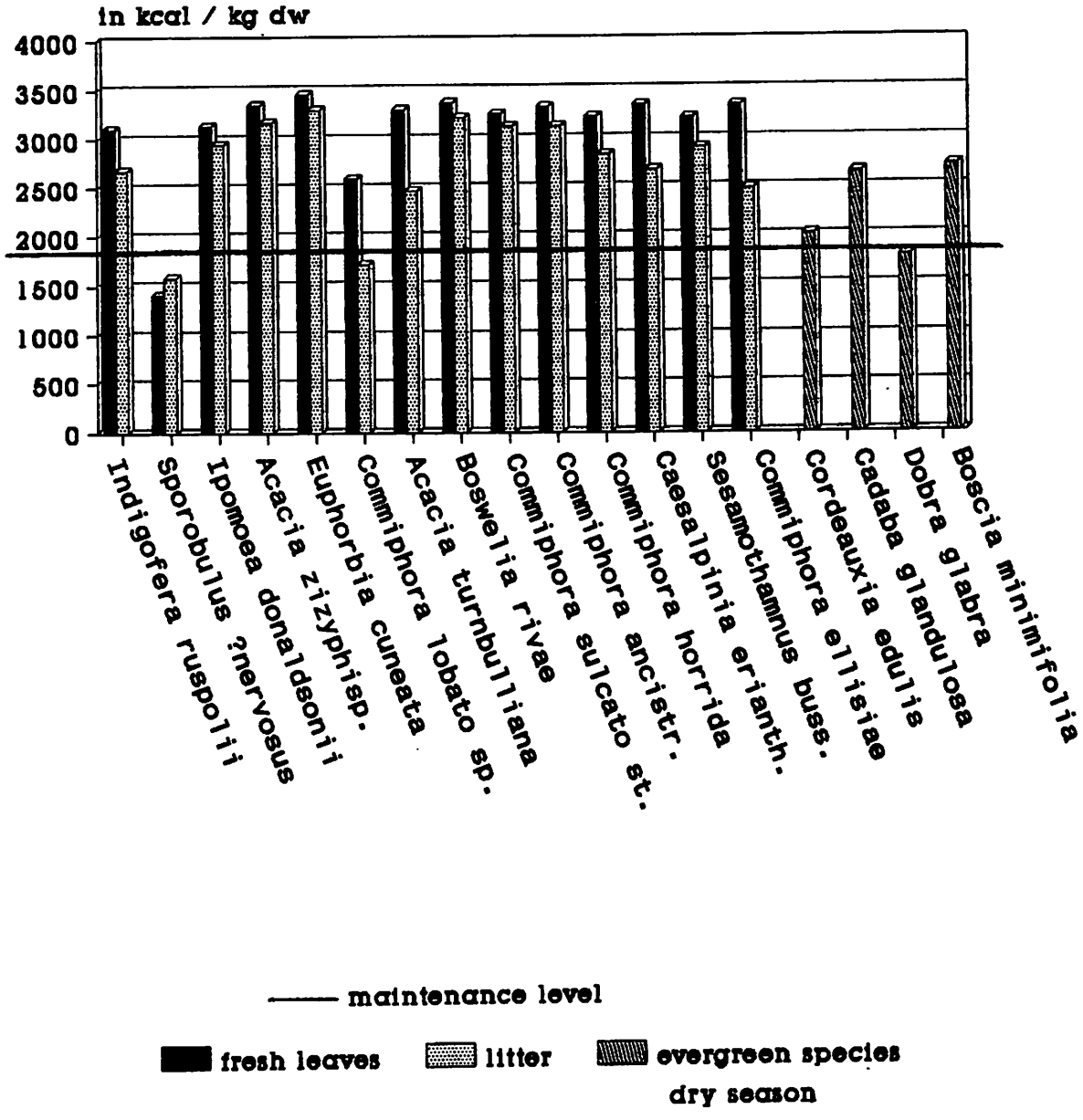
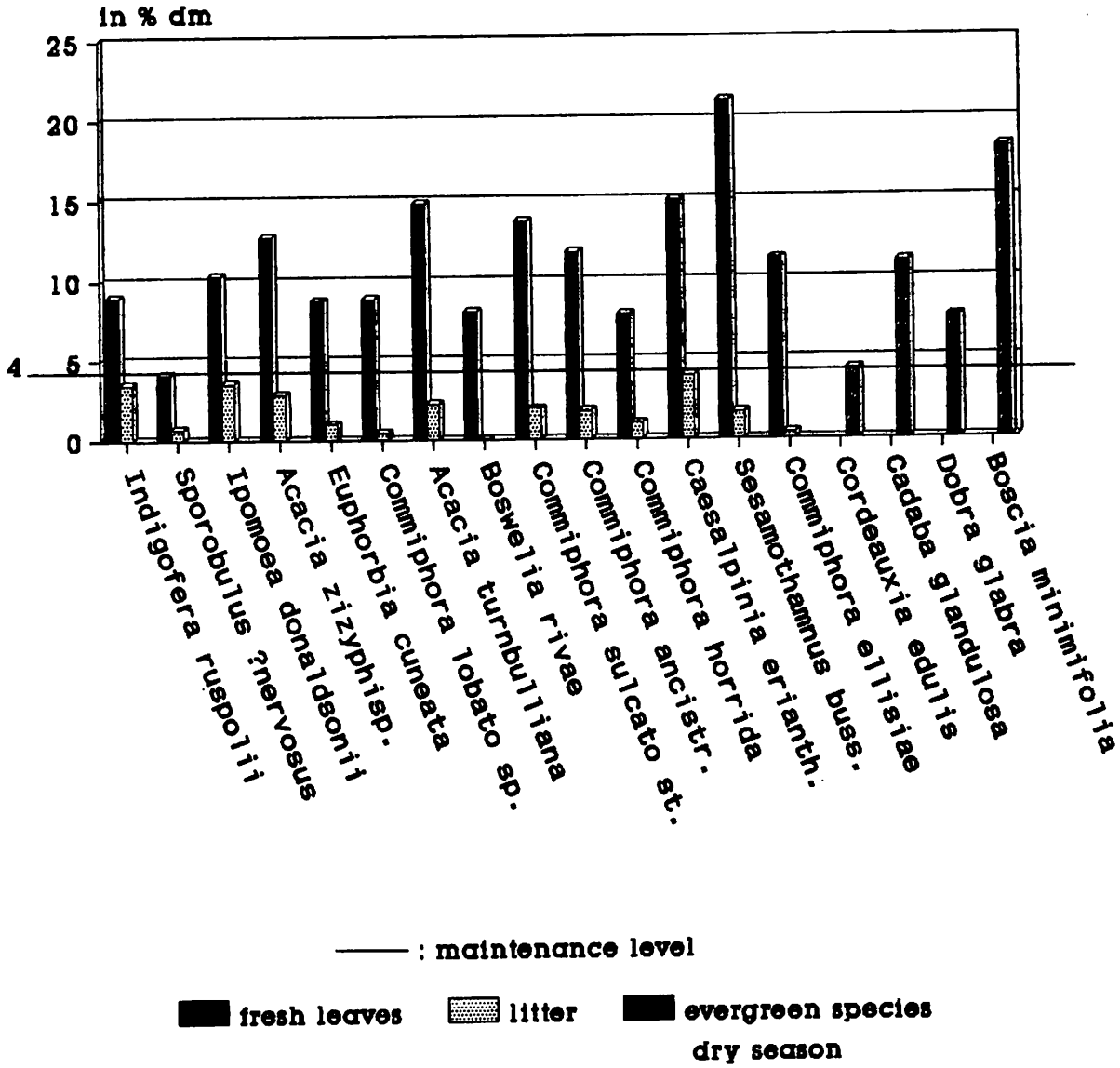


Figure 7.2 :

Seasonal supply of digestible protein in leaves

A comparison of fresh leaves and litter



"Hohenheimer Futterwert Test".[23]

It is supposed that the decline in protein content takes place before defoliation. This idea is based upon the sample of Boswelia rivae, which was collected when the leaves were dry and just before defoliation, but still on the tree. Further it is supposed that the reduction does not continue after the contact to the branches has been cut. It is thought that the fodder quality is preserved by the extremly dry climate, which does not allow organic decomposition of the fallen leaves. Samples of fresh material do not loose their nutritive value either, after they have been cut off and preserved in dry conditions. Nevertheless this issue is not entirely clear. Figure 7.3 presents the nutritive development of the leaves of Commiphora ancistrophora from the beginning of the rainy season until the situation after defoliation. In the illustration the continued development during the dry season is signed with a question mark.

A comparison of the single criterias of leaf structures or fodder quality with the palatability ratings given by the nomads, resulted in the following. In general, there are significant positive correlations of priority ratings to high protein and energy contents and high negative correlations exist to high contents of crude fibre. But there are also plants like Thespesias danis or Melhania ?incana, which do not fit into this scheme. They should provide, if one was to rely upon the criteria of chemical analyses, an ideal fodder, but nevertheless animals avoid them. Of course some more criteria of taste exist, which cannot be interpreted on the basis of analyses in a laboratry. This result once more underlines the necessity of comprehensive field activities, which include personal contact with the people for the purpose of a proper planning of range management.

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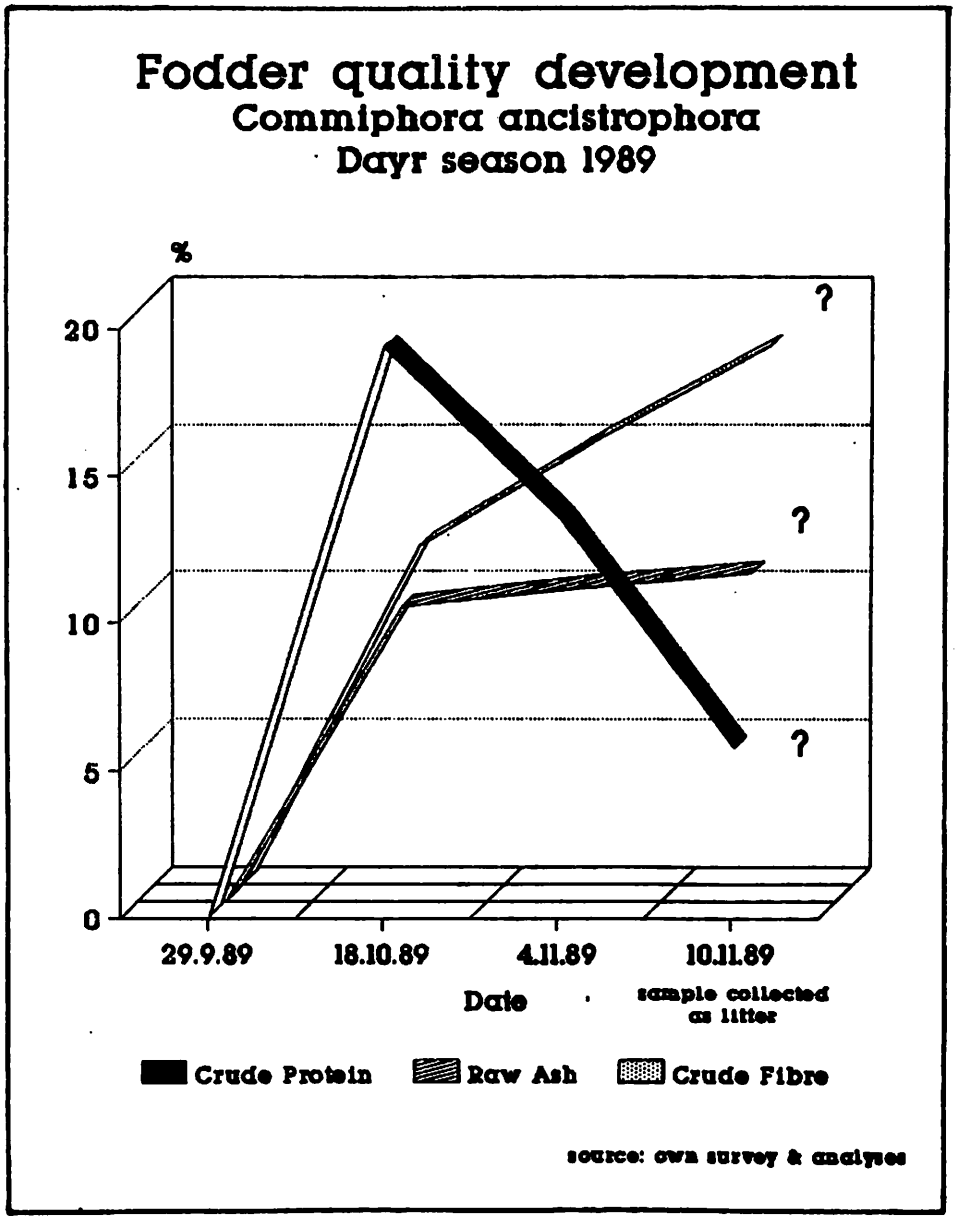
[23] The content of Lignin, an other criteria concerning digestibility, will be additionally tested.

Figure 7.3 :



3.2 The range capacity calculated with regard to fodder quality

The figures obtained by the study on fodder quality were used to calculate the direct correlation of animal requirements with the energy and protein supply of the woody vegetation which is available in the rangelands. It was intended to provide a comparison between different modes of calculation and to search for the limiting factor in fodder supply. For this comparison only those plants were accepted, for which the data set on chemical analyses and range production was available. Table 10.1 shows

the percentage of biomass production, which the plants included (60 species) cover, as compared to the total amount of biomass production.

Range unit	range potential (in kg/ha)	part of range pot. used for chemical analyses (in kg/ha)	part of range pot. used for chemical analyses (in %)
16	1327	1108	83.5
24	1306	1097	84
47	1343	1114	83
44/45	1038	852	82
31	766	597	75

Table 10.1 : The proportion of biomass production deriving from the 60 most common plant species as compared to the total biomass production (in %)

Unpalatable plants[24], which were included in the calculation of the total range potential, were not collected for chemical analyses. This means, that the correlation at the level of fodder capacity, accounts for an even higher percentage, of actual range resources, than the figures above suggest[25].

As an example, range unit 24 (which due to the presence of Cordeauxia edulis is the best range area during the dry season) and range unit 44/45 (the worst range area concerning the dry season) were compared. The results, expressed in absolute numbers and transferred into grazing days per type of animal (TLU), are presented in table 10.2. With regard to the range resources the actual fodder capacity was chosen as the data

[24] The proportion of unpalatable biomass per kind of animal was given in table 7.1

[25] RU 24, rainy season: concerning camel 85 %; goats: 97 %; sheep and cattle: 98 %. The figures on total fodder capacities - = proper use - per RU and type of animal were given in table 7.1 (compare fodder potential per season and animal in tab. 7.1 to the proportion of fodder potential included into tab. 10.3 .)

Table 10.2 The fodder capacity, calculated on the direct ratio between energy and protein supply of the range and animal needs.
(in Kcal and g of digestible protein)

	fodder pot. (included) kg/ha	fodder cap (included) kg/ha	graz. days 6.25kg/TLU	fodder cap kcal ME/ha	graz. days KcalME/TLU moderate prod.	graz. days KcalME/TLU maintenance level	dig. prot. capacity g/ha	graz. days / prt.supply moderate prod.	graz. days / prt.supply maintenance level
RU 2 4									
CAMEL									
rainy season	1013	700	112	1945004	121	177	79060	180	324
dry season	113	34	5	66857	4.1	6.0	1706	3.9	7.0
GOATS									
rainy season	1056	606	97	1600560	100	139	65141	149	254
dry season	141	56	9	73849	4.6	6.4	1884	4.3	7.4
SHEEP									
rainy season	812	475	76	1259556	78	113	50326	106	159
dry season	136	55	8.8	73849	4.6	6.6	1822	3.8	5.8
CATTLE									
rainy season	379	306	49	777356	55	90	32577	85	170
dry season	132	47	7.5	70355	5.0	8.1	1688	4.4	8.8
RU 44/45									
CAMEL									
rainy season	889	652	104	1573515	98	143	70023	160	287
dry season	52	18	2.9	12095	0.8	1.1	729	1.7	3.0
GOAT									
rainy season	915	593	95	1580538	98	137	63498	145	248
dry season	56	22	3.5	15572	1.0	1.4	818	1.9	3.2
SHEEP									
rainy season	545	419	67	1117105	70	100	44621	102	141
dry season	48	21	3.4	15068	0.9	1.4	797	1.7	2.5
CATTLE									
rainy season	445	384	61	1008371	72	117	41070	107	214
dry season	32	16	2.6	11706	0.8	1.4	573	1.5	3.0

rainy season: fodder rated as HP, MP or LP
dry season: dry season available with exception of Acacia tortilis

basis. The basic data concerning animal requirements were taken from Schwartz 1990 and they are appended in table 10.3 .

Before interpretation a preliminary remark concerning the levels of production is neccesary. It seems useful to consider the level of maintenance as the decisive demand for the dry season. The level of moderate production is proposed as the degree of demand, which is applicable for the situation of rainy season.

Tab.10.3 Animal Requirements

Animal requirements were calculated as kg dry matter forage per tropical livestock unit (TLU) per day. One TLU is equivalent to 250 kg live weight. Considering the types and breeds of livestock prevalent in Marsabit District one TLU is equivalent to 1.0 head of cattle, 10 sheep, 11 goats or 0.7 dromedaries.

The requirements were calculated at maintenance level, i. e. with no body weight changes and no other out-puts like milk or work, and based on the assumption that the available forage contains a minimum of 1.8 mcal metabolisable energy and approximately 40 grms digestible protein per kg dry matter, which is a quality commonly found at the beginning of the dry season on semi-arid and arid rangelands in East Africa.

For the calculation of the requirements for maintenance plus a moderate production the following levels of production were assumed:

cattle	300 grms daily gain or 2.5 l milk/day,
sheep	80 grms daily gain,
goats	60 grms daily gain or 0.45 l milk/day,
dromedaries	450 grms daily gain or 4 l milk/day.

To achieve these levels of production the available forage needs to contain a minimum of 2.2 Mcal metabolisable energy and approx. 60 grms digestible protein per kg dry matter. Such qualities are available in the herblayer only during the growing phase of the vegetation. In the shrublayer and in particular in larger bushes and small trees qualities in this range can be available for much longer periods.

Animal requirements [kg dry matter forage/TLU/d]		Maintenance only	Maintenance and production
Cattle	HC	4.8	6.4
Sheep	HS	6.2	7.9
Goats	HG	6.4	7.3
Dromedaries	HD	6.1	7.3

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Results : the standardized value (of 6.25 kg/TLU/d) for animal requirements seems to be valid and useful for a first and rough approximation of range capacity, if applied at the level of fodder capacity. A closer look shows that it is, if compared to the calculation on energy supply, very close to the situation of rainy season and moderate production in both of the range units. In terms of the dry season the results are less homogenous. The standardized value is similar to the supply on energy with regard to range unit 24, but it is too high with regard to the dwarf shrub land of range unit 44/45.

Concerning the supply of proteins, it can be stated that the actual provision during the rainy saeson is much higher than the standardized value suggests. Concerning the calculation of grazing days at the production level of maintenance during the dry season, the two modes of calculation come to similar results. With regards to the demands upon the production potentials postulated, the limiting factor during the dry season seems to be the energy rather than the protein supply when only the fresh fodder is rated as a resource. If the potential of leaf litter is included, the situation will probably change. The results from the study on fodder quality showed that there are high amounts of energy in litter, but only very few digestible proteins.

Further questions dealing with digestibility and the digestive system of ruminants, or with the ability to withstand starvation or malnutrition, or with the ability to built up reserves of fat or proteins in the bodies of animals during the rainy season, have to be answered by specialists on animal production.

3.3 The content of minerals and trace elements

The basic data on mineral contents and trace elements are presented in table 11. The samples were selected in such a way to allow one to make comparisons between the rainy and dry season values. It must be noted that the dry season samples of

Table 11 : Mineral contents

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	Mg in ppm	Cu in ppm	Zn in ppm	Mn in ppm	Ca in ppm	P in ppm
GOGOBO	IPHIONIA ROTUNDIFOLIA	D	5718	9,9	11,6	67,1	15064	1455
GOGOBO DRYING	IPHIONIA ROTUNDIFOLIA	D	4357	16,3	17,3	94,0	17679	2015
JILAB	INDIGOFERA RUSPOLII	D	5182	8,2	13,0	34,7	54627	2283
JILAB LITTER*	INDIGOFERA RUSPOLII	D	2025	12,2	20,0	97,3	23082	2334
KABGAL	TRIUMFETTA HETEROCARPA	D	3982	7,1	65,9	71,9	26205	2357
KABGAL	TRIUMFETTA HETEROCARPA	D	2520	11,0	42,7	36,7	23838	2568
NAGARAWR	INDIGOFERA SPINOSA	D	6438	7,4	15,3	44,3	56090	2594
NAGARDHEEB	PLEUROPTHERANTA REVOILII	D	7410	7,1	16,0	54,1	27100	1693
NAGARDHEEB DRY	PLEUROPTHERANTA REVOILII	D	7412	7,1	15,4	118,2	32110	1622
SARINCAD	SERICOCOMOPSIS PALLIDA	D	7726	8,6	13,6	351,4	45790	1706
SARINCAD DRYING	SERICOCOMOPSIS PALLIDA	D	9040	7,4	11,4	87,6	27519	1751
DHUROD	MELHANIA ?INCANA	F	2251	8,1	22,1	41,6	13957	1988
GOCOSO	CYPERUS ESCULENTUS	G	3253	3,8	14,2	49,5	10189	2812
GOCOSO-LITTER	CYPERUS ESCULENTUS	G	5024	5,0	10,3	28,6	24568	2613
JARBO - FRESH	SPOROBULUS ?NERVOSUS.	G	2159	2,5	4,6	23,7	4069	1634
JARBO DRY SEAS.	SPOROBULUS ?NERVOSUS.	G	2013	3,1	11,5	26,8	5091	1670
BUULALOOD	IPOMEA DONALDSONII	S	4572	11,9	13,5	115,6	15060	1692
BUULALOOD*LIT.^{2}	IPOMEA DONALDSONII	S	4586	5,5	13,2	145,5	20428	1668
CADAADMADOW	ACACIA ZIZYPHISPINA	S	6415	6,1	9,1	44,0	40449	1670
CADAADMADOW*LIT	ACACIA ZIZYPHISPINA	S	4685	10,8	15,8	59,9	23500	1535
DAFURUUR	GREWIA TENAX	S	4074	10,5	14,3	21,1	34602	1435
DAFURUUR	GREWIA TENAX	S	6636	7,4	12,1	56,5	31351	1769
DHIRINDHIR	EUPHORBIA CUNEATA	S	6347	8,6	19,2	102,7	11009	3016
DHIRINDHIR*LIT.	EUPHORBIA CUNEATA	S	4046	11,4	25,1	260,6	14852	1699
DHITI	COMMIPHORA LOBATO-SPATHULATA	S	2830	6,1	16,6	39,7	12844	1244
DHITI LITTER^{2}*	COMMIPHORA LOBATO-SPATHULATA	S	2824	3,1	10,3	56,0	14415	1396
GAHAYR	BLEPHARISPERUM SP.	S	2673	9,0	12,7	47,5	21973	1178
HOHOB	GREWIA PENICILLATA	S	2447	6,9	16,9	31,8	38900	1307
HOHOB	GREWIA PENICILLATA	S	2981	7,4	19,0	34,5	29961	1537
JAFEECO	IPOMEA CITRINA	S	5018	15,0	18,0	159,2	23032	1570

Table 11 : Mineral contents (contin.)

SOMALI PLANT NAME	BOTANICAL PLANT NAME	TYPE of VEGETATION	Mg in ppm	Cu in ppm	Zn in ppm	Mn in ppm	Ca in ppm	P in ppm
JEERIN	ACACIA EDGEWORTHII	S	5488	4,8	11,3	37,4	21780	1574
JEERIN	ACACIA EDGEWORTHII	S	5108	3,8	11,2	32,9	23030	1570
JIRAQ	ACACIA TURNBULLIANA	S	3678	5,3	15,1	46,0	10859	1894
JIRAQ LITTER*	ACACIA TURNBULLIANA	S	2593	17,3	56,1	260,6	11660	2844
KABXAN	THESPESIAS DANIS ■	S	14131	2,0	7,9	36,5	19844	1938
MARER	CORDIA SINENSIS	S	3394	12,0	25,4	45,7	30225	2273
MIRACAS	GREWIA TEMBENSIS	S	3562	11,4	18,5	42,6	23793	2277
MIRACAS DRYING	GREWIA TEMBENSIS	S	3369	9,2	15,1	50,0	34090	2168
QALANQAL	CADABA GLANDULOSA ■	S	25927	2,3	10,6	43,0	11537	848
SARMAAN	ACACIA HORRIDA	S	3777	4,2	11,9	44,6	26879	1448
SARMAAN	ACACIA HORRIDA	S	3899	6,1	14,2	29,9	24284	1617
YICIB	CORDEUAXIA EDULIS	S	1845	6,8	56,4	46,1	15851	1498
BEEYACAD DRY	BOSWELIA RIVAE	T	4553	4,1	10,3	29,8	17378	1100
BEEYACAD	BOSWELIA RIVAE	T	3471	10,1	19,3	56,8	11051	2316
BEEYAMADOW	BOSWELIA SULCATO STRIATA	T	4538	5,3	11,4	29,4	32133	1947
BEEYAMADOW LIT.	BOSWELIA SULCATO STRIATA	T	6258	4,5	7,1	19,4	34185	991
COMM.LITTER[2]	DIFFERENT COMMIPHORAS	T	4911	4,4	10,1	59,2	20360	753
DHUSUNDHUS	COMMIPHORA ANCISTROPHORA	T	5492	7,9	13,7	41,2	22870	1741
DHUSUNDHUS*LIT[2]	COMMIPHORA ANCISTROPHORA	T	4327	4,1	7,7	57,5	20662	1245
GABRAR	COMMIPHORA HORRIDA	T	5642	4,9	12,5	31,7	19223	1684
GABRAR LITTER	COMMIPHORA HORRIDA	T	10033	4,5	11,6	46,3	34576	1218
GARRAS	DOBRA GLABRA	T	11021	2,1	20,0	122,5	14845	796
GUNDUD	COMMIPHORA TRUNCATA	T	2816	5,8	14,4	36,2	14901	1875
KHUURI	CAESALPINA ERIANTHERA	T	3459	7,4	27,8	43,5	26251	1750
KHUURI LITTER[2]*	CAESALPINA ERIANTHERA	T	2579	12,0	25,4	123,7	24524	1906
KURA	ACACIA TORTILIS	T	4159	5,2	13,9	44,9	27568	2689
MAYGAG	BOSCIA MINIMIFOLIA	T	9388	16,2	25,8	165,7	15809	999
SALEEMAC LITTER	SESAMOTHAMNUS BUSSEANUS	T	4347	4,8	9,9	118,1	30114	896
XAGARCAD	COMMIPHORA ELLISIAE	T	6851	4,7	11,3	51,4	30502	1598
XAGARCAD LIT.[2]*	COMMIPHORA ELLISIAE	T	5580	6,5	17,2	60,0	16806	1153

■ : RIVERINE AREA

Figure 8.1 : Magnesium content in fodder plants and its seasonal variations

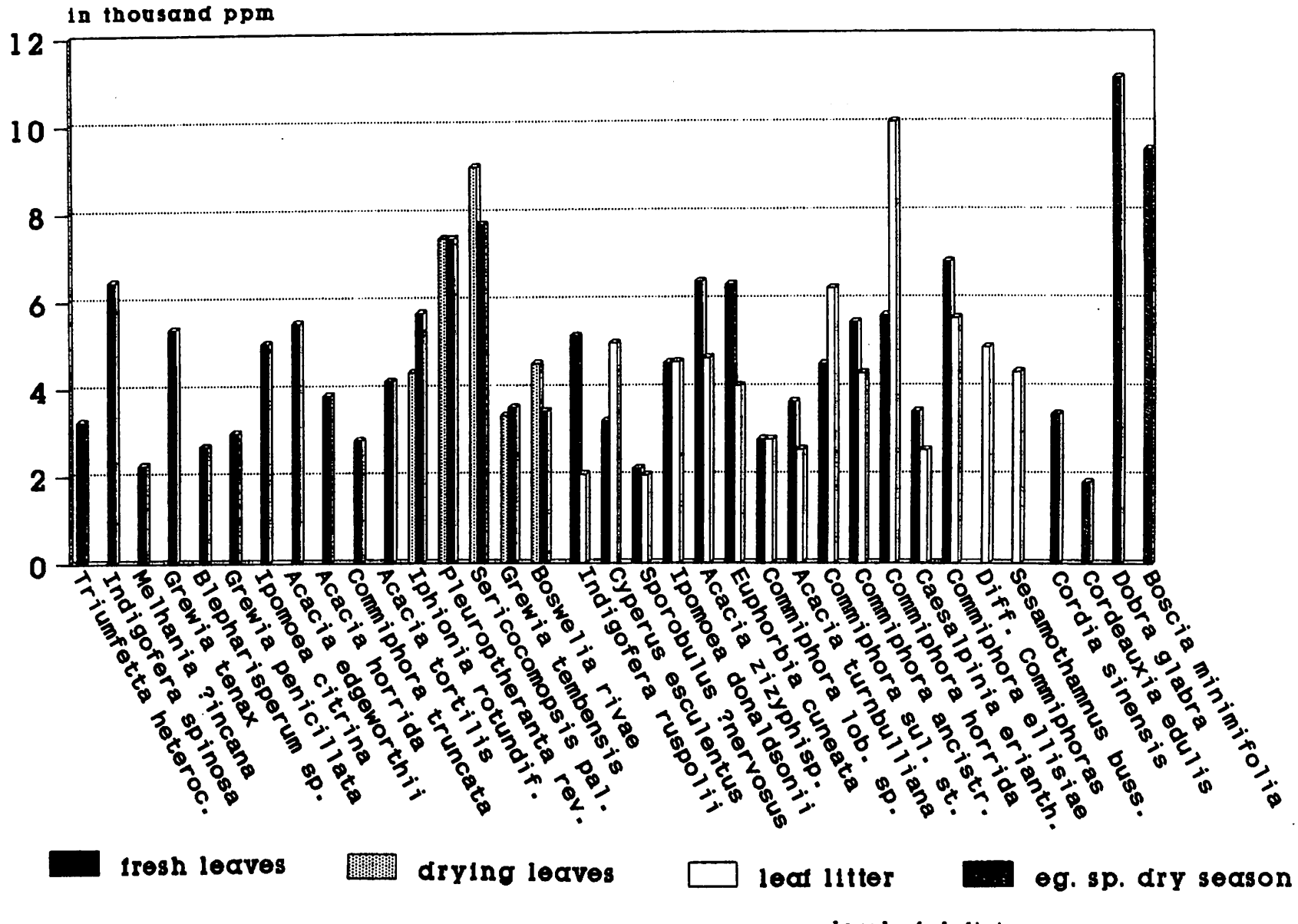
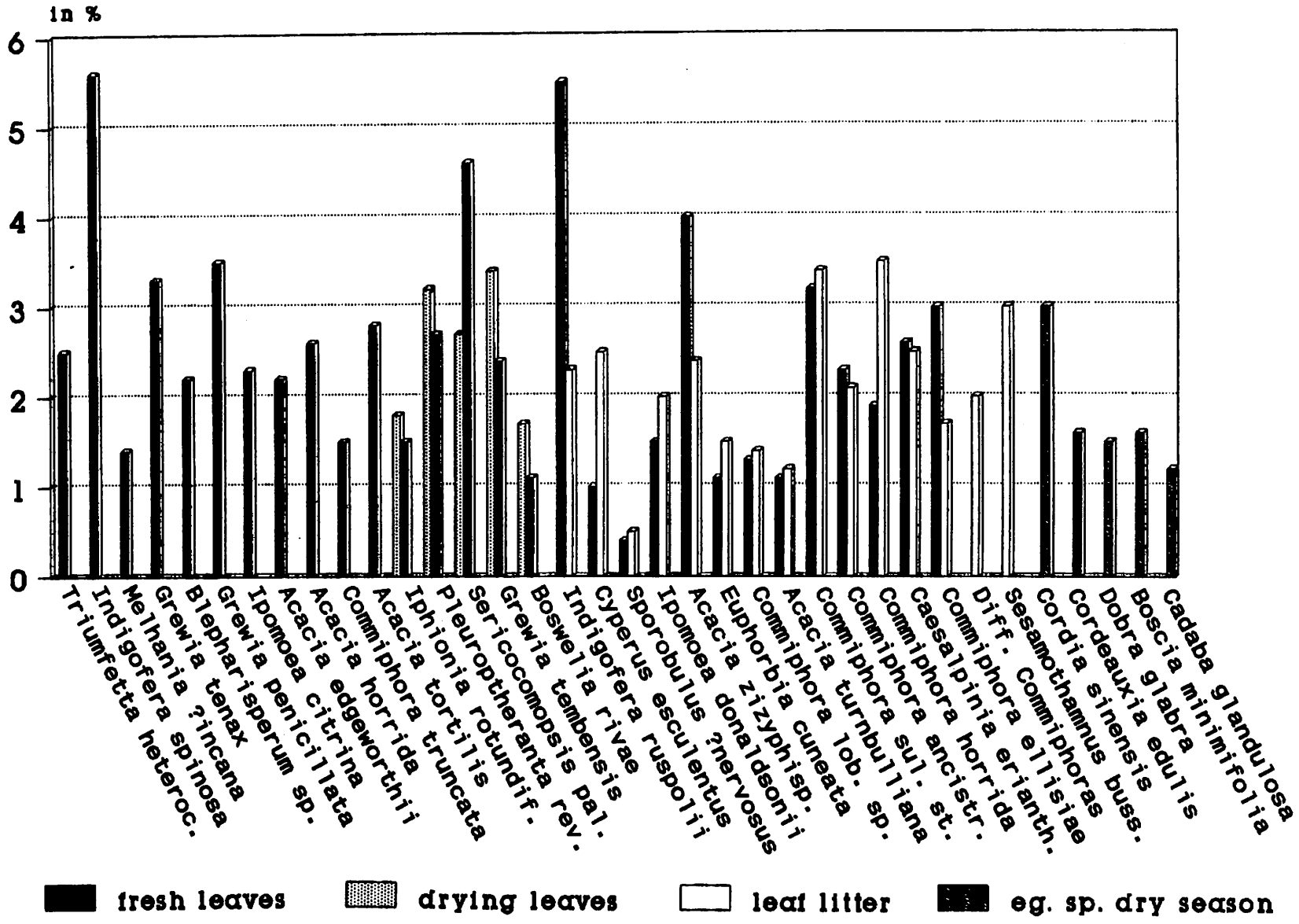
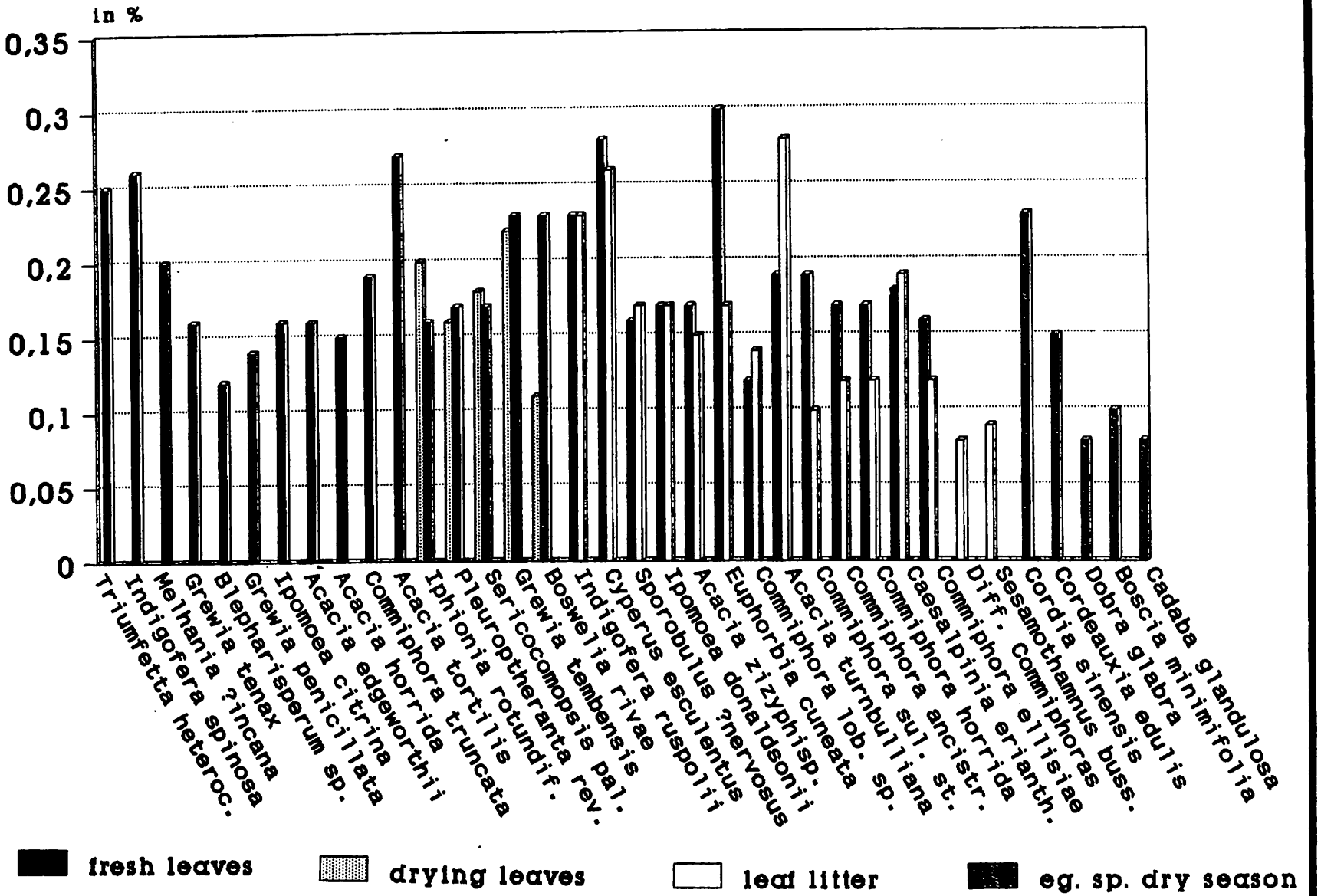


Figure 8.2 : Calcium content in fodder plants
and its seasonal variations



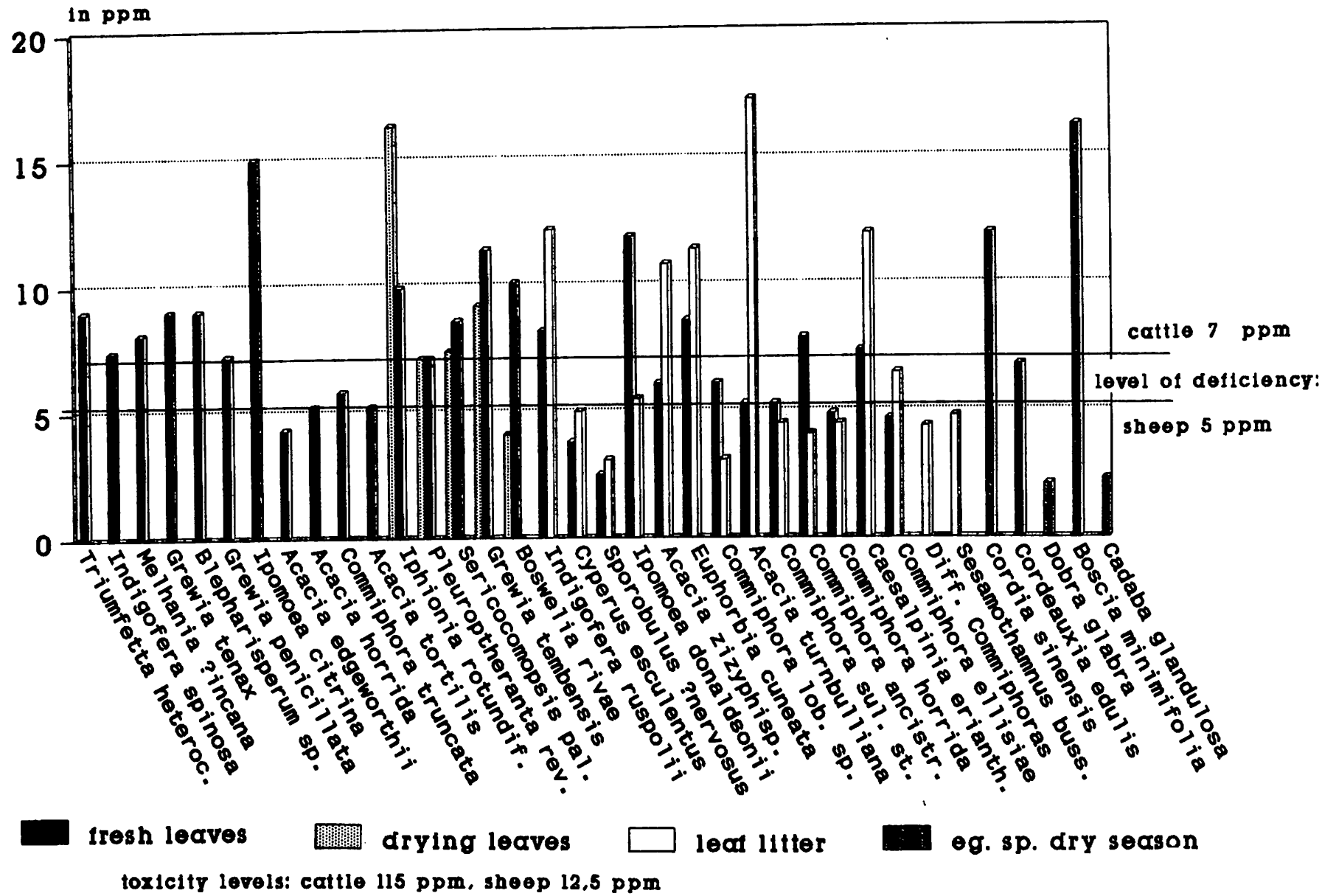
level of deficiency: Boudet: 0,2 % ; McDowell: 0,3 %

Fig. 8.3 **Phosphorus content in fodder plants and its seasonal variations**



level of deficiency: Boudet: 0,12 %; Mcdowell: 0,25 %

Figure 8.4 : Copper content in fodder plants and its seasonal variations



toxicity levels: cattle 115 ppm, sheep 12,5 ppm

Fig. 8.5

Manganese content in fodder plants and its seasonal variations

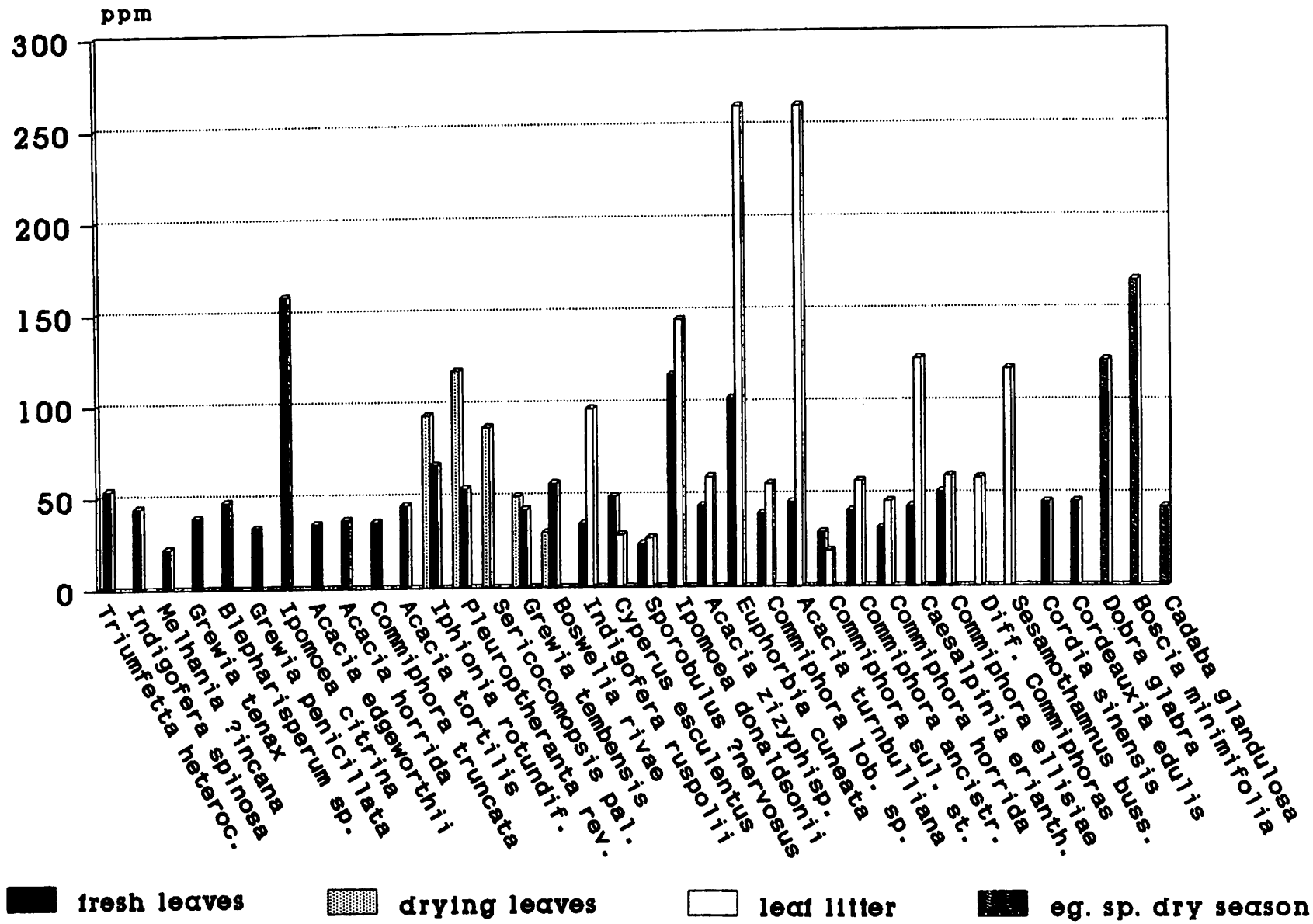


Figure 8.6 : **Zinc content in fodder plants and its seasonal variations**

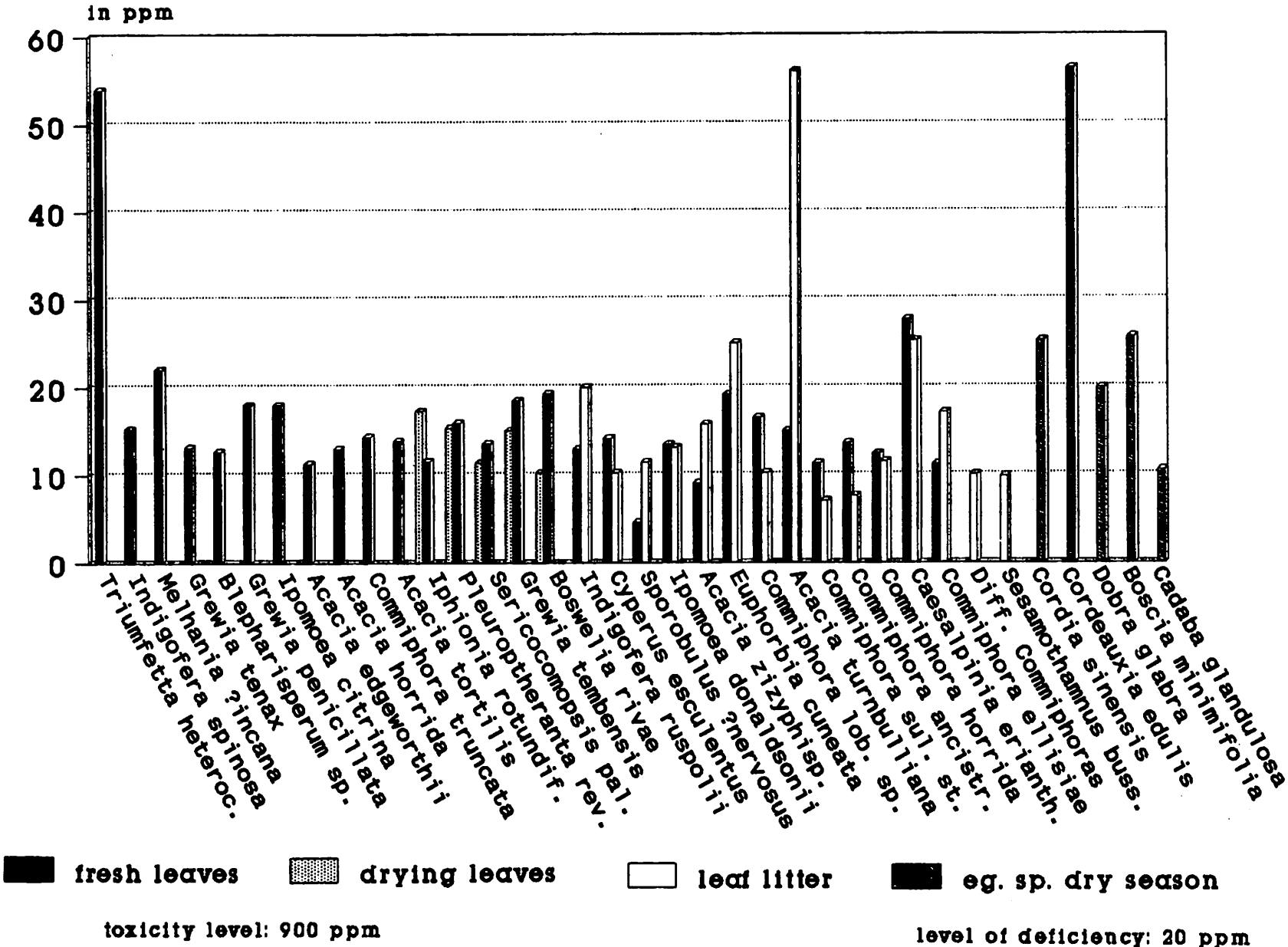
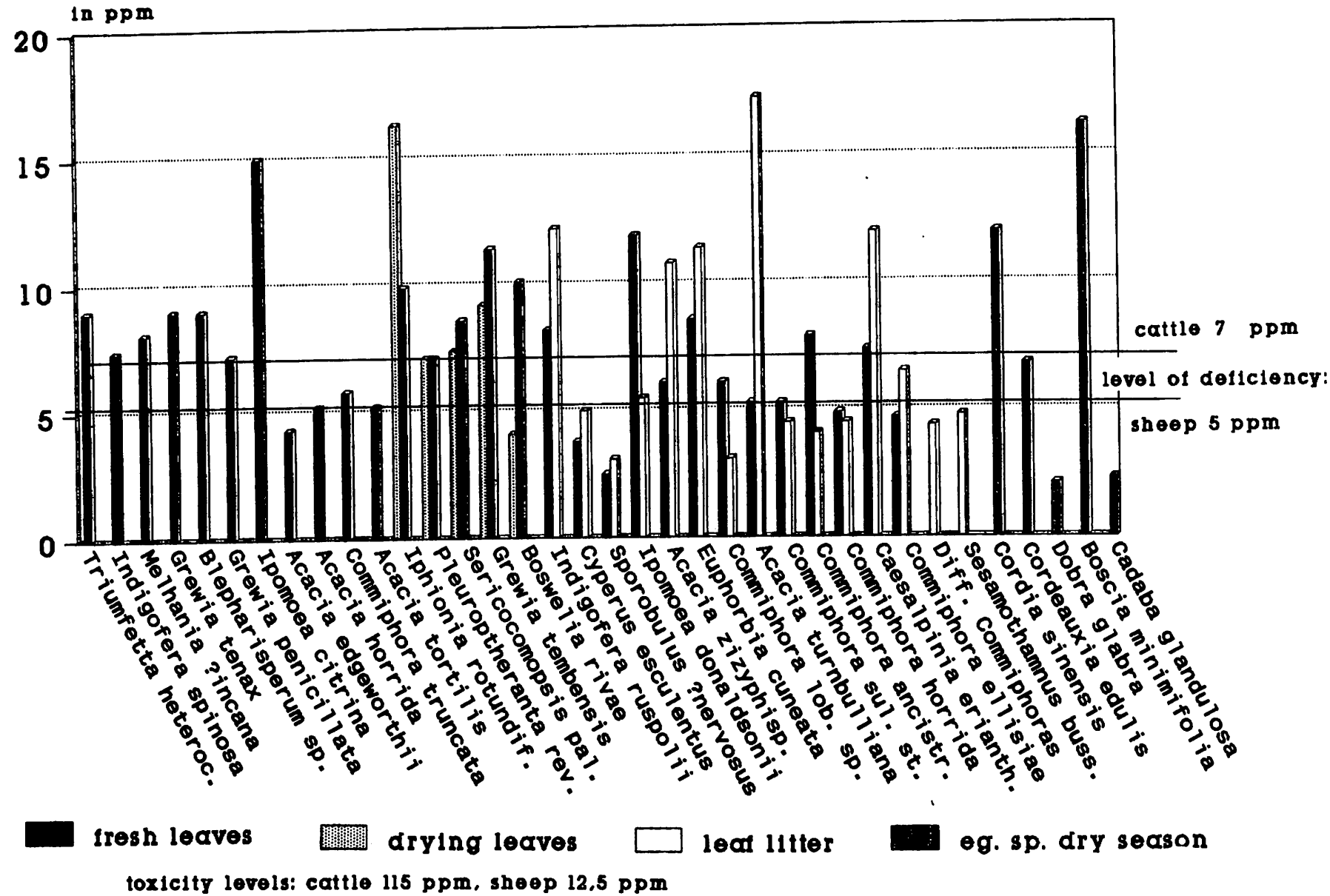


Figure 8.4 : Copper content in fodder plants and its seasonal variations



toxicity levels: cattle 115 ppm, sheep 12,5 ppm

litter included some sand, which of cource influenced the results. Nevertheless this reflects the conditions under which the animals feed. The interest was to check the minerals and trace elements in terms of animal needs and levels of toxicity.

Figures 8.1 - 8.6 illustrate the issues. The levels of need and the levels of toxicity have been are included when available. Deficienies were found for zinc while for phosphorus deficiencies were found only when the level of requirement, given by McDowell (1986), were used. The levels of calcium were found to be fairly high.

The values found in Commiphora species were generally low for all the elements concerned. It is supposed that these low values are influenced by the vegetation period, which is in case of Commiphoras, extremly short.

Levels of toxicity and deficiency which were so extreme that they would require a reduction in the biomass calculation, were not found.

III. DISCUSSION AND RECOMMENDATIONS FOR RANGE MANAGEMENT PLANNING

Range capacity: The calculated fodder capacity (without the consideration of litter), presented camels and goats with a higher use potential in bushland areas than the figures of Pratt & Gwynne (1978)[26], and Le Houerou & Hoste (1977)[27] suggested for comparable regions.

Besides the dominating influence of rainfall on the biomass production, the percentage of plant cover was found to be an important factor determining the range potential, irrespective of the various layers of woody vegetation (table 4.7). The issue of rising importance is, whether it is useful to correlate the range potential with the criteria of rainfall only, when the biomass production of bush and shrub lands is estimated. A year of enormous rainfall can not produce the potential amount of biomass if there is no root system developed which can adequately absorb the rain during the short periods of supply and convert the water into biomass before it is lost through evaporation. The largest root system seemed to be developed by woody vegetation. The quickly germinating annual herbs and grasses could not at all in terms of biomass production, reach the same levels of effectivness as the woody vegetation. Only when the "infrastructure" for biomass production (an underground root system and an above branch system, which is equivalent to the coverage) already exists, can the water supply be transferred adequately into leaf biomass ("coverage" is of course the value, which can be more easily measured than the root system).

Mäckel, Hagmann and Parlow (1991) suggest that dependant upon the different types of soil only that part of rainfall which is after soil infiltration available for absorption by plants, has to be considered. In this context of applied range management activity it is stated that the criteria of plant coverage seems

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[26] 42 ha / TLU in the eco-climatic zone VI

[27] 16,7 ha / TLU / year when the rainfall is around 100 mm

to be easier to discover and that it already reflects the degree of water absorption through the plants.

Range unit 31 can be used as example for this issue. Although this bushland area received the same amount of rain as the other range units, the biomass production was only around 60 % of those amounts found in the other bushland areas. The coverage of vegetation was around 50% below the values of the other regions. Therefore it is doubtful whether a calculation of biomass production in arid regions based only upon the total rainfall is sufficient. The result of this study is, that the criteria of plant coverage should be added to the criteria of rainfall for the generation of accurate statements concerning potential biomass production (Wijngaarden 1985).

It was found that the 60 most common and palatable plant species were representative for 85 - 95 % of the total fodder capacity for all kinds of the animals studied. These figures justify - with regard to expenditure of work - the recommendation, that studies on fodder production of rangelands can be focussed upon the most important and palatable plant species. In addition, the proportion of unpalatable plant species should be considered as a significant indicator for the condition of the range. Special concern to the range condition is needed in the case, that unpalatable plant species account for some of the important species.

Range condition: Although the aspect of land degradation was not a topic of this report (page 2) some basic results shall be included here, which deal with the continuity of those range resources found in 1989[28].

The deciduous woody vegetation cover showed, with exception of the definitively overused area of RU 31, only few signs of deterioration and seemed to be protected from severe degradation, because the dry season capacity was limiting the livestock

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[28] A more detailled discussion about this, for future development planning, important aspect of range management will be presented at an other opportunity.

densities. To some extent the dwarf shrub areas seemed to be threatened. The nomads prefer these areas as range, as it is easier for them to move about than it is in the thorny bushland. Nevertheless the dwarf shrub vegetation as well as the vast majority of bushes and trees is protected from prolonged overuse through defoliation at the end of the rainy season. After that time the animals loose - under "normal circumstances"[29] - interest in the woody remains. These findings were not valid for the grass layer and is not for areas within a radius of 1 - 3 km around locations with permanent water supply. In these areas, which made up less than three percent of the total area in 1989 (but they tend to increase), clear signs of degradation were evident.

The evergreen plants as the favorite dry season fodder were found to be heavily browsed and severely threatened (Herlocker 1986, Kuchar 1989). In this context the mobility of the nomads is the most important factor for range preservation. It is up to them to move at the right time.

With regard to the responsible institutions dealing with range management it is an important task to support the economy of mobility, because it is the only way to use the resources adequately in the long run without the neccessitiy of immense financial investments. As supporting measure, the reestablishment of evergreen fodder plants and the establishment of protection areas for evergreen species should have priority.

Palatability of plants and the proportion of proper use: The interviews with the nomads offered a very helpful data basis from which to identify the proportion of usable fodder plants of total range potential per type of animal. This in addition to the study on the "proportion of proper use", gave a very detailed picture about the different grades of adaptation of the animals to the range. It was shown that the palatability of the

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[29] in a situation of drought they will also feed on the - in case of dwarf shrubs - thin twigs.

different range plants limited the proper use of the area for camels and goats. Sheep were moderately adapted while cattle were not suitable for the region. These findings were highly correlated to the practice of animal breeding in the nomadic management system: camels are the most favoured animals, although not too high in numbers, because of their high demand in labour force and their slow rate of reproduction. Goats are the most common animals, sheep are included in every herd and cattle are very rare (Nauheimer, 1990). The keeping of sheep, which are only moderately adapted to the fodder supply but which can survive, reflects the constraints placed upon the nomadic economy by the environmental conditions. The diversification of the herd is rated more important than the perfect adaptation of the animals to the thornbush areas.

For future developmental planning, the afore mentioned qualitative aspects of range utilization should be taken into account. The attraction of an increasing market economy has to be weighed against the risk of land degradation. Today the system of production is more or less balanced, but it is already being used at close to its maximum intensity and so is highly vulnerable. It is for that reason that it should not be submitted to the uncontrolled and continuedly changing market interests which follow from an increasing demand for cattle milk and meat.

Litter: The role and the proportion of leaf litter in animals consumption could not be finally clarified. Nevertheless some important results were achieved which underline the urgent demand for futher research on this topic (Kuchar 1987).

Either alone or in combination with the consumable evergreen plants, litter is a component of the dry season nutrition, especially for goats and sheep. Huge amounts of litter are available - and at least partly consumed - during the dry season. The results from the study on nutrition confirmed the role of leaf litter as a supplier of energy, although its protein values were extremely low. The consumption of litter may fill the huge gap

in nutrition during the dry season, which was often discussed. It might explain the fact that many animals resist much longer against drought than the observers expected. Again one can only repeat that there is an urgent demand for further research in this field.

Fodder quality study: For a detailed determination of range capacity, which takes both seasonal and spatial variations into account, the direct comparision between supply and the requirements of energy and proteins, provides for greater precision in proper range management planning, than the use of standard values. This was the most obvious in those samples representative of the dry season. A fixed calculation factor for quality reduction will give a rough appoximation (Mäckel et al. 1989), but it cannot consider the differences that rise from the varying components of quality.

From the point of view of expenditure of work, it seems legitimate to recommend a concentration upon chemical nutrition analyses for the dry season supply of fodder only. While there is plenty of good quality fodder available during the rainy season, the situation of the dry season represents the time of shortage. In this situation a proper range management and exact knowlege about the availabe resources is most urgent required (FAO 1987).

In terms of the minerals and trace elements, those tendencies discovered by Elmi (1989) and Drechsel (1988) were confirmed. As a solution to fight deficiencies in these elements (or even in energy) it is proposed that salt/mineral licks should be used. In the nomadic economy it is the normal situation that the animals receive special quotas of salt and it should not be too difficult to include other deficient elements into this already existing custom.

The modes of calculation and data collection: At this point in the discussion, one should remember that the concept of the calculation of range capacity in terms of TLU only, was questioned at the beginning of this report. Now it can be stated that the quantitative analyses of range resources in terms of TLU without a consideration of the degree of adaptation of the different types of livestock to the environments, might lead to incorrect appraisals concerning range productivity. The differences in the degrees of adaptation between camels and cattle were, for example, in Range Unit 16, higher than 500 % . When calculating grazing days based on the correlation between range resources and a standard factor of needs for one TLU, irrespective of the kind of animal, mistakes are preprogrammed. The only way to reach an acceptable approximation of range productivity, based upon the standardized values (6.25kg / TLU) was found to be at the level of fodder capacity per individual type of animal (Table 10.2).

The modes of data collection and calculation which are proposed in this report, provide a concept, which gives a very detailed information on range capacity and which is an attempt to model as closely as possible reality. This degree of accuracy which considers spatial as well as seasonal variations in the range, can neither be reached when standard values are taken nor in the case that only data derived from satellite is available or used.

Range management planning. During the last decades a development took place in Afrika, which resulted in the decrease of rangeland areas and in the increase of use intensities per area. Severe ecological damage in several regions of Africa was the consequence and most of the programmes, which tried to stop the process of desertification failed. One reason for that is seen in the lack of exact knowledge about the natural resources and their potentials of use. Adequate studies on natural compatibi-

lity have to be implemented before starting any measures or projects[30]. The first demand upon the compatibility studies is that they have to be carried out at a scale, which fits into the scale of the planned projects. It is urgently necessary to think about the sense of using large scale surveys as data basis for activities, which concern with the situations at regional or even local scales. It shall be stated here that such an approach is nothing more than a luxury, which is not adequate to the nowadays alarming stage of land degradation.

One example which fits into this discussion was introduced. The FEWSD (1988) used and illustrated especially for Somalia the equations to calculate annual biomass production, presented by FAO/de Witt (1984) and Deshmukh (1984) (Map 4 and Appendix 1). This application is rated to be not suitable for the regions of Central Somalia. The climatological data both equations have to be based upon is insufficient (FEWSD 1988b). The equation offered by Deshmukh was established for the concern of grasslands not for bushlands and shrublands, as they are predominant in the Central Regions. With regard to the results it can be stated, that the potentials for above biomass production established on the basis of Fao/deWitt are absolutely unrealistic. The potentials calculated on the basis of Deshmukhs equation might be valid for the coastal grassland plain. They were not prooved as these regions were out of the study areas.

The use of the aforementioned formulas, is interpreted as an indicator for the lack of sufficient data. At the actual stage of land degradation it is urgently necesary to collect a larger data basis on a regional scale (FAO 1987), which can serve as starting point for detailed range management planning. To gain this aim, projects should be carried out as comprehensive field activities including experts from different disciplines. Both technical means and traditional knowledge from the target groups should be considered basic for a constructive development.

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[30] One example for such a failure at the stage of beginning is the veterinary project in Belled Weyn!

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APPENDIX 1

R U 2 4

Plant-species	14	29	41	42	43	115	110	48	74	11	25	27	28	29	30	31	36	37	35	33	32	34	116	21	23	24	26	113	117	37	38	75	76
HAJIIN	-			10				10									10													1			
DHURODSIMILAR																					15												
DHARGO																						13								3			
SARIN												20																					
NAGAR																					1												
JIICMADOW																			•														
DIIQLAY																									1						1		
DABAKAR																																	
AFGUB																																	
XABOW																	20				10												
KABCALSIMILAR												1					•																
JINOW																								•									
GARRAS														•												•					1		
DULWEYN																				5	10												
CANYO																					5									5			
BALAMBAL																																	
ARGEG																																	
SABINCAD2																																	
HUMASAN																																	
RIYOXIR									35																								
LAMALOOJI																																	
DUGGURON																						1								•		2	
XODAY																																	
GANSOLE																																	
HALHAL																																	
HADAXBUSHI																																	
CRUGUNBAY																										1							
GER																																	
GEEDGABOY										1							1																
DHIGTAR																																	
DHEGAYAR																																	
DARANDOWOCO																																	
DABLEF																												15					
XAYEY										•																				•	1	1	
XAMUR																																	
RAYDAB																																	
GUDDE/JABSI																									1						•		
MISABAJABIS																																	
MANDHERAQUBE																																	
JOWDHER																																	
JIICTIF																													1				
JALEELOWEYNE																											6	5					
GEELREB																																	
GEEDKURRUS																																	
DS??SALT2																																	
DS??SALT1																																	
DOGBOGOY																	5																
DHEEBYAXAAS																																	
DARANBIYOOD																																	
XERKOOD																																	
XAJIINDALUG																																	
XAGAR																																	
XABNOCAS																																	
YNSAAB																																	
SALT??										4																							
GUNLESIRIG											12																						
GWADHAYE																																	
LEBIYARO																																	
LERI								1																									
KOBOSH																																	
KIDI																																	
JAJABOOD																																	
IBOLARDOR																																	
HIGLO																								25									
HAJIINCAD																																	
GULAN																																	
GEEDHARAQ																																	
GEEDGABAL																			15														

Plant-species	77	71	58	8	17	48	15	47	18	73	63	54	52	35	78	80	82	111	81	20	45	46	73	11	12	9	16	47	10	18	13
HAJIIN	5			1																											
DHURODSIMILAR		15																													
DHARGO			25	5																				1					5	10	•
SARIN																												2			
NAGAR																					10				20			10			
JIICMADOW					1		1				•											1									
DIIQLAY				1						•																			1		
DABAKAR																					2							1			
AFGUB				1																					1				•	2	
XABOW																															
KABCALSIMILAR									5																						
JINOW										1																					
GARRAS																												4			
DULWEYN					1		•								1		•		•				1							•	
CANYO																															
BALAMBAL																					5	5									
ARGEG						5			1		5	10						1		5											
SANICAD2									5	10								5					5							•	
RUMASAN																															
RIYOXIR		5																													
RAMALOOJI															1				1				•								
QUQQURON			25																												
XODAY									1																						
QANSOLE																															
QALMAL																															
QADAXBUSHI													1																		
RUGUNBAY																										1			•	•	
.R																															
REEDGAROY																															
.IGTAR																									8						
DHEGAYAR													1		1																
DARANDOWOCO																															
DABLEF																															
XAYEY																											1				
XAMUR																															
RAYDAB																								1	2						
QUDDE/JABSI					1																										
MISARAJABIS							1																								
MANDHERAQUBE																				1										1	
JOWDHER										1																					
JIICTIF																															
JALEELOWEYNE																									12			12			
GEELREB																															
GEEDKURRUS																															
DS??SALT2																															
DS??SALT1																															
DOOBOGOY																															
DHEEBYAXAAS																					•	1					1				
DARANBIYOOD																															
XERKOOD																															
XAJIINDALUG																															
XAGAR	1																														
XABNOCAS																															
NSAAB																													20		
QALT??																															
QUNLESIRIQ																															
JWADHAYE																															
LEBIYARO																															
LEBI																															
KOBOSH													2																		
KIDI																															
JAJABOOD																															
IBOLAROOR																															
HIGLO												1																			
HAJIINCAD																															
GULAN																															
GEEDHARAQ																															
GEEDGABAL																															
GUULAAYOOD	1																	•													
DABIB													1	2							•										
CADAHOOD														6																	
CIIN																													2		
CARHO																															
DARAN																															
BURBUR																															
GADUURDEGAWEYNE																															
SHILLAN																															
BOCADHAAYE																															
DARJO																									5						

55-A

Plant-species	63	89	62	100	70	72	69	67	102	108	104	89	66
XAJIIN			5										
DHURODSIMILAR								5			5		
DHARGOADOW													
SARIN													
NAGAR													
JIICMADOW													1
DIIQLAY						1			1	•	3		
DABAKAR									1		1		
APGUB													
KABGALSIMILAR													
JINOW													
GARRAS													1
DULWEYN													
CANYO													
BALAMBAL													
ARGEG													
SARINCAD2													
RUMASAN										13	9		
RIYOXIR													
LAMALOODJI													
DUGGURON													
XODAY													
QANSOLE													
HALMAL													
MADAXBUSHI													
RUGUNBAY													
...ER													
EDGABOY											1		
DHIGTAR										1			
DHEGAYAR													
DARANDOWOCO													
DABLEF													10
XAYEY													
XAMUR													
HAYDAB													
QUDDE/JABSI													
MISARAJABIS													
HANDHERAQUBE													
JOWDHER													
JIICTIF													
JALEELOWEYNE													
GEELSEB													
GEEDKURRUS		40									5		
DS??SALT2													
DS??SALT1													
DOOBOGOY													
DHEEBYAXAAS													
DARANBIYOOD													
XERQOOD			5										
XAJIINDALUG													
XAGAR													
...WOCAS													
...NSAB													
...LT??													
...UNLESIRIQ													
QWRADHAYE													
LEBIYARO									15				
LEBI													
KOBOSH													
KIDI													
JACJACBOOD													
IBOLAROOR								10					
HIGLO													
XAJIINCAD													
GULAN													
GEEDHARAQ													
GEEDGABAL													
BUULAAYOOD													
DABIB													
CADAWOOD													
CIIN													
CARMO													
DARAN													
BURBUR													
CADUURDEGAWEYNE													
SHILLAN													
BOGADHAAYE													
DARJO													

RU 47 RU 31 RU 44 55-6

Plant-species	13	14	45	50	106	57	51	103	60	108	107	101	88	89	87	105	83	56	53	91	80	66	69	68	96	98	65	85	35	94	97	61
FARADOWOCO																																
SAALOWEYNE																																
BEEYACAD																																
ANEXO																																
GABO																																
DABAXAYR																																
KHUURI																																
DHUMOOD		2																					1									
HAJIIN																																
DHURODSIMILAR										5															10				55			
DHARQO							15														5											
SARIN			6						1																							
NAGAR	5		40																													
JIICHADOW						1																										
DIIQLAY				2																												
DABAKAR			1																													
AFGUB			1							1																						
KABCALSIMILAR								5																				30				
JINOW											2			1						1												
GARRAS		2						1										1														
DULWEYN																				1												
CANYO												10									5				70				30			
BALAMBAL																																
ARGEG												5																				
SARINCAD2																																
MASAN																													4		4	
OXIR								5																20								
LAMALOOJI			1																													
DUQQURON						60			5									80														
XODAY																																
QANSOLE																																
MALHAL												1				2				1												
MADAXBUSHI																																
JIICRUGUNBAY				2						1														1								
CUMER						8					1																					
GEEDGABOY																																
DHIGTAR																																
DHEGAYAR									3																							
DAHANDOWOCO												15		35						15												
DABLEF																															10	
XAYEY																																
XAMUR					1																											
RAYDAB															2																	
QUDDE/JABSI																																
MISARAJABIS																																
MANDHERAQUBE																																
JOWDHER																																
JIICTIF																																
JALEELOWEYNE																																
GEELREB																																
GEEDKURRUS																																
DS??SALT2												5				5																
S??SALT1												80				35				15												
OBOGOY																																
DHEEBYAXAAS																																
DARANDIYOOD												30		20																		
XERKOOD																																
XAJIINDALUG																												35				
XAGAR																							80									
XABNOCAS																																
SAYNSAAB																																
SALT??												10				10																
GUNLESIRIQ																																
GWRADHAYE																																
LEBIYARO																																
LEBI																																
KOBOSH																																
KIDI																		1														
JAJABOOD																								50								
IBOLAROOR																																
HIGLO					2																											
HAJIINCAD																																
GULAN														20																		
GEEDHARAQ																			10													
GEEDGABAL																																
BUULAAYOODL																				6												
DABIB												1																				
CADANOOD																																
CIIN																																
CARMO																																
DARAN												25																				
BURBUR												1																				
CADUURDEGAWEYNE																35																
SHILLAN																												5				
BOGADHAAYE																																
DARJO																																

BASSFLAT 55-7

APPENDIX 2

(copy from FEWDS 1988)

Forage Production.

Drawing on a previous publication by one of the present authors (Hutchinson 1986), it is possible to relate the Climate to production of forage, which is an even increasingly important topic in view of pressures on the utilisation of rangeland. By means of the methodology used by the FAO in their study of Water Use in Irrigated Agriculture, a reference production, similar to that above is first calculated according to the formula:

$$Yo = (15.3 + 10.6 \frac{n}{N}) Ra. \frac{ETa}{ETo}$$

Where Yo = reference production in Kg/ha/day.
n = actual sunshine hours.
N = maximum possible sunshine hours.
Ra = extra-terrestrial radiation.
ETa = actual crop evapotranspiration.
ETo = reference crop evapotranspiration (Water need)

This equation is similar, but not identical to that used above. It uses similar meteorological parameters, though with sunshine hours instead of cloud amount, but with no reference to saturation deficit, but the parameters are differently arranged, and the constants are different.

We included this equation to indicate that there is no one definitive method of estimating yield, rather a selection from which a choice may intelligently be made, and applied with cautions professionalism.

But to get back to the calculation:

To convert this reference producion to predicted actual production, then a number of factors need to be included:

$$K = a.C_t.e.K_f.\frac{1}{1-m}\ 0.0305$$

Where:
a = Photosynthetic efficiency of the crop,
C_t = Correction for actual temperature against optimum temperature for maximum growth of the crop.
e = Cultural efficiency.
K_f = Fraction of plant which can be harvested.
m = Moisture percentage of harvest.
0.0305 = Conversion from Kg/ha/day to T/ha/month.

For want of better information, we have taken the following values for rangeland:

a = 0.2, since, for alfalfa a = 0.3.
c = 0.9, since it is assumed that rangeland plants will exist in near optimum temperature conditions.

e = 0.5, since, for favourable agricultural practices e = 0.7.
Kf = 0.6, taking into account roots and woody material.
m is ignored, giving dry matter directly.

Finally, we have taken ETa as monthly rainfall, and ETo as Potential Evapotranspiration, and performed calculations on a monthly basis, cumulating to give annual production, and using the FAO data.

K is thus 0.54, and the actual equation used is:

$$Ydm = \sum_{1}^{12} 0.54\ (15.3 + 10.6\ \frac{n}{N})\ Ra.\ \frac{P}{PET}$$

Where Ydm = annual dry matter production in t/ha
P = Monthly rainfall.
PET = Monthly potential evapotranspiration.

This equation is most effected by the ratio P/PET, since both $(15.3 + 10.6\ \frac{n}{N})$ and R_a vary rather little over the country and the year.

PET varies from a monthly minimum of 98 mm (at Jonte, June) and a maximum of 413 mm (at Berbera, August) and thus has some effect, but it is the variations in rainfall which has most effect on the variations of Ydm, both in time and space.

The results of these calculations are shown in the Map 4 Forage production is highest in the agricultural areas of the south, reaching a maximum of 2 tons/hectare. In the traditional nomadic areas, production falls off to values of under half a ton per hectare, and to almost zero in the far northeast.

A simpler method, based on actual field measurements (and thus comparable to the figures for recorded maximum yields quoted above), is that for grasslands by Deshmukh (1984) which is derived from a number of independent trials, relating peak biomass above ground for grassland with annual rainfall. The trials were carried out by several observers in Africa, covering an area stretching from southern Africa (the Namib) to Kenya, and including sites in Tanzania and Uganda.

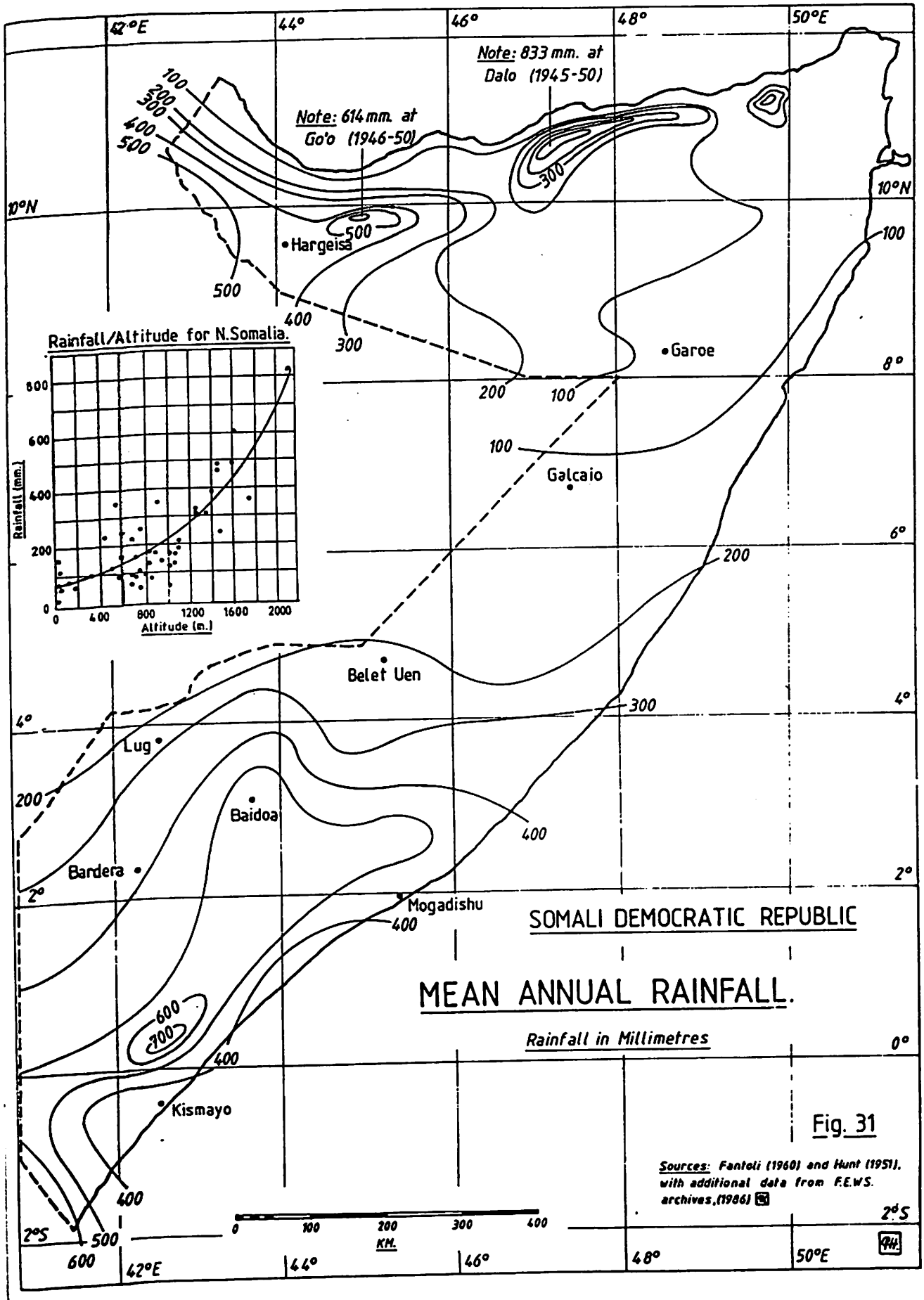
The equation is:

(Peak biomass (Kg/ha) = 8.488 x precipitation (mm) - 195.768.

Since biomass is directly related to the annual rainfall, then the geographical distribution also follows the map of annual rainfall (see figure 31). The predicted peak biomass biomass varies from less than 0.5 t/ha in the far north-east to over 4.0 t/ha in the two high rainfall areas of the northwest and over the Bay and Middle Juba areas, ( ). In this derivation, no account has been taken of soil and other variables, thus actual biomass production is likely to be less than the peak values shown.

Comparing the two methods, it is seen that the peak biomass method of Deshmukh produces higher values than the estimates of actual production by the de Witt method. In the south it is higher by a factor of 2, but in the north the factor increases, even up to a value of 5.

However, so many assumptions have been made here that the actual results need to be supported by field trials, results of which are not available at the time of writing.


42°E
44°
46°
48°
50°E
10°N
8°
6°
4°
2°
0°
2°S
Note: 833 mm. at Dalo (1945-50)
Note: 614 mm. at Go'o (1946-50)
100
200
300
400
500
600
700
Hargeisa
Garoe
Galcaio
Belet Uen
Lug
Baidoa
Bardera
Mogadishu
Kismayo
Rainfall/Altitude for N.Somalia.
Rainfall (mm.)
Altitude (m.)
0
400
800
1200
1600
2000
SOMALI DEMOCRATIC REPUBLIC
MEAN ANNUAL RAINFALL.
Rainfall in Millimetres
KM.
Fig. 31
Sources: Fantoli (1960) and Hunt (1951), with additional data from F.E.W.S. archives, (1986)