

## Rehabilitation of Rangeland and The Possibility of Productivity Improvement in Wadi Al-khun (Hadhramout)

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### Abstract

One hectare of the area in Wadi Al-khun has been fenced and plant inventory in the fenced area (Enclosure) was conducted. The enumerations in the fenced area are showed increase in numbers of perennial species such as *Merremia hadramautica*, *Tephrosia nubica* and *Acacia tortilis* while annual or seasonal species as *Cenchrus ciliaris*, *Stipagrostes hirtigluma*, *Tribulus sp*, *Dichanthium insculptum* .etc, were decreased or disappeared after few months of rainy season. Natural regeneration of perennial range species have been increased in their density in particular *Merremia hadramautica*, *Tephrosia nubica*. The dry matter of fodder production was 408 kg /ha and 100 kg / ha inside the enclosure and the site beside respectively. The animal grazing capacity was calculated to be one head of goat or sheep / 2 ha and one head of goat or sheep / 7 ha in the enclosure area and outside respectively.

**Key words:** Rehabilitation, Rangeland, Regeneration, Species, Density, Enclosure, Enumeration.

### Introduction:

Natural vegetation in arid lands is xerophytes which is a drought resistance plants scattered on the areas with empty places between them [14]. Wadi Al-khun is located near to Gusem city. It is one of the tributary wadi of the main wadi Hadramout which lay in arid or desert area. Overcutting, overgrazing, un-rotational grazing system and mismanagement as well as rangeland degradation were the main problems of the Wadi. Overgrazing is seriously threatening the genetic resources and biodiversity of these important palatable forage species [2]. The range grazing is the cheapest way to feed the livestock, especially the small ruminants. It provides house hold security to pastoral as well as a large number of farming families through livestock gains [10]. Natural regeneration can be played a great role in restoration of a medium degenerated rangeland through preventing grazing, delaying it, or enclosures dissemination [13]. In pasture grazing systems, a period of rest is essential for the grasses to recoup and rejuvenate [12]. The natural regeneration can be renew even in very arid land but it needs long time depending on site aridity [13]. Changes of the vegetation cover in dry and rainy seasons have to be studied first before any interference, and then different methods of rangelands rehabilitation can be decided according to site condition. The objective of the research is how to rehabilitate degraded rangeland and the comparison of

grazing capacity inside the area of the enclosure as protected area and outside which could explain the objective achievement of rangelands rehabilitation.

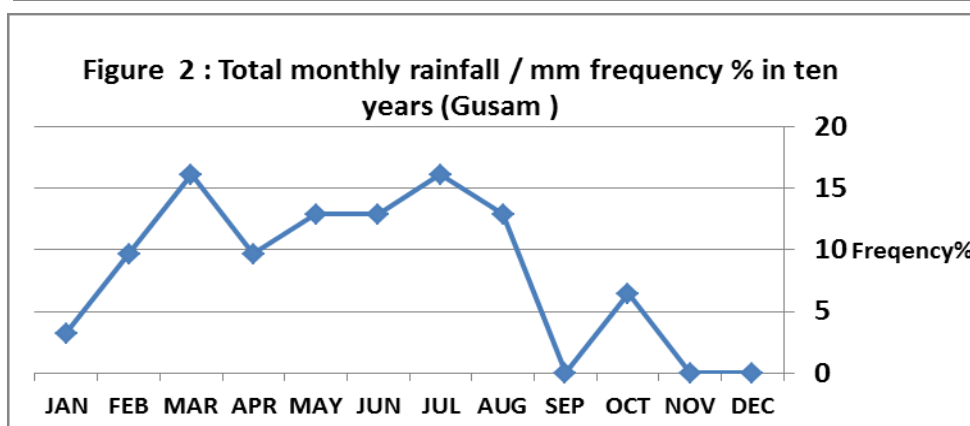
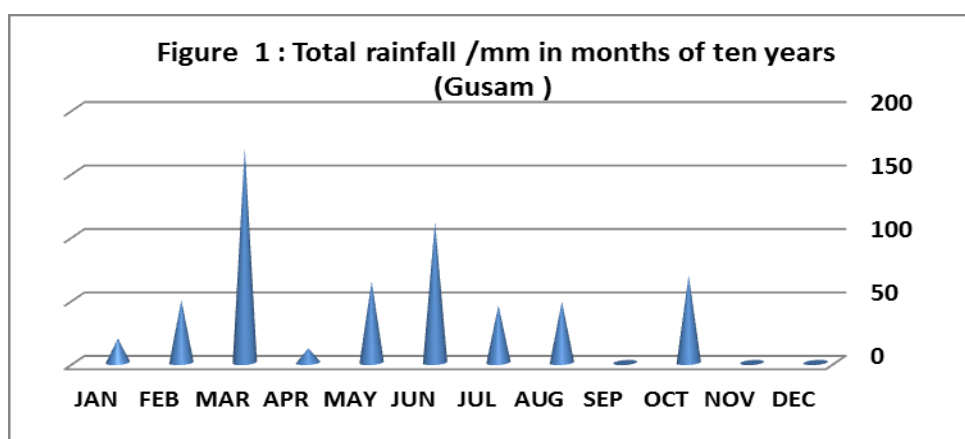
### Materials & methods:

#### Study site:

The research study was conducted in Wadi Al-khun of Hadhramout Governorate. The research was executed on degraded community rangelands. The selection of research site was based on the availability of community rangelands, small ruminants and willingness of the community for active participation in different range management activities. The Wadi Al-Khun lies at at E 49° and N 16° and is elevated 569 m above sea level [5]. The soil surface of the enclosure is mostly covered with stones and gravels while few spots covered with light soils, soil structure contains 64-66.5% gravels with a soil of silty loam, E.C 0.66-0.92 mmohs/cm and PH 7.1 at 0 – 30 cm depth [5]. At Wadi Hadhramout in general, the maximum temperatures are recorded in range of 27-42°C and the minimum 7-24°C [4]. Irregular precipitation occurs in arid desert area but heavy rains may fall in short period and on limited land for few days [14]. The mean annual precipitation at the nearest place (Gusam) is 58.62 mm, the total rainfall per each month as well as frequency percent has been calculated (Figure:1&2)[5].

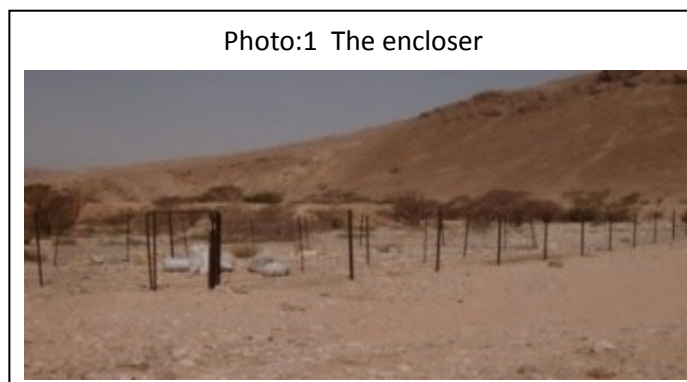
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**Recovery of vegetation:**

One hectare of area has been fenced by angle iron poles of 200 cm and three meter distance between each two poles ( photo: 1).



Each pole is fixed by concrete cement in 40 cm depth hole. Seven lines knotted iron silk steps are connected with the poles divided by 15 - 25 cm space heights. The area of the enclosure has been divided into 16 quadrates to facilitate the enumeration. Plant identification, frequency, density and growth parameters have been conducted during the surveys application. After the end of the rainy season in 2008, the green

fodder of palatable plant species was cut and weight, the dry matter forage production was converted into kg per hectare. The fodder production of these species included enclosure's plants and the plants of the site beside the enclosure were compared.

The following equations were used in calculation of frequency, plant density and relative density [1] :

### The numbers of square units consisted of a plant species

$$\text{Frequency \%} = \frac{\text{Total numbers of square units studied}}{\text{Total numbers of the individuals plant species in square units}} \times 100$$

$$\text{Plant density} = \frac{\text{Total square units studied}}{\text{Density of a plant species}} = \text{Plants/square unit}$$

$$\text{Relative density} = \frac{\text{Density of a plant species}}{\text{Total densities of plant species}} \times 100$$

#### Results and Discussions:

plant survey and natural plant regeneration:

The natural plant inventory in the enclosure is showed a diversity of plant species, which totally recoded 18 families, 32 genera and 39 species. In rainy season, most plant species can be regenerated with a little bit of difference between species due to their seed characteristics or plant physiology such as *Tephrosia nubica*, *Tephrosia apollinea*, *Tephrosia dura*, *Indigofera sp*, *Indigofera sp*, *Cassia italic*, *Acacia tortilis*, *Panicum turgidum*, *Pennisetum divisum*, *Cenchrus ciliaris*, *Cenchrus sp*, *Stipagrostes hirtigluma*, *Cymbopogon schoenanthus*, *Dactyloctenium indicum*, *Dichanthium insculptum*, *Merremia hadramautica*, *Tribulus arabicus*, *Fagonia sp*, *Zygophyllum spp*, *Cleome scaposa*, *Cleome brachycarpa*, *Cleome droserifolia*, *Ziziphus leucodermis*, *Dipterygium glucum*, *Heliotropium ramossisimum*, *Boerhavia elegana*, *Aerva sp*, *Citrullus colocynthis*, *Blepharis ciliaris*, *Cyperus sp*, *Chrozophora sp*, *Anticharis linearis*, *Abutilon sp*, *Farsetia lincarlis*, *Rhazya strictaet*. Most of these species increase very soon after rainy season and decrease in dry season as well as noxious or unpalatable plants like *Aerva sp*, *Cleome spp*,

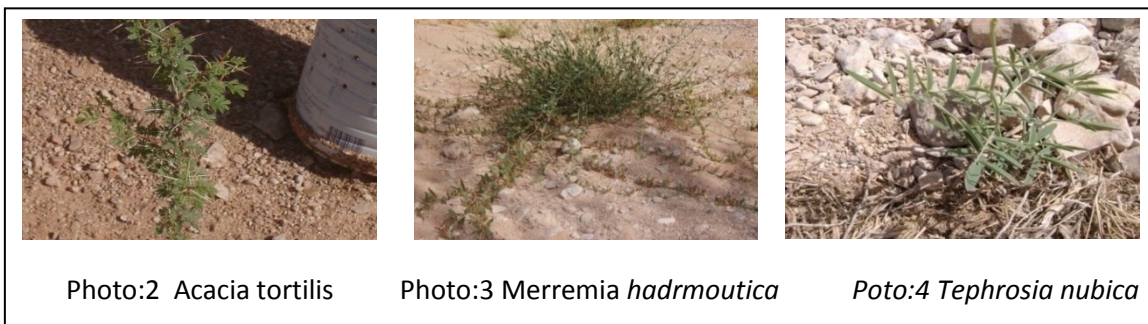
*Citrullus colocynthis*, *Rhazya stricta* etc. In rainy seasons plant species increase in frequencies and densities much more in dry seasons [6]. The regenerated perennial plants may be continued their survival in case of soil moisture availability and good root system which capable to penetrate the soil following soil moisture content. The annual and seasonal plants have shallow root system which they have not tap roots to follow up soil moisture content deeply and that is why these plants can't survive long time. Since rainfall of October/2003 followed by subsequent rainy and dry seasons till April/2012, the regenerated *Merremia hadramautica*, *Tephrosia nubica* and *Acacia tortilis* were still alive while *Cenchrus ciliaris*, *Stipagrostes hirtigluma*, *Tribulus sp*, *Dichanthium insculptum* etc, were disappeared after few months of rainfall. From the first started date of the enumeration as a basic, the enumerations are showed increase in numbers of the three mentioned perennial species which were become a performance and a sustainable species for rangeland rehabilitation (Table 1). During the subsequent years of enumerations, some plants may be dying due to their late seed germination or weakness to combat dryness period.

**Table 1: Survival plant trend in rainy and dry seasons of four range species ( Oct/2003 - Apr/2012 )**

Species	Enumeration years					
	Oct/2003 (Rainy)	May/2004 (Dry)	Oct/2008 (Rainy)	Feb/2010 (Rainy)	Jan/2011 (Dry)	Apr/2012 (Dry)
<i>Acacia tortilis</i>	57	50	62	64	73	65
<i>Merremia hadramautica</i>	103	89	266	244	262	236
<i>Tephrosia nubica</i>	104	93	119	107	181	181
<i>Panicum turgidum</i>	50	3	7	8	6	6

The regenerated plants growth:  
The survival of Perennial plants have been measured after 8 years of germination. The growth of height, width and stem diameter for

*Acacia* , *Merremia* and *Tephrosia* reached up to 15 – 43 , 20 – 35 , 0.4 – 1.0 cm; 15 – 40 , 20 – 70 , 0.5 - 1.0 cm; 12 –45 , 8 – 45 , 0.8 – 2.0cm respectively ( Photo 2,3,4 and Table 2 ).



**Table 2 : Measurements of species**

Species	Height/cm	Crown width/cm	Stem dia/cm
<i>Acacia tortillas</i>	15 – 43	20 – 35	0.4 – 1.0
<i>Merremia hadrmoutica</i>	15 – 40	20 – 70	0.5 – 1.0
<i>Tephrosia nubica</i>	12 – 45	8 – 45	0.8 – 2.0

Enumeration of four range plant species during the years 2003 and 2011:

The enumeration conducted in the enclosure is showed changes in plant numbers according to the

soil structure as a suit site viz *Merremia hadramautica* has been increased in stony and gravel site quadrates ( 1,3,4,5,6,... etc.) better than light sandy soil quadrates (14,15) (Figure 3 ).

**Figure 3 : Enumeration changes of four perennial plants at the enclosure quadrates (25x25m) in season 2003 and 2011**

	2003	2011	2003	2011	2003	2011	2003	2011
M.H	10	13	12	19	5	43	4	11
T.N	3	6	14	23	11	13	14	16
P.T	1	0	8	2	9	2	16	47
A.T	3	3	5	6	5	7	6	12
M.H	10	13	22	47	4	23	0	0
T.N	1	9	12	14	12	18	3	2
P.T	2	0	7	0	10	0	15	0
A.T	0	4	2	5	3	3	2	3
M.H	5	22	5	13	0	2	1	2
T.N	1	6	18	15	4	11	0	2
P.T	3	0	6	0	11	0	14	0
A.T	2	5	5	6	7	5	5	0
M.H	6	15	3	30	1	7	1	2
T.N	2	10	8	25	1	8	0	3
P.T	4	0	5	0	12	1	13	0
A.T	2	3	5	5	0	1	5	6

M.H: *Merremia hadramautica*.  
T.N: *Tephrosia nubica*.  
P.T: *Panicum turgidum*.  
A.T: *Acacia tortilis*.

The protected rangeland sites showed an increase in both density and total dry biomass of perennial species [2]. Plant enumeration revealed that perennial range species have been increased in

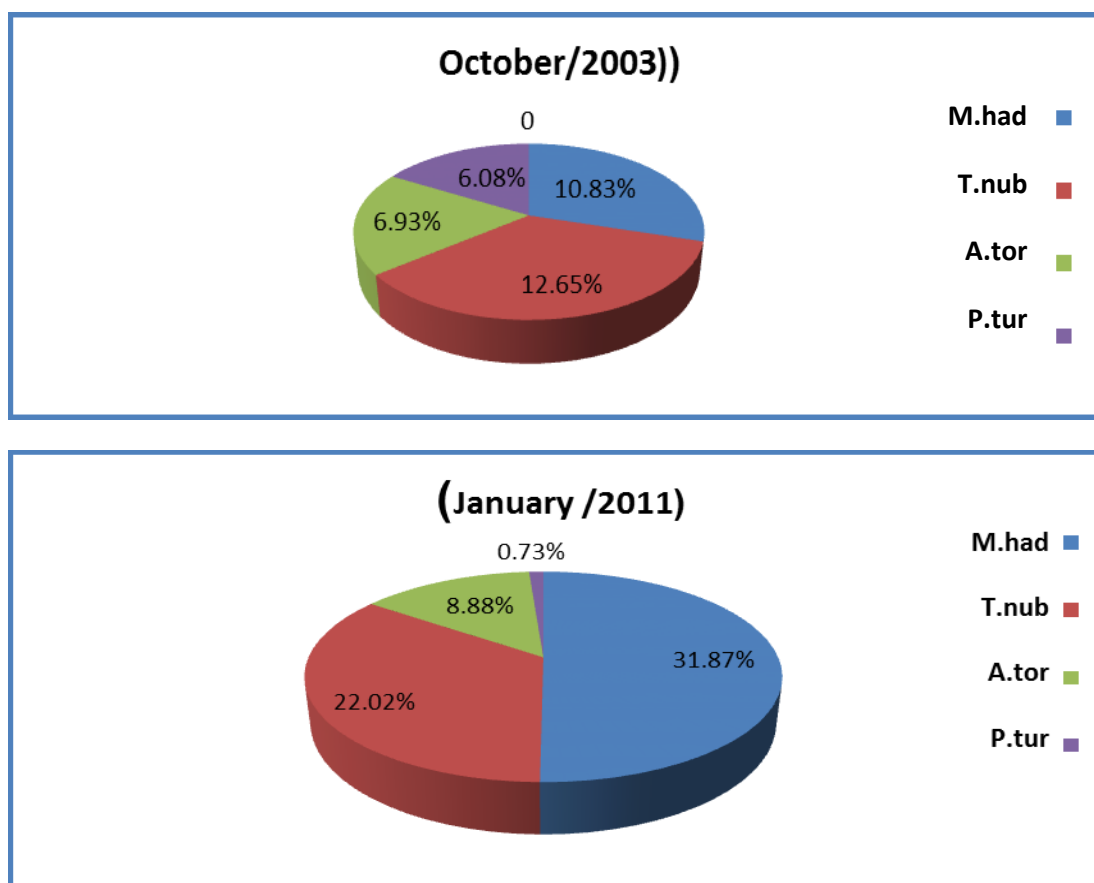
their density in particular *Merremia hadramautica*, *Tephrosia nubica* more than *Acacia tortilis* and *Panicum turgidum* ( Table 3 ).

**Table 3 : The plant density of four perennial species inside the enclosure at the years 2003 and 2011**

Species	Enumeration year/2003 Plant density/ha	Enumeration year/2011 Plant density/ha
<i>Merremia hadrmoutica</i>	89	262
<i>Tephrosia nubica</i>	104	181
<i>Acacia tortilis</i>	57	73
<i>Panicum turgidum</i>	50	6
<b>Total</b>	300	522
<b>Gross total</b>	822	

On the other hand, plant relative density for the above four species have been increased from

36.5% to 63.5% inside the enclosure since the year 2003 up to 2011 (Figure 4).



**Figure 4 : The relative plant density of four perennial species inside the enclosure during the years 2003 and 2011**

In order to increase the pasture productivity in dry areas, it is essential to replace low yielding annual grasses with high yielding perennial grasses that are adaptable to the prevailing conditions of that

region [12]. The most fitted to the above characteristics land is the local *Merremia hadramautica* plant which is possess high yield and palatability, followed by *Acacia tortilis*,

*Panicum turgidum and Tephrosia nubica.*  
 Grazing capacity estimation after rainy season of 2008 in the enclosure and outside:  
 It is well known that the rainfall and its distribution pattern during a particular year affected the growth , and production of different plant species on the

rangeland [9]. After the end of rainy season in 2008, the green fodder of palatable species was cut and weight. The green fodder production was 1019 kg / ha (408 kg dry matter / ha) inside the enclosure and 250 kg green matter / ha (100 kg dry matter / ha) outside (Table 4).

**Table 4 : The green and dry fodder production of palatable species and grazing capacity after rainy season 2008**

Description	Green fodder kg/ha	Dry fodder kg/ha	Dry matter mean of all fodder species %
Fodder production inside the enclosure	1019	408	40
Fodder production outside the enclosure	250	100	40
Grazing capacity inside the enclosure	one head / 2 ha		
Grazing capacity outside the enclosure	one head / 7 ha		

Goats preferred legumes and weeds over grasses while the grazing behavior also indicated their

preference to weeds over perennial pasture grasses [11].



Animals are seemed to be selective to forge plants because it was found that goats and camels grazing *Merremia hadramautica* more than other species and that is the reason caused the herder to cut *M. hadramautica* for feeding his animals (Photo: 5,6,7). According to the daily diet needed for sheep; One sheep needs 2 kg dry fodder daily [1]. On the other hand, it was found that one local goat needs 2 kg green matter of Alfalfa and 1.5 kg dry sorghum straw daily which totally equal 2 kg dry matter [7]. The grazing capacity was one head / 2 ha and one head / 7 ha in the enclosure and outside respectively ( Table 4 ). Fathallah found in Northern Hadramout that grazing capacity on the sloped mountains, valleys and their banks, plain desert and sand dunes were 4.2 – 8.4 ha, 0.84 – 2.52 ha and 6.3 – 12.6 ha per one head of goat respectively [8].

**Conclusion:**

The rangelands of Wadi Al-khun need urgent and well-planned program in management and utilization to halt the degradation process leading

towards desertification. Range management should also be based on knowledge of pastoral communities, traditions, and local arrangements. Communities should be involved in range management planning and implementation processes. Formation of pastoral communities or associations in major range areas may help in taking care of herd mobility, marketing of livestock, and maintenance of rangelands. In dry land, rangeland rehabilitation may take long period more than semi-arid areas. In Wadi Al-khun as a dry land, the conducted work showed survival of perennial species, which grew after rainfall. At long dry period, supplementary watering or rainwater harvesting application is needed and may assist in sustaining the new regenerated plants.

**Recommendations for range land rehabilitation:**

1- Seed collection of *Merremia hadrmoutica*, *Panicum turgidum*, *Pennisetum divisum*, *Lasirus indicus*, *Tephrosia nubica*, *Acacia tortilis* and

*Acacia hamulosa* should be started.

2- Intensify seeding and seedlings plantation of the above mentioned species and other palatable plants in the enclosure before and after rainy seasons.

3- Evaluation of seeding and seedlings plantation practices toward range rehabilitation.

4- Expanding plantation of the successful species in large scale in the Wadi Al-khun site.

5- Use of modern and simple techniques of water harvesting in the objective large scale site.

6- Closing the objective rehabilitation site for a suitable period.

7- Dissemination of this research study in different ecological sites of Hadhramout Gov, like coastal area, the two plateaus and Ramlt Al-sabatain .

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## إعادة تأهيل المراعي وإمكانية تحسين إنتاجيتها في وادي الخون محافظة حضرموت

أحمد سالم باطاهر

### الملخص

تم تسييج واحد في وادي الخون ونفذت بداخلة عملية الحصر النباتي التي أظهرت أن النباتات المعمرة مثل *Merremia* يضعه شهر من نزول المطر وذلك مثل *hadramautica*, *Tephrosia nubica* and *Acacia tortilis* *Cenchrus ciliaris*, *Stipagrostes hirtigluma*, *Tribulus sp*, *Dichanthium insculptum*. النباتات الرعوية المعمرة الطبيعية المتجددة قد زادت كثافتها وبشكل خاص مثل *Merremia hadramautica*, كمية المادة العلفية الجافة المنتجة داخل المروج بلغت 408 كج/ هكتار بينما خارج المروج بلغت 100 كج/ هكتار. الحمولة الرعوية المحسوبة وصلت إلى راس واحد من الماعز أو الضان لكل 2 هكتار من المروج داخل المروج و 7 هكتار من المروج خارج المروج.

الكلمات المفتاحية: مروج ، أنواع ، حصر ، كثافة ، تجدد ، إعادة تأهيل.