Evaluation of Grazing Systems and Seasons to Combat Desertification Resulting from Grazing in The State of Kuwait

Saad A E Abdelrazek [1] *, Khaled Abdallah El Naka [2]

ABSTRACT

Many studies indicated a trend towards desertification and the deterioration in grazing areas due to the changes in land tenure and management. To improve the ecosystems of arid and semi-arid pastures, livestock can used to overcome the problem of land degradation. In light of the results obtained, it asserted that Holistic Planned Grazing rotational grazing can boosted rangeland production and stop climate change. Animal density and double the stocking rate both reduce productivity. Too many findings included soil and compost qualities from cattle dung, which addressed the relative impact of rotational grazing on soil and plant or animal biodiversity. Rotary grazing contributes in solving the problem of desertification. When the rotational grazing method applied the amount of biomass, activity of enzymes, and decomposition of fertilizers increased, so the plant productivity will increase. With increasing the density of the green grass, thus the rate of humidity in light of the tough climate in the State of Kuwait will controlled. In the case of rotational grazing, the number of heads of livestock that can be grazing are controlled and managed. Rotary grazing differs from traditional grazing in preserving the soil, increasing plant productivity and storing water. Therefore, attention was oriented to improve rangeland ecosystems in drought areas using livestock for the solution of land degradation problem and avoid the desertification and to review the degradation causes of pastureland, how to treat and manage it in arid and semi-arid regions.

Keywords: desertification, land degradation, grazing, animal density.

INTRODUCTION

Due to climate change and human activity, desertification spread in arid and semi-humid regions. Desertification causes biodiversity of environment and decrease land productivity (Savory, 1999; Reynolds, 2001; Keith & Shannon, 2011). The loss of the variety of life in a particular ecosystem, overgrazing and localization are the main factors that create desertification condition (Al-Dousari, 2006; Sebzal et al., 2008).

The herding vocation is the main activity in the Gulf countries (Krane, 2012). The drought areas have spatial and time variabilities characteristics (Salzman, 2004).

The increasing of marginal lands was because of increasing the population and animal numbers. The climate change was an effective factor to create drought condition in the Transjordan Plateau (Hill, 2006). The management of natural resources and human behavior in ecosystems help in finding good pattern of zoological product to maintain the crisp ecological balance until recently (Managing systems at risk, 2011; Abdelrazek & El Naka, 2022).

The most of livestock grazing around the world are subjecting to ecological degradation and overgrazing. Integrated management of grazing is one of the promising mean for renovating the damage occurred to deserts and grasslands by climate change (Carter et al., 2014).

Desertification and deforestation resultant have a significant effect of the global environmental change (Gregory et al., 2004).

Numerous studies are confirming that although grazing time is significant for sustainability but it is not the main management unit in grazing and land use systems. (Niamir-Fuller & Turner, 1999; Reynolds, 2001; Salzman, 2004; Snyman, 2005; Sheppard et al., 2009; Pelletier et al., 2010). Types of grazing systems include continuous and rotational grazing are studied (Savory, 1999). Advantages of continuous grazing are low cost fencing; minimum management application while rotational grazing conserves soil moisture enhances plant production and helps to a uniform distribution of manure (Wallace et al., 2008; Darwish, 2011).

The groundwater is the main source of water in State of Kuwait so, the recharge of groundwater for feeding the aquifers is necessary. Soil salinity, because of shallow water table, water cutting and rangelands deterioration are challenges facing the world. Usually, the deterioration is due to the climate and the human factor. Desertification can formed due to land tenure decisions and deterioration of aquifer (Stockholm Environment Institute – US Center, 2006; Al-Ragum et al., 2008; Hadban et al., 2010).

Due to considerable yearly greenhouse gas emissions, deserts and grasslands are incapable to hold,

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[1]Soil Salinity Department, Alexandria Soil, Water and Environment Research Institute, Agriculture Research Center (ARC), Giza, Egypt
[2]Kuwait National Guard
* saadabdelsamad1@gmail.com - Gmail
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the annual emitted carbon (Hajiah, 2006). Soil carbon and nitrogen content are lowering and resisting climate change (Savory, 2013). However, the balance between carbon storage produced from cattle grazing and methane produced from livestock metabolism (Milutinovic and Eltahir, 2006). The rumen bacteria of the cow break down the grass to provide the same amount of energy as grain while the microorganisms in its rumen are producing the methane. The cattle released 30% more than the emissions of greenhouse gas. (Johnson and Johnson, 2011; Abend 2010; Pelletier et al., 2010).

Emissions because of usage of manure and fossil fuels with animal production also release nitrous oxide that more effective 300 times than methane at capturing greenhouse gas. The change of land use from forests to grazing lands the emissions from the livestock will include Carbone dioxide (Steinfeld et al., 2006; Goodland and Anhang, 2009). Environmental Protection Agency (2013) preferred using more tied definition of livestock emissions that only involve feed-based emissions and exclude any external factors organic matter in soil holds three times as much carbon as present in the atmosphere (Asner et al., 2004). However, grasslands and shrub lands plus additional amounts stored in the accompanying flora, are able to hold 30% of the world's soil carbon (Neely et al., 2009). Livestock grazing significantly affects the amount of stored carbon in pasturelands. In addition, long-term intensive agriculture significantly, deplete soil organic carbon and the disposal of shrub land that currently grazed to net carbon storage (Benbi and Brar, 2009; Daryanto et al., 2013).

Grazing caused destruction of fungi, reduced the ability of vegetation cover and soil to segregate carbon and finally, causes losses of carbon storage (Asner et al., 2004; Allmaras et al., 2000).

Three quantitative meta-analysis approaches already discussed. There was no differences between holistic planned grazing (HPG) and continuous grazing. The studies showed that there was a small portion of rangelands has the capacity to sustain HPG. There is also attention to investigate how the holistic planned grazing (HPG) affects socio-ecological constitution of rangelands (Hawkins, 2017).

Rochea et al. (2015) reported that Over 93% of all rotational grazer defendants in California characterized as using extensive intra-growing season rotation with moderate grazing period durations, livestock densities, and growing season rest periods. They also found that the majority of grazing systems research has largely conducted at spatial and temporal variability. The contradictions solving between the grazing systems observations and management database is required firm communications and new path of a highly participatory research projects between scientists and managers.

MATERIAL AND METHODS

Soil sampling

Physical characteristics

The soil samples were air-dried, ground, and put in storage for examination after being put through a 2 mm plastic screen. Mechanical analysis using the pipette method, FAO (1970) proceed using Sodium hexametaphosphate as dispersing agent and soil texture was obtained using the texture triangle diagram Soil Survey Staff (1962). Soil bulk density (D_b) using core sampler, as described by Richards (1954). Saturated hydraulic conductivity of disturbed coarse textured soil samples (Ks, cm hr $^{-1}$) was determined as described by Baruah and Barthakur (1997).

Soil dehydrogenase (DHA) activity estimated following the methods of Casida *et al.* (1964). The absorbance of TPF measured using a spectrophotometer at 485 nm and soil phosphatase using disodium p-nitro-phenyl phosphate at pH 11. (Tabatabai & Bremmer, 1969; Eivazi & Tabatabai, 1990; Tabatabai, 1994; Ekenler & Tabatabai, 2002). Soil Urease (urea amid hydrolase) is the enzyme that catalysis the hydrolysis of urea to carbon dioxide and ammonia. The method used to measure urease activity was that of Alef and Nannipieri (1995).

Water sampling and analysis

Sampling process based on scientific methodology that will preserve as much as possible on the characteristics chemical properties of water and by following the procedure of WPCF (1998). pH of the saturated soil paste was determined using Beckman's pH meter (Jackson, 1958). Electrical conductivity (EC, dS/m) of the saturated soil extracts using a conduct meter (Jackson, 1958). SAR (Sodium Adoption Ratio) already calculated as follows:

$$SAR = Na^{+} / \sqrt{(Ca^{++} + Mg^{++})/2}$$

Where Na^{+}, Ca^{++} and Mg^{++} refer to their concentrations in eq/l (Miller and Donahue 1990). Heavy metals determined the method of APHA and AWWA (1998). Microbial Biomass (MB) Soil MB was determined using chloroform fumigation extraction method (Wu et al., 1990), organic matter (Bertran & Andreas, 1994; El-kouny, 1999).

Statistical analysis

All obtained data of soil, plant and water statistically analyzed. The statistical programme SYSTAT-12 was used to evaluate the data. The means of the various treatments were compared using one-way analysis of variance, and Duncan's multiple range test (DMRT) was used to determine the differences with the least significant differences at P 0.05. (Duncan, 1955). In order to determine the link between the variables and to determine the essential soil parameters that are susceptible to exposure to heavy metals, the data was also subjected to cluster analysis and Pearson correlations analysis.

RESULTS AND DISCUSSION

Planned grazing, which includes much more than merely changing the pastures systematically depicted in Table (1). The overall planning process encompasses the environment, the economy, the community and the personal values of the sponsors. However, desertification still occurred. Day management (Table 1). To reduce bare soil, weeds must remove from the soil surface by feeding livestock on them rather than burning, which leads to the destruction of biomass and reduced rainfall and carbon emissions. For these reasons, it became obvious developed to what known today as holistic. Another way, would a grazer who moves his livestock to fresh pasture twice each year. The results of the statistical analysis showed significant results in the levels of enzyme activity with the presence of fertilizers.

Table 1. Comparison of the rotational grazing system and holistic planned grazing

Decision basis Holistic	Rotational grazing system	planned grazing
Grazing period Adjustments to grazing period	Height of grazed plants	Daily growth rate of plants, livestock performance, and/or wildlife needs
Stocking rate	Estimated dry matter intake	Animal days per acre along with a reserve for drought and effective water cycling
Use of herd effect	Not included	Essential in plan especially in xeric environments
Wildlife/other land uses	Not included	Incorporated into plan
Drought planning	Reserve grazing areas	Reserve time in all pasture
Fire prevention	Not included	Routinely incorporated into plan
Ecosystem	Good short-term results in	Developed for arid and semiarid environments
application	mesic environments	*****

Source: (Keohane, 2008)

Table 2. Soil analysis in the State of Kuwait after using rotational grazing

Sand %		Silt %	
Fine 0.25 -1	Coarse 1 – 2	Fine 0.2 – 0.002	Coarse 0.2 -0.5
97.3	-	-	2.5
98.4	-	-	0.9

Soil mechanical analysis of rotational grazing areas in the State of Kuwait depicted in Table (2). The Soil in the State of Kuwait after using rotational grazing is Sandy soils (97.9% fine sand). Sandy soil is poor in fertility (nutrients) and water holding capacity.

Concentrations of some Indicators Hydrology in irrigation water sources shown in Table (3). Irrigation sources: water delivery to the farm is by gravity Pressurized systems of irrigation is also used where, water from tertiary canals is pumped using either collective pump stations in the case of investors and small settlers, or separate pumps for units of 20 feddans (feddan = 4200 m^2) for small groups of two to four graduates. Heavy metals content in effluents of these factories, sewage drainage, and artesian well Table (3).

There are specific criteria for evaluating the quality of fertilizer, including biological, physical, chemical, microbiological and biological (Epstein, 1997). The compost had the ideal levels of organic-C, total N, and water-holding ability, but it also had a high electrical conductivity that required attention. The compost rated as stable and mature based on factors like color, pH, CEC (cation exchange capacity), total humus, and microbial biomass. Biologically, the compost wasn't hazardous to plants, according to a test using the germination index. Total zinc, copper and cadmium contents of the compost were above critical level (Epstein, 1997), which require careful monitoring on application to soil. Results revealed that soil grazer markers as MB and enzyme activity were unaffected by the addition of MSWC at levels as high as 20 tons fed^{-1}. Table (4). These result are matching with findings of (Perucci, 1990) how reported that a rise in soil enzyme activity occurred after a fall in MB showed that the release of the enzymes was related to microbial cells that were nearing the end of their life cycles.

Table 3. Concentration of some Indicators Hydrology in irrigation water

IWS*	**Salinity (mg/L)**	IWS*	**Salinity (mg/L)**
Al-Shakaya-a	3.250	Alsalibia	4000-5000
Al-Shakaya – b	3000	Umm Qadeer	3700-4100
Al-Shakaya – c	2800	Alwafra	4500-5500
Al-Shakaya - D	2800	al'atraf	4000 -4500
Al-Shakaya - H	4200	Alsalibia	4000-5000

Sources *Irrigation water sources

Table 4. improve arid and semiarid rangeland ecosystems using livestock (Cattle manure (compost)

Characteristic	**pH**	**T- N**	**T-P**	**T-K**	**Cl**	**Na**	**EC (1:10)**	**Dry matter**	**Bulk density**
		%	**%**	**%**	**%**	**%**	**(dSm^{-1})**	**%**	**kg/m^3**
Cattle manure (compost)	7.2	1.9	1.15	0.52	0.19	0.22	5.10	81.5	640
Correlation coefficients	0.952*	0.959**	0.799**	0.952*	0.966**	0.925**	0.863	0.923	0.892

Table 5. Cattle manure (compost) activities vs. sandy soil in Kuwait

Characteristic	**Cattle manure (compost)**	**Sandy soil**
Microbial biomass	130 $\mu g g^{-1}$ compost	25 $\mu g g^{-1}$ soil
urease activity	56 (µg urea hydrolyzed g^{-1}soil h^{-1} at 37 ºC)	25 (µg urea hydrolyzed g^{-1}soil h^{-1} at 37 ºC)
Acid phosphatase activity	260 (µg paranitrophenol released g^{-1}soil h^{-1} at 37 ºC)	117 (µg paranitrophenol released g^{-1}soil h^{-1} at 37 ºC)

LSD ($p < 0.05$) for T = 4.83; P = 5.72; P * T = 12.77

When compared to the control treatment, the increased dose of cattle dung (compost) considerably increased the soil's urease (UR) and acid phosphatase (AP) activity. (Table 5). Up until 60 days, UR activity in the soil grew, but after that, it started to diminish. In contrast, regardless of treatment, the acid phosphatase activity in the soil rose up to 90 days before declining at 120 days. In the soil, the dynamics of UR and AP activities did not correspond to the trajectory of biomass. Biomass of microbes (MB): Between treatments and time periods, there were statistically significant differences in soil MB (5). For each increment in MSWC dose from 2.5 to 20 t fed^{-1}, a noticeable rise in soil MB was recorded. Significantly more biomass was present in the treated soil combination than in the control. Significant increases in soil MB at application rates of 20 and 80 t fed^{-1} cattle dung (compost). The greater content of soluble organic-C in MSWC-enriched soils may be the cause of this rise in soil MB. The soil MB in compost-treated soils peaked after 30 days of incubation, then gradually fell until it reached its lowest point after 120 days. However, the soil MB in the control treatment began to decline after 10 days. Biogenic material is readily available for biomass stimulation. (Jenkinson and Ladd 1981) induced the increase in soil MB of enriched soils.
The increase in organic matter as a fertilizer increases the biological properties of the soil (Vance et al., 1987).
Reduced biomass because excess biomass resulting from this capacity killed or broken down.

CONCLUSION

The obtained results show the effect of animals and the length of grazing periods as a step toward enhancing the pasture ecosystems as a remedy for the issue of land degradation using livestock. It noted that the improvement of the physical properties of the soil and the increase of soil fertility، biological properties represented by microbes, enzymes and in general an increase in the yield of organic manure.

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RECOMMENDATIONS AND SUGGESTIONS

1. recommended develop Technology of combating desertification and develop Desertification areas mapping
2. Banning livestock grazing to protect cultivated areas and preserve the soil. In addition to the use of plant and animal species adapted to climate change and temperature conditions.
3. Combating desertification has multiple local and global benefits such as mitigating climate change and biodiversity loss.
4. Earth mounds, off-road vehicles, or other sustainable measures that cause soil compaction.

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الملخص العربي

تقويم نظم ومواسم الرعى لمكافحة التصحر بدولة الكويت

سعد عبد الصمد السيد عبد الرازق ، خالد عبد الله الناقة

تشير العديد من الدراسات إلى وجود اتجاه عام نحو التصحر وأن التدهور في مناطق الرعي يرجع إلى التغيرات في حيازة الأراضي وإدارتها. لتحسين النظم البيئية للمراعي القاحلة وشبه القاحلة يمكن استخدام الثروة الحيوانية كأحد الحلول للتغلب على مشكلة تدهور الأراضي. يستكشف هذ البحث الأسباب المقترحة لتدهور الأراضي الرعوية وتحدد إدارة الأراضي ومعالجات الرعي التي تشترك فيها العديد من الثقافات الرعوية. كما نحاول فى هذا البحث التركيز على عمليات التخطيط الشاملة التي قد تحسن النظم البيئية للمراعي القاحلة وشبه القاحلة باستخدام الثروة الحيوانية كحل لمشكلة تدهور الأراضي.

بناءًا على النتائج المتحصل عليها فإن إدارة الجوانب المكانية والزمانية للرعي (تأثير الحيوانات ومدة فترات الرعي) كخطوة واحدة نحو تحسين النظم البيئية للمراعي من خلال استخدام الثروة الحيوانية كحل لمشكلة تدهور الأراضي. زاد الغلة من السماد العضوي ، مع تحسين الخصائص الفيزيائية للتربة ، وزيادة خصوبة التربة والمجموعات الميكروبية المفيدة ونشاط الإنزيمات. ان الرعى الدورانى يساهم فى حل مشكلة التصحر كما ان كمية الكتلة الحيوية تزداد عند اتباع اسلوب الرعى الدورانى وبالتالى يزداد نشاط الانزيمات وزيادة تحلل الاسمدة فيستفيد منها النبات. وتزداد كثافة العشب الاخضر وبالتالى التحكم فى معدل نسبة الرطوبة فى ظل قسوة المناخ بدولة الكويت. فى حالة الرعى الدورانى يمكن التحكم فى عدد رؤوس الماشية المراد رعيها . فالرعى الدورانى يختلف عن الرعى التقليدى فى الحفاظ على التربة وزيادة انتاجية النبات وتخزين المياه. لذلك ، تم توجيه الاهتمام لتحسين النظم البيئية للمراعي في مناطق الجفاف باستخدام الثروة الحيوانية لحل مشكلة تدهور الأراضي وتجنب التصحر ومراجعة أسباب تدهور المراعي وكيفية معالجتها وإدارتها في المناطق القاحلة وشبه القاحلة.