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Remarks on Land Degradation Neutrality (LDN), the Case of the Terrestrial Environment of Kuwait

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Abstract

Land degradation neutrality (LDN) in arid, semi-arid and dry sub-humid areas is a state whereby the amount of healthy land resources remains stable or increases within specified temporal and spatial scales (UNCCD, 2014). The ultimate goal of a land degradation neutral world, to be realized by is reducing the rate of land degradation and increasing the rate of restoration of degraded land, as the Rio+20 Conference in 2012. In the terrestrial environment of Kuwait, several land degradation indictors are identified. These are differentiated into biophysical, socioeconomic and land use. Examples of biophysical indicators are: loss of top soil (both by wind and water), soil salinization/water logging in agricultural lands, soil crustation /sealing, reduction of vegetation cover, soil moisture loss, loss of biological diversity and loss of wild life habitats (animals). On the other hands, loss of agricultural production and degradation of plant species of high grazing value are the most common socioeconomic indicators. Change with time for urbanization and area of livestock grazing as well as percentage of protected terrains to the county are the main land use indicators. The main target of this study is to reduce land degradation from 72% in the year 2015 to 0-5% in the year 2030. To achieve this target, a 15 year LDN implementation plan is proposed. This LDN implementation plan consists of the following programs: 1) Land degradation decision support system 2) Sustainable land use/land management program, 3) Public awareness/human resources development program 4) Rehabilitation/restoration program. The study will discuss the targets, practices, policies and schedule of each program.

Keywords Land degradation indicators, land degradation decision support, land management & rehabilitation.

Rationale

Kuwait covers about 17,800 km2. It consists of two main ecosystems. These are the terrestrial (about 85%) and the coastal and marine (15%). Some 72% of the terrestrial environment of Kuwait is degraded terrains. Three classes of land degradation are identified (Misak R., J. M. Al-Awadhi & M. Al-Sudairawi 1999 and Al-Awadhi, et al. 2005). These are slight (15%), moderate (75%) and intensive (10%). Biophysical, land use and socioeconomic indicators of land degradation are reported in Kuwait (Misak 2014). The most significant land degradation indicators are deterioration of vegetation cover and loss of biodiversity, loss of topsoil through water and wind erosion, soil sealing and compaction and soil salinization (in several farms of Wafra Agricultural Area). The extent of these disturbances is not well documented.

In Kuwait the following classes of drought are recorded: (Misak R. & Al-Dousari A. 2013.)

- Very severe : Total annual rain fall, less than 25 mm (seasons 1963/1964 and 1993/1994).
- Severe : Total annual rain fall, from 25-50 mm(seasons 1972/1973, 1976/1977 and 2007/2008).
- Moderate : Total annual rain fall, from 50-75 mm (seasons,1966/1967, 1991/1992, 2008/2009).
- Slight : Total annual rain fall, 75-100 mm (seasons 1964/1965, 1996/1997 and others).

Categories of desertification/land degradation in Kuwait include:

- Land use related (socio-economic). This category is caused by overgrazing, deforestation, quarrying & mining, over-exploitation of resources, (specially irrigation water in some agricultural areas) as well as camping and recreation over fragile desert surface.
- Military operations related. This category is caused by maneuvers & troops transport, establishment of ground fortifications, landmines plantation, demining activities, etc. (August 1990-February 1991).
- Natural. This category is caused by prolonged drought, flash floods and strong winds.

In Kuwait, sustainable action plan to control land degradation is actually not in practice. Land degradation neutrality (LDN) in arid, semi-arid and dry sub-humid areas is a state whereby the amount of healthy land resources remains stable or increases within specified temporal and spatial scales (UNCCD, 2014). After the UN Convention to Combat Desertification has entered into force for the State of Kuwait (22 June 1997), the need to assess land degradation/desertification in Kuwait has substantially increased. While standard and traditional methods for undertaking such an assessment and measurements are inaccurate, time consuming and expensive, it has been demonstrated that satellite-based and airborne remote sensing offer a considerable potential.

Methods

This study discusses the feasibility of reducing land degradation from about 72% in the year 2015 to 0-5% in the year 2030. For this purpose, a 15- year LDN scheme is proposed. It consists of several programs. These include: 1) Land degradation monitoring, mapping and assessment (ground and remote sensing investigations), 2) GIS based knowledge support system 3) Restoration/rehabilitation (soil, vegetation and water supplies), 4) Sustainable land use and 5) Public awareness and human development. Under the umbrella of this study land degradation monitoring, mapping and assessment will be tackled.

Based on recent field surveys (March 2014) and updated remote sensing information, the approximate areas of degraded and non-degraded terrains of the main land use types of the terrestrial environment were estimated (Table 1).

In addition, monitoring and assessment of land degradation in 21 pilot sites represent open areas of terrestrial ecosystem of Kuwait were conducted. Each site covers 25 km^2. Land use, vegetation type and land degradation severity (very severe, severe, moderate and slight) were identified.

Based on field measurements and surveys, degraded terrain in five pilot sites were mapped using recent IKONOS images (Fig. 1 is an example).

Land use	% of Kuwait	Area (km^2)	Degraded	Non-degraded	Remarks
Agriculture	2.6	470	80 (17%)	390(83%)	Soil salinization and and loss of top soil (by wind& water).
Abandoned gravel quarries	2.1	383	203 (53%)	180 (47%)	
Protected areas	18	3242	1679(52%)	1563(48%)	
Military	4	688	100(15%)	588(85%)	
oil	6.6	1177	114(10%)	1063(90%)	
Rangelands	51	9123	9123 (100%)	0%	Loss of top soils (by winds and water) degradation of vegetation cover and loss of biodiversity.
Other uses	4	657	31(5%)	626(90%)	
Total	**88**	**15740**	**11330(72%)**	**4410(28%)**	

Table 1. Degraded and non-degraded terrains, terrestrial environment of Kuwait

Results

About 11330 km^2 of the terrestrial environment of Kuwait representing 72% of the country are degraded. For agricultural areas which cover 470 km^2 (2.6% of Kuwait) about 80 km^2(17%) are degraded, while the rest (390 km^2)is non-degraded. Land degradation in agricultural areas is represented by soil salinization and loss of agricultural production. For abandoned gravel quarries which cover 383 km^2 (2.6% of Kuwait) about 203 km^2 (53%) are degraded. Land degradation in the abandoned gravel quarries is represented by surface deformation, hydrologic disruption, soil compaction, vegetation deterioration and loss of biodiversity. With respect to protected areas which cover about 3242 km^2 (18% of Kuwait) about 1679 km^2 (52%) are degraded terrains as real protection is still in progress. For areas used for rangelands grazing which cover about 9123 km^2 (51% of Kuwait) are highly degraded. Loss of biodiversity, vegetation degradation, loss of top soil (by both wind and water), soil compaction and sealing are the prevailing land degradation processes.

Outcomes

- Recent statistics on percentages of degraded terrain by land use type (agriculture , quarrying, protected areas, military, oil and rangelands).
- Land degradation information system including basic information on the magnitude, mechanisms and trends of land degradation processes in pilot sites.
- Set of recent land degradation maps (through remote sensing and ground truth).

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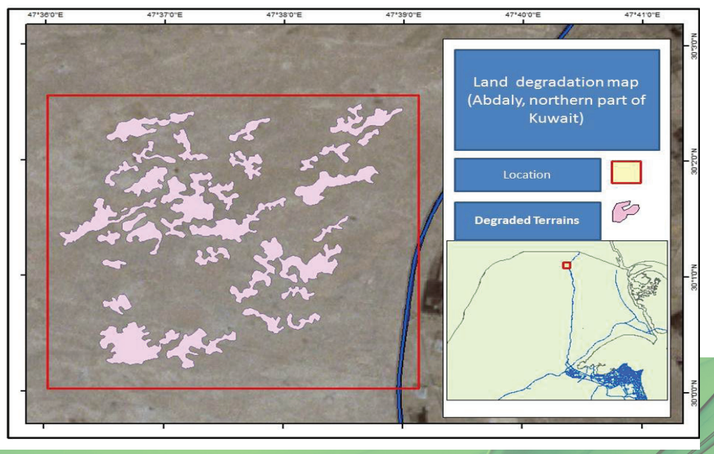

Fig.1. Land degradation map for Abdaly Area (an example)

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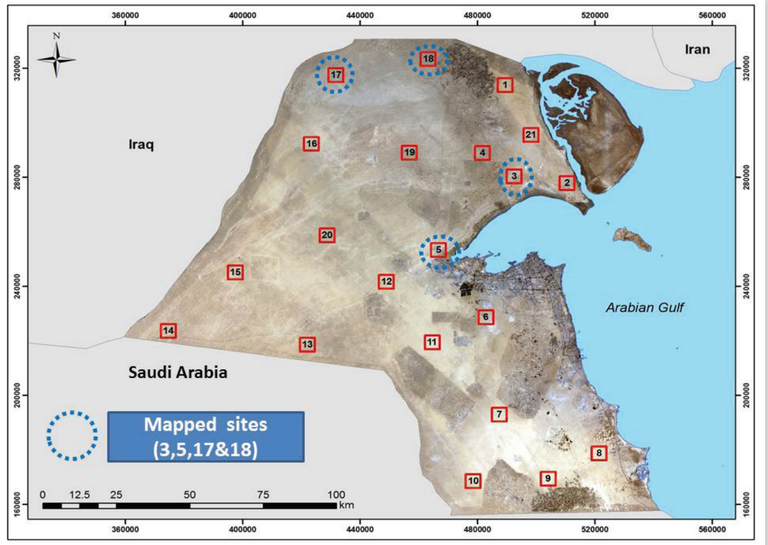

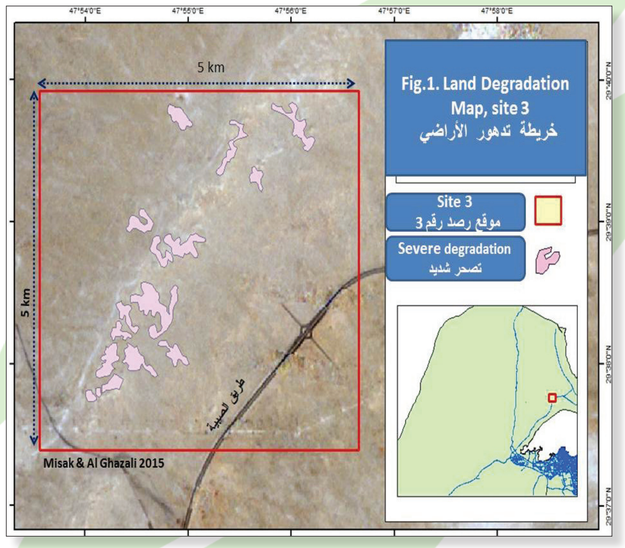

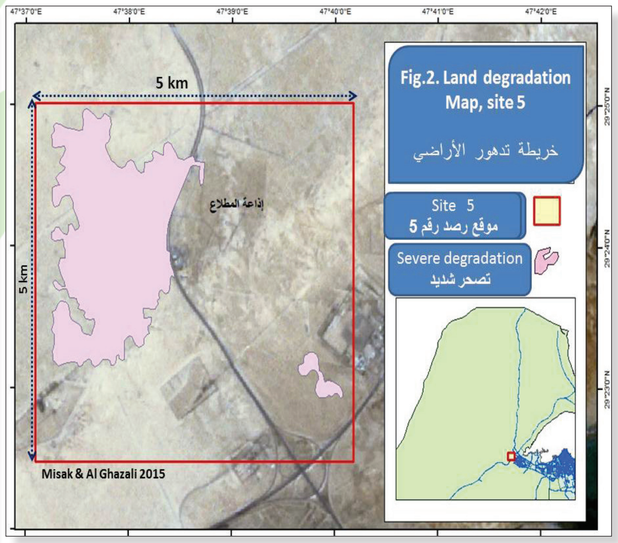

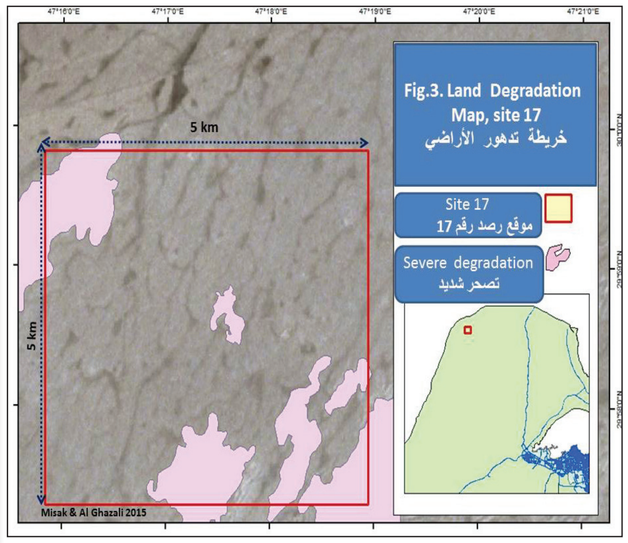

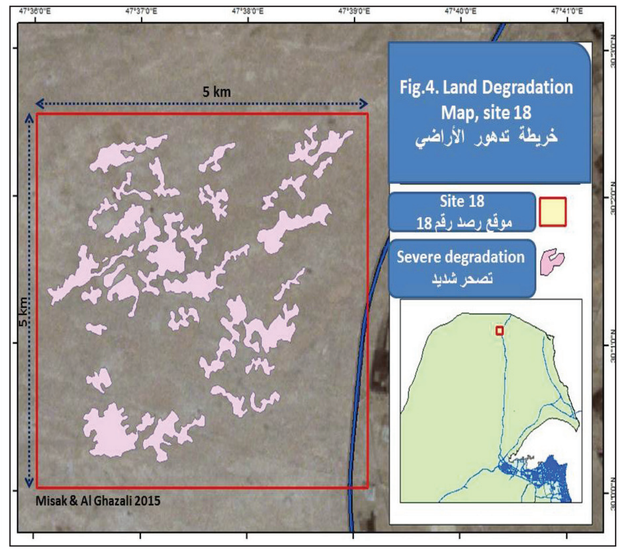

Table 1. Percentage of degraded areas for selected sites

Site	*Total Area (Km2)*	*Severely Degraded Area (Km^2)**	*% Of Degraded Area*
3	25	1.14	4.56%
5	25	4.81	19.24%
17	25	6.34	25.26%
18	25	3.77	15.08%

* Complete Loss of Soil Productivity (Due to Soil mining and surface deformation)