Vegetation Changes in the Long Abandoned Farms In Qatar

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ABSTRACT:

An attempt was made in this study to investigate the changes that occur in vegetation cover in the totally abandoned farms in Qatar. An effort was also made to compare the vegetation communities found in the abandoned farms with those in the uncultivated "natural" depressions. The following hypothesis was formulated : In the long abandoned farms vegetation is gradually recovering to the original pre–cultivation communities due to the steady decrease in soil salinity. To test the above hypothesis soils and vegetation of both the uncultivated "natural" depressions and the long abandoned farms were sampled and analysed. Soil samples were taken for chemical analysis and their salinity content was determined. Empirical sampling methods of the vegetation were applied. Species frequency and density were calculated, while the degree of species similarity was estimated by Kulezynski's (1937) formula for comminity coefficient given by Oosting (1956). It was found out that following total farm abandonment, the vegetation communities start to recover in a rather slow process. This recovery procsess is caused and at the same time paralleled by a steady decrease in soil sllinity, as salts are washed away by rain water. Different vegetation communities as well as different species within the communities were found to be in different stages of recovery, i.e., secondary succession. Only few species from the origianal vegetation were encountered in some abandoned farms, while in the other end of the spectrum some totally abandoned farms have almost attained full recovery.

INTRODUCTION:

Most farms in Qatar are confined to surface depressions known as "Rohdat" or "Riyad". It is estimated that, out of the eight hundred and fifty (850) surface depressions, there were five hundred and seventy three (573) registered farms mostly in the north and north east of Qatar (FAO, 1981). It is agreed by several investigators (UNDP/FAO 1977, FAO 1981) that the origin of these depressions is due to subsurface solution of evaporites and subsequent collapse. Depressions receive runoff water in addition to water–borne and/or wind blown materials, thus giving rise to deep, fine–textured deposits. These are colluvial soils made up of calcareous loam, sandy loam and sandy clay loams which have accumulated to depths ranging from 30–150 cm. overlying limestone debris and bedrock (FAO, 1981).

In their natural conditions, depressions harbour denser vegetation compared to the surrounding areas. In his recent study, Batanouny (1981) found out that vegetation cover varies among the different depressions due to differences in soil characteristics. Usually in deeper depressions with water–borne, fine–textured deposits **Ziziphus nummularia** is dominant. In depressions with shallow surface deposits, **Z. nummularia** disappears and is replaced by **Acacia tortilis.** Where the sediments are fine–textured, compact an mainly water transported, **Acacia ehrenbergiana** dominates. Both **Acacia** species, however, often occur together in the same depression. The spiny shrub **Lycium shawii** occurs in nearly all depressions, while **Cymbopogon parkeri** is the dominanat perennial grass (Batanouny 1981).

These vegetation communities have been disturbed in as much as 70% of the country's depressions. Pre–cultivation indiscriminate cutting is usually practised. Few individual plants of certain species are, however, saved from cutting either for their shade or fruits. These are usually larger plants of **Acacia spp. and Ziziphus nummularia.**

However, due to unfavourable soil–water–plant relationships a large number of these farms are ultimately abandoned. The FAO experts consider only 228 out of the 573 registered farms as productive (FAO 1981). Moreover, they estimated that 5% of the arable land is going out of production each year as a result of soil salinization (FAO 1981).

This process of farm abandonment is a driect result of poor quality, saline or brakish water resulting from excessive pumping coupled with poor soil and water management. In recent years a substantial amount of research has been done in groundwater quality, irrigation problems and other problems related to agriculture particularly the problem of farm abandonment. Readers are directed to

look into Parker and Pike 1976, Parsher 1977, Hashim 1980, Pike 1980, Lloyd, Eccleston and Pike 1981, Halcrow–Balford 1981 and FAO 1981. These high quality professional reports and papers make impressive diagnosis to the farm abandonment problem. To start with these depression soils have poor water–holding capacity together with low organic content. Therefore, under cultivation these poor properties give rise to serious management problems. Surface crusting soon becomes a problem and interfers with the emergence of seedlings and creates unfavourable relationships. This situation is usually aggravated by the poor quality irrigation water due to excessive abstraction and the poor soil and water management. As the total dissolved solids in the irrigation water range from 1000 to 2000 mg/1 with a high salinity hazard and low to medium (alkali) hazard, there is usually a rapid build up of salts in the surface layers leading to reduced yields and eventual abandonment.

THE STUDY:

This study was stimulated by the recent study made by professor Batanouny (1981). In his study, Batanouny concludes that abandoned farms support plants different from the originally present before agriculture was practiced (Batanouny 1981). He (Batanouny 1981) further concludes that the change in vegetation depends on the reason of the failure of agriculture, e.g., due to salinization, lack of water or formation of hard pans.

In this study, however, the above conclusions are further extended. The vegetation communities on the long abandoned farms are thought to represent different stages of recovery. In other words the vegetation communities in the long abandoned farms represent different stages in the secondary succession.

The above additional ideas were built up during the several field visits undertaken by the author to some of the long abandoned farms in the years 1981 and 1982. During these field trips, it was noticed that the vegetation communities in the long abandoned farms share many species with the communities of the uncultivated "natural" depressions. Not only that, but the species associations are more or less the same.

Thus, the following hypothesis is formulated: Following total farm abandonment, salts are steadily washed away by rain water from the top soil and simultaneously the vegetation cover starts a gradual recovery process back to the original climatic climax. The present vegetation cover represent different stages in a secondary succession.

METHODS:

In order to test the above hypothesis soil and vegetation samples were studied on both the long abandoned farms and uncultiveted "natural" depressions. Sampling was preceded by field reconnaissance and a literature review aimed at determining the major trends in soil and vegetational composition.

Basic information on the number and location of the long abandoned farms was obtained from the records of the Ministry of Industry and Agriculture of the State of Qatar. Here the long abandoned farms are those officially registered as abandoned for more than ten years. All information concerning the number and actual sites of the long abandoned farms has been double checked in the field. Eventually, the long abandoned farms were plotted on a map together with the currently cultivated and the uncultivated "natural" ones (Figure 1).

The above map (Figure 1) was used to select and locate samples. Samples were randomly selected using stratified techniques. Twenty five per cent of the long abandoned farms and an equal number of the uncultivated "natural" depressions were selected and studied. Both soil and vegetation on the long abandoned farms and the uncltivated depressions were sampled.

In each selected abandoned farm and uncultivated depression 5 x 5 m quadrates were located by random numbers and were used for soil and vegetation sampling. The number of quadrates was allocated in proportion to the farms or depression's area.

Samples of the top 25 cm were taken for chemical analysis. Within the quadrate the vegetation cover is described and plants present were counted and recorded by species. Nomenclature of species follow that of Batanouny (1981). The total data set for the vegetation analysis consisted of 48 quadrates. Included were 20 species of vascular plants (Appendix 1). Data were talublated as frequency and density for each species in both abandoned farms and uncultivated "natural" depressions. The degree of species similarity was estimated by Kulczynki's (1937) formula for community coefficient given by Oosting (1956).

RESULTS:

Soil salinity, expressed as electric conductivity in Mhos/cm at 25°C has been determined for all samples. As a general guide soils with values ranging from zero to 4 are considered to be free from salts, those with values from 4–8 as having medium salinity, 8–12 high slainity and those with values over 12 are considered hazardous. These limits are based on the finidings of the Ministry of Industry and Agriculture soil scientists*.

Only two of the long abandoned farms soil samples show medium salinity values, while the rest of the soil samples in the whole study show little or no salinity (Tables 1 and 2). These soil analysis results clearly demonstrate the basic fact that salts have been washed or in th process of being washed away from the long abandoned farm soils.

As for the vegetation cover, the natural depressions hold 16 out of the 20 encountered species, while the long abandoned farms hold only 11 species. The most frequent species in all area sampled are in the following order: **Lycium shawii, Ziziphus nummularia, Acacia tortilis, Zygophyllum quatarense, Cymbopogon parkeri, Stipa capensis and Capparis spinosa** (Table 3).

The long abandoned farms share seven species with the unclutivated "natural" depressions of which five species are among those having the highest mean frequencies claculated for all quadrates. These species are: **Acacia ehrenbergiana, A. tortils, Corchorus depressus, Cymbopogon parkeri, Lycium shawii, Stipa capensis and Ziziphus nummularia.** With the exception of **Corchorus depressus,** which grows in all types of loamy compact soils, all other six species are dominant and co–dominant plants in uncultivated "natural" depressions in Qatar, particularly in the center and the north of the peninsula (Batanouny 1981). They are also frequently encountered in association with one another, e.g., **Ziziphus nummularia and Lycium shawii** (Table 4 and 5).

On the other hand, there are frequently encountered species in the uncultivated "natural" depressions and they are rare or absent in the long abandoned farms and vice versa. For instance, the aromatic perennial grass **Cymbopogon parkeri** is a frequent plant in uncultivated "natural" depressions while it is rarely encountered in the long abandoned farms. On the other hand the cultivated plant **Phoenix dactylifera** is only confined to the long abandoned farms.

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* Personal conversation with the Ministry of Industry and Agriculture soil scientists.

In general, nine species out of the twenty encountered are only found in natural depressions, though some are in vey low densities (Table 4). These are six shrubs and undershrubs and three herbaceous plants. The shrubby plants are : **Capparis spinosa, Ephedra foliata, Francoeuria crispa, Heliotropium subsp. tuberculosum, Ochradenus baccatus and Salvia aegyptiaca.** The three herbs are : **Anagallis arvensis, Aizoon canariense and Herniaris hemistemon.** With the exception of the shrub **Francoeuria crispa,** which grows in fine textured soils wherever water accumulates and the herb **Herniaria hemistemon,** which is a widespread plant in Qatar on compact and gravelly soils, all other species are common on the alluvial soils in depressions in northern and central Qatar (Batanouny 1981).

Only four species are however found to be confined to the long abandoned farms. These are **Phoenix dactylifera Salsola baryosma, Schanginia aegyptiaca and Zygophyllum quatarense.**

The vegetation covers on both the long abandoned farms and the uncultivated "natural" depressions are found to be very similar, i.e., the community coefficient for all samples is 70. Community coefficients calculated for each pair of a long abandoned farm and an uncultivated "natural" depression are found to range between 22.2 and 84.6.

DISCUSSION:

As mentioned above the process of farm abandonment is directly related to the poor quality groundwater due to excessive abstraction and/or inefficient irrigation methods which degrade the soil through excessive salinization . It is also mentiond above that this study was confined to the farms which have long been abandoned.

The chemical analyses of the soil samples show that the salinity content have decreased steadily as salts are annually washed by rain water. In fact the chemical analyses of most samples taken from long abandoned farms, show that there is little or no difference between the soils in the long abandoned farms and those in the uncultivated "natural" depressions especially in their salt content (Tables 1 and 2).

Thus, as a direct result of this decreasing soil salinity the vegetation cover on the long abandoned farms is found to be fairly similar to that on the nearby natural depressions, the community coefficient being 70. Not only the vegetation cover is similar, but the frequently encountered species in both the abandoned farms and the uncultivated depressions are usually common associates. For instance, the five most frequent species which are also common

associates are : (ordered according to their frequent presence) **Lycium shawii, Ziziphus nummularia, Acacia tortilis, Cymbopogon parkeri and Stipa capensis.**

However, the major differences in vegetation cover between the long abandoned farms and the uncultivated depressions are in species frequencies and densities and in the percent of vegetation cover (Tables 4 and 5). The general picture in the long abandoned farms is of widely scattered trees and bushlets. In other words, the vegetation cover on the abandoned farms is far less dense compared to that on the uncultivated "natural" depressions (Tables 4 and 5). The individual plant species are less frequent in the long abandoned farms, while the vegetation percent cover is far less (Tables 4 and 5). The percentage of bare ground calculated for all quadrates sampled in the long abandoned farms is 49.6 %, while it is only 28 % in the uncultivated "natural" depressions.

Moreover, nine out of the twenty species encountered in all quadrates are confined to the uncultivated "natural" depressions, while four other species are only found in the long abandoned farms.

Although the number of dissimilar species is high, it does not give any indication to major changes in the vegetation composition on the long abandoned farms. That is because four out of the nine species confined to the uncultivated "natural" depressions are not particularly among the important constituents although they are quite common in shallow depressions. These are the two shrubs **Francoeuria crispa and Heliotropium bacciferum** and the two herbs **Aizoon canariense and Herniavia hemistemon.** Another three of the nine species confined to the uncultivated depressions are more or less related if not dependent in their growth on either the microhabitat developed by members of the climatic climax community or are physically supported by these members. This close relationship between certain species probably explains why some of the common species are still absent from the long abandoned farms. For instance, the woody climber **Ephedra foliata** is often encountered in the uncultivated "natural" depressions ascending in **Ziziphus nummularia** bushes, while species like **Ochradenus baccatus** also grow protected by the dense growth of **Ziziphus nummularia. A third example is Anagallis arvensis** which usually grows in the shade of **Acacia** trees (Batanouny 1981).

The above mentioned major associates in the climatic climax community, of the uncultivated "natural" depressions i.e., **Acacia spp.** and **Ziziphus nummularia,** though are frequently encountered in the long abandoned farms, are still young shrubs and have not yet developed the right microhabitat for closely associated species.

The remaining two shrubs which are not encountered in the long abandoned farms are **Capparis spinosa snd Salvia aegyptiaca.** There are two possible exlpanations for the absence of these two species from the long abandoned farms while they are usually common in uncultivated "natural" depressions. The first one is probably that they haven't got enough time to reestablish themselves in the long abandoned farms and the second explanation is that they might have simply missed the sample quadrates.

On the other hand, the four species which are only confined to the long abandoned farms and absent from uncultivated "natural" depressions are: **Phoenix dactylifera, Salsola baryosma, Schanginia aegyptiaca** and **Zygophyllum quatarense.** The date plams are the major and usually the only conspicuous remnants of the cultivation era. **Salsola baryosma and Schanginia aegyptiaca** are representative of the very early abandonment stages as they usually common on fallowlands and salinized cultivated lands (Batanouny 1981). Another possible explanation is that; these two species have low frequencies therefore they might not be true representatives of the vegetation and they might have just been picked up by the sampling methods. A third possible explanation is that; the vegetation on certain sectors of some of the long abandoned farms might possibly be stranded in the very early recovery stages due to high soil salinity resulting from minor topographical differences. This last explanation could also be used to explain the presence of **Zygophyllum quatarense** only in the very early stages of the secondary succession though it is the most frequently encountered species in all area sampled in the long abandoned farms. **Zygophyllum quatarense** dominates the early recovery stages because it is a common plant in slightly saline habitats (Batanouny 1981).

CONCLUSIONS:

The above discussion clearly demonstrates that whatever the original reason of farm abandonment might be, given enough time the vegetation cover ultimately recovers and becomes quite similar to that on the uncultivated "natural" depressions. The steady decrease in soil salinity in the long abandoned farms appears to be the prime factor enhancing change and development in vegetation cover. However, due to different reasons of the failure of agriculture and different histories of abandonment, each single long abandoned farm is unique in the sense that it is in one vegetation recovery stage or another or, as it is often the case, it desplays a mosaic of different successional stages.

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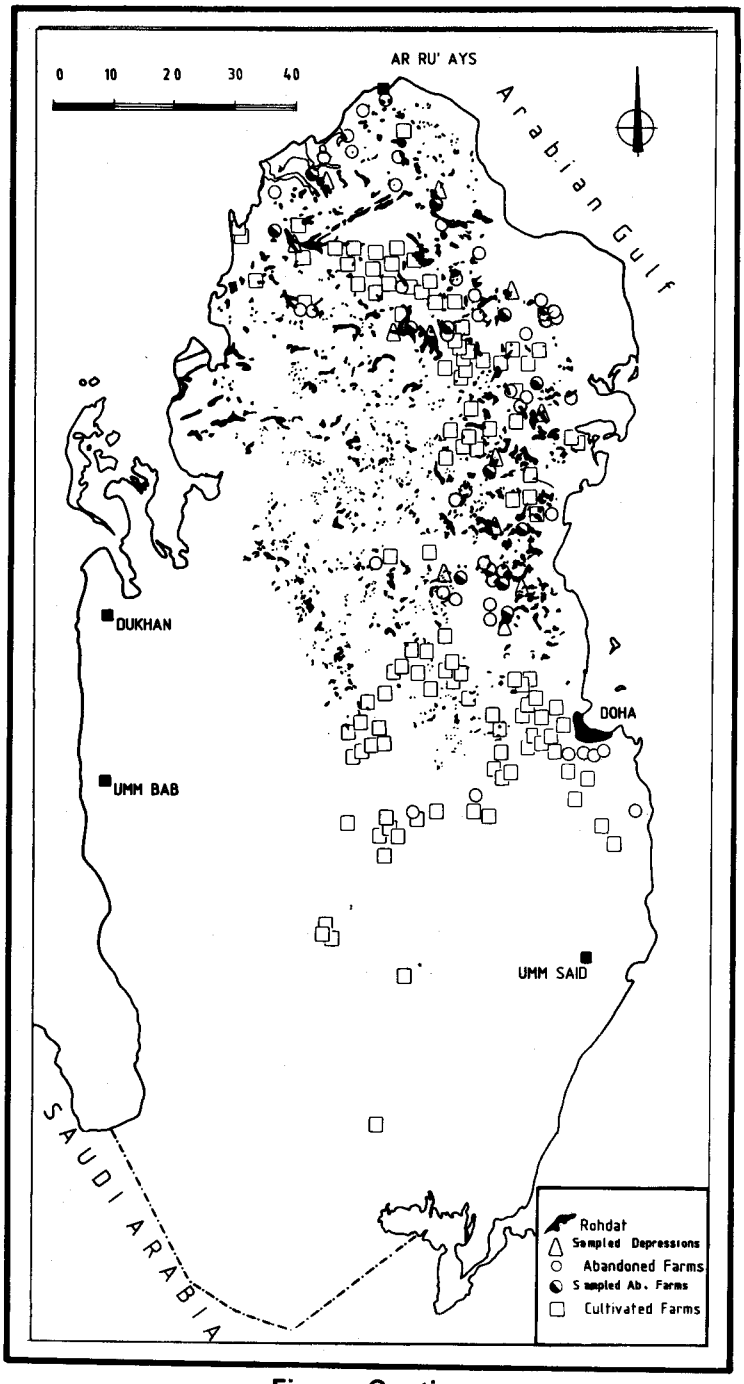

Figure Captions

Figure 1 A map showing the distribution of abandoned farms, uncultivated "natural" depressions and cultivated farms. Notice the location of samples.

Sample Number		PH	E.C	Organic Matter %
1	Sample No 1	8.06	1.15	0.40
2	Sample No 2	7.98	1.55	0.76
3	Sample No 3	7.80	3.52	0.20
4	Sample No 4	8.03	1.70	0.62
5	Sample No 5	7.86	2.10	0.62
6	Sample No 6	7.96	2.40	0.73
7	Sample No 7	7.88	2.60	0.76
8	Sample No 8	7.50	5.45	0.90
9	Sample No 9	7.84	4.50	1.73
10	Sample No 10	8.23	0.60	0.45
11	Sample No 11	7.92	1.70	0.93
12	Sample No 12	8.02	1.90	0.90

E C = Mhos/cm 25°C

Table 1 Analysis results of soil samples taken from abandoned farms showing PH, organic matter and soil salinity expressed as Electrical Conductivity (EC in Mhos/cm at 25°C)

Sample Number		PH	EC	Organic Matter %
1	Sample No 1	7.14	0.50	0.74
2	Sample No 2	8.32	1.10	0.31
3	Sample No 3	8.03	0.70	0.94
4	Sample No 4	7.84	1.80	0.79
5	Sample No 5	7.02	2.10	0.45
6	Sample No 6	8.02	1.14	0.67
7	Sample No 7	7.81	1.40	0.40
8	Sample No 8	7.71	1.70	0.42
9	Sample No 9	7.95	1.90	0.98
10	Sample No 10	8.02	1.55	0.90
11	Sample No 11	8.08	1.15	0.64
12	Sample No 12	7.19	1.70	0.64

E C = M hos/cm 25°C

Table 2 Analysis results of the soil samples taken from uncultivated "natural" depressions showing PH, organic matter and soil salinity expressed as Electrical Conductivity (EC in Mhos/cm at 25°C).

Plant Species	Mean Frequency %
Acacia ehrenbergiana	3.2
Acacia tortilis	6
Aizoon canariense	0.4
Anagallis arvensis	2.4
Capparis spinosa	4.4
Corchorus depressus	3.2
Cymbopogon parkeri	5.2
Ephedra foliata	0.4
Francoeuria crispa	0.8
Heliotropium bacciferum subs. tuberculosm	0.4
Herniaria hemistemon	0.4
Lycium shawii	7.6
Ochradenus baccatus	0.8
Phoenix dactylifera	0.4
Salsola barysoma	0.4
Salvia aegyptiaca	4
Schanginia aegyptiaca	0.4
Stipa capensis	5.2
Ziziphus nummularia	6.4
Zygophyllum quatarense	6
Bare ground	41.2

Table 3 Individual species mean frequencies in percent total metres sampled.

Individual Plant Species	Frequenceis %	Densities %
Acacia ehrenbergiana	4.8	1.6
Acacia tortilis	10.4	9.6
Aizoon canariense	0.8	1.6
Anagallis arvensis	4.8	6.4
Capparis spinosa	8.8	10.4
Corchorus depressus	3.2	4.8
Cymbopogon parkeri	9.6	12.8
Ephedra foliata	0.8	0.8
Francoeuria crispa	1.6	4.0
Heliotropium bacciferum subsp. tuberculosm	0.8	0.8
Herniaria hemistemon	0.8	0.8
Lycium shawii	9.6	8.0
Ochradenus baccatus	0.8	1.6
Salvia aegyptiaca	4.8	4.0
Stipa capensis	0.8	0.8
Ziziphus nummularia	11.2	9.6
Bare ground	26.4	

Table 4 Individual species frequencies and densities on abandoned farms.

Individual Plant Species	Frequencies %	Densities %
Acacia ehrenbergiana	3.2	1.6
Acacia tortilis	5.0	3.2
Corchorus depressus	3.2	3.2
Cymbopogon parkeri	1.6	3.2
Lycium shawii	5.6	5.6
Phoenix dactylifera	1.6	1.6
Salsola baryosma	0.8	0.8
Schanginia aegyptiaca	0.8	0.8
Stipa Capensis	7.2	19.2
Ziziphus nummularia	6.4	2.4
Zygophyllum quatarense	12.0	26.4
Bare ground	52.6	

Table 5 Individual species frequencies and densities on uncultivated "natural" depressions.

Species list :

Acacia ehrenbergiana
Acacia tortilis
Aizoon canariense
Anagallis arvensis
Capparis spinosa
Corchorus depressus
Cymbopogon parkeri
Ephedra foliata
Francoeuria crispa
Heliotropium bacciferum subsp. tuberculosm
Herniaria hemistemon
Lycium shawii
Ochradenus baccatus
Phoenix dactylifera
Salsola barysoma
Salvia aegyptiaca
Schanginia aegyptiaca
Stipa capensis
Ziziphus nummularia
Zygophyllum quatarense

Appendix 1