THE DESERTISATION OF RANGELANDS AND CEREAL CULTIVATED LANDS IN TUNISIA. A STATEMENT ON SOME POSSIBLE METHODS OF CONTROL

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CONTENTS

PreSaharan Tunisia, referred to in this brief report, is located approximately between the 200 and 100 millimeter isohyetal lines.

I. The desertisation process

In Tunisia, desertisation developed especially in the areas bordering the Sahara, and its most apparent evidence is either the appearance of large areas of deflation or the appearance of dunes.

Desertisation involves a whole process characterized by a double phenomenon:

A. Physical phenomenon is caused by

- wind erosion occurring in a zone (O) where soil particles are freed. Once these particles are blown away, a deflation area is constituted, often covered with many boulders.
- transport
- accumulation that takes place in a zone (A); (A) can be close to or far from (O)

Rangelands where desertisation appears generally have a specific microtopography: alternations of small deflation spots and of non-eroded mounds (mosaic-type appearance due to the fact that wind erosion, at least at its beginning, occurs in spots).

B. Biological action: Following erosion, the soil around the roots is broken and the roots are exposed to desiccation as well as to the mechanical action of sand particles. Since the roots do not have protective devices as those of the plants growing in dunary media, the calligonum type, for instance, they wither.

There is a tendency to associate desertisation with climatic change. In reality, a study by Professor Flohn (1) and observations quoted by Le Houérou (5) indicate that there has been no change in rainfall since the beginning of this century. The main agent for desertisation is actually man (1, 5, 2).

II. The main factors of desertisation

Among the main factors the following should be indicated:

- intrinsic factors resulting from well determined local conditions prior to any action by man (Table 1): regimen of the wind; physical properties of the soil; microrelief (including vegetation); macrorelief; types of deposits, if any (9)
- extrinsic factors that modify the local conditions -- especially those related to man, who acts in two ways:

TABLE 1

A. Wind Regimen	B. Physical Properties of the Soil	C. Relief	D. Modifying Agents
Wind velocity at ground surface	Size of the particles	Microrelief -- coefficient of roughness: clods, vegetation	Overgrazing
Wind velocity at various elevations above ground surface	Cohesion and structural stability	Macrorelief -- landscape geomorphology, gradient of the slopes as compared to the horizontal plane	Cereal cultivation followed by grazing or stubble removal
Critical velocities: V_1 determines erosion V_2 determines transport by the wind V_3 determines sand accumulation		Forms of sand accumulation. Their type, number and dimensions	Destruction of vegetation for domestic needs: cooking, heating

1. by direct action: destruction of the natural vegetation (5) for domestic needs (heating, cooking); sowing of cereal crops on sandy soil followed by stubble pasturing or removal of stubble by hand (2)

2. by indirect action: primarily that of livestock (sheep, goats, camels) causing overgrazing. Two cases are to be singled out:

   a) in a non-dry year. For a given type of soil and vegetation there is a load (= carrying capacity) not to be exceeded; beyond it desertisation appears and develops. Grazing during the period of active growth aggravates this phenomenon.

   b) in a dry year. Grazing intensifies erosion and sand movement.

III. The Tunisian PreSaharan project of the U.S./IBP Desert Biome; its objectives and the importance of studies on desertisation

A. Objectives of the project

The Tunisian PreSaharan project is dependent upon the U.S./IBP Desert Biome which, within the scope of the I.B.P., coordinates studies at the Utah State University (Logan), U.S.A. on ecosystems of the four American deserts. The long-term objective of the Tunisian PreSaharan project corresponds to that of the Desert Biome (3, p. 7), that is to say, to describe an ecosystem of the regions of PreSaharan Tunisia in such a way that one can predict changes in the system due to natural or man-made causes.

Thus the purpose is to create a predictive model that could be utilized particularly in range management. In order to develop it, the following has to be accomplished beforehand:

- A comprehensive inventory must be made of the abiotic (rainfall, wind, soil, underground water) and biotic factors: microorganisms, arthropods, rodents, small vertebrates, vegetation, herbivores (goats, sheep).
- The processes interlinking these different factors must be studied.

The mathematical model will be prepared in Logan and then tested on the project plot.

B. Importance to the project of studies on desertisation

1. The plot has been chosen within an area of several thousand hectares where the phenomena of desertisation have appeared.
2. The grazed portion of this plot (with a mixed flock of sheep and goats) will allow the determination of the critical

carrying capacity beyond which desertisation appears as well as the basis for a rational management of rangeland.

3. Another portion of this plot has been put under varied grazing; the study of vegetation evolution will define its conditions of utilization for stabilizing the soil.

4. In the regions where eolian erosion prevails, there often appears on the surface a loamy film that smooths the soil, stabilizes it, and makes germination difficult. A study made by J. Skujins (4) showed that this film contained fungi which could be important in stabilizing the sand; future studies will determine their role.

5. Starting in the fall of 1974 and if financing is provided, the following measurements will be made on the three plots of the project (The first plot presently exists; it is grazed by a mixed flock of sheep and goats.):

   a) measurement of eolian erosion with adjustable metal rods installed on a square of T-shaped structure

   b) measurement of transport by saltation of the ground surface by means of trenches and of transport at various elevations with sand traps

   c) measurement of accumulation by means of posts placed perpendicularly to the accumulation shape (if it has a clear or a starlike shape, or if it has a diffuse form)

   These measurements will be made at five locations (microplots of 40 m x 40 m) on each plot.

6. A comparative study of vegetation evolution on these three plots will bring out the importance of goats in desertisation, as has already been studied particularly in the coastal area (7) of Egypt.

   The second plot will be grazed by a flock of sheep; the third plot will be grazed by a flock of goats.

IV. Desertisation of rangelands and cereal growing areas in PreSaharan Tunisia; proposed methods of control and their efficiency

A. Selection of study areas

Within an ecosystem and where otherwise all things are equal, desertisation seems to increase during dry years (6, 9), as has been also observed in Tunisia (2).

It would be useful to place this phenomenon in a prominent position by selecting three areas (one of which already exists and corresponds to the plots) distributed within the same ecosystem according to a gradient ranging from the coast to the PreSaharan continental zone.

B. Proposed methods of control

Within each of these areas, the methods of control will vary according to the type of farming (livestock or cereal) and the intensity of desertisation.

1. Areas of livestock farming

We will differentiate their management from their exploitation.

a. Management

Two types of management could be tested:

1. where eolian erosion is distributed in spots and when there are ripple marks but no forms of dune accumulation. It would be possible to utilize a technique already used in Australia (2) for cereal crops. It is an alternation of vegetation strips under varied grazing and of grazed strips with the length greater than the width (for instance the area ratio could be 1/4 under varied grazing versus 3/4 grazed) installed perpendicularly to the prevailing winds.

2. where vegetation is scarcer and where sand accumulations (as small dunes) alternate with deflation areas. There it would be possible to plant sammophile species that give large bushes such as Retama retam (0.60 m - 0.80 m high and 1 m in diameter) which, in years when rainfall is close to 20 millimeters, are fed on by goats; this will be accomplished as a complement to the previous management.

In either case, water points have to be established and access roads prepared.

b. Exploitation

1. In want of a more precise determination of the critical carrying capacity, these areas should be utilized under varied grazing rotation as has been done in Australia (6) and Tunisia with a number of heads noticeably smaller than the one empirically determined by the shepherds.

2. In dry or low rainfall years, it would be necessary to move the livestock away from these rangelands (6, 9). This action requires either the agreement of the farmers or, if there is no agreement, a compensatory solution, e.g. establishment of forage reserves (dry or irrigated) or the supply of WFP feed rations.

2. Areas of cereal farming

Where soils are sandy and without structure it would be possible to leave some fields with their stubble and not remove or pasture it (2); eventually it would be possible to test a system

of cultivated strips with the length greater than the width and separated by strips of vegetation under varied grazing. If the plots are large in number, then we can distribute the plots like on a checkerboard in order to avoid the so-called "avalanche" effect. Besides, and as Le Houérou (5) suggests, the use of disc plows should be forbidden.

C. Verification of the efficiency of the control methods

Efficiency of the methods proposed for the control of desertisation must be verified by measurements. They include:

1. Similar measurements to those indicated in Section IV-B; besides those measurements made on microplots (40 m x 40 m), measurement of wind velocity at various elevations (with anemometers) would be added.
2. Study through aerial photographs taken at low altitude of the evolution of desertisation. A system of aerial photographs taken at low altitude can be used according to transects to control vegetation and soil evolution; Dr. Rolf Larsson (Department of Physical Geography, University of Uppsala) has studied its application after interpreting characteristics of river erosion and he could be advantageously consulted on this matter.

V. Conclusions

We have only enumerated a certain number of possible tests to control desertisation. This control, in order to be efficient, must envisage all the aspects of the problem and must constitute an integrated set of measures, as follows:

- technical measures: construction of water points and access roads, establishment of a small irrigated perimeter or, if need be, of forage reserves dry farmed; selection of one type of animal exploitation, limitation of the number of heads in time and space
- sociological measures: often a certain attitude of a population causes the failure in introducing a determined technique; also we find in the traditional system empirical solutions and solutions proven with time. Thus, it is necessary to relate sociological studies to the above technical studies.

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