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REPUBLIQUE TUNISIENNE
MINISTERE DE L'AGRICULTURE
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1983

RAPPORT DE MISSION

3ème REUNION D'EXPERTS SUR L'EVALUATION ET LA CARTOGRAPHIE DE LA DESERTIFICATION

F.A.O. - ROME

25 - 30 OCTOBRE 1982

Présenté par : Ahmed SOUISSI, Adel HENTATI et Ameur M'TIMET

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Présenté par

Messieurs AHMED SOUISSI
ADEL HENTATI
AMOR M'TIMET

Cette réunion a regroupé des représentants de huit pays et de quatre organisations internationales - F.A.O. - U.N.E.S.C.O - A.C.S.A.D. et U.N.E.P., s'intéressant aux études de la désertification. L'ordre du jour des différentes séances (voir annexe 1) a porté sur la mise au net d'une méthodologie permettant l'évaluation et la cartographie à différentes échelles de la désertification.

La F.A.O. a élaboré un projet de légende qu'elle a soumis aux différents pays invités pour le tester dans leurs pays. Le résultat de cet exercice a fait l'objet de rapports qui ont été exposés par les représentants des différents pays qui ont mis l'accent sur les avantages et les insuffisances de cette méthodologie provisoire (voir rapport Tunisien, annexe 3). Les premières séances de la réunion ont été consacrées à la discussion des rapports nationaux. Puis quatre groupes de travail se sont constitués pour sélectionner les meilleurs paramètres permettant une évaluation objective de la désertification dans différentes régions du globe et sa cartographie à différentes échelles. D'autre part deux commissions se sont constituées afin de réfléchir sur la meilleure forme de présentation des rapports nationaux afin de les publier et le suivi du projet de la carte mondiale de la désertification. Les dernières séances ont été consacrées aux discussions des résultats des travaux des différents groupes de travail et des commissions en plus de la discussion d'un premier essai de la carte de la désertification de l'Afrique au 1/5.000.000 présentée par M.T. BOYAJEV.

1) PRESENTATION ET DISCUSSION DES RAPPORTS NATIONAUX.

Ces rapports portent sur les résultats des essais d'application de la méthodologie provisoire de l'estimation et de la cartographie de la déser-

.../...

tification. Dans chaque pays, les chercheurs ont pris des secteurs menacés par la désertification sur lesquels a été testée cette méthodologie. Certains pays ont combiné les données de la méthodologie avec d'autres provenant de leurs expériences personnelles, ce qui a permis de présenter un rapport critique sur la méthodologie. D'autres pays ont pris les critères de la méthodologie et ont essayé de les confronter avec la réalité de leurs secteurs testés, ce qui a permis de sélectionner les critères qui peuvent traduire les plus objectivement possible le phénomène de la désertification.

Enfin un troisième groupe de pays s'est contenté de présenter les problèmes causés par la désertification dans certaines régions faisant objet de projets d'étude et de mise en valeur financés par les instances internationales.

D'autre part, la perception du phénomène de la désertification par les différents chercheurs n'a pas été identique. En effet, certains ont axé leurs recherches sur les phénomènes de désertification causés par les processus hydriques. Pour d'autres, c'est la salinisation des sols qui est prise comme paramètre de base pour l'évaluation de la désertification et un troisième groupe de chercheurs considère les processus éoliens comme le critère le plus fiable qui permet une estimation objective de la désertification.

Les discussions des différents rapports ont permis de dégager que :

- le phénomène de la désertification est le résultat de l'action combinée de plusieurs processus physiques naturels et anthropiques. Son

.../...

estimation doit se faire par la combinaison de plusieurs para-ètres qui traduisent, selon les régions, l'action des processus les plus déterminants dans la désertification du milieu.

- La désertification ne peut pas être évaluée en fonction de l'ampleur et de la dynamique d'un seul processus.

Ces discussions ont permis de rapprocher la perception qu'avaient les différents chercheurs du phénomènes désertification, ce qui a rendu plus facile le déroulement des travaux des groupes.

2) LES CONCLUSIONS SUGGEREES PAR LES GROUPES DE TRAVAIL.

Quatre groupes de travail se sont constitués afin de sélectionner les paramètres les plus fiables permettant une estimation objective de la désertification nécessaire à la cartographie de celle-ci à différentes échelles, les groupes sont :

- désertification par les processus éoliens
- désertification par les processus hydriques
- désertification par la salinisation
- occupation du sol et intervention de l'homme.

La délégation tunisienne s'est partagée entre les trois premiers groupes. On doit mentionner ici que les points de vue soulevés par le rapport tunisien étaient bien considérés et on constitué un point de départ pour la sélection des paramètres fiables et utiles.

Les résultats des travaux de différents groupes ont été discutés lors des séances plénières où fut adoptée la méthodologie définitive (voir annexe 2).

.../...

3) PRESENTATION ET DISCUSSION DE LA CARTE PROVISOIRE DE LA DESERTIFICATION AU 1/5.000.000 DE L'AFRIQUE

L'auteur de cette carte a essayé d'appliquer les critère de la méthodologie provisoire aux régions africaines situées sous la menace de la désertification. Il a présenté trois cartes distinctes représentant l'état actuel de la désertification, sa vitesse d'évolution et les degrés de risque qu'elle fait subir aux régions atteintes.

Il a pris la salinisation comme processus commandant directement la désertification; les autres processus éoliens et hydriques étant relégués au second plan.

Toutefois la légende est présentée d'une façon telle qu'elle laisse à penser que l'auteur n'a pas cartographié la désertification pas l'impact des divers processus pris séparement sur la désertification. Or selon les explications de l'auteur, chaque classe de désertification cartographiée désigne l'action combinée de ces différents processus dont seulement le plus dominant est mentionné sur la carte. Ce procédé cartographique n'a pas été explicite l'auteur à accepté de reprendre la légende afin qu'elle puisse contenir le maximum de renseignements possibles sur les facteurs de la désertification dans les différentes régions cartographiées.

RECOMMANDATIONS GENERALES

- La première recommandation concerne l'adoption d'un même plan de travail pour la publication des rapports nationaux des différents pays (voir annexe 3).

.../...

- Le second type de recommandation est présentée par la commission de reflexion sur le suivi du projet de la carte mondiale de la désertification (voir annexe 4).

- La publication en quatre langues (Anglais, Arabe, Espagnol et Français) de la méthodologie.

THIRD EXPERT CONSULTATION ON DESERTIFICATION ASSESSMENT AND MAPPING

Ethiopia Room C 285/9

25 - 29 October 1982

A G E N D A

Annexe 1

Monday, 25 October 1982

09.15	Participants assemble in Ethiopia Room (C285/9)
09.30	Opening of the session by Dr. F.W. Hauck, Chief, Soil Resources, Management and Conservation Service Adoption of the Agenda General Information on the preparation and testing of the methodology
10.15	Coffee break
10.30	Presentation and discussions on the country reports: 10.30 - 11.30: Texas 11.30 - 12.30: Mexico
12.35	Lunch break
	14.30 - 16.00: Tunisia (2 reports)
16.00	Coffee break 16.15 - 17.30: Upper Volta
17.30	End of first day's session
17.45	Cocktail - Indonesia Room (8th floor)

Tuesday, 26 October 1982

09.00	Presentation and discussions on the country reports: 09.00 - 10.15: Sudan
10.15	Coffee break 10.30 - 11.30: Syria 11.30 - 12.30: Turkmenia
12.30	Lunch break
	14.30 - 16.00: Pakistan (2 reports)
16.00	Coffee break 16.15 - 17.30: Australia
17.30	End of the second day's session

Wednesday, 27 October 1982

09.00	Presentation and discussions on the country reports: 09.00 - 10.15: Report presented by Dr. C.J. Tucker
10.15	Coffee break 10.30 - 11.30: Report presented by Dr. L.T. Kadry and Mr. C. Travaglia 11.30 - 12.30: Report presented by Dr. G.M. Higgins
12.30	Lunch break

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14.30 Discussions on the provisional methodology for desertification assessment and mapping
16.00 Coffee break
16.15 Continuation of the discussion
17.30 End of the third day's session

Thursday, 28 October 1982

09.00 Continuation of the discussion on the provisional methodology presentation
10.15 Coffee break
10.30 Conclusions and recommendations for the finalization of the methodology
12.30 Lunch break
14.30 Discussions on the World Map of Desertification at 1:5 000 000:
Presentation of the provisional desertification maps of North Africa at 1:5 000 000: Present status of desertification
Rate of desertification
Risk of desertification
16.00 Coffee break
16.15 Discussions
17.30 End of the fourth day's session

Friday, 29 October 1982

09.00 Continuation of the discussions on the World Map of Desertification
10.30 Coffee break
10.45 Conclusions and recommendations
12.30 Closing of the session

CRITERIA FOR DESERTIFICATION ASSESSMENT

Annexe. 2-

Wind Erosion

Criteria	Classes of Desertification			
	Degree of Impact			
	None or low	Moderate	Severe	Very Severe
Status				
Surface area covered by sand sheets, hummocks, dunes, % of total	< 5 < 30	5 - 15 30 - 60	15 - 30 > 60	> 30 (mobile dune - (fixed dune
Loss of soil depth over root-inhibiting layer				
a) soil depth /m, % loss	< 25	25 - 50	50 - 75	> 75
b) soil depth /m				
Thickness of remaining soil	1 m -90cm	90 - 50	50 - 10	< 10 cm
Present productivity as % of potential productivity (at any one level of management)	100 - 75	75 - 50	50 - 25	< 25
Surface gravels, % of surface covered, when man-made erosion responsible for surface gravels	< 15	15 - 30	30 - 50	> 50

Socio-Economic Factors

Several factors useful to confirm or deny conclusions based on physical and biological factors. They include animal numbers, rural population, out-migration, family income, land use pattern, health status, farm size, fertilizer use, etc.

Rate	Number of years for 50% loss of land area			
	None to slight 50 years	Moderate 25 years	Severe 15 years	Very Severe 10 years
Expansion of cropped land into marginal areas, %/yr	< 2	1 - 2	2 - 5	> 5
Volume of loose sand deposited in sheets, t/ha/yr	< 300	300-1000	1000-5000	> 5000
Growth rate of affected area as % of total productive land, per year	< 1	1 - 2	2 - 5	> 5
Soil loss, t/ha/yr				
a) soil /m thick over root-inhibiting layer	< 30	30- 50	50 - 100	> 100
b) soil /m thick over root-inhibiting layer	< 10	10- 50	50 - 100	> 100

Time period to determine rate:

Irrigated land	- 3 years
Dryland	- 5 - 10 years
Rangeland	- 10 years
Forestry	- 20 years

Risk

Extrapolation of current rate 10 or 20 years ahead. Evaluate estimated status for future. Express risk as expected future status. Adjustments can be made by projecting changes in animal and human population, government policies, income status, etc.

CRITERIA FOR DESERTIFICATION ASSESSMENT

WATER EROSION

CRITERIA	Classes of Desertification			
	Slight	Moderate	Severe	very Severe
Status Criteria				
Surface Status (%)	Gravel and Stones < 10	Stones and Boulders 10 - 25	Boulders and Rocks 25 - 50	Boulders or exposures of rocks > 50%
Type of erosion	In Sheets and rills slight to moderate	In sheets and rills moderate to severe	In sheets and rills and gullies severe	In sheets, rills and gullies very severe
Subsoil presence (%)	< 10	10 - 25	25 - 50	> 50
Surface affected by gullies (%)	< 10	10 - 25	25 - 50	> 50
Soil Thickness (cm)	> 90	50 - 90	10 - 50	< 10
Sediment deposits in dams in % of retention per year	< 0.5	0.5 - 1.0	1 - 2	> 2
Rate Criteria	The above parameters will be evaluated with a periodicity of every 5 years			
Risk Criteria				
Type	< 8	< 16	< 30	> 30
Potential Soil Loss in ton/ha/yr 1/	< 4	4 - 40	40 - 400	> 400
2/	< 2.5	2.5 - 150	150 - 800	> 800

1/ FAO methodology

2/ Universal Soil Loss equation with present vegetative cover

Procedure to classify Current Rate of Desertification

CLASS OF RATE	CLASS OF STATUS DESERTIFICATION AFTER 5 YEARS
SLIGHT	slight, Moderate, Severe, very Severe
MODERATE	Slight, Moderate, Severe, very Severe
SEVERE	slight, Moderate, Severe, very Severe
VERY SEVERE	slight, Moderate, Severe, very Severe

Soil Crusting and Compaction

Nature of Cementation	Classes of Desertification			
	Slight	Moderate	Severe	Very Severe
Calcic accumulation 1/ and cementation form/depth in cm	Generalized accumulations and/or nodules / 30-50	Crusting / 20-50 or Generalized accumulations and/or nodules / < 30	Crust / 10-30 or crusting / < 30.	Crust / < 10
Gypsic accumulation and cementation form/depth in cm	Gypsum accumulation / 50-100	Gypsum sand or powder / 30-50	gypsum powder / < 30	Crust / < 10
Ferric accumulation and cementation form/depth in cm	nodules and concretion / 30-50	Crusting / 30-50 or nodules and concretion / < 30	ironstone / 10-30 or crusting / < 30	ironstone / < 10
Silicon dioxide accumulation and cementation / depth in cm	Crusting / > 50	Crusting / 30-50	Crusting / 10-30	Crusting / < 10

1/ When 2 or 3 forms of accumulation are found in the pedologic profile, the horizon which is the nearest to surface must be selected as determining horizon to evaluate the status of desertification

CRITERIA FOR DESERTIFICATION ASSESSMENT

Salinization

Criteria	Classes of Desertification			
	Slight	Moderate	Severe	Very Severe
Status Criteria:				
- ECe x 10^3 mmhos (maximum accumulation within 75 cm depth) in growing period of important crops	< 4	4 - 8	8 - 16	> 16
- ESP (in %) in part of soil (Tubular pores ≥ 1 mm dia)	< 5 (present)	5 -20 (present)	20 - 45 (present)	> 45 (absent)
Crop yields (% of yields of similar non desertificated soils) using wheat or maize as a reference crop under irrigation, and wheat, millet or sorghum under rainfed cultivation	90 - 100	70 - 90	40 - 70	40
Morphological indications	no salts visible	spots of salts	spots and mycelium of salts	crystals efflorescence pseudo sand, salt crust or salt puff
- Depth of soil affected (cm)	0	< 30	30 - 50	> 50
- Surface affected (% area)	< 5	5 - 20	20 - 50	> 50
Rate Criteria				
- Rate of increase in salt affected area (%/year) with EC ≥ 16 mmhos/cm and/or ESP ≥ 20	< 0.5	0.5 - 1.0	1.0 - 2.5	> 2.5
Observation period of 10 years				
Risk Criteria				
- Number of dry months	≤ 9	10 - 11	12	12
- Average depth to groundwater table (cm)	> 300	100 - 300	50 - 100	< 50
- Characteristics of irrigation water:				
Salt content in g/l	< 0.5	0.5 - 1.5	1.5 - 2.5	> 2.5
EC in mmhos	< 0.75	0.75- 2.25	2.25- 3.5	> 3.5
SAR	< 5	5 - 7	7 - 10	> 10
RSC	< 1.25	1.25- 2.5	2.5 - 4.0	> 4.0

CRITERIA FOR DESERTIFICATION ASSESSMENT

Salinization

Criteria	Classes of Desertification			
	Slight	Moderate	Severe	Very Severe
Status Criteria:				
- ECe x 10^3 mmhos (maximum accumulation within 75 cm depth) in growing period of important crops	≤ 4	4 - 8	8 - 16	> 16
- ESP (in %) in part of soil (Tubular pores ≥ 1 mm dia)	≤ 5 (present)	5 -20 (present)	20 - 45 (present)	> 45 (absent)
Crop yields (% of yields of similar non desertificated soils) using wheat or maize as a reference crop under irrigation, and wheat, millet or sorghum under rainfed cultivation	90 - 100	70 - 90	40 - 70	40
Morphological indications	no salts visible	spots of salts	spots and mycelium of salts	crystals efflorescence pseudo sand, salt crust or salt puff
- Depth of soil affected (cm)	0	≤ 30	30 - 50	> 50
- Surface affected (% area)	≤ 5	5 - 20	20 - 50	> 50
Rate Criteria				
- Rate of increase in salt affected area (%/year) with EC > 16 mmhos/cm and/or ESP > 20	≤ 0.5	0.5 - 1.0	1.0 - 2.5	> 2.5
Observation period of 10 years				
Risk Criteria				
- Number of dry months	≤ 9	10 - 11	12	12
- Average depth to groundwater table (cm)	> 300	100 - 300	50 - 100	< 50
- Characteristics of irrigation water:				
Salt content in g/l	≤ 0.5	0.5 - 1.5	1.5 - 2.5	> 2.5
EC in mmhos	≤ 0.75	0.75- 2.25	2.25- 3.5	> 3.5
SAR	5	5 - 7	7 - 10	10
RSC	≤ 1.25	1.25- 2.5	2.5 - 4.0	> 4.0

Criteria	Classes of Desertification			
	Slight	Moderate	Severe	Very Severe
- Physiography/landform	Levees and high plains	Level plains	Basins and channel remnants	Basins and channel remnants
- General drainage	good	imperfect	poor	poor
- Internal drainage	≥ moderate	slow	very slow	very slow
- Soil management practices and drainage system	good/special	moderate	poor	poor

NOTES:

1. While considering EC and ESP figures, the percent area affected and crop yield depression should be taken into account, considering the crop yield as a deciding criterion. Likewise, the depth of soil affected should be used in combination with EC and ESP using the reduction in crop yield as a guiding criterion.

2. In soils containing gypsum, ESP is meaningless. So one EC should be considered, and probably the EC limits for various classes would be a bit higher.

3. In soils having problems due to high ESP, EC has limited meaning but the interaction of ESP and soil permeability or internal soil drainage should be considered. The soil amendment (gypsum) requirements may be used as a guiding factor.

4. Interaction of different criteria should be taken into account for estimating the resultant effect of salinity/sodicity problem, using crop yields as a guiding factor. For example, the number of dry months and salt content of irrigation water will act in combination, allowing the use of highly saline/sodic water in areas having 9 dry months.

5. The EC, SAR and RSC limits for irrigation water under risk criteria will be higher if only winter cropping is the land use. In summer the harmfull effects of high EC, SAR and RSC are much greater than in winter. The cropping intensity also has a modifying effect.

6. In assessing the adverse effects of salinity/sodicity, the crop yields should be used as a guiding factor together with land capability class and the source and the rate of internal return flow of irrigation water.

7. In assessing the risk of desertification, the basic consideration should be what the condition is expected to be after 10 or 20 years, in relation to the present condition. If no change in 20 years is visualized, the risk is slight; if the change of one step in 20 years is expected (e.g. slight to moderate or moderate to severe), the risk is moderate; if the change of two steps is expected, the risk is severe; and if more than two steps, then it is very severe. Likewise, the rate could be assessed by comparing the condition 10 or 20 years ago with the present condition.

8. The class 'slight' should be taken to mean no problem or negligible problem.

VEGETATION CRITERIA

Current Status	Classes: None to slight	Moderate	Severe	V. severe
Canopy cover of perennial plants (%) (1.)	> 50	50-20	20-5	< 5
Range condition % of climax vegetation (2.)	> 75	75-50	50-25	< 25
% of potential productivity (3.)	> 75	75-50	50-25	< 25
RATE				
Decline in % of biomass production/ha over a 10 year period	0-10	10-25	25-50	> 50
Range cover trend line over a 10 year period	0 to -0.25	-0.25 to -0.50	-0.50 to -0.75	> - 0.75
Range condition trend line over a 10 year period	0 to -0.25	-0.25 to -0.50	-0.50 to -0.75	> - 0.75
Decrease in area of woodland over a 10 year period	0 to -0.1	-0.1 to -0.3	-0.3 to -0.6	> -0.6

These may differ from wind criteria class limits

Criteria	Classes of Desertification			
	Slight	Moderate	Severe	Very Severe
- Physiography/landform	Levees and high plains	Level plains	Basins and channel remnants	Basins and channel remnants
- General drainage	good	imperfect	poor	poor
- Internal drainage	$\geq$ moderate	slow	very slow	very slow
- Soil management practices and drainage system	good/special	moderate	poor	poor

NOTES:

1. While considering EC and ESP figures, the percent area affected and crop yield depression should be taken into account, considering the crop yield as a deciding criterion. Likewise, the depth of soil affected should be used in combination with EC and ESP using the reduction in crop yield as a guiding criterion.

2. In soils containing gypsum, ESP is meaningless. So one EC should be considered, and probably the EC limits for various classes would be a bit higher.

3. In soils having problems due to high ESP, EC has limited meaning but the interaction of ESP and soil permeability or internal soil drainage should be considered. The soil amendment (gypsum) requirements may be used as a guiding factor.

4. Interaction of different criteria should be taken into account for estimating the resultant effect of salinity/sodicity problem, using crop yields as a guiding factor. For example, the number of dry months and salt content of irrigation water will act in combination, allowing the use of highly saline/sodic water in areas having 9 dry months.

5. The EC, SAR and RSC limits for irrigation water under risk criteria will be higher if only winter cropping is the land use. In summer the harmfull effects of high EC, SAR and RSC are much greater than in winter. The cropping intensity also has a modifying effect.

6. In assessing the adverse effects of salinity/sodicity, the crop yields should be used as a guiding factor together with land capability class and the source and the rate of internal return flow of irrigation water.

7. In assessing the risk of desertification, the basic consideration should be what the condition is expected to be after 10 or 20 years, in relation to the present condition. If no change in 20 years is visualized, the risk is slight; if the change of one step in 20 years is expected (e.g. slight to moderate or moderate to severe), the risk is moderate; if the change of two steps is expected, the risk is severe; and if more than two steps, then it is very severe. Likewise, the rate could be assessed by comparing the condition 10 or 20 years ago with the present condition.

8. The class 'slight' should be taken to mean no problem or negligible problem.

VEGETATION CRITERIA

Current Status	Classes: None to slight	Moderate	Severe	V. severe
Canopy cover of perennial plants (%) (1.)	> 50	50-20	20-5	< 5
Range condition % of climax vegetation (2.)	> 75	75-50	50-25	< 25
% of potential productivity (3.)	> 75	75-50	50-25	< 25
RATE				
Decline in % of biomass production/ha over a 10 year period	0-10	10-25	25-50	> 50
Range cover trend line over a 10 year period	0 to -0.25	-0.25 to -0.50	-0.50 to -0.75	> - 0.75
Range condition trend line over a 10 year period	0 to -0.25	-0.25 to -0.50	-0.50 to -0.75	> - 0.75
Decrease in area of woodland over a 10 year period	0 to -0.1	-0.1 to -0.3	-0.3 to -0.6	> -0.6

These may differ from wind criteria class limits

Risk	Classes None to slight	Moderate	Severe	V. severe
Increase of arable dryland (%/yr)	<0.5	0.5 - 2.0	2.0 - 5.0	>5.0
Increase in livestock numbers (%/yr)	0	0 - 0.5	0.5 - 4.0	>4.0
Overgrazing (A.U. over carrying capacity/ha) (5)	0	0.1 - 0.4	0.4 - 1,0	>1.0
A.U. carrying capacity/ha	>1.0	1.0 - 0.4	0.4 - 0.1	<0.1
Ratio of population to population supporting capacity (6)	<0.15	0.15 - 0.35	0.35 - 0.55	>0.5

Notes

It is anticipated that not all criteria can be assessed in all countries and that the class/units suggested are only guidelines.

1. Class/units for canopy cover will vary for different vegetation associations.

2. Range condition assessment can be based on the Quantitative Climax Concept (Dyksterhuis, 1949, explained on p. xx of this methodology). This approach may only be applicable in certain areas where data is available about pristine vegetation conditions.

3. Can be assessed by reference to exclosures

4. Recent advances have enabled assessments of biomass of fodder production to be made using satellite data. Where such data can be collected over a 5-10 year period an indication of rate of desertification can be made.

5. Calculated by determining the number of animal units (domestic and wild animals) greater than proposed carrying capacities.

6. Refer to p.xxx of this report A value 1.0 for this ratio would indicate that food production already exceeds demand and that pressure of land resources is not high.

Organic matter - no major changes proposed to previous version. Only

Annexe 3.

DESERTIFICATION ASSESSMENT AND MAPPING

SUMMARY COUNTRY REPORTS

METHODOLOGY TESTING

1. 10 - 20 pages, double-spaced lines

2. Report outline:

   A. Background information on project area (environment)
   B. Which criteria were used, and why?
   C. Which criteria were not used, and why?
   D. Problems encountered in testing the methodology?

      1. Data availability (what data)
      2. Map scales used (problems with respect to each map scale)
      3. Time needed for each map scale

   E. Cost of the test project?
      (salaries, travel, map preparation, etc.)

   F. Specialists involved in the project and their fields of specialization

   G. Perception in each country at the governmental level of the need for desertification assessment and mapping

   H. Comments on the provisional methodology.

Annex 4

FOLLOWING ACTIVITIES ON THE PROJECT: DESERTIFICATION ASSESSMENT AND MAPPING

RECOMMENDATIONS:

1. To recommend countries the utilization of FAO-UNEP methodology for desertification assessment and mapping in order to have maps at national, regional and global levels, this will also help to reorientate research and development projects.

2. To establish training programmes for academical and technical staff in order to use FAO-UNEP methodology.

3. To distribute in a wide way the final report to decision makers, scientists, technicians and scientific associations.

4. The above activities should be basic for periodical reviewing in order to improve the methodology.

5. These actions will be connected to several international efforts such as:

   a. World Soil Policy;

   b. Plan of Action to Combat Desertification;

   c. MAB Programme;

   d. International Hydrological Programme.

Annexe.5.

ATTEMPTS TO ASSESS AND MAP DESERTIFICATION IN STATIONS REPRESENTATIVE OF TUNISIAN SEMI-ARID AND ARID ZONES

Synthesis Report

F.A.O. Methodology for assessment and mapping of desertification enables to identify zones that suffer from desertification, and the risks they run. Are we able to assess this phenomenon at the present time? What are the limits of this methodology, and to what extent should certain data be applied instead of others? Now, the question is to test this methodology in two zones in the arid and lower semi-arid.

Tests undertaken in test zones in central and southern Tunisia enabled us to make some remarks concerning assessment of three aspects of desertification (current status, rate and risk).

1. Assessment of currrent status of desertification.

Criteria for determination of the degree of desertification presented by the methodology have shown their resiliency. This feature makes it possible to use these criteria everywhere in the arid, and lower and middle semi-arid. However, if we take into account the boundaries of classes as defined by the methodology, application of this one in the upper semi-arid and sub-humid does not yield satisfactory results. As a matter of fact, some watersheds in the upper semi-arid, in northern Tunisia, have such a high density of gullies, that they will be automatically mapped, according to the criteria used by this methodology as zones with severe desertification, whereas this does not seem to be the case because of the high standard of production of lands and the low dynamics of gullying.

On the other hand, the success of this methodology lies, above all, in the fact that it uses the rate of the amplitude of desertification. This was proved at the time of study of test zones of Gour El Agab in central Tunisia and Dar Dhaoui in southern Tunisia (see report in annex). The impact of the dominant process on the landscape masks the effect of certain secondary processes which, in some cases, should not be neglected. This is confirmed by the example of Gour El Agab, where wind erosion as a secondary process does but increase desertification dominated by water processes (surface erosion, and gullying). On the other hand, it may happen that we are in presence of two dominant processes working at the same time: wind and water erosions (regions of Sfax and Maknassy). In this case, assessment of the status of desertification should be made by considering the nature and the evolution of the activity of these two processes at the same time, a point the methodology did not say anything about. Furthermore, the process of bank sapping can constitute in some places a very active desertification process since it often entails annihilation of terrace lands which may constitute the only fertile lands in the landscape (see the area of Gour El Agab). Now, this kind of process was not well considered by the methodology as a decisive factor of desertification. Therefore it is preferable to establish relations between the background movement of banks and the width of endangered terraces, or combine this process with the density of gullies in order to be able to assess, in the most possible objective way, the degree of desertification caused by gullying. A mean density of gullies causes, after the methodology, a moderate status of desertification. However, when it is accompanied by a very active process of bank sapping, the result is a severe desertification. (After Tunisian standards, a sapping is considered as active when background movement is equal to one meter per year.)

Vegetation cover was rightly considered as the cause and/or the consequence of desertification processes, thereby playing a decisive role in environmental degradation. Nevertheless, the methodology did not consider in detail the vegetation cover factor; for we distinguish two ypes of vegetation cover: natural and agricultural. The protection, each of these two types of cover brings to the soil, is not the same. Some plots in central Tunisia, with the same geofacies but used differently (some cultivated as cereals, the others as a steppe of alfa), do not resist in the same way against the sapping process. As for plots with cereals, desertification is more serious for the reason that the soil undergoes a repeated breaking up of the surface horizon during the year, which facilitates their ablation. For plots with natural vegetation (alfa), even though the present cover is lower than for plots with cereals, sapping is slower and more superficial, thus causing a less serious desertification.

All these considerations should be taken into account so that this methodology can be operational in different environments and at different scales.

2. Determination of the evolution rate of desertification.

It consists of knowing the acceleration of the desertification process in the course of time. After the methodology, accelaration assessed by the use of some measurable criteria (gradual increase in the volume of erosion materials, increase in sanded surfaces, etc.). These criteria, which are quite important, can not be applied unreservedly for all processes, different morphological units, and at all scales.

Classes of soil volume should be reconsidered in terms of soil thickness since we are assessing the rate of desertification. As a matter of fact, desertification which affects shallow crusted soils (depth $\leq$20cm) of central Tunisia, and causing a loss of 1 to 3 mm/year, has, according to the methodology, a moderate rate, whereas it seems that this rate is quite high for these soils. Is it, then, necessary in this case to introduce the ratio $\frac{\text{Sapped depth}}{\text{Total depth}}$?

Assessment of the evolution rate of desertification processes through the tonnage of erosion materials is easy to do when we have to deal with large watersheds controlled by measurement stations. They can be studied easily at small scales. However, for a mapping at higher scales, a zone of study may not have any station; other criteria easy to determine should then be used. Since the effect of the desertification process is very closely related to the type of protecting vegetation cover, it would be preferable to assess the acceleration of this effect by the increase of cleared lands or degradation of zones protected against erosion.

Indeed, sapping rate is higher when clearing is made in favor of cereal crops than arboriculture. It is preferable to go deeply into the analysis of this parameter, and integrate it into the methodology. For, it has a direct impact on soil degradation in arid and semi-arid environments.

As for desertification caused by wind processes, assessment of their evolution rate, could be made in various ways according as we are in presence of wind erosion with deflation-accumulation, such as in the zone of Dar Dhaoui, or with huge sandings (oasis of Menchia; vicinity of Ben Guardane). In the first case, the ratio $\frac{\text{ploughed surface}}{\text{non ploughed surface}}$ between two dates is used. As a matter of fact, cultivation is considered, from the experiences of Dar Dhaoui and Zougrata, as the dominant cause of wind erosion of the landscape (this is for currently observed winds). This process is all the more active as ploughed lands increase.

For this we propose the ratio $\frac{\text{sanded surfaces}}{\text{non ploughed surface}}$ instead of the ratio $\frac{\text{sanded surfaces}}{\text{total surface}}$ advanced by the methodology. The latter ratio uses the threatened surface, a variable which is very difficult to assess. It seems that the boundaries of the proposed classes for the ratio $\frac{\text{sanded surface}}{\text{total surface}}$ could suit the new proposed ratio.

In the case of desertification by large sandings, assessment of the evolution rate consists of determining changes which affect these deposits between two dates. A decrease in the volume of sand for a sanded surface, results in sandings in neighbouring regions, and an increase give evidence of the existence of surrounding zones undergoing a continous deflation. In both cases, rate can be estimated by the following formula, which is based on the sanded surface at a well defined date:

$$R = \frac{St_2 - St_1}{St_1} \times \frac{1}{n} \times 100$$

Where:

St_1 = surface occupied by sandings at the beginning of the period.

St_2 = surface occupied by sandings in the end of the period

n = duration of observation between t_1 and t_2 in years.

If $St_2 < St_1$, a rare case, this means that the zone is being desanded.

If $St_2 > St_1$, several cases can be distinguished:

$R < 1\%$, low evolution rate

$1 < R < 3\%$ moderate evolution rate

$3 < R < 8\%$ accelerated evolution rate

$R > 8\%$ very accelerated evolution rate

When we have to deal with a sanded zone, a part of which is occupied by vegetation, the effective evolution rate of sanding is definitely lower than that of the first case. Here it is a question of potential evolution rate, since these accumulations of sand constitute a reservoir of sand which could function as soon as the protecting vegetation cover is destroyed or becomes deteriorated, or if wind increases in violence. The evolution rate could be given by the following ratio:

$$R(\%) = \frac{Sd_2 - Sd_1}{Sd} \times \frac{1}{n} \times 100$$

Where:

Sd_1 = surface occupied by fixed dunes at the beginning of the observation period

Sd_2 = surface occupied by fixed dunes in the end of the observation period

Sd = total surface occupied by dune sandings at the beginning of the observation period

n = duration of the observation period in years.

If $Sd_2 < Sd_1$, fixation of dunes by vegetation is receding; wind processes are changing at a speed estimated from the previous formula.
If $Sd_2 > Sd_1$, we are in presence of a deceleration of the wind phenomenon, since the zone is being protected against desertification by vegetation.

A good assessment of the evolution rate of degradation processes may be considered as a first criterion for the determination of the risk of desertification a region runs.

3. Determination of desertification risks.

This aspect is important since all planning actions of an environment threatened by desertification, depend upon it. It should enable to bring out sectors which - although, at the present time, are not undergoing desertification - could be hit by this phenomenon more or less severely.

The first criterion to emphasize, in order to determine risks, remains the evolution rate of processes causing desertification in a given region.

We suggest that this criterion be correlated with one of the measurable parameters which determine the dominant desertification process in the region. These parameters are numerous. We can quote among others:

- the decrease in soil fertility revealed by the fall in yields,
- the behavior and the frequency of meteorological agents responsable for the start of the dynamics of desertification processes (frequency of violent winds, frequency of teeming rains),
- the inadaptation of cropping modes and bad land use such as overgrazing and increase in human density in rural zones.

In order to assess desertification risks in the test sectors, we proceeded in the following way:

- For the sector of Chour El Agueb (central Tunisia), the degree of the risk is considered according to the interaction between the evolution rate of superficial sapping and gullying, and human density and the type of outcrops.

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The table below illustrates this interaction:

Nature of outcrops, and human density	Evolution of the dominant process		Very High	High	Moderate	Low
Loose formation	Density of dwellings	High density	4	4	3	2
		Mean density	4	3	2	2
		Low density	3	2	1	1
Mixed formation	"	High density	3	2	1	1
		Mean density	2	2	1	1
		Low density	1	2	1	1
Coherent formation	"	High density	1	2	1	1
		Mean density	2	1	1	1
		Low density	1	1	1	1

4 = very high risk of desertification

3 = high " " "

2 = moderate " " "

1 = low " " "

- For the sector of Bir Dhaoui, oasis of Menchia, and vicinity of Ben Guerdane (southern Tunisia), the degree of risks is considered in terms of the interaction between the evolution rate of wind processes (deflation, accumulation, sand cut), and the frequency of violent winds as indicated in the following table:

Following examination of this methodology, it can be noted that we are in the presence of a lot of various data, more or less rich in information. Their classification according to their importance is often difficult because of the complexity of phenomena causing desertification. We determined for each case the prevailing factor that should be considered when mapping desertification. The other factors of minor importance depend, generally, on the main chosen factor, and will be considered at the time of mapping.

Examples:

- Superficial surface erosion was chosen as the determinant factor of desertification for the semi-arid zone, whereas the dynamics of sanding-deflation, accumulation and salinization were chosen for the three test zones of arid Tunisia.

  It should be noted that some factors were preferred to others for lack of reliable and available data.

  The choice of factors is very closely related to the mapping scale. Thus, for a large-scale mapping, generally, a single factor determines the desertification, for we are in a relatively homogenous geographical setting.

For small-scale mapping, the determinant factors vary from one sector to another, which leads not to use the same factor for mapping. But this does not exclude the possibility of having evaluation of desertification by a homogenous map.

Mapping representation

We conceive the representation, on the same map, of the three aspects of desertification namely: current status, rate and risk. For this, we suggest the following:

- current status:
  - . in letters, parameters such as:
    Vegetation (V), Wind (W), Crust (C), etc...
  - . in numbers, low (1), moderate (2), severe (3), very severe (4)
- rate (which expresses dynamics in the processes):
  - . in trams going from class one (low) to class four (very severe):

low
moderate
severe
very severe

-risk:

- . in colored bands in order to enable to this aspect to be more expressive:
  - orange : low
  - pink : moderate
  - red : severe
  - bright red : very severe

This representation mode has the advantage to bring out in relief by colors the sectors to safeguard to avoid desertification. It has also the drawback of enabling to distinguish desertification status only by letters.

FIN

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VUES