Assessment and Mapping of Desertification Sensitivity in an Insular Sahelian Mountain Region
Case study of Ribeira Seca Watershed, Cape Verde

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1. INTRODUCTION

Desertification phenomenon is consequence of a set of various processes in arid and semi-arid environments, in which water is the major factor for the use of lands in the ecosystems. It is generally associated to geo-physical conditions (e.g. soil, slope, vegetation cover) coupled with inclemency of drought and also water availability. Several methods have been developed to evaluate desertification process, including mathematical models, parametric equations, remote sensing, direct observation and measurement.

2. OBJECTIVE:

General : Develop a desertification assessment model for arid and semi-arid areas in Cape Verde.
Specific: Assess and map desertification sensitivity in the main anthropogenic watershed of Santiago Island, Ribeira Seca (RSW)

3. MATERIAL & METHODS

Study site description:

- Location : East-central section of Santiago Island ; latitudes 15°07'40''N and 15°01'55''S ; longitudes 23°32'05''E and 23°38'40''W.
- Surface area: 71.5 Km²; Annual rainfall: 200 to 650 mm
- ***Medallus Model*** (Kosmas et al., 1999)
- Selected 104 sites (DESIRE approach for describing land degradation indicators)
- Field information on main indicators used in GIS

Stage 1: Six quality indices (soil, climate, vegetation, management, water runoff and social) selected from sub-indicator layers

Stage 2: Quality layers combined in single desertification sensitivity index

Eq.1: $\text{Index}_x = [(\text{Layer}_1)*(\text{Layer}_2)]*(\text{Layer}_3)]*\ldots(\text{Layer}_n)]^{1/n}$ as very high, high, moderate, low or very low (Tables 1)

Stage 3: Indicators combined to calculate single index of desertification risk

Eq. 2: Desertification Risk = $(SQI*CQI*VQI*MQI*WRQI*SoQI)^{1/6}$

Table 1:Classification of environmental sensitivity index (Ferrara *et al.* 1999, Kosmas *et al.* 1999)

Desert. risk classes	Sensitivity score	Type of areas and sign	Short description
Very low	[1.000 – 1.160]	Not affected (N)	Areas in which critical factors are very low or absent, with good balance between environmental and socio-economical factors
Low	[1.170 – 1.225]	Potential (P)	Areas threatened by desertification under significant climate change, if a particular combination of land use is implemented or where offsite impacts will produce severe problems. This would also include abandoned land, which is not properly managed.
Medium	[1.226 – 1.265] [1.266 – 1.325] [1.326 – 1.375]	Fragile (F1) Fragile (F2) Fragile (F3)	Areas in which any change in the delicate balance between natural and human activity is likely to bring about desertification.
High to very high	[1.376 – 1.415] [1.416 – 1.530] > 1.530	Critical (C1) Critical (C2) Critical (C3)	Areas already highly degraded through past misuse, presenting a threat to the environment of the surrounding areas or with evident desertification processes.

4. RESULTS & DISCUSSION

- ✓ Fig. 1 shows the quality maps for the six main indicators
- ✓ Soil, vegetation and erosion were most important indicators affecting desertification process with 60, 79 and 74 %, respectively (table 2).
- ✓ Desertification map (Fig. 2) shows that areas more sensible to desertification are founded in the center part of watershed, where vegetation and soil qualities are low.
- ✓ 45% of watershed presents high to very high risk desertification while 26% presents low to very low risk (table 3)
- ✓ Areas where any change in the delicate balance between natural and human activity are likely to bring about desertification represent 29 %
- ✓ Results indicate that the modified MEDALLUS model is a suitable tool for assessing and mapping of environmental sensitive areas to desertification in RSW and other watersheds in the mountainous islands of Cape Verde

Table 2: indicator qualities and corresponding areas

Quality	Climate		Soil		Vegetation		Management		Erosion		Social	
	Km²	%	Km²	%	Km²	%	Km²	%	Km²	%	Km²	%
Very high	9.34	13.06	0.43	0.60	3.52	4.92	6.95	9.72	1.10	1.54	12.16	17.01
High	13.73	19.20	4.88	6.83	6.65	9.30	8.54	11.94	6.80	9.51	17.17	24.01
Moderate	18.64	26.07	22.9	32.03	4.59	6.42	22.83	31.93	10.79	15.09	36.06	50.43
Low	18.91	26.45	29.48	41.23	35.66	49.87	24.43	34.17	16.96	23.72	4.61	6.45
Very low	10.88	15.22	13.76	19.24	21.08	29.48	8.75	12.24	35.85	50.14	1.50	2.10

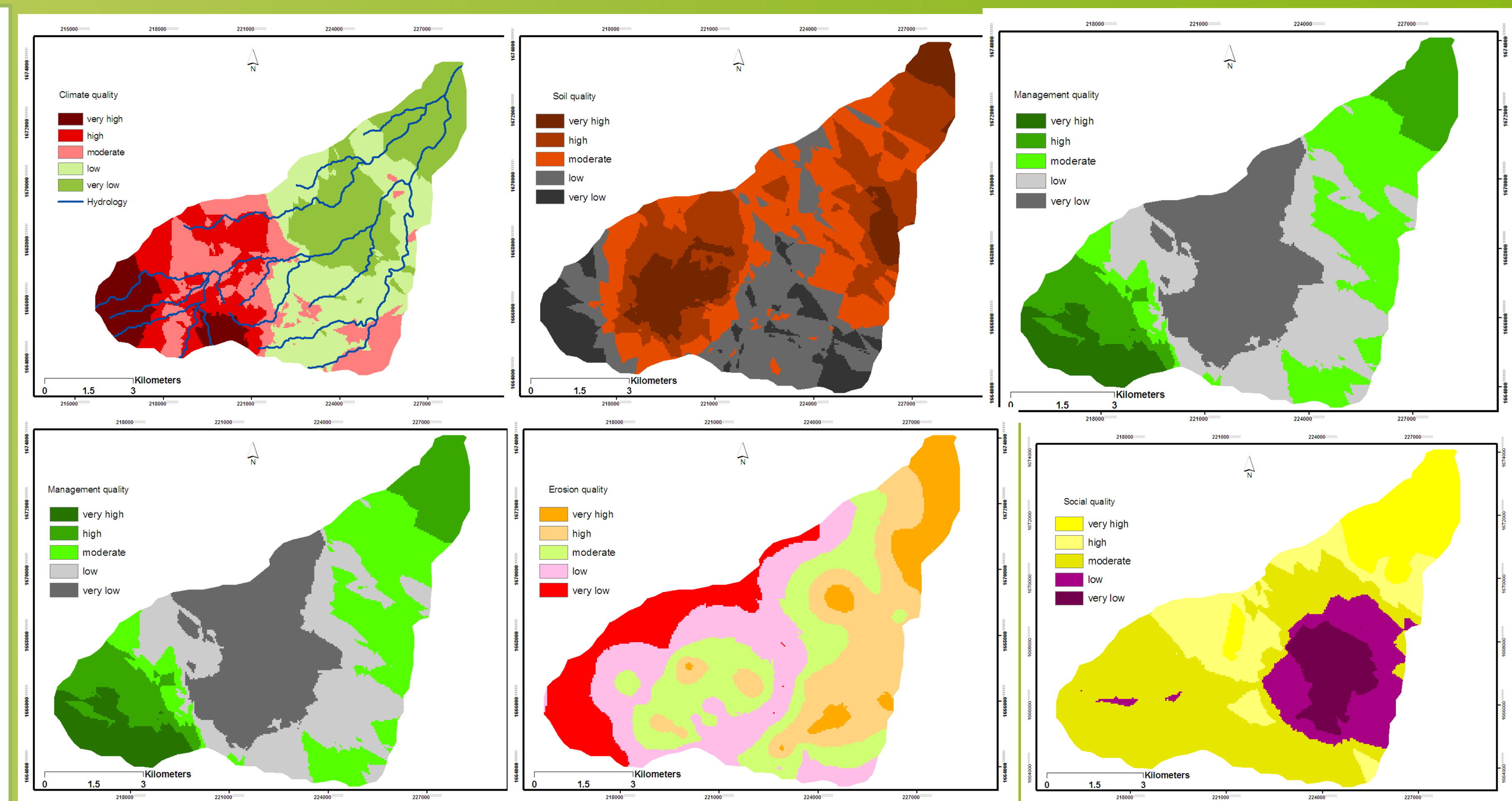

Fig.1: Map qualities of the six indicators

Table 3: Desertification risk classes and respective areas

Desertification risk class	Area	
	km²	%
Very low	4.0	5.6
Low	14.4	20.1
Moderate	21.0	29.3
Severe	28.0	39.2
Very severe	4.1	5.8
TOTAL	71.5	100.0

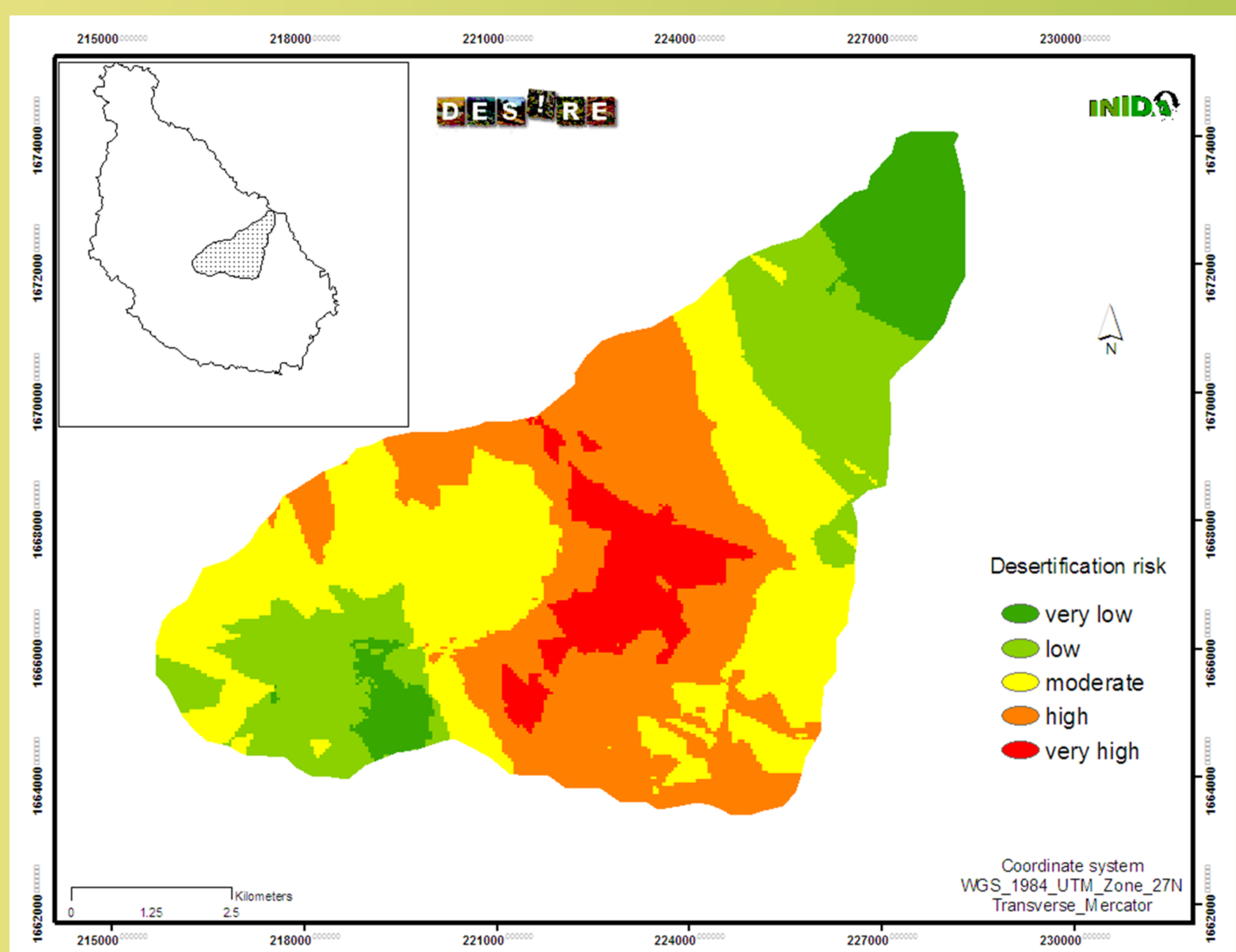

Fig.2: Ribeira Seca desertification risk map

5. CONCLUSION & RECOMMENDATIONS

✓ Study should be considered a case study both in methodological and technological approaches for assessing and mapping desertification risk

✓ The modified MEDALUS model is a valuable tool to assess environmental sensitivity areas to desertification in arid and semi-arid areas like RS W

✓ 45 % of areas is at high to very high risk of desertification, 29.3 % at moderate risk and 25.7 % at low to very low risk

✓Results confirm that actions against land degradation implemented since the 80´s by the government have had positive effect against desertification

✓ Nevertheless, it is necessary to strengthen actions in areas where the risk of desertification is moderate to very high

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