TASHUR – AN INTEGRATION OF INDICES TO ASSESS DESERTIFICATION

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Introduction

Desertification encompasses a wide range of processes of a physical and biological nature. Knowing the extent and severity of the land degradation is important as decisions for effective control of the land degradation are made by policy makers, resource managers as well as local communities and nomads (Gisladottir & Stocking, 2005). Therefore, land degradation must be monitored on a regular basis so as to implement control measures in good time. At present there is no easy way for these decision makers to access the information available from scientific research and so many of the decision are made with inadequate or incomplete datasets. This should not be the case, as there are many highly sophisticated methods that could be used to analyse the data. The aim here was to make it easier for decision makers at various levels to access the data and integrate it so as to use it to make an informed decision.

The wide range of physical and biological processes involved in land degradation and desertification are seldom integrated into a single index. The challenge is to bring local and scientific knowledge systems together into a single accessible and structured database. This would provide land users and managers as well as scientists with more opportunities to inform and stimulate each other to making improved assessment of the situation and a common basis to work from for sound decision making. If land use planners, managers and land users are to be encouraged to become formally involved in the monitoring and adaptive management process, they also require access to user friendly tools, which provide them with a view on the current status of the situation (Squires, 1998). The decision support framework would provide an opportunity for the inclusion of software to support land planners and managers in assessing and interpreting the condition of their land. The most important part of the Decision Support Tool (DST) paradigm is the focus on the end-user (Stuth & Stafford Smith, 1993) and the aim of developing a simple user friendly tool that can address some of the questions facing them.

Methodology

The “Tashur” (meaning ‘desertification’ in Arabic) decision support tool was developed as a user friendly tool to assess the severity of desertification in arid and semi-arid regions by integrating biophysical and social parameters (Elhag, 2006). It uses macros in a Microsoft Excel spreadsheet. It is based on the interaction between vegetation and climate factors with human activities, highlighting the role of climate change and climate variability in land degradation. “Tashur” is to be used to raise the awareness of the planners and policy makers working in agriculture, forestry, environment, water affairs and landscaping in the arid and semi-arid regions concerning the impact of desertification. It brings together several indices to assist with this type of operational decision.

The inputs include long-term rainfall time series data (either daily or monthly data) and NDVI (Normalized Difference Vegetation Index) (from FewsNet), Aridity Index (AI) (Hare, 1993), long-term rainfall trends (from either daily or monthly data), Bare Soil Index (BSI), Moving Standard Deviation Index (MSDI) for at least two time intervals and the Human Activities Impact (HAI). NDVI is the most widely used vegetation index calculated from the visible red and infra-red channels monitored by various satellites and is sensitive to the presence of vegetation on the land surface. AI is important, as predictions from global models are that drylands will become hotter and drier due to an increased evaporation. AI is the ratio between precipitation and potential evapotranspiration so can give an idea of changes in aridity of an area over time. BSI is used to map the bare soil areas and differentiate them from those covered with vegetation using various bands of Landsat data. MSDI is a standard deviation calculated for a moving window of nine pixels of data so as to be able to monitor the changes in the landscape that would be noticeable if
degradation was occurring. HAI is calculated as the residual effect from the NDVI and the rainfall using a residual trend method (Wessels, 2005).

The model starts with an assessment of the trends in NDVI then proceeds to analyse the rainfall and AI trends. If these all show stable or increasing trends it means that there is no sign of degradation, then the condition is considered to have remained stable or could even have improved. However, if any two of those indices show a declining trend then it is necessary to do further analysis of soil and human activities. The model then proceeds to check BSI, HAI and MSDI, to give an indication of the severity of desertification. If BSI, heterogeneity of the landscape and HAI have all increased then the area is classified as “severe desertification”. If BSI and MSDI increased but HAI is stable or decreasing there is “moderate desertification”. If BSI and HAI were decreasing or stable then there is “slight desertification”. All the necessary data needs to be acquired for the selected period and entered on a spreadsheet in the required format. Then the model can be run. If the trends of NDVI and rainfall are declining, then second stage computations will be made before the result is displayed. The final display will state the level of desertification in the selected area and then give the outcome of the three trends (NDVI, rainfall & AI) and the direction of the changes of the other three factors (BSI,MSDI & HAI).

Results

Validation of “Tashur” was done using three sites – two in grazing areas in the western part of the Butana region and one irrigated site in the Rahad irrigation scheme. The output was “severe desertification” for both of the grazing sites as the NDVI, rainfall and AI all gave decreasing trends and so the MSDI, BSI and HAI indices were consulted and all gave increasing trends. This particular combination of factors then results in the output advice “severe desertification”. This result agreed with the observations made during the field survey visits from March to August 2005. The desertification in those areas has led to sand encroachment and accelerated development of dunes. The Rahad site gave an output of “slight desertification” which is also in line with observations made in that area.

Conclusions

The output from “Tashur” can then help the planners (agriculturist, foresters and landscape planners) and decision makers in arid and semi-arid regions to assess the landscape conditions and to monitor and map the extent of the land degradation. This will enable them to make better management and planning decisions for the sustainable use of natural resources in these regions.