Optimization of rural land health: integrating multiple functions

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Abstract: The MULBO (Multi-criteria Landscape Assessment and Optimisation) framework has been specifically developed to help guide these complex multiple objective decisions. In this current project MULBO has been trialled in the Lake Tyrrell Basin of Northern Victoria, Australia. Lake Tyrrell is situated within the Mallee region and covers an area of around 400,000 hectares. The Mallee is a semi-arid region which supports broad-scale cropping on sandy low nutrient soils, where traditional agriculture has had a high impact on native fauna and flora, and where naturally saline groundwater and wind erosion present significant threats to both agricultural production and biodiversity. The MULBO process includes the following steps (a) goal determination across multiple management criteria, (b) function analysis on the basis of GIS, (c) function assessment, (d) scenario formulation and (e) land use compromise optimisation to calculate land use scenarios . In this project, major land management goals within the Mallee were identified on the basis of regional and local management objectives and input from regional land managers, representatives from community environmental programs and farmers. Major landscape health problems in the region were identified, as were the major management objectives to be optimized. These objectives included indicators for (a) farm income, (b) salinity risks, (b) wind erosion and (d) habitat connectivity.

Keywords: MULBO; land-use change; natural resources management; landscape health

Introduction

As the results of the Millennium Ecosystems Assessment has shown, there is an obvious and urgent need for integrated land use planning to help provide optimal outcomes for the health of rural landscapes. Land use problems in rural landscapes involve complex tradeoffs between multiple, and sometimes competing, objectives. These land use decision problems require new kinds of decision methodologies which can integrate these multiple objectives and provide optimal solutions.

1. Methods

The MULBO (Multi-criteria Landscape Assessment and Optimisation) framework has been specifically developed to help guide these complex multiple objective decisions. In this current project MULBO has been trialled in the Lake Tyrrell Basin of Northern Victoria, Australia. Lake Tyrrell is situated within the Mallee region and covers an area of around 400,000 hectares. The Mallee is a semi-arid region which supports broad-scale cropping on sandy low nutrient soils, where traditional agriculture has had a high impact on native fauna and flora, and where naturally saline groundwater and wind erosion present significant threats to both agricultural production and biodiversity.

The MULBO process includes the following steps (a) goal determination across multiple management criteria, (b) function analysis on the basis of GIS, (c) function assessment (figures 1 and 2), (d) scenario formulation and (e) land use compromise optimisation to calculate land use scenarios (figure 3).

In this project, major land management goals within the Mallee were identified on the basis of regional and local management objectives and input from regional land managers, representatives from community environmental programs and farmers. Major landscape health problems in the region were identified, as were the major management objectives to be optimized. These objectives included indicators for (a) farm management (figure 1), (b) salinity risks, (b) wind erosion (figure 2) (d) habitat connectivity and e) arable production capacity.

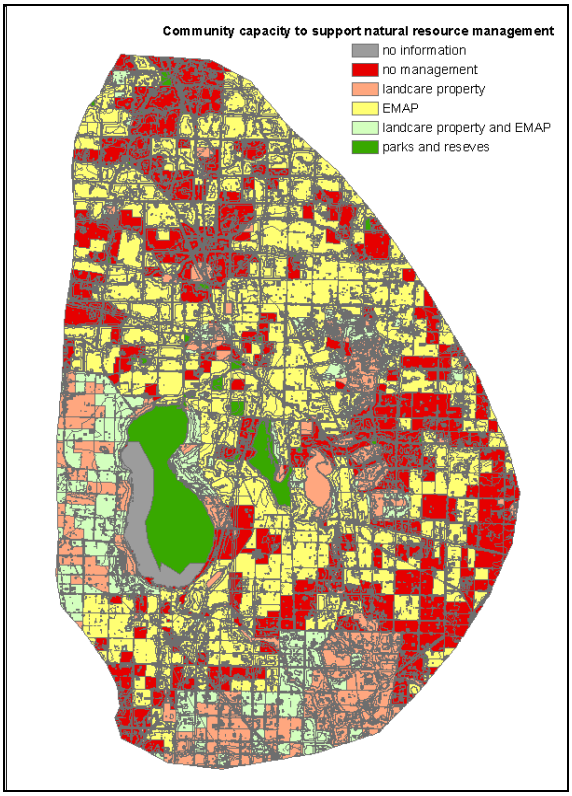
Inputs to the MULBO process include a range of data sets from a variety of sources. Based on an initial consultation, these data sets were processed to provide new decision geography. The resulting data sets take the form of qualitative landscape value surfaces classified from low to high.

The land use optimisation software LNOPT 2.0 was used to integrate the spatial data sets and provide suggested optimal land use patterns providing a range of compromise solutions for land use distribution in the Lake Tyrrell Basin Region. Different land use scenarios were calculated by adjusting weights for each indicator.

Results and discussion

The application of the MULBO framework in Victoria's Mallee region has shown the framework's ability to integrate a range of qualitative and quantitative information in support of complex land use decision making. The framework's ability to integrate spatial data from a range of sources and its open and flexible structure make it a highly flexible decision tool to support sustainable solutions to rural land health. In particular, MULBO was able to support the engagement of important stakeholders through a deliberate and clear decision methodology.

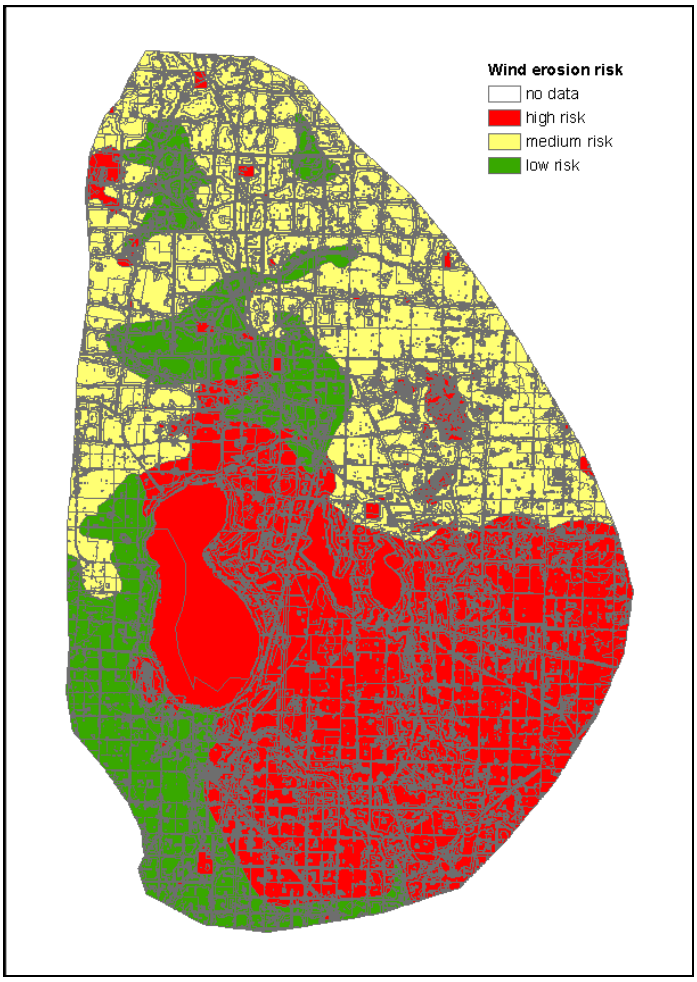
Figure 1: Management function: Community capacity to support natural resource management (EMAP =Environmental Management Action Plan)



The management function was assessed using 5 classes with different management types. The best class of management is „landcare property and EMAP". This function shows a high differentiation over the whole area. Maximising the management function should

result high priority for best practice farming and natural vegetation on areas with no management or on landcare properties. It was then integrated in the optimisation process.

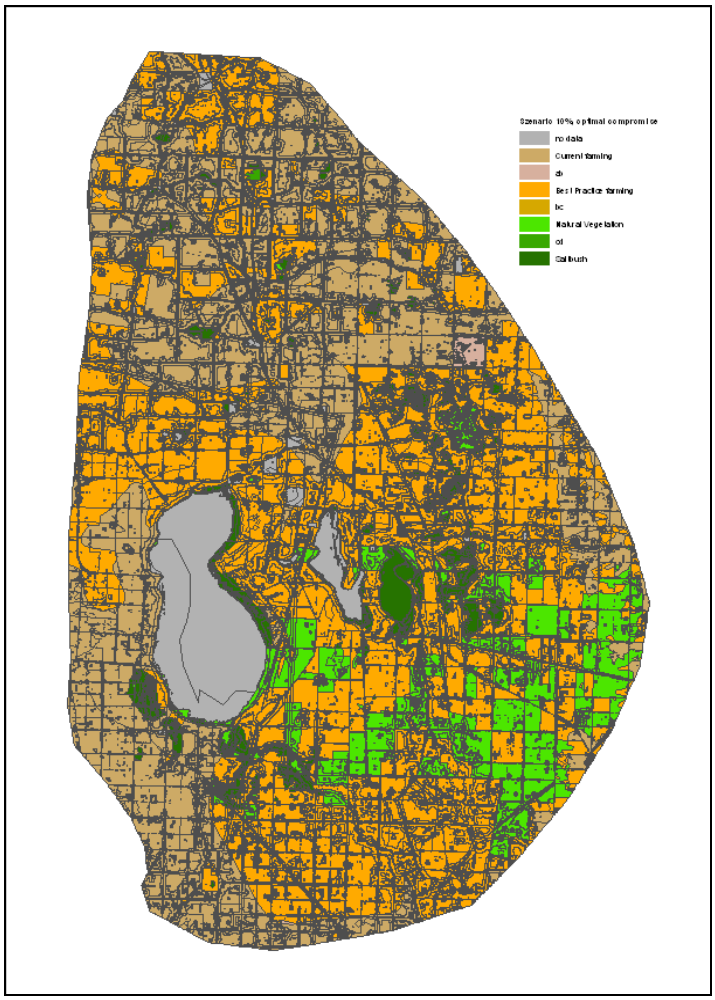
Figure 2: Wind erosion risk



The wind erosion function was assessed using 3 classes (low risk, medium risk and high risk). The wind erosion risk function was also used for optimisation. Minimising the soil erosion risk means that land use types with less soil erosion risk than the current farming will be placed on areas with high risk.

For the optimisation two scenarios for new land use distributions are formulated. Both are dealing with a change of 10 % of current farming into natural vegetation and 5 % of current farming into saltbush. They differ in the change to best practice farming.

Figure 3: Land use scenario: optimised spatial outputs from the MULBO process



Results for one of the scenario: Saltbush is located in the area with low production values. On the other hand best practice farming will take place in high or medium erosion risk areas. Natural vegetation will be placed only in high erosion risk areas, where mostly no

management is available or sometimes also in EMAP areas. The results show the capacity of MULBO to find the places to solve several problems in form of a best compromise in the context of the whole region. The variation of input layers, scenario assumptions and weights offers a wide range of potential optimal solutions. The results are used in policy advice on State level and also for landscaping action on the landscape level.

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