Developing a Decision Support Tool for the Steppe Zone of Ghom-Iran, by Implementing a State and Transition Model within a Bayesian Belief Network

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Introduction Although State and Transition Models (STM) provide a description of rangeland dynamics , the typical descriptive flowcharts and associated catalogue of states and transitions lack practical application . They also handle uncertainty associated with transitions poorly . It is therefore clear that a mechanism is needed to convert these models into predictive models that can accommodate uncertainty associated with the nature of transitions . Bayesian Belief Networks (BBNs) (Jensen 1996) can be used to overcome this problem . The approach is based on BBNs , which are cause and effect models that relate variables through the use of conditional probabilities . This allows for uncertainty to be incorporated into the models . This paper describes the development of a rangeland decision support tool by combining BBN with STM for the Steppe zone of Ghom , Iran .

Materials and methods The STM was the starting point for model development . An influence diagram was built to show the possible transitions and the factors influencing each transition . Next , the influence diagram was populated with probabilities to produce a predictive model , and finally the behaviour of the model was tested using scenario and sensitivity analysis .

Results The STM consists of 7 vegetation states and 15 transitions . The sensitivity analysis revealed that grazing impact and growing condition were the two most important drivers of almost all but two of the transitions . Grazing impact represents the management influence on transition and growth condition represents the environmental influence on transitions . This result is supported by other studies in Iran , which suggest that frequent droughts coupled with mismanagement (e .g . overgrazing) combine to produce rapid land degradation (Nemati 1986) . This result , however , does not match the beliefs of governors or livestock managers . Most governors believe that grazing is the dominant factor responsible for rangeland degradation , while livestock managers believe that it is drought and growing conditions .

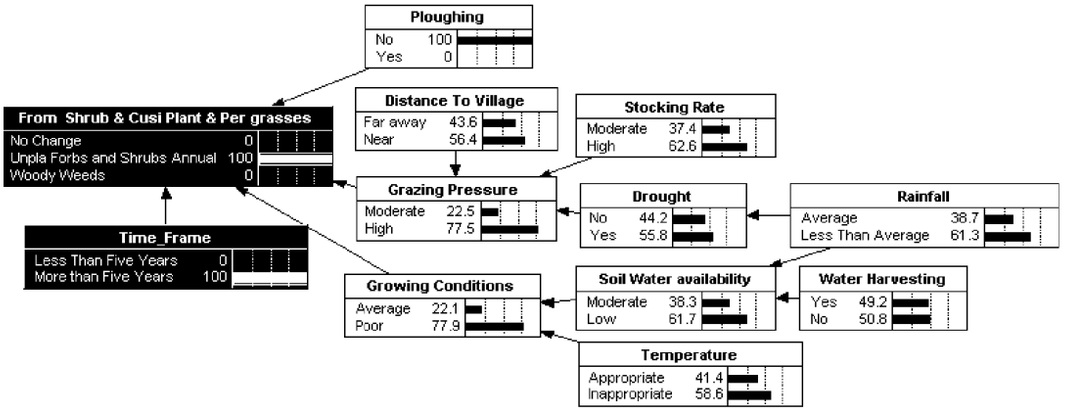

Figure 1 *This figure shows that within a five-year time frame , the transition to Unpalatable forbs & shrubs and annuals" is most likely if grazing pressure is high and growing condition is poor . This is most likely where stocking rate is high and soil water availability is low . The numbers are probabilities . Under this scenario , for example , there is a 61 .3% chance that rainfall is less than average .*

Conclusions Combining STMs and BBN provides a novel means of modeling rangeland dynamics in that it (a) accommodates uncertainty in rangeland dynamics in a straightforward way , (b) captures experiential knowledge of outcomes of rangeland management scenarios , (c) provided a graphical and transparent modeling environment that can facilitate communication about cause and effect , and (d) allows for the consequences of rangeland management decisions to be predicted . It also identifies the management scenarios that are most likely needed to prevent decline in rangeland condition .

References

Jensen , F .V . , (1996) . An introduction to Bayesian Networks , University College London Press .
Nemati , N . , (1986) . Pasture improvement and management in arid zones of Iran . *Journal of Arid Environments* , 11(1) : 27-35 .