

PAPERS and REPORTS related to
MULTI – CRITERIA DECISION MAKING
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Agriculture

1. Srdjevic B., and Jandric Z.: **Analytic hierarchy process in selecting the best irrigation method**, submitted for publishing in Elsevier's Journal on Agricultural Systems.
2. Srdjevic B., and Jandric Z.: **Walnut varieties valuation by Analytic hierarchy process**, submitted for publishing in Journal of Yugoslav Pomology "Jugoslovensko vocarstvo" (in Serbian).
3. Srdjevic B., and Jandric Z.: **Multicriteria approach to the selection of the most suitable irrigation method**, Book of Abstracts, p. 208, 3rd International Symposium on Irrigation of Horticultural Crops, Estoril, Lisbon, Portugal, June 28 - July 2, 1999.
4. Jandric Z., and Srdjevic B.: **Comparative analysis of different multicriteria techniques in selecting the most suitable irrigation method**, Book of Abstracts, p. 181, 3rd International Symposium on Irrigation of Horticultural Crops, Estoril, Lisbon, Portugal, June 28 - July 2, 1999.

Water Resources Management

5. Jandric Z., and Srdjevic B.: **Analytic hierarchy process as decision support system in water management**, submitted for publishing in National Journal on Water Resources "Vodoprivreda" (in Serbian).
6. Srdjevic B., Jandric Z., and Potkonjak S.: **Evaluation of potential reservoir purposes by Analytic hierarchy process**, Journal Vodoprivreda 0350-0519, 32 (2000) 183-185, p. 237-242, 2000. (in Serbian)
7. Jandric Z., and Srdjevic B.: **Analytic hierarchy process (AHP) in selecting best groundwater pond**, 31st International Geological Congress, Rio de Janeiro, Brazil, August 6-17, 2000.

Forestry

8. Srdjevic B., and Jandric Z.: **Analytic hierarchy process in strategic forest management**, Report for Srbijasume - National forests enterprise, Forest district of Novi Sad, November, 2000 (in Serbian).

Analytic Hierarchy Process in selecting the best irrigation method

Srdjevic B., and Jandric Z.

Abstract

Selection of the best irrigation method for a given field conditions is a complex decision making problem. It is influenced by many factors such as crop density, growing conditions, water quality or topography, but it is also subject of judgments to be made by more or less experienced farmer or decision maker. In turn, consistent reasoning and a method of deriving solution (decision) by person(s) involved may become critical. A major issue of related decision process is how to manipulate decision factors efficiently and to assure consistency of the whole process, particularly of that part in which decision maker determines intensity of mutual dominance between factors. To handle a problem and trustworthy find the relative importance of objectives, sub objectives and alternatives with respect to stated overall goal, and all this in real field conditions, the Analytical Hierarchy Process (AHP) appears to be a good choice. In specific assessments described here AHP plays a role of efficient supporter to the decision maker in selecting the best irrigation method. Decision alternatives considered in the article are four methods of agricultural irrigation: border, furrow, sprinkler and trickle. They were mutually compared with respect to 7 criterions: crop density, sensibility to diseases, growing conditions, slope, infiltration rate, water quality and skills of labour. Brief description of AHP is followed by results of its application in selecting the best irrigation method. Comparison of AHP's results with results obtained by two other evaluating methods is also given.

Walnut varieties valuation by Analytic Hierarchy Process

Srdjevic B., and Jandric Z.

Abstract

A new approach is proposed for valuating walnut types, selections and varieties based on the Analytic Hierarchy Process (AHP), one of approved and modern decision support tools. Three Yugoslav walnut selections (currently under procedure for registration as varieties) and two trademarked varieties are valuated within a process that combined walnut expert's knowledge and system analysis approach. By using AHP method, it was concluded that Yugoslav selection Rasna has the best overall nut characteristics, comparing to the other two Yugoslav selections (Macva and Kasni rodni), and varieties Sejnovo from Bulgaria and Franquette from France. The worst overall nut characteristics has Yugoslav selection Kasni rodni. Performed valuation proved that the AHP method is suitable in creating decision space for walnut selection. It enables precise structuring of criterions' and sub criterions' hierarchies, even if these had different metrics or had no metrics at all (qualitative criterions), which is, furthermore, typical situation in multicriteria decision making. Communication between the walnut expert and AHP based software application was excellent. A pleasant interactive seance was completed in less than an hour.

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Authors would also like to thank to The Expert Choice Inc., Pittsburgh, USA, for providing temporal license for software EC Pro (Expert Choice Professional) used in this research.

3rd International Symposium on Irrigation of Horticultural Crops

Lisbon, Portugal, June 28 - July 2, 1999.

Paper No. 3 (Agriculture)

Multicriteria approach to the selection of the most suitable irrigation method

Srdjevic B., and Jandric Z.

Abstract

Irrigation methods such as sprinkler, furrow, drip and flooding represent a complex decision space as far irrigation planning is considered. To select the one for specific field situation and to put a claim that it is the best or at least the favorite one, it is necessary to adopt systems approach and preserve that applied evaluating techniques are consistent with irrigation decision-making process itself. In fact, the major issue is how to relate a variety of factors such as crop (plant) cover, availability of water, soil structure, field topography, climate, labor skills, energy, etc., than to recognize their impacts and importance in real field conditions, and finally to determine dominance of one factor to another. Different dominant/weak structures may be created and evaluated by selected multicriteria decision making methods and techniques, such as equal importance method, weighting coefficient method, or the Analytic Hierarchy Process (AHP).

The aim of this paper is to present general scope of the decision making problem related to selecting of an appropriate irrigation method for given field conditions and to discuss some issues as far comparison of above mentioned techniques is considered. An accent is given to a relatively new technique – AHP. It is a powerful and flexible decision making tool for multicriteria problems which decomposes complex problem into a hierarchy, and where both qualitative and quantitative aspects of a problem need to be incorporated.

3rd International Symposium on Irrigation of Horticultural Crops

Lisbon, Portugal, June 28 - July 2, 1999.

Paper No. 4 (Agriculture)

Comparative analysis of different multicriteria techniques in selecting the most suitable irrigation method

Jandric Z., and Srdjevic B.

Abstract

Continuing discussion presented in preceding paper, herein particular attention is focused on results obtained in Yugoslavia where recent investigations were conducted primarily to improve regional and local (farm) irrigating planning and operating practices. For selected typical field conditions in Vojvodina Province, the most productive agricultural area in Yugoslavia, different evaluation procedures has been applied to identify appropriate irrigation methods. Three multicriteria decision making methods were applied such as equal importance method introduced by Holzapfel *et al.* (1985), weighting coefficient method suggested by Srdjevic (1996), and analytic hierarchy process (AHP) proposed by Saaty (1992). Set of typical irrigation factors has been identified to include land, climate, plant and other important irrigating conditions. Related decision space has been created with different priority schemes, i.e. dominant/weak structures which reflect mutual relative importance of selected factors if particular irrigation method should be adopted. Comparative analyses are presented in the paper, followed by discussion on practical applicability of three selected multicriteria decision making methods.

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Paper No. 5 (Water Res. Management)

Analytic Hierarchy Process as decision support system in water management

Jandric Z., and Srdjevic B.

Abstract

The article deals with decision-making support technique well known as the Analytic Hierarchy Process (AHP). Consequently understood as promising decision support system, AHP is considered as computer oriented decision tool which is expected to play significant role in national water resources planning and management. Methodological and mathematical background of AHP is presented, followed by small instructive example. In conclusions, certain remarks are given with respect to practical experience gained through AHP's recent applications.

Evaluation of potential reservoir purposes by Analytic Hierarchy Process

Srdjevic B., Jandric Z., and Potkonjak S.

Abstract

The article presents capabilities of The Analytic Hierarchy Process (AHP) in evaluating and selecting potential water reservoir's purposes. Global economical goal is defined as the most profitable allocation of reservoir storage. Total of six reservoir purposes is considered in the article as decision alternatives: (1) hydroelectric power, (2) irrigation, (3) flood protection, (4) municipal and industrial water supply, (5) tourism and recreation and (6) river traffic (navigation). They are mutually compared subject to 5 prescribed economical criteria with different metrics: (1) gain in national income, (2) earn foreign exchange, (3) improvement of a balance of payments, (4) import substitution (self-sufficiency) and (5) gain in regional income. Discussion of results and their potential use in simulation, optimisation and mixed techniques and models in water management concludes the paper.

31. International Geological Congress

Rio de Janeiro, Brazil, August 6-17, 2000.

Paper No. 7 (Water Res. Management)

Analytic Hierarchy Process (AHP) in selecting best groundwater pond

Jandric Z., and Srdjevic B.

Abstract

Selection of the best source/pond for water supply from aquifer systems may be understood as ultimate decision after systematic evaluation of appropriate alternatives is performed and related decision space is created. To choose the one for specific situation in a region and to claim that it is the best or at least the favorite one, systems approach appears necessary to be applied. The main reason is that it preserves all important issues are included such as: ponds' capacities, water quality, technical accessibility, protection and environmental impacts, exploitation economy, sociological influences etc. Besides, systems approach assures consistency of applied evaluating technique with decision-making process itself. In fact, the major issue is how to relate a variety of factors, i.e. to recognize their impacts and importance in real field conditions, and finally to determine dominance of one factor to another by investigating different dominant/weak structures.

The Analytic Hierarchy Process (AHP) appears to be a flexible decision making tool for multicriteria problems such as selection of the best groundwater supply pond. It enables decomposition of a problem into hierarchy and assures that both qualitative and quantitative aspects of a problem are incorporated in evaluation process. AHP has been successfully applied in a recent case study for evaluating potential ponds in the Danube river valley in Vojvodina Province, Yugoslavia. Results of it's application are presented in brief and followed by extended discussion.

Analytic Hierarchy Process in strategic forests management

Srdjevic B., and Jandric Z.

Abstract

Typical decision making areas of interest in Yugoslavia forestry are identified for possible application of advanced decision making tools and decision supporting systems. Encountered areas are: land management, sustainable forest development, biodiversity, risk and uncertainty issues in forest management, timing in forest works, in/out forest transport, fire management, wildlife management, etc. Decision making tools and supporting software included those that belong to general class of decision support systems (DSS), such as Analytica, Judgment Maker, Criterion Decision Plus, Crystal Ball 2000, DATA Interactive, Decision Explorer, Decision Hosting, Decision Tools Suite, ELECTRE, EQUITY 2, EXSYS, Frontier Analyst, High Priority, HIPRE 3+, HIVIEW 2, Hugin Professional, Impact Explorer, Joint Gains, Logical Decisions, Mesa Vista, Netica, Opinions Online, Pertmaster Professional, +Risk, Policy PC Judgment, Analysis Software, PRIME Decisions, Expert Choice, TreePlan, Web HIPRE and WINPRE.

With respect to strategic decision making in forestry and implementation of DSS, several principles are briefly discussed, followed by review of forest DSS that are used in US, Australia, Finland, Canada and other countries. Brief description is given for FORPLAN/IFPS, NDM (Northeast Decision Model), RELMdss, Sylvatica (Forest landscape simulation model), Expert Choice 2000, DIVERSITY, FORUM, Spatial Fire Management System, FERIS, MELA, and Woodstock. The other DSS are also listed, but not described, such as PLANS (Preliminary Logging Analysis System), FOLPI (Forestry Oriented Linear Programming Interpreter), Arc Forest, TSM (Timber Supply Model), CGTM (Center for International Trade in Forest Products Global Trade Model), LUPIS, TERRA-Vision, and SmartForest.

Particular attention is given to the Analytic Hierarchy Process (AHP) – worldwide acclaimed decision-making method. Description of the AHP method consists of its mathematical background with illustrative example included. Brief description of AHP related software, The Expert Choice 2000, is also given. It is noted that Expert Choice 2000 may be accepted as decision making tool and DSS in the same time.

Core of the report comprises description of several case studies and scientific papers presenting where and how AHP was applied in strategic forest management. Case studies from Finland, Indonesia and US are used to show full power of AHP in resolving diverse forestall multi-criteria and multi-attributes problems. The next chapter presents an instructive example how to use AHP and Expert Choice 2000 in evaluating 5 strategies prescribed to manage 2 600 hectares large forested hunting area Plavna near Novi Sad in Yugoslavia. The planning horizon of 20 years was assumed. Set of criteria and sub-criteria included timber production, wildlife habitat conservation, and scenic beauty preservation. It was shown how AHP philosophy helps decision maker to create hierarchy of the problem. In turn it is demonstrated how AHP attacks the problem and come-up to the solution represented by relative values (weights) of all 5 strategies regarding global goal. To identify the best strategy means to pick the one with the highest relative value. The report is concluded by selected references and list of relevant internet links in decision-making and forestry.