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A Concept of Forest Information System in Hyrcanian Forests Case Study: Kheiroud Forest

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Abstract: Now a day, Forestry managers tend to plan a comprehensive module for sustainable management of forest lands of Iran in order to achieve the aims of sustainable forest management due to concerns about large data volume, competition in acquiring information and data organizing/processing. In this work, we have designed the forest information system for Hyrcanian forests (Iran) for the first time; the system was experimentally planned for research/extension station of Kheiroud (Mazandaran prov.). Forest information system results from integrating spatial- and non-spatial data of various points of the forest land in data bank format. Conceptual data model was designed using Gee! Software based on the entity relationship, then planned at physical level under Access2007; non-spatial data entity relationship given in Access2007 also cover spatial data using Arc view 2.3a software. Finally, the work indicates a promising perspective resulting from systemic view over sustainable forest management emphasizing the advantages of planning forest information system as a way to future sustainable forest management compared with traditional method applied in forest lands at present.

Key words: spatial database, non-spatial database, forest information system, entity relationship, conceptual data model, logical data model, physical data model, GIS, Arc view 2.3a, Access2007

INTRODUCTION

Information systems have appeared late 1950s. In 1957, transition from industrial era to informatics era, number of people handling information systems, information and processing, increased (industrial workers). During 1970s, active personnel of information technology consists more than 50% of total force work (Sprag and McNorlain, 1986, Cited by: Rezaeian, 2002). In every organization, a manager managed five major resources including: 1) personnel, 2) material, 3) machines (facilities and energy), 4) finance and 5) data (information). The manager's duty is to efficiently handle with the resources using them to achieve the organizational aims. First four resources physically exist, while the fifth, i.e. information, is not observable so called conceptual resource. Managers manage the physical resources using conceptual resources (Hepman, 1962, Cited by: Rezaeian, 2002, 2002). Recently, managers have become highly interested in information management for two reasons: 1) increasing complexity of various businesses and 2) improving informatics skills. Informatics which is now essential for carrying out every task/business in the world recognized as computer knowledge. In addition to computer knowledge, today manager should know how to use the information. Information knowledge includes how to use data for resolving problems and how to acquire and share data with others. Use of data is more important than computer operating, although it does not depend on computer knowledge. Thus, it is ideal that a manager has both abilities (McLude, 1998, Cited by: Rezaeian, 2002). Like other managers, forest managers need mentioned knowledge. Every manager should process management-required data in an organized manner in order to apply both scopes. In fact, the aims of forestry management changes as the information technology progressing; therefore data alteration requires a flexible strategy for information

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managing and integrity of multi-resource acquired data. This is a routine task line for information systems. Principally, a forest information system is designed for improving forest management; the usage of the system is recording, saving, processing, displaying spatial-/non-spatial data (of a given forest land), planning/executing and controlling forest activities (Feghhi, 1988). The system consists of two spatial- and non-spatial databases. Conceptual model of the system covering whole forest land meets users' demands using a single database (Award and Gotterer, 1995). Indeed, the represented model is including a set of concepts and proper illustrative symbols for expressing/describing the contexts and rationalizing problems (Tokola *et al.,* 1997). Generally, database design is carried out at three levels of conceptual-, logical- and physical models (Award and Gotterer, 1995, Bolchini *et al.,* 2007). Each information system has its own functions making efficient management possible for the system and could meet users' managing requirements (figure1).

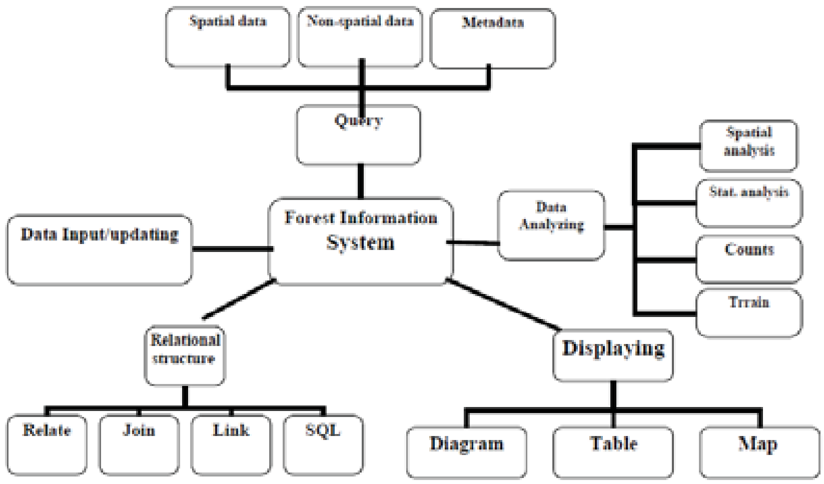

Fig. 1: Functions of a forest information system (Feghhi, 1998)

The quality of a designed model should be based on certain standardized indices. One way to assess 4 the quality of a given conceptual data model is input entrance followed by analyzing (Moody, 2005) Data quality is in turn considered. Numerous efforts have been made over data quality of databases;however, the quality and interrelationships to applied data remained unclear in conceptual models(Sciore and Rosenthal, 1993; Wang, Kon and Madnik, 1993). Compatibility requires modular adaptability (Davies *et al,* 2005). Each database may be completely unique because there is no single common model for designing databases (Eichman, 1988).

Study Area:

Research/extension station of Kheiroud, an 8000hec area, is located as 7km east far from Nowshahr. The lowest part, also northern border, is 10 meters higher than sea level extending to 2200 meters height. In 1962, faculty of natural resources (University of Tehran) took charge of Kheiroud forest from then ministry of natural resources for training purposes. The forest land has been divided into eight Districts, three of which have been provided with comprehensive forestry plans by now. Public sector is in charge of Kheiroud; the faculty is actually a public executive agent. The plans are compiled for a 10 year mid-term period.

MATERIALS AND METHODS

Entity-Relationship (E-R) model is a common method of designing conceptual data model. Introduced in 1970s, E-R model revolutionized the techniques of data representation indicating the characteristics of each component of the system and applied with many researches (Chen, 1976; Genero, 2007; Bolchini et al, 2007; McIntosh, 2007; Tavana, 2007). Modular symbols determine how a component interrelates to another. Relational symbols are displayed as 0, 1 and * (* means "many") (Ponniah, 2007). Using Gee! Software (version 1.1), Conceptual data model of Kheiroud was designed based on E-R diagram. Due to a simple view of conceptual data model (which is in turn a complicated one), Gee! Software (version 1.1) was selected where also model displayed as rectangles connected together through relational symbols of E-R diagram. Models were designed at physical level using Access 2007. Similarly, modular components were designed as uniquely characterized tables in which non-spatial inputs inserted. Non-spatial data was completed through linking to spatial data represented in Arc view 2.3a to cover spatial data enhancing modular comprehensiveness. Inputs were experimentally given to correct possibly occurred errors when designing. Data was computed according forestry plans accomplished during various years (Namiranian, 1981, 1999). In this model, minimum data volume is computed according mentioned plans. Data updating, essential numerical operations for forest management, figure/map display and various links to other different spatial soft wares are some of presented functional features.

RESULTS AND DISCUSSION

One results of this study is designing conceptual data model of forest information system. The mentioned model is composed of a central table called formed operation and the rest operations are indirectly connected to it (fig2). This indirect connection is made through levels within which these operations are per formant the forest (Forest, Districts and Compartment) .The operation table in turn is divided to two major parts. These parts are as follow: 1- functional tables (harvesting, silviculture and sampling/recording), 2- non-functional tables (environment, threats, livelihood stock, and village).

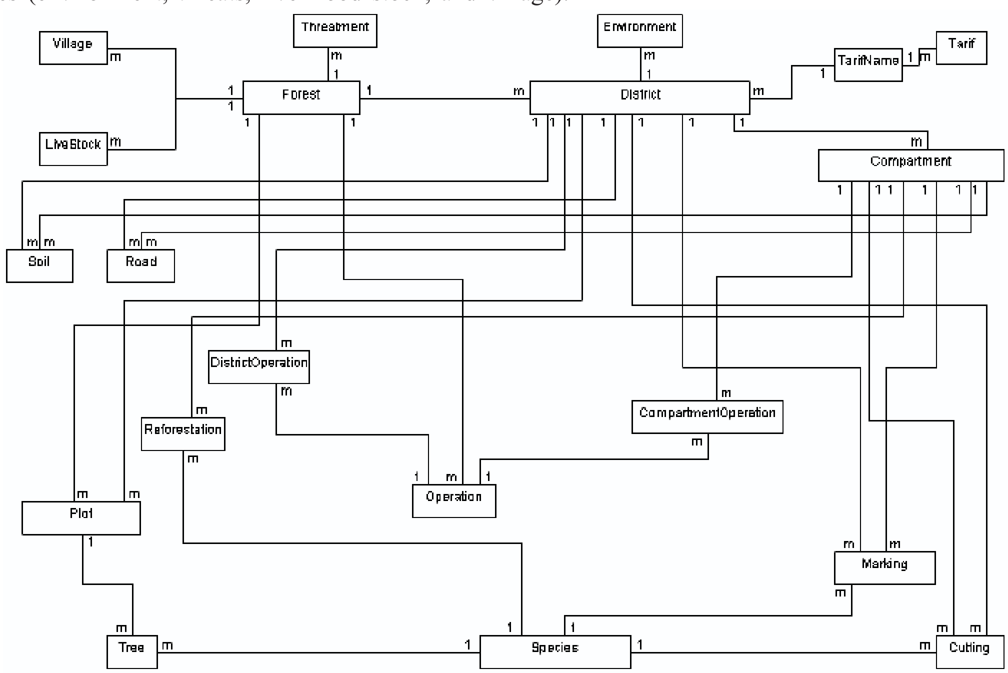

Fig. 2: conceptual data model (Gee,1993)

Harvesting section is grouped in three subsections including marking, cutting and road construction in which data of counterpart operations contained. Measured compartment data will be directly inserted in designated harvesting tables; calculations will be finally carried out through queries. Also, harvested trees volume is calculated through Tarif tables mostly used in sampling/recording section. Harvested volume can be compared to primary volume (before harvesting) which inserted in marking section. Selective indices for all three sections are established based on forms directly applied to field operations. Silviculture section consists of compartment description, pedology and reforestation subsections. Most compartment data (as the basic unit of planning) is obtained from compartment descriptive subsection. In order to compile separate maps, pedology and reforestation are segregated from compartment descriptive subsection. Because of its dependency on two previous mentioned sections, separation of the third section (as a distinct item) is somehow complicated. In this section, numerical procedures are carried out for calculating available trees volume. Planned environmental sampling/recording has not yet carried out in Kheiroud forest, thus the section is only applied to sampling/recording compartments used to determine available volume. In sampling/recording section, use of unique Tarif tables for each district is applied numerical model of volume. The last part of applied model is occupied by tables in which other sections reports are included. Other sections data is rarely altered leading to no functionally dynamic data tables unlike three sections mentioned before. The model is able to establish links to spatial soft wares locating the target zone of operation on the map. The links are established through SQL Connection section and adding modular tables in the form of by-questionnaire tables under Arc view 2.3a software.

Operation chart is a table to which main parts of the model are principally connected checking any kind of field operation. Beginning/ending times and type of the operation are also included in the chart. "Time" is considered as an index in the tables; therefore the model is able to give respond to three principle questions: "what?" "When?" and "where?" An ideal forest information system should be able not only to carry out required numerical procedures but modulate and predict future forest situation in order to respond above- and other similar questions so that it improves traditional management.

1. The Applications of Kheiroud Forest Information System:

From an applied view point, a forest information system should be able to help managers with defining aims and short-, mid- and long term planning. Represented system is able to estimate total available trees volume through measuring the volume of sampled compartments resulted in improving managers' planning for forest harvesting. Therefore, available trees volume and harvest amount can be compared at various levels in different dates; even assessing resulted patterns, thus one can predict harvest levels and appropriate developing operations for achieving desired volume within different years; also, forest vegetation rate can be predicted until a given time through stabilizing certain factors and applying appropriate formula. Additionally, the system improves short term forest planning through determining appropriate developing operations and reforestation for each compartment. Providing information, it meets needs such as developing operations in different compartments in various dates. Represented system also indicates information about forest history in terms of residents' livelihood, type and number of livelihood stock, destructive factors, date of destruction and destruction level/volume. In addition, data is available regarding rare fauna/flora of the forest, number and species of forest dried trees, however, the information are given to the system unchanged reports, but useful for managers' long term decision making. For instance, the system respond to a question like "what species have been forested/developed in which compartments in 1999?" as follows (figures 3 and 4):

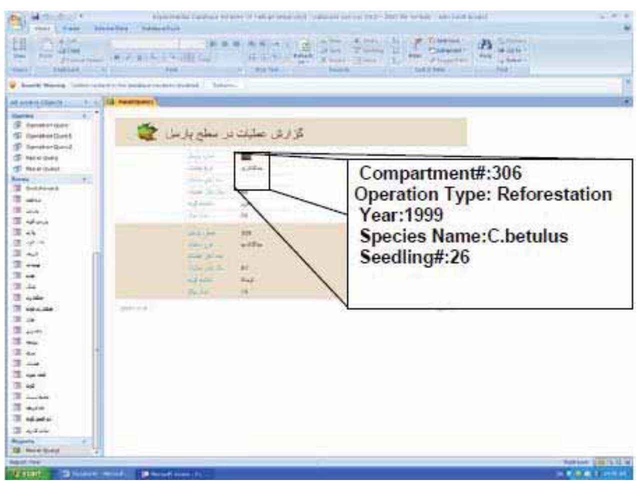

Fig. 3: displaying of forest reforestation (Access2007)

2-comparing Kheiroud Forest Conceptual Data Model with Other Models:

The model partly resembles certain previously planned ones in terms of conceptual structure similarity. For instance, Murray's model (1999) has described every type of field activity as an event with two spatial- and chronicle characteristics. Represented model also describes the same dimensions for each operation. Feghhi's model (1998) has considered the field operation as the characterized field occurrence for which the same dimensions available. But the model has its own differences with many other models. Comprehensiveness is one of the most important characteristics of a model so that it is able to cover most forest-related concepts and considerations. McIntosh (2007) and Tokola *et al.* (1997) models have focused only on ecological aspects or sampling/recording, or Pronos model (2007) has been concentrated in forest protection (pests and diseases of tress). Mentioned models have been planned for a specific application/scope, while the positions of different items/sections are primarily defined in represented model; thus it can be used as a primary core of a more comprehensive information system. Introduced system is a completely new member of Iranian forest management system. Recently, designation/planning of trade/industrial-aimed information systems/databases have been a new scope in Iran; however, environment-based systems (e.g. forest) are a generally less comprehended issue worldwide.

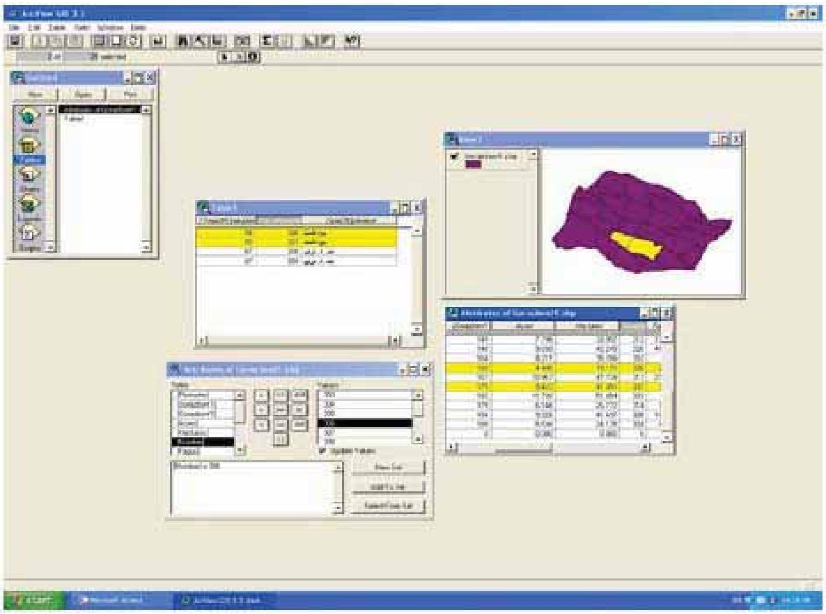

Fig. 4: the location of reforestation in 1999 (Arcview2.3a)

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