Bangladesh Journal of Extension Education *ISSN 1011-3916*
Volume 27, No. 1&2, 2015: 9-19 *Research Article*

Decision Support System: Helping Farmers Help Themselves

S. K. Acharya[1] & A. Saha[2]

Abstract

There is a substantial amount of empirical evidence that human intuitive judgment and decision making can be far from optimal, and it deteriorates even further with complexity and stress. Because in many situations the quality of decisions is important, aiding the deficiencies of human jud gment and decision making has been a major focus of science throughout history. Disciplines such as statistics, economics, and operations research developed various methods for making rational choices. More recently, these methods, often enhanced by a variety of techniques originating from information science, cognitive psychology, and artificial intelligence, have been implemented in the form of computer programs, either as stand-alone tools or as integrated computing environments for complex decision making. Such environments are often given the common name of decision support systems (DSSs). The concept of DSS is extremely broad and we have defined them as interactive computer-based systems that aid users in judgment and choice activities. Another name sometimes used as a synonym for DSS is knowledge-based systems, which refers to their attempt to formalize domain knowledge so that it is amenable to mechanized reasoning. This paper traces decision support applications and research studies related to model and data-oriented systems, management expert systems, multidimensional data analysis, query and reporting tools, online analytical processing (OLAP), Business Intelligence, group DSS, conferencing and groupware, document management, spatial DSS and Executive Information Systems as the technologies emerge, converge and diverge. All of these technologies have been used to support decision making and their role in bringing about more ICT interaction with the people through E-governance. Decision support systems research and development will continue to exploit any new technology developments encouraging E-governance and will benefit from progress in very large data bases, artificial intelligence, human-computer interaction, simulation and optimization, software engineering, telecommunications and from more basic research on behavioral topics like organizational decision making, planning, behavioral decision theory and organizational behavior. In agriculture, a large number of database queries can be generated according to crop, water availability and requirement, socio-economic constraints and so on. Design and Development of this database is purely based on Relation Database Management System Model, so the large volume of queries can be easily handled. Finally, knowledge-driven DSS will likely be more sophisticated and more comprehensive in offering convenience to people in short time with lucidity providing effective e- governance.

Keywords: *Decision support systems, online analytical processing (olap), Executive Information Systems (EIS)*

Introduction

The agricultural production and entrepreneurship are basically depends on micro level decision, macro level policy and strategy. Decision is the process to select the best alternatives in neo modernization of agriculture and the concept of urbanization

[1]Professor and [2]Research Scholar, Department of Agricultural Extension, Bidhan Chandra Krishi Vishwavidyalaya, Nadia, West Bengal, India. Corresponding author: S. K. Acharya (acharya09sankar@gmail.com)

is the process that is becoming more complex and confusing.

There is a substantial amount of empirical evidence that human intuitive judgment and decision making can be far from optimal, and it deteriorates even further with complexity and stress. Because in many situations the quality of decisions is important, aiding the deficiencies of human judgment and decision making has been a major focus of science throughout history. Disciplines such as statistics, economics, and operations research developed various methods for making rational choices. More recently, these methods, often enhanced by a variety of techniques originating from information science, cognitive psychology, and artificial intelligence, have been implemented in the form of computer programs, either as stand-alone tools or as integrated computing environments for complex decision making. Such environments are often given the common name of decision support systems (DSSs). The concept of DSS is extremely broad, and its definitions vary, depending on the author's point of view. To avoid exclusion of any of the existing types of DSSs, we will define them roughly as interactive computer-based systems that aid users in judgment and choice activities. Another name sometimes used as a synonym for DSS is knowledge-based systems, which refers to their attempt to formalize domain knowledge so that it is amenable to mechanized reasoning.

For the last twenty years, different kinds of information systems are developed for different purposes, depending on the need of the business. In the present article the authors discuss two kinds of information systems, namely, MIS and DSS, and then their characteristics, interrelationship and their relations with decision-making process in an organization. Computerized decision support systems became practical with the development of minicomputers, timeshare operating systems and distributed computing. The history of the implementation of such systems begins in the mid-1960s. In a technology field as diverse as DSS, chronicling history is neither neat nor linear. Different people perceive the field of Decision Support Systems from various vantage points and report different accounts of what happened and what was important (cf., Arnott & Pervan, 2005; Eom & Lee, 1990b; McCosh & Correa-Perez, 2006; Power, 2003; Power, 2004a; Silver, 1991). As technology evolved new computerized decision support applications were developed and studied. Researchers used multiple frameworks to help build and understand these systems. Today one can organize the history of DSS into the five broad DSS categories explained in Power (2001; 2002; 2004b), including: communications-driven, data-driven, document driven, knowledge-driven and model-driven decision support systems. A variety of DSS have been postulated for describing the characteristics of DSS. These frameworks are helpful in organizing and identifying the relationships of DSS. The identification of DSS applications is important in planning organization strategy for the deployment of information technology.

DSS is defined as the use of computer to: (i) assist managers with their decision process in semi-structure tasks; (ii) to support, rather than replace managerial judgment, and (iii) to improve the effectiveness of decision making rather than its efficiency. While definitions of e-government by various sources may vary widely, there is a common theme. E-government involves using information technology, and especially the Internet, to improve the delivery of government services to citizens, businesses, and other government agencies

to interact and receive services from the federal, state or local governments twenty four hours a day, seven days a week. E-government involves the use of information and communication technologies (ICTs) to support government operations and provide government services. There is a relation between E-government and DSS where E-government encourages citizen participation in the decision- making process and making government more accountable, transparent and effective. The problem focuses on where is the decision support system into the e-government components/ layers and how to utilize the useful of DSS into e-government. No explicit e-government framework includes DSS into its components. So the proposed framework used to solve this problem. In this work, a novel proposed DSS framework for e-government is presented by integrating its components into the e-government framework layers. The aim is to utilize its components to help decision-makers within the e-government.

Objectives

- Sensitization of the concept of Decision support system
- Analysis of the methodology of decision support system
- Identification of the area of DSS application
- Issues and challenges faced by DSS
- The present status of DSS application in agriculture and allied sectors.

What is Decision Support System (DSS)?: A decision support system (DSS) is a computer-based information system that supports business or organizational decision-making activities. DSSs serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

Operational Concept: The concept of a Decision Support System (DSS) emerged in the 1970s following developments in IT which allowed the interactive use of computer technology. The DSS concept reflected dissatisfaction with previous inflexible modelling approaches which did not allow management intervention in problem solving.

The early definitions of DSS emphasized the role of DSS as flexible systems combining database and model components aimed at less structured decisions. These modelling and database components are under the control of the user through an interface or dialogue system.

DSSs include knowledge-based systems. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, documents, personal knowledge, or business models to identify and solve problems and make decisions.

Typical information that a decision support application might gather and present are:

- Inventories of information assets (including legacy and relational data sources, cubes, data warehouses, and data marts),
- Comparative sales figures between one period and the next,
- Projected revenue figures based on product sales assumptions.

DSS help executives make better decision by using historical & common data from internal information systems & external sources .By combining massive amounts of data with sophisticated analytical models & tools,& by making the system easy to use ,they provide much better source of information to use in decision making

process.DSS are a class of computerized information system that support decision making activities.DSS are interactive computer-based system & subsystem intended to help decision makers use communications technologies, data, documents, knowledge or models to successfully complete decision process task. A decision support system or DSS is a computer based system intended for use by a particular manager or usually a group of managers at any organizational level in making a decision in the process of solving a semi structured decision (Figure 7). The DSS produces output in the form of periodic or special report or the results of mathematical simulations (Raymond, 1990). It is difficult to pinpoint that are completely structured or unstructured. The vast majorities are semi structured. This means that the DSS is aimed at the area where most semi structured decision is needed to be made.

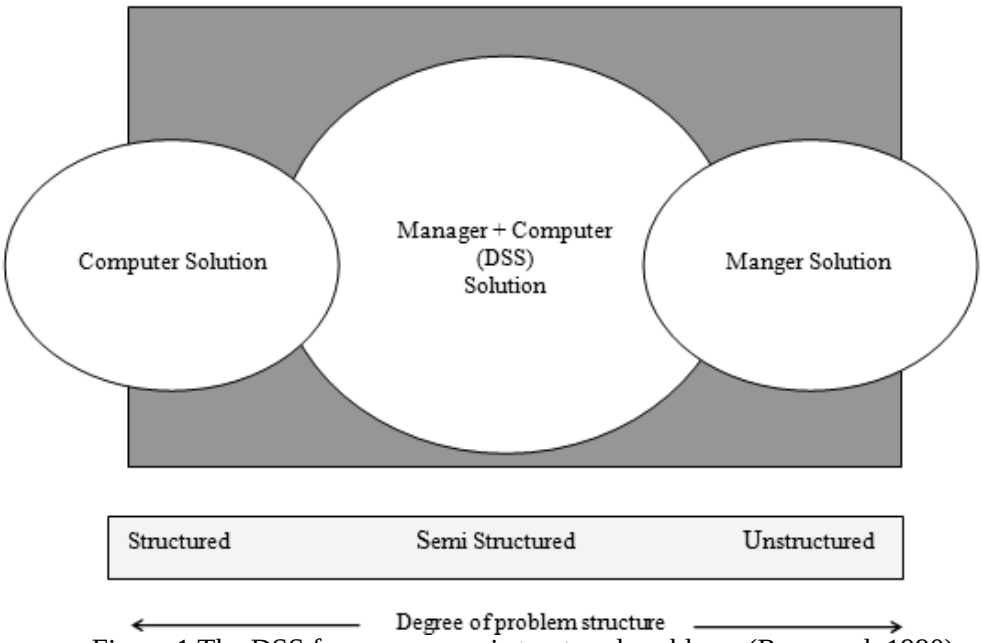
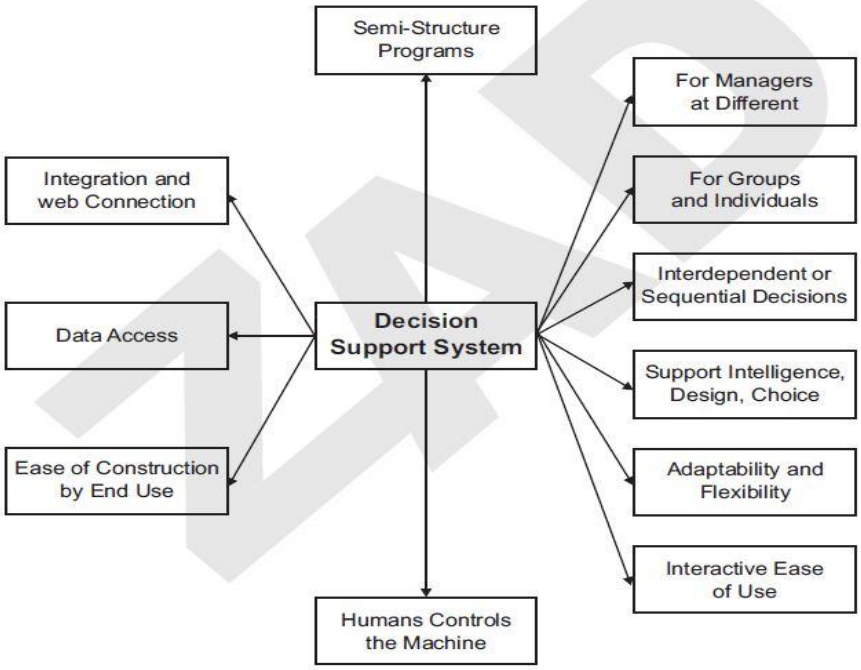


Figure 1 The DSS focuses on semi structured problems (Raymond, 1990)

Characteristics of DSS: The characteristics of the DSS are as follows:

- DSS focuses on towards providing help in analyzing situations rather than providing right information in from of various types of reports.
- DSS is individual specific. Each decisions maker can incorporate his own perceptions about the problem and analyze its effect.
- DSS incorporate various mathematics, statistical and operations research models.
- DSS is only supportive in nature decisions makers still retain their supremacy. It does not thrust its outcomes on the decision maker.
- DSS is effective in providing assistance to solve semi-structured problems at all levels. It is used at first line, middle level and top level management.

- DSS needs an effective database management system. It is extensively uses database.
- DSS helps decision makers to carry out **'what- if'** analysis.



Objective of DSS:
The objectives of the DSS are stated below:-

1. Provide assistance to decision makers in situations which are semi-structured.
2. Identify plans and potential actions to resolve problems.
3. Rank among the solution identified, those which can be implemented and provide list of viable alternatives.

Needs of DSS:DSS have become necessary for today's manger because of following reasons:-

1. **Fast computation:** A decision maker can perform a large number of computations very quickly and that too at a low cost with the help of computer support systems.
2. **Enhanced productivity:** Decision support system can enhance the productivity of support staff and also enable the group members to discuss the problems among themselves as a distance.
3. **Better decisions:** Computer support system can help a decision-maker in arriving at a better decision. For examples, more alternatives can be evaluated, risk analysis be perform quickly, and views of experts from differ places can be collected quickly and at a lower cost.
4. **Data transmission:** Sometimes the data, which may be stored at different locations, may be required to be transmitted quickly from distant locations. Computer support system can

search, store and transmitted the required data quickly and economically.

DSS benefits: That said, even if DSS do not necessarily result in quantifiable, tangible benefits, they do provide identifiable ones. The following list is derived from about 30 DSS studies. Only benefits mentioned in at least five case studies are included. A few typical illustrations or quotes are given for each category on the list: increase in number of alternatives examined; better understanding of the business; fast response to unexpected situations; ability to carry out ad hoc analysis; new insights and learning; improved communication; control; cost savings; better decisions; more effective teamwork; time savings; and making better use of data resource.

These categories add up to a concept of productivity. It is these often qualitative aspects of effectiveness that managers value. The operating assumption of Decision Support is that improving communication, flexibility,' learning and responsiveness leads to better decision making.

DSS in Farm System: The model will help the farmers in increasing their productivity by raising the yield/hectare in food grains: thus, leading to their economic growth. This system has been developed to keep track of farmers all type of information related to crops. Certain applications that are successfully developed using this database are:

- ❖ Farmers can manage their cash flow through the DSS system in a more predictable and efficient way. It is a more common problem with the farmers to manage the cash received at time of harvesting the crop.
- ❖ They can avail full benefit of their cash management by co-relating it with the loans and advances.
- ❖ The administrator can add information to the database without stopping the application.
- ❖ If implemented at Village, District and State level, the model will provide valuable information to other agencies and panchayats in particular.

Growing population and demands for improved watershed management, there is an obvious need to implement sustainable resource use that best serves the communities and the nation. To satisfy this need, the DSS is developed to aid decision – makers and various stakeholders in identifying and assessing options for resource uses. The DSS applies an integrative approach, combining biophysical data, perceptions and socioeconomic conditions of the farmers in the given area. The DSS attempts to stimulate the farmer's behavior in selecting farming systems given relevant constraints and then aggregating up to the node.

A large number of database queries can be generated according to Crop, Water Availability and Requirement, Socio-economic constraints and so on. Design and Development of this database is purely based on Relation Database Management System Model, so the large volume of queries can be easily handled.

DSS with all the ready information help the farmers in a very useful manner. The farmers can get all the information at just at click of the mouse, and they need not to travel to Agricultural Universities for that.

DSS for Agro-Technology Transfer:

- The Decision Support System for Agro-technology Transfer (DSSAT) is a software package integrating the effects of soil, crop phenotype, weather and management options that allows users to ask "what if" questions and simulate results by conducting, in minutes on a desktop computer, experiments which

would consume a significant part of an agronomist's career. It has been in use for more than 15 years by researchers in over 100 countries.

- DSSAT is a microcomputer software product that combines crop, soil and weather data bases into standard formats for access by crop models and application programs. The user can then simulate multi-year outcomes of crop management strategies for different crops at any location in the world.
- DSSAT also provides for validation of crop model outputs; thus allowing users to compare simulated outcomes with observed results. Crop model validation is accomplished by inputting the user's minimum data, running the model, and comparing outputs. By simulating probable outcomes of crop management strategies.
- DSSAT offers users information with which to rapidly appraise new crops, products, and practices for adoption. The release of DSSAT Version 4 incorporates changes to both the structure of the crop models and the interface to the models and associated analysis and utility programs.
- The DSSAT package incorporates models of 27 different crops with new tools that facilitate the creation and management of experimental, soil, and weather data files. DSSAT v4 includes improved application programs for seasonal and sequence analyses that assess the economic risks and environmental impacts associated with irrigation, fertilizer and nutrient management, climate change, soil carbon sequestration, climate variability and precision management.
- DSSAT is one of the principal products developed by the International Benchmark Sites Network for Agro-technology Transfer (IBSNAT) project supported by the U.S. Agency for International Development from 1983 to 1993. It has subsequently continued to be developed through collaboration among scientists from the University of Florida, the University of Georgia, University of Guelph, University of Hawaii, the International Centre for Soil Fertility and Agricultural Development, Iowa State University and other scientists associated with ICASA.

Problems with DSS Development and Adoption: Although these systems seem to have many benefits to producers, they have not widely been taken up by them (Wilde, 1994; Lynch *et al*., 2000). Cox (1996), Campbell (1999), and Lynch *et al*. (2000) have examined reasons behind the low adoption of DSS and other intelligent support systems within agriculture.

Some of the reasons they suggest are as follows:

- Limited computer ownership among producers,
- Lack of field testing,
- No end user input preceding and during development of the DSS,
- DSS complexity and possibly considerable data input,
- No reason seen for changing current management methods,
- Distrust for the output of a DSS because producers do not understand the underlying theories of the models,
- Mismatch of the DSS output with the decision-making style of the producer because the producer’s conceptual models are excluded, and Unclear definition of the beneficiaries (e.g., scientists, primary producers, and technology transfer agents).
- Availability of back up & software.

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A. **Sitemap:** Sitemap gives us the complete description of how the control flows through the site. The main page that links to all the pages is called the Home Page. This page shows the introduction about the Farm Entrepreneur System, the objective of the system and the principles of activity.

B. **Information Retrieval System:** The main advantage of this model to the farmer is that they can retrieve the dynamic information for their farm management decisions. DSS Framework being an agent for the driving force behind the changes in highland resource uses, the farm or household is considered to be the center of this analysis. The decisions on agricultural land and water uses are made in response to resource endowments, economic conditions and socio-cultural norms of the household or communities.

C. **Resource Management Unit:** Farms or households are classified into different types, called resource management units or RMU.

D. **Modeling at the Node Level:** The term node is defined, conceptually, as 'water balance unit'. Its implication depends much on the aspect from which a node is looked at. From hydrological view point, a node represents a village and a network of nodes. Hence each node has a physical domain, which has to conform to that of the village it represents. Within this physical domain exist other biophysical attributes such as soil type, climate type etc. These biophysical attributes constitute a process, which determines the amount of water that flows in and out of the node.

From a socio-economic viewpoint, the characteristics of farm households, alternative land use options and farmers' priorities and constraints characterized by RMU types may differ from node to node. The different set of socio-economic conditions would influence the decisions on how they should manage their available resources to their optimal level of production [4].

From a modeling viewpoint, a node plays a major role in the whole Decision Support System. A node is the level at which all modeling Engines are activated and linked together. The main outputs from modeling process, although initialized at farm or plot level, are reflecting interaction between human and resource availability at the node level.

E. **Outputs and Implications:** The simulation system provides the output on land and water allocation that can maximize gross margin to the communities and Farm Entrepreneur within the node by taking into account the biophysical and socio economic constraints specific to the area. The effects of a partial change in the land uses, prices, investment and other developments plans on farm gross margin, labor and capital requirements can be easily assessed and the results can be presented both at the non-aggregated RMU (household) level and the aggregated level (node or village).

The economic and environmental tradeoffs of various plans can be determined for improving welfare. Since water is basically a very important shared resource with lack of true ownership, the Decision Support System, can aid assessing management options to help resolving or avoiding

land and water use conflicts. Although the output is quantitative in its nature, this DSS is aiming towards providing the trend of resource use options rather than quantifying the amount of resources being used. The workflow overview of the DSS is shown in Workflow of DSS.

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Future Scope:

The Scopes for the future research are-

- The Farm Entrepreneur System can be made more useful for the farmers by converting the language of the system to the local language.
- Further development of the economic model is required in order to address more complicated resource management patterns effectively.
- Market information relating to prices of the crop, particularly if quoted higher than the maximum support price offered by the government.
- Information transfer to the farmers can be increased substantially by providing email, news groups, messenger services, online chatting, and discussion groups.
- Voice support in local language can be provided for illiterate or semi-literate farmers.

Research on growing different crops in protected environments.

Conclusions

DSS practice, research and technology continue to evolve. Decision support systems research and development will continue to exploit any new technology developments and will benefit from progress in very large data bases, artificial intelligence, human-computer interaction, simulation and optimization, software engineering, telecommunications and from more basic research on behavioral topics like organizational decision making, planning, behavioral decision theory and organizational behavior. Trends suggest that data-driven DSS will use faster, real-time access to larger, better integrated databases. Model-driven DSS will be more complex, yet understandable, and systems built using simulations and their accompanying visual displays will be increasingly realistic. Communications-driven DSS will provide more real-time video communications support. Document-driven DSS will access larger repositories of unstructured data and the systems will present appropriate documents in more useable formats. Finally, knowledge-driven DSS will likely be more sophisticated and more comprehensive. The advice from knowledge-driven DSS will be better and the applications will cover broader domains.

Current researchers should remember that Decision Support Systems pioneers came from a wide variety of backgrounds and faced many challenges that they successfully overcame to demonstrate the value of using computers, information technologies and specific decision support software to enhance and in some situations improve decision making. The DSS pioneers created particular and distinct streams of technology development and research that serve as the foundation for much of today's interest in building and studying computerized decision support systems. The legacy of the pioneers must be preserved.

The association with e-governance is very important for government to interact with people and business transactions. E-government proffers a huge potential to find innovative way to satisfy need of people. This can be helpful to the farmers as well. Progress of new technologies allows electronic services to be applied in e-government. So, DSS must be integrated with e-government managerial levels. DSS is a very helpful tool for all e-government enterprises

References

Alavi, M. and Joachimsthaler, E. A. 1992. *"Revisiting DSS Implementation Research: A Meta-Analysis of the literature and suggestions for researchers,"* MIS Quarterly, pp. 95-116.

Alter, S.L. 1980. Decision Support Systems: Current Practice and Continuing Challenge. Reading, MA: Addison-Wesley.

Alter, S.L. 1975. *"A Study of Computer Aided Decision Making in Organizations,"* Ph.D. dissertation, M.I.T.

Alter, S.L. 1977. "*Why Is Man-Computer Interaction Important for Decision Support Systems?"*, Interfaces. pp. 109-115.

Armstrong, M. P., Densham, P. J. and Rushton, G. 1986.*"Architecture for a microcomputer based spatial decision support system,"* Second International Symposium on Spatial Data

Handling, 120, 131 International Geographics Union.

Arnott, D. and G. Pervan, 2005. "*A critical analysis of decision support systems research",* Journal of Information Technology, pp. 67-87.

Baskerville, R. and M. Myers 2002. *"Information Systems as a Reference Discipline",* MIS Quarterly, pp. 1 - 14.

Berners-Lee, T. 2007. *"The World Wide Web: Past, Present and Future,"* August 1996, URL http://www.w3.org/People/Berners-Lee/1996/ppf.html, last accessed.

Bhargava, H. and D. J. Power. 2001. Decision Support Systems and Web Technologies: A Status Report. Proceedings of the 2001 Americas Conference on Information Systems, Boston, MA.

Bhargava, H. K., R. Krishnan and R. Müller. 1997. *"Decision Support on Demand: Emerging Electronic Markets for Decision Technologies,"* Decision Support Systems, 19(3):193-214.

Bonczek, R. H., C.W. Holsapple, and A.B. Whinston. 1981. Foundations of Decision Support Systems, New York: Academic Press.