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A road map through the maze - a typology of farm management decision making research

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Abstract

A review of 183 papers published between 1990 and 2006 lead to development of a typology of farm management decision making (FMDM) research. An existing model which categorises decision research according to purpose as being either D: descriptive, N: normative or P: predictive was blended with a second form of categorisation based on six emergent decision domains: (1) factors, (2) processes, (3) events, (4) evaluation, (5) patterns and (6) aids. The result was a typology of seven main discernible types of FMDM research. Each of these types is outlined and examples of representative publications listed. Finally, some trends in publication patterns, in accord with this typology, are presented. This work is presented in the hope it helps readers to navigate more easily though a large and complex literature.

Introduction

Understanding how farmers make decisions is of great interest to many stakeholders including researchers, extension workers, policy makers, input suppliers, product marketers and supply chain managers. The field of farm management decision making (FMDM) research has a long history, and now is represented in a vast and multi-faceted literature which can be seemingly impenetrable to the casual reader and even to the experienced researcher. This paper attempts to address the maze of FMDM research literature by providing a guide or 'road map' based on the type and purpose of research. It was developed as part of doctoral research into decision making by farmers of the Republic of South Korea. Our aim is to share with others what we believe is a useful typology of decision theories and research methods used in FMDM research. We also report on several trends apparent in recent FMDM literature.

Materials and Methods

The review of FMDM research was conducted through two steps, with a broad overall review followed by in-depth review. The overall review was focused on drawing the general profile of a research publication to allow categorisation, and in-depth review was conducted to deal with its more detailed characteristics, such as research methodology employed.

FMDM research was reviewed through following procedures:

1. For ease of electronic access, it was decided to review only articles published since 1990 and listed

on two powerful databases ‘CAB abstract® ’ and ‘Science Direct’. This yielded a total of 183 journal articles. Although much useful FMDM research had been published before 1990, it was quite difficult to gain the full text of all these articles. The key words for searching the databases were ‘farm* and decision*’ which captured any articles including the words ‘farm’ (e.g., farmer or farm management) and ‘decision’ (e.g., decision making, decision process, or decision support) within their title.

2. Articles having full-length text in English were obtained and reviewed in full, whereas for those published in other languages the review depended on their abstracted text.

3. The initial broad review focused on comparing the aims and area of each study, and resulted in identification of two main categories and nine subcategories. The second, in-depth stage resulted in consolidation of these into seven types of FMDM research.

Categorisation of FMDM research

The review showed that research dealing with farmers’ decision-making can be broken into two main categories according to (1) its aim or purpose (Category I) and (2) the domain of farm management (e.g., production, marketing, financial, resources, personnel, environment) on which it is focused (Category II).

Category I research

For Category I, three subcategories of research purpose were adopted: descriptive (D), normative (N) or prescriptive (P), in accord with the analysis provided by Bell, Raiffa and Tversky (1988), and Rapoport (1989). Category I and its three subcategories are illustrated in Table 1 below.

Table 1. Classification of farm management decision research by purpose

Categories	Subcategories	Main focus
Category I The aim of FMDM research	Descriptive study (D)	Understanding how farmers actually make decisions
	Normative study (N)	Providing solutions for how farmers should (ought to) make decisions
	Prescriptive study (P)	Developing decision support systems to help farmers make better decisions

Descriptive decision research, subcategory D, which is typically studied in psychology (especially social psychology) and behavioural sciences, deals with questions pertaining to how people really *do* make decisions. Descriptive decision research starts with observations of how decision makers react in a given choice situation (e.g. a financial issue that need to be tackled) and attempts to describe systematically (inductively) their decision processes or social phenomena resulting from decisions (e.g. causes and effects

of observed events described in terms of psychological states (motivations, preferences, satisfaction, disappointment, etc). The purpose of descriptive decision research is to find out the rules determining decisions of certain classes of decision makers and to predict decisions or their consequences.

In contrast, normative decision research, subcategory N, which is usually studied in the context of economics, statistics, and mathematics, aims at addressing the question of how people *ought to (should)* make decisions in given decision situations by using mathematical language in which the precise definitions of terms, deductive analysis, and assumption of idealised conditions (rationality) are essential; that is the reason why normative studies are formal and optimal (Bell *et al.*, 1988; Einhorn *et al.*, 1988). Thus, the main objective of normative decision research is to reveal the logical essence of an idealised decision problem (Rapoport, 1989).

Prescriptive decision research, subcategory P, has interests in how to help people to make good decisions or how to train people to make better decisions. Thus, prescriptive research, which is usually studied in the disciplinary area of operational research or management science, uses some of the logical consequences (normative study), the empirical findings (descriptive study), and perhaps something else added from another discipline (Bell *et al.*, 1988). One good example of prescriptive study is the development of the decision support system (DSS).

Category II research

Category II (FMDM research area) is made up of 6 subcategories with which reviewed studies mainly dealt. These were identified as: (1) decision factors affecting farmers' decision-making; (2) decision processes; (3) the decision event; (4) decision outcomes; (5) decision patterns; and (6) decision aids (see Table 2). Identifying these six categories was quite difficult and somewhat arbitrary, because most previous address more than one subcategory and also because the subcategories themselves can not be neatly separated by explicit definition of each subcategory; this is a weakness of categorising FMDM research. In other words, some previous studies could be included to some extent in every subcategory. However, in spite of difficulties and weaknesses of the procedure of classification, the decision research area is classified by considering FMDM research on which researchers had tried to put much heavier emphasis, because the purpose of classification of previous studies is not to define them by rigorous criteria.

Subcategory 1, the decision factors, includes studies that are mainly dealing with factors influencing farmers' farm management decision making such as economic, environmental, and social factors (External

factors) and farmers' goals, motivations, attitudes, personality, and biography (Internal factors). Studies that deal with farmers' full decision-making process from detecting problems to implementing decisions are categorised into subcategory 2, the decision process. Studies focusing on farmer's decisions on a specific event under the decision situation such as an uncertain or risky situation are grouped into subcategory 3, the decision event. Studies evaluating decision outcomes or exploring the relationship between farmers' decision-making and their performance are classified into subcategory 4, the decision outcome. Subcategory 5, the decision pattern, includes studies especially focused on who the main decision makers are within each farm household and what their roles are. Subcategory 6, the decision aid, is strongly related to studies developing decision support systems (DSS) or extension services for the purpose of farmers' decision-making assistance. These are illustrated in Table 2 below.

Table 2. Classification of farm management decision research by domain

Category II FMDM research domain	(1) Decision factors	Factors affecting farmers decision-making (external & internal)
	(2) Decision processes	Farmers' decision-making processes from detecting problems to implementing decisions
	(3) Decision events	Farmers' decisions on a specific event in a particular situation (uncertainty, risk, or multi-objective)
	(4) Decision evaluation	Evaluation of decision outcomes or relationship between decision making and performance
	(5) Decision patterns	Roles of decision-makers amongst family members
	(6) Decision aids	Decision support system (DSS) or other helpful means to improve farmers' decision-making

Consolidated typology of FMDM research

Review of these two forms of categorisation allowed consolidation into one scheme of seven main types of FMDM research, as illustrated in Figure 1. Each type is described briefly in Table 3, with some examples of key references for each type.

Explanatory notes and discriminating features for each type of research are set out below.

Type D1: studies that describe and analyse factors influencing farmers' decision making

Type D1 of decision research has a focus on identifying and analysing factors affecting farmers' decision-making in either day-to-day management decisions or a given decision situation. Many studies similarly conclude that factors influencing farmers' decision behaviour differ among farmers because of different goals, different resources, different levels of knowledge, different operating environments, and different approaches in confronting uncertainty. Therefore, researchers agreed that it would be quite difficult to

identify the key determinants affecting farmers' decision behaviour. However, these types of studies were carried out for the purpose of identifying diverse variables that are needed to build farmers' decision model or providing the implications related to the extension service or policy-making.

Figure 1. Categorisation of farm management decision making research published between 1990 & 2006 (n = number of papers)

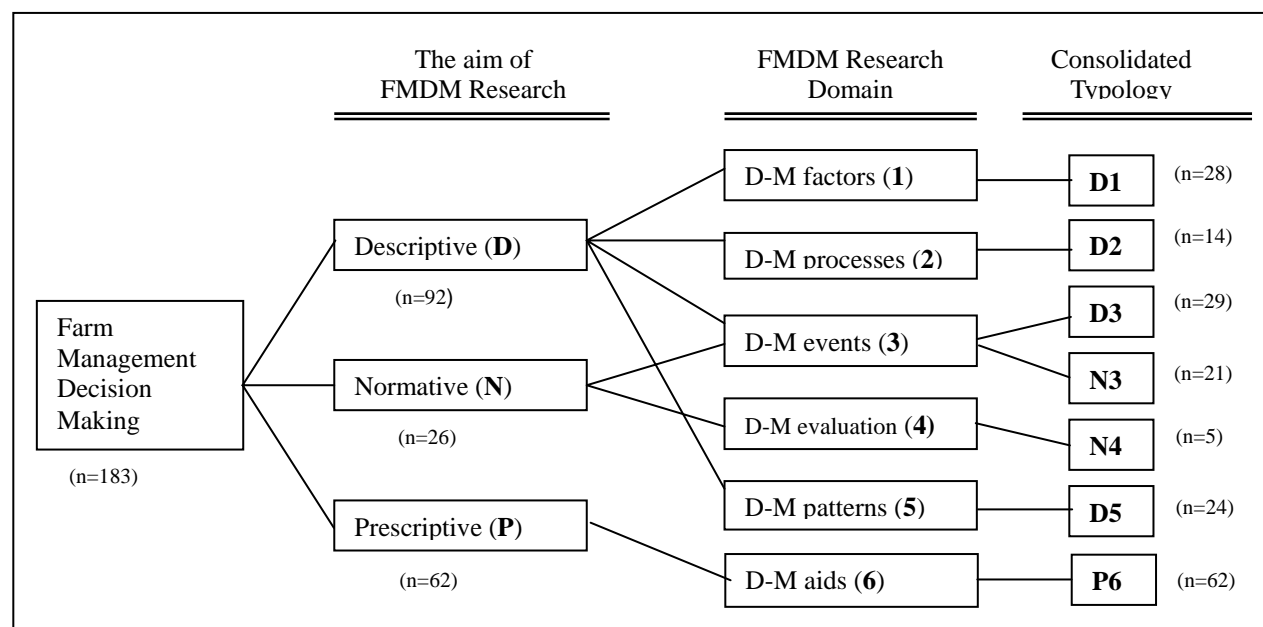


Table 3. Typology of farm management decision research

Types	Description	Examples
D1	Studies on the understanding or analysis of factors influencing farmers' decision-making	(Featherstone <i>et al.</i> , 1993; Kolodinsky <i>et al.</i> , 1997; Willock <i>et al.</i> , 1999; Solano <i>et al.</i> , 2003; Stirm <i>et al.</i> , 2003; Bragg <i>et al.</i> , 2004; Iqbal <i>et al.</i> , 2006)
D2	Studies on the understanding of the farmers' decision processes	(Gonzales-Intal <i>et al.</i> , 1990; Murray-Prior, 1998; Ohlmer <i>et al.</i> , 1998; Murray-Prior <i>et al.</i> , 2001; Dounias <i>et al.</i> , 2002)
D3	Studies on the certain farm management decision issues by the way of descriptive approach	(Mistry, 1998; Bandong <i>et al.</i> , 2002; Vaarst <i>et al.</i> , 2003; Matshe & Young 2004; Blackett <i>et al.</i> , 2006)
N3	Studies dealing with rational decision models on specific issues especially under the uncertain or risky situation	(Piech <i>et al.</i> , 1993; Juan <i>et al.</i> , 1996; Backus <i>et al.</i> , 1997; Strassert & Prato 2002; Humphrey & Verschoor 2004; Pritchett, 2004)
N4	Studies on evaluation of the outcomes of decision behaviour	(Varela-Ortega <i>et al.</i> , 1998; Buysse <i>et al.</i> , 2005; Qiu, 2005)
D5	Studies dealing with decision patterns or decision makers' decision styles	(Timsina <i>et al.</i> , 1992; Rogers & Vademan 1993; Kalinda <i>et al.</i> , 2000; Ozkan <i>et al.</i> , 2000)
P6	Studies aimed at developing decision support systems or useful means to help farmers make better decisions	(Gauthier & Neel 1996; Attonaty <i>et al.</i> , 1999; Morag <i>et al.</i> , 2001; Pomar & Pomar 2005; Dorward, 1991; McCown, 2001; Swinton <i>et al.</i> , 2002; Coleno <i>et al.</i> , 2005)

Various factors influencing farmers' decision making have been studied. With respect to internal aspects, farmers' attitudes and objectives, usually believed to depend on their beliefs, values, or personalities, considerably affect farmers' behaviours (Tassell *et al.*, 1991; Farinos Dasi, 1994; McGregor *et al.*, 1996; Willock, J. *et al.*, 1999). Many decision studies found that farmers' characteristics such as age, education, farm size, or farm income level have very close relationships with their decision behaviour (Featherstone *et al.*, 1993; Fox *et al.*, 1994; Stirm *et al.*, 2003; Bragg *et al.*, 2004; Chianu *et al.*, 2004; Selvaraju *et al.*, 2005; Iqbal *et al.*, 2006). Solano *et al.* (2006) analysed the impact of farmers' biographical variables and decision-making profiles on farm management and performance.

With regard to external factors associated with farmers' decision behaviour, environmental and economic factors (Kolodinsky *et al.*, 1997; Illukpitiya *et al.*, 2004; Lindgren *et al.*, 2005) and government policies (Hollick, 1990) have deep impact on farmers' decision-making. It is also obvious that farmers' preferred information sources (Solano *et al.*, 2003), the role of information or knowledge (Casey *et al.*, 2002), and information systems (Streeter, 1992; Versteegen *et al.*, 1998) have played a very important role in farmers' decision-making.

Type D2: studies focusing on the farmers' decision processes

Types D1 and D2 of decision research are usually predicated on the belief that the main reason for the failure of policies or programs launched for the purpose of improving farm management is due to the lack of understanding of farmers' decision behaviour or decision processes (Ohlmer *et al.*, 1998; Murray-Prior *et al.*, 2001; Bekele *et al.*, 2003; Illukpitiya *et al.*, 2004). Therefore, type D2 decision research shares a similar purpose with type D1.

Decision research included in type D2 has attempted to describe and predict farmers' decision-making behaviour through understanding the process of decision-making. Most type D2 decision research concludes that the process of farmers' decision-making is very complex and does not follow a linear process. In order to understand their decision processes it needs to be considered within a broad context.

Type D3: studies focusing on decision issues with descriptive approaches

Type D3 decision research is focused on alternatives that farmers tend to choose rather than the decision-

making factors (type D1) or the full decision-making process (type D2). This study type usually tries to describe or analyse which alternatives of certain decision issues are chosen by farmers so that researchers can understand farmers' decision-making on the specific issues related to farm management, e.g., allocation of land use, pest management, water management, and so on.

However, type D3 typically has a broader research boundary than type D1 and type D2 because it considers both decision factors and decision processes in order to achieve research objectives (Mistry, 1998; Bekele *et al.*, 2003; Blackett *et al.*, 2006). Some D3 type research employs decision tree models to depict the process of choosing the alternatives or to describe farmers' decision behaviour (Gonzales-Intal *et al.*, 1990; Bhuiyan *et al.*, 1995; Le Quang *et al.*, 2004).

Type N3: studies dealing with rational decision models especially under uncertainty and risk

Although similar to D3 because it also deals with decision issues or decision events, type N3 is totally different in approach because it is normative rather than descriptive.

In normative decision studies, decision makers are assumed to have profit-maximising or cost-minimising intentions amongst multiple objectives. Decision makers' goals, objectives, and values are also assumed to be known. The consequence of alternative decisions may be known, probabilistically known, or unknown, depending on the particular decision issue.

Type N3 of decision research aims for an optimal and rational decision model which farmers *should* consider when they choose one alternative over another, especially in uncertain or risky situations. It is typically carried out on the basis of economic theory, e.g. subjective expected utility theory (Backus *et al.*, 1997) and multiple criteria decision model (Piech *et al.*, 1993; Strassert *et al.*, 2002).

Type N4: studies focusing on evaluation of the outcomes of decision behaviour

The main purpose of type N4 of decision research is to assess or evaluate the consequences of decision-making on the basis of the assumption that the farmer as a decision maker tries to maximise his/her profit function. However, this type of decision study concerning evaluation of decision outcomes is relatively rare in both normative and descriptive decision study in the period under review.

To evaluate the economic or environmental impact of decision-making, a multi-criteria decision making

(MCDM) model was used by (Martinez-Cordero *et al.*, 2004; Qiu, 2005) and also in a farm household optimisation model employed by (Bernet *et al.*, 2000). Buysse *et al.* (2005) and Varela- Ortega *et al.* (1998) evaluated the impact of decision-making on the nutrient balance of dairy farms and the impact of the changes of policies on decision-making, respectively.

Through type N4, it is evident that decision outcomes can be evaluated in various ways such as economic performance, environmental benefit, or the effect of policies. Evaluation of decision outcomes is very critical to recognise the importance of farmers' decision-making. However, other aspects like farmers' values or preference need to be considered because, for example, the outcome of decision can be also evaluated subjectively by the degree of decision-maker's satisfaction.

Type D5: studies dealing with decision patterns or decision styles

Most type D5 FMDM research deals with the role of farm family members, especially women, in decision-making concerning both on- and off-farm activities. The importance of women's participation in almost all stages of farming has been increasingly recognised, especially in developing countries. Thus this type of decision research tries to seek for answers to the following research question: to what extent do women participate and in what kinds of farm management decision-making?

Many studies concerning women's participation in decision-making processes (Timsina *et al.*, 1992; Kalinda *et al.*, 2000; Masur, 2000; Ozkan *et al.*, 2000; Debasish *et al.*, 2005) show that men or husbands tend to dominate decision-making on farm management, especially on the matter of financial management, although men and women jointly make decisions somewhat on production or marketing management. However, these studies do not put emphasis on whether women's participation in decision-making process is helpful to farm management decision-making or why women's role in decision-making is important. Therefore, in terms of family members' partnership and better decision-making, the importance of women's participation in decision process needs further study.

Type P6: Studies aimed at developing decision tools or means to help farmers make better decisions

In type P6 FMDM research, numbers of web-based or computer-based systems and software programmes have been developed to help farmers or advisors collect and analyse various types of information effectively and use it for their decision-making (Kerr *et al.*, 1999; Bracke *et al.*, 2001; Morag *et al.*, 2001;

Pomar *et al.*, 2005).

However, P6 type research usually focuses on the development of a new decision support system (DSS) as the use of the computer or the Internet has been enlarged among farmers. In spite of their potential usefulness, DSS remain unavailable or unhelpful to many farmers, especially those who are relatively poor, old, or less educated, even in developed countries. Therefore, to be effective, type P6 research should not only deal with development of user-friendly DSS but also needs to be accompanied by appropriate programs to train and equip farmers to make better decisions through education or extension programs.

Trends in FMDM research

Three further analyses were conducted as part of the process of reviewing FMDM publications since 1990. One of these was directed towards detecting any noticeable trends in the type of research being published, the second to patterns of publication by country of origin, and the third to aspect of research. Results are presented and briefly discussed below.

Trends in by period and country

The number of FMDM articles published has increased notably, from 39 articles during the period of 1990-1995 to 79 articles during 2001-2006 (Table 4). As the circumstances surrounding farm management have become more complex and increasingly affected by unpredictable variables it is evident that researchers' concerns about farmers' behaviour and decision-making have also been increasing. Research has been dominated consistently by type P6 which represents one third of all studies, followed in order of frequency by D3, D1, D5, N3, D2 and finally N4.

Four nations dominate publication, with half coming from USA (35), India (29), UK (17) and Australia (11). It is noteworthy that India has played such a significant role in publication, and also that a large proportion of its publication are of type D5, a domain relatively neglected elsewhere, that deals with family management patterns and specifically the role of women in farm management.

Table 4. Farm management decision-making research by period and by country

Type	By period			By country					Total
	1990-95	1996-2000	2001-06	USA	India	UK	Australia	Other	
D1	9	7	12	8	2	6	1	10	28
D2	1	10	3	2	1	-	3	8	14
D3	2	13	14	5	4	3	-	17	29
N3	4	8	9	4	3	1	-	13	21
N4	-	1	4	1	-	1	-	3	5
D5	5	8	11	1	17	-	-	6	24
P6	18	18	26	14	1	6	7	34	62
Total	39	65	79	35	29	17	11	91	183

Trends by aspect of farm management

Only 68 of the 183 FMDM research articles reviewed have dealt with farmers' decisions across the whole span of farm management, while the remaining articles have focused on decision behaviour in a particular management area such as production or resource management (Table 5). As environmental issues (e.g. soil or water management) and production management (e.g. issues related to organic products) have become matters of greater social concern in terms of sustainable farming or consumer-oriented agriculture, the need for decision-making studies on these farm management area has increased in recent years.

On the other hand, in spite of the importance of marketing and financial management in farmers' business performance, relatively few studies have been published on these aspects of FMDM research. In particular, few type D2 and D3 studies have been carried out in the financial management research area (see Table 5).

Table 5. Farm management decision-making research by aspect of farm management

Type	Whole farm management	Managerial ability	Production management	Marketing management	Financial management	Resource management	Environmental management
D1	7	9	2	1	2	4	3
D2	6	4	3	-	-	-	1
D3	6	3	8	1	-	7	4
N3	8	-	7	1	2	1	2
N4	3	-	2	-	-	-	-
D5	20	1	-	-	2	1	-
P6	18	13	9	2	5	11	4
Total	68	30	31	5	11	24	14

It is apparent that one trend in FMDM research has been a move from broader understanding of farmers' decision-making in a whole farm context to more detailed analysis of the specific decision matters leading to development of decision support systems.

Conclusion

In this paper, FMDM research has been reviewed to document the kinds of research that has been published since 1990 and a scheme for its categorisation has been proposed. Prescriptive FMDM research (type P6) that aims to support farmers' decision by developing various computer systems or software dominates FMDM research. However, it could be argued that studies that improve understanding of decision processes should be conducted prior to development of decision support systems because better understanding can be the foundation of developing more useful decision support systems. A notable feature of this analysis is the relative paucity of studies into marketing, financial and environmental aspects of management (respectively 5, 11 and 14 of 183 studies) despite the growing evidence of the extreme importance of these dimensions to sustained success of farm businesses.

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