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AN EXPLORATORY USE OF GROUP DECISION THEORIES IN EVALUATING FARM PLANNING PROGRAMMING MODELS

by

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ABSTRACT

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Farm management research has produced programming models capable of accurately simulating the interaction of physical, biological, and institutional factors and models of economic rationality. This precision has not resulted in significant farm usage. Normative assumptions implicit and explicit in these models may be major problems. If so, criteria reflecting the acceptability of normative assumptions should provide an effective means of model selection.

It is hypothesized that (a) it is possible to establish general criteria which distinguish normative propositions of programming models which will be usable in farm decision making from those that will not, and that (b) such criteria are implied by existing decision theory and research.

Working hypotheses were established regarding the nature of model normative assumptions. These served to guide a review of research in farm decision making which in turn implied general criteria of normative validity. Analysis of proposed planning models revealed a fundamental assumption of goal-directed maximizing behaviour by the

farm decision unit. Goals for the planning period are regarded as a static evaluative reference. They are assumed exhaustive in discriminating between alternatives and all significant goals are assumed to be quantifiable functions of measurable levels of economic goal achievement. Additional more specific assumptions operating within the scope of these fundamental assumptions are required by traditional analytical procedures or mathematical requirements.

A conceptual framework for group decision making established by rural sociology, group sociology, behavioural theory of the firm and diffusion theory suggests serious conflicts with modelled normative assumptions. Farm family goal formation and decision making are revealed as dynamic and simultaneous processes in which interpersonal goal-value conflicts play a major role. As a result hazy, ill-defined, and operational group goals are the normal case.

Although much research has been conducted on the importance, dynamic quality, and pervasiveness of group decision processes, no definitive theory exists which quantitatively describes the evolution of group goals and decision processes. Current farm management practice places the job of interpreting expressed goals and translating these intuitively into a mix of integrative and analytical tasks (and thus into resource allocations between integrative or harmonizing, and productive functions) in the hands of the decision unit and its advisors.

Research and theory reviewed indicate that the fundamental goal-directed maximizing assumption is representative of only a few short-run, technical decisions with globally accepted effects on income. More typically, expressed goals, values, and beliefs point not to ends for action but to needs for allocating resources between integrative and productive activities. Modelled goal structures must be explicitly recognized as conditional bases for intuitive allocations of resources between integrative and productive tasks.

Two strongly supported corollaries are possible. Firstly, the recognition that goal-directive maximizing behaviour is not possible indicates that model builders should focus on integrative requirements rather than normative exhaustiveness. No normative assumption is valid simply because it represents an expressed goal or value. Secondly, the large variety and dynamic nature of operational goals suggest that models should be capable of analysis conditioned on a wide range of firm goals. Weakly supported corollaries are possible in two additional areas. Firstly, utility functions are rejected for use in farm planning since they are part of an operational-goal oriented maximizing model and in addition focus on individual decision making. Secondly, extension agency objectives and techniques and diffusion theories imply that the conditioning base on which models should be built should be defined within the context of individual extension practices and objectives.

On the basis of the major criterion and its four corollaries it is concluded that the original hypothesis is acceptable. While no empirical test of the hypothesis was attemped it is notable that the criteria established are consistent with the degree of success encountered by existing farm planning programming models.

FOREWORD

The research on which this study is based has developed out of a concern that farm management research in the computer modeling era has grown out of touch with the human conditions surrounding farm decision making. While much effort in the farm management profession has been devoted to the building of normative models, farmers and extension workers have seldom found use for them in decision making. Is there something fundamentally wrong with the models? Do farmers and extension specialists not understand their potential? Are farm management researchers not sufficiently application-oriented?

As usual a considerable amount of time was spent developing and refining a concept of the problem. At first, it seemed that the problem was in large part mathematical, or at least had to do with cataloguing and weighing the characteristics of quantitative techniques potentially useful in farm planning. Could it be that farm management researchers had not yet developed models of farm planning within realistic decision environments? It appeared from a review of conceptual research into methods of modeling the farm decision environment (in all its stochastic, non-linear, lumpy and institutional complexities) that, in point of fact, models were available which could cope with the major tasks of environmental description. The further research along these lines continued, the more it became apparent that the problem was the absence of criteria capable of assessing the worth of farm management models, and this had more to do with the normative aspects of farm management than mathematical models per se. The problems of farm management did not appear sufficiently well understood that "the model", which adequately accounted for the normative aspects, could be recognized if in fact it did exist.

A first reaction in pursuing this line was that since planning models are normative and aimed at the satisfaction of decision makers, utility theory offered a sound framework for assessing the worth of farm management models. After some inquiry it became apparent that utility theory offered no sound basis for viewing the problem since the decisions in question were "small group" decisions, not the decisions of isolated decision makers. At this point, it appeared that a slightly different tack might prove useful. The theory of social welfare functions developed by Arrow [6] and enhanced by Fishburn and others [43] appeared to provide a framework for normative analysis of decision making in a group context. Further review revealed that this body of theory could not yet provide a foundation for assessing small group decision models. However the welfare function concept did point out a major problem in assessing normative decision models for use in group decision making.

Any theoretic base for purposive behaviour at the group level has to provide for the problems imposed by conflicts between individual objectives. At this point, it appeared necessary to abandon the familiar axiomatic bases provided by economic theory and to fall back on a more general base for developing a means of model assessment by basing a set of criteria on accepted theories of farm family group decision making. This was the point of departure for the thesis presented below.

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CHAPTER 1

THE PROBLEM

Farm management research has produced a large number of models each proposed for use in farm decision making. Farm management advisory personnel and farmers have the task of selecting from these models for use in farm planning. Development of selection criteria which can discriminate between models with a high potential for acceptance in farm decision making and those with a low potential is the central problem addressed by this study.

The appearance of complex farm management models has been associated with increasing sensitivity of economic rewards to management performance and increasing availability of complex operations research techniques. On the farm side, dependence on unstable international markets, increasing use of capital-intensive production techniques, decreasing equity positions, production specialization, dependence on off-farm suppliers, increasingly commercial oriented farm goal-value systems and increased competition for labour have contributed to the critical dependence of farm firms on decision making rather than tradition. On the other hand, models developed during the last two decades have proved adept in simulating the effects of increasingly complex production processes, business systems, and resource and institutional constraints on economic decision making. Linear programming (L-P) and increasing availability of electronic computers have permitted the evaluation of large numbers of farming alternatives [56,50,5,86]. Integer programming has provided an answer to non linearity problems such as lumpiness in assest acquistition, selection between either-or alternatives and selection of all-or-nothing alternatives [40]. Separable programming has allowed the representation on non-linear functions as linearly segmented functions [111, 112]. Stochastic programming formultions (L-P and quadratic programming) have been developed and they provide for selection between alternatives with stochastic: levels of achievement, resource levels, and production coefficients [92, 31, 91, 96].

In spite of extensive developments in farm management modeling, only a small number of specialized models has been used in farm decision making. The 1972 "Inventory of EDP Programs" [78] used in U.S.A. Agricultural extension Programs indicates extension oriented services having "highly usable reports" and over 50 recorded uses were in the following categories: ration formulation or nutritional analysis, technical simulations (eg. breeding programs), crop operations scheduling, debt analysis (eg. loan repayment), long-run and short-run budgeting, discounting, and tax calculation.

All services available to farmers treat the firm as a series of independent subsystems. No attempt is made to achieve an overall optimum. Most models are static and aimed at improving technical efficiency in a way that can only have favourable effects on farm income. Long-run planning is restricted either to a relatively minor use of long-run budgets which incorporate no selection process or to discounting models.

All models reporting extensive usage incorporated only weak consideration of farm goals and objectives within various farm firm subsystems. Information provided is directed at "what-if" questions or at universally acceptable goals rather than at generalized "what-should-I-do" questions. Feed formulation models (which make up about half of the above uses of planning models) are aimed at reducing feed costs, budgeting, and simulation models are aimed at testing the implications of farmer formulated plans. Reported long term planning models utilize traditional discounting concepts. No models incorporating the selection of optimal long run planning strategies in complex whole farm decision environments have reported, significant numbers of uses.

As a result of adherence to static programming procedures which closely parallel the approach of traditional farm management extension, normative considerations are usually relegated to the pre-optimization (defining alternatives) and post-optimizing (interpreting model solution) stages in programming approaches to farm planning. For example, Tennessee's use of static linear programming in the "Rapid Farm Adjustment Program" [115] has aimed at suggesting adjustments necessary to maximize net returns to the operator, given available resources without regard to the size of the production unit. Adjustments are made to resulting plans on the basis of the planner's judgment and farmer's preferences. Major emphasis appears to have been on using L-P to arrive at a basis from which acceptable farm plans could be developed rather than explicitly introducing normative elements to arrive at the farm plan.

In Chapter IV of his thesis, which led to the Oklahoma L-P Farm Program,[1] Bitney [13] notes that the programming approaches to farm planning can only be successful as an integral part of an education program. Apparently, current educational (extension) programs are structured in such a way that normative elements enter the programming process in roughly the same way that they have traditionally entered budgeting-oriented farm planning, since in developing his area information system in a programming context, a normative content is not elaborated.

In contrast with the type of models in current use, research in the programming area has concentrated on the modeling of long run planning under complex decision environments and consequently on producing models with strong normative assumptions. Programming offers rapid calculation of a best possible solution from a wide range

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[1] L-P Farm is a static farm enterprise selection L-P model used in Oklahoma's farm management extension program.

of alternatives. As a necessary part of the processes, decision criteria are explicitly incorporated into the planning model. Decision makers are required to define best solutions before they can be calculated, rather than simply recognizing best solutions when they see them. Thus normative propositions are a required component of all programming models. In contrast with budgeting procedures, programming sacrifices active involvement in planning decisions in some measure in order to implement the optimizing concept.

The more complex the modelled decision environment, the more complex the set of normative propositions that are required to support choice between alternatives. For example, if the problem situation is the formulation of dairy rations given fixed nutrient requirements, feedstuff analysis and costs, a simple normative statement that cost should be minimized is sufficient to justify the use of a least-cost feed formulation model. Normative propositions in existing farm management use are of this type.

If, on the other hand, the problem situation is the determination of a mix of capital purchases required in a stochastic production process subject to stochastic resource constraints, more complex decision criteria are called for. At the very least, normative propositions are required to support choice between levels of achievement over time. Since levels of achievement are a function

function of production processes, choice between levels with varying probability distributions is required. Since the modelled production system has implications for a wide range of conceivable goals (eg., debt avoidance) choice between them must be supported by a prior normative proposition. Even the use of simple choice criteria in a complex decision environment does not reduce the complexity of underlying normative assumptions since they must in this case imply the insignificance of other more complex criteria.

Model acceptability in a farm planning setting can be pictured as having a normative and a technical component. A high level of technical acceptability has been achieved in many programming models. The limits of tractability are apparently sufficiently wide to permit accurate portrayal of the bounds imposed by the decision environment. Illustrations are in recent conceptual research in stochastic programming (eg. see Cocks [30] or Rae [112, 111] and in recent attempts at designing linear programming based decision systems (eg. Harter [56], Goldschmidt [50], Acton [5] and Marceau [86]. Normative acceptability is, however, an unknown quantity.

In general, model normative content has been defined à priori as a matter of expedience to allow illustration or use of other concepts. Those who have attempted to develop operational programming systems for farm management decision making have concentrated on the modeling of generally recognized elements in the decision environment or some aspect of such modeling.

Goldschmidt [50], for example, has concentrated on data acquisition techniques to provide information for a decision environment described by linear programming. Farms studied were generally large and had a relatively highly developed organizational structure within which profit maximization provided a reasonable objective function. Acton [5] has concentrated on the integer aspects of the decision environment while superimposing an admittedly hypothetical normative intent for illustrative purposes. Marceau [86][2] has used the general linear programming model to investigate the feasibility of a commercial short-run planning system using a cost reducing method of automatic generation of required program input. Profit maximization is assumed for illustrative purposes. Harter [56] has conducted a field study, incorporating data acquisition, problem formulation and solution interpretation elements in a linear programming based system. His major intent was to assess the generality and operationality of the linear programming approach in an actual extension setting. In the main, satisfaction with the system was expressed by both farmers and extension agents, but little attention was paid to feasibility of the role played by the profit maximizing choice function postulated in the model.

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[2] Essentially the same research has been reported by Tongate [119].

Cocks [30] investigated the ability of linear programming and quadratic programming to accommodate stochastic elements in long-run decision making. Here again little attempt was made to reconcile normative propositions with firm decision processes.

In contrast with the *à priori* rationality assumptions in most programming models, it is interesting to note complex decision making patterns presented in sociology. Keefe and Burke [71] have noted that,

> "The family farm is a complex entity. It is composed of a great variety of expensive physical facilities and carries on a variety of production activities. But human beings are involved, tied together in a unique family relationship. In addition to the family and its individual members counted demographically, roles (father, son, mother, manager, parent, etc.), power relationships (head, subordinate), and interaction patterns, eg. autonomic, autocratic, syncratic, are also important components. All of these interact in varying degrees during decision making and planning situations, with the amount and quality of interaction influenced by personality and family characteristics."

Four points suggest that criteria of normative acceptability are required. Firstly, programming models which are potentially useful in farm planning are capable of incorporating wide range of normative concepts. Secondly, where normative elements in decision making are clear, their inclusion in a planning model can only render its search for solutions more efficient. Thirdly, it is to be expected that as new and more comprehensive models and data sources are brought to bear on increasingly complex farm decision situations, the volume of information available to decision makers will be increased to the point where a need for choice criteria will arise to limit the flow of information to a manageable level. Lastly, it appears that the farm decision processes with which programming models must interface, result in complex and dynamic normative standards as a result of continually adapting goals and "hands on" control of production and investment processes.

In summary, farm management research has produced many programming models capable of simulating in detail the effects of decision environments on variously defined models of economic rationality. Increasing precision in the simulation of physical, biological, institutional effects in the decision environment has not increased farm management use of these models. The normative assumptions implicit and explicit in these models may be a major factor in their apparent unacceptability for farm planning use. If this is the case, criteria reflecting the acceptability of model normative assumptions should provide a means of selecting models of potential use in farm planning.

CHAPTER 11

METHODOLOGY

The notion of "optimization"[1] is fundamental to farm management advisory services since it provides a means of determining the validity of normative propositions on which management recommendations are made. It is the intersection of a philosophical proposition and a convention or rule of prescriptive analysis. The convention of prescriptive analysis is that the prescriptor must continually seek an optimum. Even "better" plans are to be based on some conception of "best" or optimum". The philosophic position is that the something to be optimized must, to the greatest extent possible, come from within the individual decision unit. Simply stated, the principle of opimization is that individual farming units should try to achieve <u>something</u> inherent in <u>their own</u> social and psychological makeup. That wished-for something may be ill-defined, seldom achieved in practice, possibly inconsistent with physical reality and fleeting in its existence, but it must be the only standard by which alternative decision paths may be judged.

Decision making in a prescriptive sense may follow many non-optimizing patterns but it does not suit the

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[1] "Optimization" as used here explicityly includes the usual notion of less than universal optimality since a contextual framework is always implied.

normative approach of farm management to consider these. A convention of optimization gives direction to the search for better farm plans and is therefore a necessary start-

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2) It is often implied in farm management literature, (for example, see Strickland [130 Ch. 3], or Eisgruber [41 p. 127]) that simulation yields intrinsically more realistic solutions than programming because of its greater flexibility in describing behavioural processes as compared to the obvious optimizing context of programming (i.e. because other processes, not optimization, are observed in practice). This however, amounts to a confusion between "optimization" in the sense used above and optimization in the narrower sense imposed by individual programming models.

Behavioural theory supports the notion that firms do not always follow a single and logically consistent goal structure, that multiple and changing goal structures occur, and that inconsistency may persist over long periods. However, the empirical fact that firms apparently do not optimize in their decision processes does not imply that it is a wrong strategy for prescriptive analysts to try to optimize something in their decision processes. A principle of "optimization" states only that the prescriber should act as though there is something in the nature of human affairs to be optimized. It does not fail when that something is difficult to describe or does not permit analytical solutions. The principle is proposed as a grand strategy after the manner of a principle of causation in the logic of scientific discovery. It is acceptable not because of its own empirical validity, but because, only by pursuing it can it be assured of not moving away from better solutions (in terms of current ethical standards) if they exist. Since some solutions are preferred to others, we cannot go wrong by continually pursuing a "best" among these even though it may not be unique and it may be difficult or even impossible to identify. Optimization viewed in this manner implies that simulation models may in fact be better "optimizers" than mathematical optimizing models. This is however, not an intrinsic superiority. If optimization models do not optimize, it is because they are not, or cannot be, correctly specified, not because they are "optimizing" models.

ing point. This is not to imply that approaches employing non-optimizing (in a mathematical sense) models have no part to play in farm management. They too, may be a part of attempting to "optimize" in the sense given above.[2]

The adoption of optimization as a strategy for farm management is not ethically neutral. It rejects the notion that there exists what Arrow [6, p. 22] has called a "social good" which can be defined independently of individual desires. Rather, it adopts from the beginning the philosophic proposition that decision makers should act as though there exists something in the nature of human desires to be maximized.

In general, this proposition makes no empirical assumption beyond the existence of human desires and an ability of prescriptive analysts to derive some direction of purpose from these. It is not necessary, in the adoption of such a strategy, to postulate that some measurable funtion, subject to mathematical optimization procedures, actually exists since, as Arrow [6, p. 22] states, all that is required for an unambiguous choice to be made is that there exists weak ordering of preference on the set of alternatives being considered. However, in the context of the present study of programming feasibility this necessity is imposed. Some minimum mapping of decision space into preference levels is required by mathematical programming procedures.

A clear distinction between alternate approaches and optimization is required because of the strong tendency for farm planning models to evolve out of economic models of rational entrepreneurial behaviour (eg [36]). Several alternate philosophic positions are possible in lieu of a principle of optimization in prescriptive analysis. One could hold that an objective good quite apart from human preference exists and should be the goal of all human action. The difficulty of establishing such a universal rule is apparent given the unlikelihood of political concensus on one hand as a pragmatic vindication, and the certainty of infinite regress involved in argumentation basing such a rule on a higher order objective good on the other hand. Appeal to authority provides another inadequate basis for prescriptive analysis, for it leads to the possible dogmatic acceptance of rules which may be neither strategically efficient nor based on currently acceptable ethical standards. A variant of such a position is to appeal to the authority of tradition which has the same basic fault as other appeals to authority.

Optimization has been presented as the objective of farm management and thus the normative content in programming models. It has been presented as a philosophic and strategic proposition and is quite distinct from optimization in the narrower mathematical sense. Acceptance of optimization implies that the validity of normative elements can only be determined in an examination of the social and psychological makeup of farm decision groups. Other approaches have been rejected as being either strategically inefficient and/or founded on unacceptable philosophic propositions. To the extent that optimization has been practised, it can be regarded as having resulted in a number of proposed decision criteria for use by farm managers. It is equally likely that normative elements have not been generated by a concept of optimization but rather from more specific models of economic rationality.

During the last two decades, research in small group and farm decision making has developed a theoretical framework for decision making within the farm decision unit. Research in the sociology of small groups has developed an individual and group value based theory for action in situations where choice prevails [29]. Rural sociologists have studied farm goal holding and decision patterns which support and specialize generalized group decision theories [36,56]. Extension education and farm management research have studied the disemination of concepts among farm decision groups [120,118]. Behavioural theories of the firm have developed concurrently with group decision theories and explicitly integrate the role of individual value conflicts in firm decision processes [11,28].

It is hypothesized in this study that (a) it is possible to establish criteria which distinguish between the normative propositions of programming models which will be used in farm decision making and those which will not, and that (b) such criteria are implied by existing decision making theory and research. Part (b) of the hypothesis can be accepted only if part (a) is accepted and the criteria established are also implied by existing research results and theory. In the final analysis part (a) can only be accepted if empirical evidence indicates that models indicated as usable are in fact used. To the extent that criteria are implied by empirically validated theory and research both (a) and (b) are acceptable.

A hypothesized set of criteria could be verified directly by field testing available programming models and using the correspondence between the performance of these models and the degree of feasibility suggested by the hypothesized set of criteria as a test of validity.

However by its very nature, an empirically based study must become solution-oriented and thus can only deal tangentially with the problem of generating generalized criteria. An empirical study would have to focus on the normative validity of specific aspects of specific programming models for a small sample of potential users. For example an empirical study by Rades [110] has produced some criteria for the development of decision aids based on acceptability by a small sample of Indiana farmers who had used three versions of a corn production scheduling model. Although such studies are required to deal with details of implementing specific management services, they are less likely to produce the strategic model development generalizations required at this time.

An empirical test is not feasible for three additional reasons: (a) the number of potential models is large, (b) the field testing of individual models is time consuming and expensive and (c) the technical expertise necessary to carry out such a testing program is not likely to be available until after the need for such a test has passed. A valid set of criteria must then be a logical extension of existing farm decision making theory.

By requiring only a theoretical verification of proposed criteria the analysis can avoid becoming solution oriented and thus focus on the more general nature of the problem. To this extent, the approach taken is similar to that of Renborg [116] who has analyzed growth theories of the agricultural firm, "in terms of their possibilities for directing and controlling the growth process of an agricultural firm over time", though, as will become apparent, it is much more specialized in scope. The contrast here is provided by studies which attempt to catalogue and contrast elements of models in order to determine which among them contains the more favourable set of realistic elements. The emphasis here is basically problem not solution oriented.

To guide a review of research and theory related to farm decision making, working hypotheses regarding what comprises an operational or potentially operational programming farm decision model have been established and in turn indicate areas in which criteria are most critically required. This extensive development of working hypotheses is supported by the proposition that it is often useful at some point in hypothesis (criteria) formulation to decide that fruitful hypotheses will occur in a certain domain[3]. Whether or not developed criteria are valid does not depend on the validity of the working hypotheses made to assist in their creation. Developed criteria are to be considered sufficient for their purpose until they either conflict with more readily supportable[4] hypotheses or are the object of direct or indirect empirical falsification.

In reviewing models, considerable emphasis has been placed on operationality. Most programming models developed in agricultural economics have had a research orientation. Few farm management models have aimed at anything beyond conceptualizing a given problem situation in a particular programming framework, with the result that a vast number of very specialized planning models exist. Models considered below, however, are only the select few which have some claim to efficient algorithms,

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[3] See Kaplan [68, Chapter 111] regarding the use of working hypotheses.

[4] See Margenau [87] on "regulative principles" for choosing between empirically validated hypotheses.

technically feasible data requirements and specifications, and sufficient conceptual clarity to permit extension use. In the usual case, they have been suggested either as general, systematic approaches to actual prescriptive analysis or as tools for the study of farm firm growth in various normative contexts.

A review of operational programming models allows the classification of underlying normative propositions. Certain normative propositions are explicit in all programming models. By analyzing the various dimensions of this normative content, implicit model assumptions are determined. These, in turn, imply basic normative assumptions relating to farm firm decision processes. After working hypotheses have been established, a review of research and theories of farm decision making is conducted to establish criteria for model evaluation.

Although it is not possible to develop generalized criteria and at the same time carry out a fully empirical test, it is possible to conduct a limited empirical test of validity. Since a limited number of programming models are currently being used in farm planning, developed criteria should be consistent with the degree of success which these have achieved. This provides a limited test of the ability of criteria to select useful models. It is not possible to test, even in a limited way, the ability of criteria to reject models unlikely to be acceptable since there is no way of knowing whether models are currently unused because they are unacceptable or simply untried.

Chapter 1 of this thesis has developed a problem situation which implies the need for generally accepted criteria for the evaluation of the normative content of mathematical programming models proposed for use in farm planning. This chapter has defined a methodology for the development of model evaluation criteria. The basis for this approach to developing evaluation criteria lies in a concept of optimization as a philosophic and strategic proposition which implies that the validity of normative elements can only be determined in an examination of the social and psychological makeup of farm decision groups. Since empirical studies are viewed as forcing solution oriented and thus narrow approaches, this examination takes place at a theoretical level. In order to provide direction to the examination of established theory, it is proposed to use currently operational planning models as indicators of significant areas for criteria development.

General Organization

At this point we have: a defined problem, a broad, general framework in which to analyze it, and some basic guidance as to which direction the search for solutions (evaluation criteria) should take. Chapter 111 narrows the search for evaluation criteria still further. An "operational" programming context is developed to illustrate the types of normative propositions required to support the normative content of programming models which have been proposed for use in farm planning.

The primary task of the first three chapters is to provide sufficient focus to the search for evaluation criteria to permit efficient examination of subject matters related to farm decision making. Chapter 1V begins the consideration of these relevant subject matters by developing a conceptual framework for group decision making. Since this is primarily a review of received theory which may not be generally familiar to agricultural economists, extensive use is made of expert opinion. Attention is paid to developing group decision concepts as well as theories which are necessary for Chapter V and following chapters' analysis of decision making in the farm firm.

Following Chapter 1V, available literature relating to normative elements in farm decision making is examined. Studies are reviewed which support, supplement and specialize concepts and theories from Chapter 1V. Where evidence warrants them, summary statements or generalizations are proposed as a base for establishing criteria for the evaluation of programming models. The concluding chapter V111 draws on reviewed decision theories in implying general criteria for the evaluation of programming models. A final chapter 1X suggests several areas in which further research is required.

CHAPTER III

NORMATIVE ELEMENTS OF THE FARM PLANNING PROCESS IN A PROGRAMMING CONTEXT

This chapter presents an "operational" programming context into which normative factors in farm firm decision making are forced by the use of programming models in farm planning. Since the intent of this chapter is to illustrate areas in which normative assumptions are being made no overall analysis of each model is attempted. Analysis is retricted to normative factors except to explain interactions between normative and environmental factors.[1]

In essence the chapter cites and in many cases illustrates the pervasive use of three fundamental precepts relating to the use of normative elements in operational programming models. Firstly, a set of normative standards which is known and specifiable in terms of the firms goals and objectives for the planning period exists at the planning date. Secondly, the exhaustive treatment of firm normative standards within planning models represents an ideal for model builders. Thirdly the normative decision base which exists as of the planning date is

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[1] No detailed explanation of either problem specification or solution techniques is given. However, an attempt is made to relate all discussion to familiar concepts from accessible farm management literature. It is anticipated that either the reader has a fairly extensive knowledge of operational programming models in the area of farm management or wishes to pursue the extensive references cited in appropriate instances.

complete in the sense that no gaps exist in goal areas within the scope of the decision environment (eg. both long run and short run goals are complete) and contains a number of particular characteristics which coincide with traditional economic rationality (eg. time preference, risk aversion, diminishing marginal propensity to consume, diminishing marginal utility). The reader who is willing to accept that these precepts are in fact pervasive may proceed to summary at the end of this chapter and read that brief discussion without loss of continuity. However, it is important to recognize that these are strong and pervasive normative assumptions in virtually all recent research attempts to develop programming models for farm planning in the face of complex, comprehensive decision environments.[2]

An introductory section reviews the general nature of programming models, establishes a working hypothesis regarding the admissability of various planning models in establishing a programming context and considers more specifically the mathematical nature of admissable models which have been most commonly used or proposed. Following this introductory section, several sections are

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[2] Recent research into improving the efficiency of search techniques utilized in non-analytical decision models shows that strong normative assumptions are not restricted to programming models [18].

presented to illustrate the general nature of normative assumptions in a number of potentially operational programming models.

Within models discussed major emphasis is on what might be called their most limiting resources, where questions of feasibility are most acute. As noted by Hutton [59, pp 195], these would appear to "centre on the nature of the objective function, treatment of risk of error in coefficients and treatment of time associated variables". Unlike Hutton's treatment however, this study is specifically directed at normative elements of programming models.

Dimensions examined are clearly interdependent and in order of presentation are: The Time Dimension, The Financial Dimension, The Consumption Dimension, The Risk Dimension, and the Choice Dimension. By definition of normativity, one would expect elements of choice to be inherent in each of the dimensions above. It is useful, however, to consider a separate choice dimension to relate methods used in weighing the importance of other dimensions and reconciling them into a single choice criterion and a set of normative constraints. This procedure of necessity causes some duplication of discussion but results in a clearer presentation than a discussion of choice criteria within each of the other dimensions.

Introduction

The general mathematical programming problem can be stated as optimize $Z = f\ (X),\ X = x_1, \ldots, x_n$ (1)

subject to $g_i\ (X) \leq, \geq, = b_i,\ i=1, \ldots, m.$ (2)

As stated, the problem does not necessarily have an obtainable global optimum. However, the addition of restrictions on f and g has allowed mathematical programmers to develop algorithms for the solution of particular cases of the general programming problem. (See for example, Mangasarian [84], McMillan [95], Hadley [53]. In one of the most restrictive cases (linear programming), both f and g are required to be linear, continuous, and $X \geq 0$. Recent developments have indicated the conditions under which obtainable global optima exist for more generalized restrictions on f and g[3] and algorithms for obtaining these solutions have been developed in many cases. Relatively few algorithms (notably linear programming and its variants integer programming, mixed integer programming, separable programming and quadratic programming) have reached a stage where they can be considered potentially usable in solving real world farm management problems for a number of reasons related to computational efficiency and problem specification.

Regardless of conditions of optimization and existence of solution algorithms, the general programming approach requires that criteria of choice between

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[3] For example, Bector [12] has investigated the properties of Quasi-Convex objective functions defined over a non-empty closed convex set in R^n.

admissable alternatives be single measurable magnitudes (i.e. a single function). In the case where multiple goals exist, a set of relations must be defined such that this single dimension objective exists. In the words of Charnes and Stedry (Johnsen [64, p. 186]):

> "It may be tautological, but nevertheless interesting that it is impossible to simultaneously optimize two functions: one can, at best, optimize one, placing a constraint on the other; or one can construct a superfunctional which is some function (perhaps a weighted sum) of the initial functions".

The above outlines, in a general way, show the programming context into which modeled normative factors in farm planning are being forced. To proceed farther in developing the programming context it is necessary to review recent farm management research to obtain information on the nature of potentially operational planning models. In doing so it is not necessary to dwell at length on the status of related research in mathematical programming since the development of criteria relates more directly to what must be portrayed rather than how, in a mathematical sense, it must be specified. Specification will be dictated by optimality requirements. Whether these are reasonable or not is part of what is to be judged by established criteria. To determine the normative assumptions of programming models it is necessary to include in the programming context only those models which have been seriously proposed either as normative tools in actual farm planning or as tools for investigating problems inherent in farm planning. Systems[4] approaches to farm planning such as those reported by Acton [5], Goldschmidt [50], Harter [56], Marceau [86], Cocks [30], Stonehouse [128], Bitney [13] and Ray and Hudson [115], are clearly included. As a general rule, these systems approaches have had a cursory normative content possibly because of their concentration on environmental matters and static models which limit the incorporation of dynamic normative concepts such as time horizon, time preference, and goal sequences. Many of the sytems approaches, particularly those currently being used (e.g. Roy [15], Bitney [13]) rely on pre-optimizing (e.g. selection of alternatives) and post optimizing (e.g. altering solutions to render them more acceptable) consideration of normative elements and thus seldom explicitly document normative considerations. However a considerable variety of explicitly incorporated normative elements usually based on a priori reasoning does appear in farm growth literature in models which are a direct generalization of the system approaches. These generalizations of currently operating models can be considered a preview of future operational planning models and contribute, in large part, to the programming context established below.

The literature on growth models is pertinent only on a selective basis since there is a grey area between

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[4] By systems approaches is meant any of the proposed or operational farm planning models which place decision making for the whole farm in one analytical framework.

normative growth models which are aimed at studying problems inherent in how a farm should grow in various normative contexts and positive models which are aimed at analysis of how, in fact, farms do grow. As Irwin and Eisgruber [61, p. 4] have noted:

> "A review of the rather extensive literature leaves one with the uneasy feeling that most of the work lies in limbo between optimization and prediction, between management of the firm and aggregate analysis, or between specific problem solving and generalization".

Growth models aimed at understanding the problems of growth, in particular normative contexts, such as those of Martin and Plexico [88], Baker [7 and 8], Duvick [39], Smith [126], and Johnson [67] have been included in establishing a programming context. Growth models more clearly aimed at positive description, however, are not included.

The majority of models which fall within the established operational designation can be classified as variants of linear programming, quadratic programming, integer programming, or separable programming. Separable programming allows strict linearity restrictions of f and the g_i to be relaxed in favour of a more general restriction of concavity and separability on f and convexity (concavity for constraints) and separability on the g_i [Hadley 53, Chapt. 4 or McMillan 95, Chapt. 6]. Stochastic linear programming and quadratic programming have allowed some considerations of non-linearities caused by stochastic elements in the constraints or objective function. Integer programming has permitted the accommodation of discontinuities in f and the g_i where the domain consists of intergral values only.

It should be noted that a number of mathematical and computational efficiency problems have prevented the development of a single all-inclusive generalization of the linear programming approach to farm management. Stochastic linear programming is hampered by computational efficiency problems (Cocks [31]). Computationaly efficient integer quadratic programming algorithms are not available, and separable programming poses computational efficiency problems particularly where a large number of non-linearities are approximated. Because of the above problems, programming approaches with any claim to operationality in farm planning have been restricted to minor deviations from the linear programming approach. Examination of a recent U.S.D.A. review [133] of U.S. Farm Management E.D.P. programs reveals that all of the reported 12 routinely available programming approaches to whole farm planning[5] were based on linear programming with the exception of one which incorporated quadratic programming as well. Additional noteworthy systems not reported in the survey, L-P Farm (Oklahoma State University) and Mascot (Imperial Chemical Industries) also used linear programming. The following sections enlarge

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[5] Programming services were reported by University of Mass., University of Missouri, University of New Hamphire, University of North Carolina, Pennsylvania State University, University of Tennessee, Texas A & M. University, University of Vermont, Virginia Polytechnic Institute, Washington State University, West Virginia University and Oregon State University.

on the normative content of the most commonly used or proposed programming models.

The Time Dimension

Although normative assumptions made in operational model specification of the time dimension are normally implicit, two aspects of the time dimension have received attention in farm management literature. Length of planning horizon and dynamic relations between formulated goals have usually been based on à priori specification of rational behaviour. Intertemporal equivalence, the most often specified dynamic relation between goals, postulates standards of equivalence between goals specified over time. Length of time horizon is rationalized by a conception of goal formualtion and relations between formulated goals.

The Time Horizon

Operational programming models considering a time horizon greater than one year usually come to grips with the time horizon problem by incorporating multigoal decision functions. Essentially this is a result of the need to give some weight to the achievement of goals in both the current planning period and beyond. Planning periods beyond the current one cannot be considered extensively without in effect extending the planning horizon thus horizon[6] length is determined by specification of a point sufficiently distant that a given cursory treatment of future planning periods is acceptable to the decision unit. Most operational farm management models have adopted an implicit "going concern" principle in this respect. For example, in a situation in which profit maximization is deemed all important, it is usual to place some weight on variables such as terminal net worth to insure that the business will be maintained as a going concern past the current planning period.

Approaches to time horizon determination in farm management literature can be placed into one of two categories which, for want of better terminology, we can call the "pragmatic" approach, usually used in farm planning models, and the "turnpike" approach which appears in some conceptual farm growth models. Only the former has received any extensive use in operational farm planning hodels; however, its use has often implicitly presumed some elements of the latter approach. Both approaches are considered here in an attempt to determine fundamental normative assumptions.

Both approaches begin with the clearly appealing planning imperative that sooner or later a halt must be called to the expansion of the planning horizon.

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[6] As pointed out by Boussard [22], the planning horizon may be considerably shorter than the period cited since the object of planning is specification of immediate action in the light of all available information, and under certain conditions optimal immediate actions are insensitive to the lengthening of the planning period beyond a certain point.

Boussard [23] has developed, in a farm growth context, Modiglianni's notion that long run plans are not developed for their own sake but rather are to provide a means of incorporating all available information in the optimal determination of initial period actions. This being the case, it makes sense only to extend the time horizon as long as the information so incorporated has some effect on optimal initial period actions. As Boussard [23, p. 468] points out, in general, this does not necessarily imply the existence of a finite planning horizon. He gives as an illustration the maximization of classical time discounted consumption functions in linear programming models. Boussard [23] accepts as a definition of time horizon, "the time within which it is necessary to plan in order to make a decision for the first period". Since, as he notes, this does not place any restriction on the length of the horizon, the extra conditions that the planning horizon exist and be "not too long" are added.

In his development of the turnpike theorem in a farm planning linear programming context, Boussard has examined very general conditions which guarantee that a finite planning horizon exists. This formalistic approach to time horizon determination does however, make some strong normative assumptions. In effect, it redirects the specification of normative content from the point of view of the decision maker to the point of view of the model builder. Objectives of the decision unit must be constrained to permit an analytic guarantee of finite horizon legth. It is necessary to begin with the assumption that a goal structure, suffieciently clearly formulated for a time period long enough to permit the implication of a time horizon, exists as an expression of decision unit's intentions.

Given the existence of such a goal structure, further normative assumptions are made regarding its content. Boussard's model requires that: a linear consumption function exist for each time period, the decision unit desires to maximize terminal net worth,[7] and neither the decision unit nor the environment place any absolute constraints on alternative courses of action considered. In making these assumption, the model builder indirectly insures the existence of a finite planning horizon, whose length cannot be specified à priori.

In contrast with the turnpike approach, the pragmatic approach does not seek to guarantee in an analytic sense that the model developed will have a finite planning horizon, but achieves the same end in a more direct manner. It also begins with the assumption that a sufficiently complete goal structure exists, but the object of sufficiency is quite dirrerent. The goal structure is presumed to directly imply that decision

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[7] Boussard [23] has shown that these first two requirements are equivalent to the maximization of a weighted sum of yearly consumption.

periods beyond a given date are sufficiently inconsequential to the decision unit that they may be given a defined cursory treatment in establishing model normative content.[8] Defined cursory treatment will vary from decision unit to decision unit. For example in a given model, a going concern principle may be followed by either placing any one of a infinite number of weightings on various stocks of terminal wealth or placing constraints on terminal wealth.

Intertemporal Equivalence

The majority of multiperiod planning models incorporates some notion of intertemporal equivalence in their objective functions or constraint systems. In the usual case, the objectives are specified, following the Hicksian model[9] as the present value of a stream of values depicting annual goal achievement. (see for example, Johnson,

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[8] The implicit rational for supposing time periods beyond a point can be regarded as relatively inconsequential appears to be based on the empirical notions that (a) individuals have positive time preferences (that is they discount successive future goal achievements at higher rates) and thus distant periods add little to goal achievement; and that (b) individuals do often display definite planning horizons within their cognitive processes which reflect directly on their willingness to consider solutions as meaningful; and the analytical hope that (c) current period actions will be largely independent of distant time period specifications.

[9] For an illustration of commonly used Hicksian models see Cocks [29].

[67, Ch. 11]). Rationale for this approach is provided by an a priori model of rational behaviour in an environment characterized by: (1) perfect foresight (single valued expectations of all possible eventuations) and (2) perfect capital markets (in the sense of the classical perfectly competitive market). Rational behaviour is defined as preferring the stream, of say income, which has all elements ≥ to those of other streams. Given the above perfect capital market and perfect foresight, individuals are free to convert streams of income to current sums of money and vice versa. On this basis, it appears reasonalbe to make the further rationality assumption that the individual should be indifferent between a given future stream of income and the given current sum which is known to be capable of generating that stream. Since all streams have an equivalent current sum, these can be used to rank various investment projects.

If these notions of rationality are accepted and in addition, the decision environment provides an objective measure of marginal returns to investment, an objective equivalence between future streams of income and a current sum of money can be established by determining the sum required to generate the given stream at the prevailing marginal return to investment. Such a marginal rate prevails for the investor facing a certain future in the classical perfect capital market. This investor will continue to invest to the point where the costs of increased investment equal returns from increased investment.

As a result the prevailing cost of investment funds can be used as a proxy for marginal return to investment in discounting future income streams.[10]

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[10] It will be noted that this entire presentation of the classical discounting concept is couched (as is most related literature) in terms of a stream of income flowing from a given investment which has positive elements only. In the more generalized case, where any element may be positive or negative, the present value concept (even given that the discount rate can be somehow justified) presents logical inconsistencies related to the Internal Rate of Return (IRR) versus Present Value (PV) controversy. Simply stated, the problem is that in cases where multiple solutions to the IRR exist, (I.E. PV=0 for more than one IRR), P V as a function of the interest rate is not monotonic (Teichroew, Robichek, Montalbano [131]. To illustrate, if the discount rate is interpreted as a marginal investment return, the PV model may yield the intuitively inconsistent implication that an increase in the market rate renders acceptable (i.e. PV $\geq$ 0) a project not acceptable at a lower rate.

In such cases, Teichroew, Robichek and Montalbano [131], have established conditions which allow the decision maker to make consistent decisions (market rate < project acceptance level always produce a larger PV) using either IRR or D.P.V. in such a way that the firm will be assured of increasing its PV as classically described, i.e. PV=F (income stream and perfect competition market rate. In doing so, they have solved the inconsistency problem; however, they have not addressed the more fundamental problem of how to justify an objective discounting procedure, which is, of course, our primary concern, since it would presumably negate the need for specifying normative content regarding intertemporal equialence.

Real farm managers face a more complex environment where capital markets are not perfect (unlimited funds are not available at the market rate) and the future is not certain. As a result, the marginal return from investment is not likely to equal the market rate of interest and this objective external means of assessing marginal returns to investment ceases to exist [Mao 85 Chapter 7]).

Discrepancies inherent in externally justified objective discount rates lead to the search for an objective internally specified discount rate. The fundamental problem here is that such an opportunity cost cannot be known ahead of optimization, thus leading to a paradox since optimization cannot proceed unless a discount rate is known a priori [Baumol and Quant 9]. Recourse to the use of utility theory provides a way around the paradox [Gunn and Hardaker 52], but amounts to abandonment of the search for an objective choice criterion.

The realization that the assumptions of classical Hicksian discounting procedures are seldom realistic in a farm planning setting has led a large number of model builders to consider another means of theoretic support for discounting. In general, their approach is to consider the discount rate to be a subjective measure of time preference, thereby eliminating the need to assume perfect foresight and a perfect capital market. Virtually all models use some form of subjective discounting as an alternative to more complex utility functions, which are generally viewed as nonoperational in farm planning (see for example [52]).

In practice however, farm management personnel usually settle for some estimate of market rate or rate of return on investment. Indications are that the subjective concept is not taken seriously. In any case, standards of intertemporal equivalence are required to exist on the planning date, they must be quantifiable in the form of discount rates and they must be independent of eventuations in the decision environment.

Other Dynamic Relations Between Formulated Goals

In the usual case, farm management models do not make special provision for other dynamic relations between formulated goals such as those presented by a family life cycle. Dynamic models tend to be formulated as a series of similiar single period models with the addition of appropriate inter-period linkages and specification of a single objective function. Baker [8] however, has indicated that an allowance for the family life cycle can be made by specializing the constraint system and objective function to reflect known dynamic processes in the family goal structure. He suggests, in particular, that different activities be considered at various stages in the life cycle. It may be useful "to include more growth relevant alternatives in early years of a farm firm, and more financial alternatives, expecially with respect to estate management in later years".

To summarize, two approaches to the determination of time horizons, a turnpike approach and a pragmatic approach, were briefly discussed. The overall implication of discussion regarding time horizon is that it is useful to investigate available evidence and establish criteria relating to both the formulation of normative standards and the content of formulated normative standards. Further, it will be useful to investigate and establish criteria relating to more specific questions of empirical support for various elements of normative intent such as the nature of decision unit consumption functions and the nature of decision unit conceptions of tradeoffs between planning periods.

In the usual case, normative standards are modelled as the achievement of goals in one or more series of goals (each series consisting of corresponding goals defined over time). Within each series, it is necessary to determine some form of intertemporal equivalence. Current concensus in farm management literature favours the use of subjective discount rates, but since no readily apparent means of empirical determination is available, operational planning systems usually resort to market rate discounting. Clearly important implicit assumptions regarding the existence and magnitude of subjective discount rates are being made in using this expedient.

In addition, some conceptual studies have suggested the incorporation of other dynamic relations between goals in an L-P contex on the basis of family cycle relationships. It should be useful in this respect to examine research related to the nature of family goals over time.

In general the time dimension in programming models implies the existence of a set of normative standards within the farm decision group. These standards operate over a planning period in such a way as to either directly or indirectly imply its length. In the majority of models a going concern assumption is used to directly imply that goal achievement beyond a point is not significant. In addition, standards of intertemporal equivalence which have a number special properties are assumed to exist. Firstly they are quantifiable as discount rates. Secondly these discounting rates are established independently of the decision environment and thus related normative standards remain static over the time horizon. This assumption of a static normative base holds even where dynamic goal structures are modeled since their functional form must be fixed on the planning date. Thirdly although discount rates may vary from period to period they must exist in all periods. An assumption is therefore made about comprehensiveness of the underlying set of normative standards. Basic assumptions in the time dimension relate to the existence, dynamics, comprehensiveness, length of run, and functional form of group normative standards.

The Financial Dimension

Production and marketing aspects of farming have long been recognized as important dimensions of farm planning models. In recent years, a number of medels have been developed to accommodate the financial dimension. Previous comments regarding the absence of documented normative intent in operational farm planning are also applicable here. However, growth-oriented studies have revealed normative considerations in the financial dimension often as a by-product of the extensive development of other considerations in the financial dimension. A variety of means have been proposed for incorporating normative concepts such as debt avoidance, liquidity preference and equity requirements. Since, in general terms, normative aspects of the financial dimension revolve around the liquidity concept, this section focuses on liquidity[1] and specifically on the work of Baker [7, 8] who has been a major proponent of the need to expand consideration of the financial dimension in farm planning models.

Liquidity Preference

The rationale for incorporating the concept of liquidity reserves into farm planning models is that

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[1] "Liquidity" as used here refers to the convertability into liquid assets of fixed assets and debts under the firm's control. Liquidity preference is defined as a desire for certain levels of access to liquid assets.

planners are expected to require a contingency reserve against unforseen expense or opportunity. Liquidity is seen as an informal insurance policy. Opportunity costs of maintaining high levels of liquidity (that is, arranging contingency measures to accommodate virtually all possible eventualities) can be thought of as the cost of being able to plan under a situation approaching certainty. The decision maker's liquidity preference may then be looked at as an expression of preference for planning under certainty as opposed to uncertainty.

Liquidity is available in many forms and has the potentiality of being used to insure against a variety of unforeseen expenditures. Feed grains may be held in excess of yearly feed requirements to either maintain production or to sell for cash in case of a crop failure. Cash may be withheld from operating capital to take advantage of a possible drop in feeder prices or to provide for a sudden outbreak of disease in a poultry flock. Life insurance may be purchased to prevent forced dissolution on the death of a partner or to use as collateral for unforeseen machine repairs. There are, of course, an almost limitless number of possible liquidity reserves that could be cited. However, the majority of those that have been developed fall within the more traditional financial areas (eg. savings, investment and credit acquisition).

The process of credit acquisition has been considered of fundamental importance in the growth of farm firms.

As a result of critical reliance of firm growth on credit availability and acquisition terms, growth models (eg. [39, 126, 134]), both normative and positive, have been developed which limit credit availability. However, as noted by Eisgruber and Irwin [61, pp. 11] "the usual models constrain borrowing capacity at specified interest rates and leverage ratios merely by the cash flow required to service long term debt." Recent research by Baker [7] and others has aimed at a more explicity consideration of the limitations on the firm's credit reserves and the relation of these reserves to the firm's liquidity preference.

Instead of simply restricting the amount of credit by type available in any one time period, Baker has gone further to consider the processes whereby credit reserves are generated and absorbed. He has developed the concepts of a credit reserve at each credit source and a lender's preference for various loan uses and sources. These are incorporated into a system of linear constraints as lender's "interaction coefficients" and "credit absorption rates" to achieve a more accurate portrayal of the credit market. Credit absorption rates relate the net rate at which each reserve is depleted by various credit uses while interaction coefficients relate the reaction of specific lenders to credit obtained from another [7].

Given this more precisely defined credit reserve, the firm must then determine an appropriate trade-off between the benefits of borrowing (leverage) and reduced liquidity due to reduced credit reserves. The firm's valuing of liquidity provided by credit reserves can be incorporated in a linear programming framework by assigning either positive weights to credit reserves or negative weights (not to be interpreted as credit charges which are also included as costs) to debts in the objective function. In the case where reserves are valued by the farmer at a constant marginal rate, only a single weight needs to be specified for each reserve. Where value is a non-linear function of reserve level, several weights must be specified for each reserve so that the function can be approximated by linear segments. Baker suggests that an opportunity cost principle be used in determining weightings (ie. what is a dollar's worth of liquidity from a particular credit reserve worth, relative to liquidity from other sources?) between various reserves. In this sense, a dollar's worth of credit based liquidity should be worth no more than a dollar's worth of cash withheld from productive actiities since, in fact, this forms a very general alternate source of liquidity.

In any case, returns to a liquidity reserve are difficult to determine and no operational procedure has been given. Various levels of liquidity from a given source of liquidity may "rationally" bear some relation to each other (liquidity preference functions are usually held to value increased reserves at decreasing marginal rates) but liquidity value weightings relating values obtained from other sources will be difficult to generalize on, even in a broad sense. It is possible to suppose however, as Baker [8] has suggested that certain flexible credit reserve sources such as banks, might "rationally" receive higher weightings than less flexible ones such as trade credit.

Smith [126] in using Baker's approach to credit reserve generation has defined a firm's debt aversion as a negative weighting less than 1.0 in the objective function (discussed in the section on the choice dimension). The relative weightings of other goals such as expected profits relative to liquidity reserves are another difficult and unresolved issue. Baker has reported some preliminary, but far from operational, attempts at determining weights involved in linear programming objective functions incorporating liquidity preference schedules by analyzing past firm performance.

Liquidity and Risk

Boussard [24] has also developed a technique, "focus of loss", for dealing with reserves maintained in the face of uncertainty. He has used the notion of liquidity as an antidote to uncertainty in an admittedly positive model of farmer's behaviour under uncertainty. His decision maker is allowed the luxury of planning under virtual certainty (negligible possibility of ruin) by including liquidity constraints in the form of a focus loss concept, on his current cash flow. The decision maker is viewed as focusing his decision making on a given disaster level of total disposable income sufficient to cover certain necessary expenditures.

Each activity is constrained to contributing no more than a given proportion 1/K to the disaster level. Maximum per unit activity contributions (a measure of individual riskiness) are considered individual foci of loss. In Boussard's study, disaster foci for various crops were consensus values given by various extension experts. Presumably a focus loss concept could be applied in a farm management application by simply obtaining the farmer's subjective estimates of total focus of loss, individual foci of loss and k.

In a normative context, the above approach presents the anomaly that a decision maker chooses to make plans as if certainty exists, provided focus loss constraints (a provision for uncertainty) on choice in the certain environment are obeyed.[12] Presumably, experience has taught him that he can do so. The basic question of how he would like to choose in the face of a stochastic environment is avoided by assuming that the decision unit is sufficiently conservative to constrain its alternatives to those which closely approximate a certain planning environment.

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[12] In this sense the focus of loss concept is similar to the conservatism often displayed in farm planning L-P's which limit the acreage levels at which "risky" activities can enter L-P solutions so that planning can proceed under assumed certainty.

Other Financial Restrictions

The alternative to using a weighting system to express the desire for liquidity preference is to impose direct, borrower-imposed, limitations on sources and uses of credit reserves. Such restrictions may be the outgrowth of striving in the liquidity preference area, but may also reflect other normative functions not related directly to liquidity preference. Johnson [67], for example, has taken this approach by including borrower restraints on various types of credit use.

In summary, the financial dimension reveals a single concept, liquidity preference, of overriding importance in portraying the impact of normative intent on financial processes. Further, emphasis appears to be on the application of this concept to the more traditional financial aspects. However, a number of less elegant direct restrictions on credit use and sources have been included in planning models from time to time.

Normative elements presented are conceptualizations of financial preferences or objectives which are presumed known and measurable as of the planning date. Although measurement problems are recognized, it is assumed possible to quantify the relationship between these objectives and some overall objective such as profit maximization. The decision units liquidity preferences are considered static even though lendor's liquidity preferences are regarded as dynamic.

Known liquidity preferences or objectives generally relate to the holding of reserves, and primarily to insure against uncertainty. Non-risk oriented reasons for maintaining reserves are of course possible. However, from a risk point of view an underlying assumption appears to be that the decision unit desires to plan as though certainty exists (choice is not made on the basis of distributions confronted) provided certain reserves are maintained. An additional assumption which will reappear in many of the models reviewed concerns the assumed exhaustiveness of normative elements. Clearly the detailed treatment of liquidity suggested here implies an inadequate treatment of these elements by other prescriptive procedures.

The Consumption Dimension

The fundamental importance of the production-consumption interface in farm planning has been stressed in farm management literature since Heady's presentation of the Household-firm competitive interaction model [57, Ch. 14]. Acceptance of this model has led even those specifying model normative content in terms of non consumption goals (for example, growth goals such as net worth accumulation) to recognize the consumption dimension as an important normative modifying influence in choices between alternatives.

Farm family consumption functions act as constraints and drain off disposable income which could otherwise be made available for investment. Since their influence is through investment such constraints are often not found in static models which usually don't emphasize the investment process. Since virtually all farm planning models developed to date have been static, little attention has been directed to the consumption dimension. (see Marceau [86], Harter [56], Stonehouse [128]). The whole farm model developed by Acton [5] however, is dynamic and incorporates constraints and activities which force family consumption to a $5,000 minimum plus 40 per cent of disposable income in excess of $12,500. No empirical evidence is given to support the form of the function and no means is specified for quantification in actual application. Presumably, the farmer would simply be asked to state his consumption preferences in terms of a minimum acceptable consumption and a marginal propensity to consume.

The general approach in multiperiod farm planning models is to impose a consumption function, often exhibiting diminishing marginal propensity to consume, in each time period considered. Since a diminishing marginal propensity to consume implies the approximation of a concave function in the constraint system, a variety of means have been devised to meet the convexity requirements of programming models. A number of models reviewed have chosen to use a linear (Keynesian) consumption function which is both concave and convex. Many other models have used a constant consumption function for similar reasons. On a more complex level, L-P models have been developed which make consumption a linearly approximated concave function of income. Concavity problems are overcome by simply maximizing consumption in the objective function. Still further complexity has been added within an L-P framework by making consumption a function of additional variables such as past income levels and capital gains.

Farm growth (usually defined in terms of net worth) models are usually aimed at an understanding of the role of various aspects of investment. Since consumption places an obvious limit on investment in all periods, it is extensively treated in many growth models. A consumption function similar to that used by Acton was used by Boehlje and White [19] in a dynamic L-P model of firm growth ($3,000 minimum plus 50 per cent of disposable income above $3,000)[13] As before, neither the form of equations nor their means of quantification were specified. Baker [7,8] has investigated the use of consumption functions exhibiting diminishing marginal propensity to consume relative to current income and exhibiting linear relations to past income and capital gain.

Baker's model is presented below in some detail because it represents one of the most comprehensive attempts to build marginal propensity to consume into farm planning models. His formal model gives:

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[13] This type of function is particularly common in growth literature. (For another example see Kay [70]).

consumption outlays = f_1 (current ordinary income +
1/4 current capital gain)
+ f_2 (past ordinary income)
+ f_3 (past capital gains)

where, with respect to the bracketed quantities:

f_1 is a discontinuous decreasing marginal propensity to consume schedule;

f_2 is a constant marginal propensity to consume schedule; and

f_3 is a constant marginal propensity to consume schedule.

The actual translation of these concepts into an L-P model has been specified by Baker [7,8,135]. This translation is not particularly important for our purposes except in illustrating that it requires that "consumption outlays" be a positive component of the objective function to be maximized. Baker's model maximizes a linear combination of yearly consumption outlays and terminal net worth with intertemporal weightings determined by conventional discounting procedures.

The model developed clearly illustrates that complex processes of choice between savings and consumption can be built into a L-P model. However, no means is given for the determination of f_1, f_2, or f_3, for a particular decision unit. It seems reasonable to assume non-increasing marginal propensities to consume and that both normative and positive elements will exist in the determination of necessary coefficients; but these are at best broad generalizations which are far removed from coefficient determination.

The consumption dimension reveals that it is possible to incorporate relatively complex consumption relationships in programming models. It is implicitly assumed that the necessary consumption relationships exist, are specifiable, and are necessary to the generation of useful solutions as of a given planning date. While it is true that some sort of normative consumption relationships exist as of the planning date, it is not necessarily true that they represent useful normative propositions for evaluating future periods. Even given that they are measurable, there remains the problem of validity over the planning period. As in other dimensions, there appears to be a tendency to think of the normative element (in this case consumption) as an input into the planning process rather than an output. It follows then that most model builders are inclined to include as many normative propositions as possible within the limitations of their ability to measure, specify, and pay the costs of analysis. Assuming that normative consumption standards are established over the period, it is of course, logically possible to include this process within the model, however the relative merit of this procedure versus other methods of accomodating normative propositions would come into play. Regarding the particular functions reviewed, two specific areas for criteria development are suggested. The first and most obvious relates to the relative importance attached to various consumption goals relative to other goals and to each other since weighting factors are clearly required to establish

MPC's. Secondly, convexity requirements place specific constraints on the specification of consumption functions.

The Risk Dimension

Up to this point, we have discussed a variety of dimensions of farm planning programming models. Explicit consideration of one essential dimension, however, has been omitted. This section considers the explicit incorporation of risk elements into farm planning models[14] in contrast to the more implicit risk accommodating elements which have been discussed in the time dimension and the financial dimension. In carrying out an examination of the risk dimention, it is useful to examine, first the role of utility concepts, and secondly their incorporation into risk planning models.

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[14] Incorporation of risk elements is taken here to be the development of: a constraint set which is feasible under all possible states of nature, and a choice criterion which reflects the preferences of the decision unit given the risky situation at hand. That is, environmental description must account for stochasticity while normative elements do not necessarily have to. Clearly quadratic programming and chance constraint programming are not included unless they incorporate a stochastic constraint system: focus loss programming is excluded because its constraint system contains infeasibilities for some states of nature. Where such models have been used without making provision for the risky nature of the decision environment, normative content appears to reflect the model builder's need to constrain the output from an inadequately specified model as much as it reflects the decision unit's intentions.

The risk dimension has only recently been incorporated into programming models in a manner approaching our definition of operationality (see Cocks [31], or Rae [111 and 112]. Cocks, in a major move toward systematic stochastic farm planning in a programming context, has developed what he calls the "linear programming theory of farming systems". This approach accounts for major elements of uncertainty in both the objective function and the constraint system. His approach is sufficiently general that it has been used extensively as a framework for this section on the risk dimension.[15]

In general, the aim of Cocks' discrete stochastic multi-stage approach is to provide a more accurate protrayal of the decision environment by including the concept of discretely stochastic elements in a linear constraint system. Models developed to date (by Cocks [31], and Rae [112, 111]) have focused normative content in the objective function which has been variously specified as a linear, linear-by-approximation, and quadratic function. Theoretic support for the specification of normative content in these, as in virtually all stochastic farm planning models is provided

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[15] A brief discussion of a more simplistic "FAT" approach which achieves the same purpose is also included.

by the maximization of expected utility maxim.[16] Thus before considering actual programming formulations, it is useful to briefly touch on the nature of utility concepts used in farm planning models.

At the opposite end of the model complexity scale a non utility oriented approach to risk in the decision environment has been reviewed in [31], and demonstrated in [91]. It is only briefly reviewed here. The "FAT" approach is essentially a formalization and more extreme version of the conservatism often practised by farm management specialists in evaluating farm alternatives. According to this model, the decision unit attempts to maximize the expected value of a given goal function subject to the additional normative constraint that the usual linear constraint system must be feasible in any foreseeable state of nature. This

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[16] The aim of this chapter is to provide a programming framework for the creation of useful evaluation criteria. Utility theory as such has played a minor role in models that can be termed operational in a farm planning sense. However, the effect of utility as a supportive concept and its more explicit use in some risk oriented objective functions makes it useful to include Appendix A to relate some broad generalizations inherent in utility theory which support the more narrowly based context established in this chapter. Many systems of axiomized rationality have been devised to allow operational development of utility functions and to support the use of utility based strategies. An excellent review of the utility concept may be found in Becker and McClintock [11]. More specialized presentations are in Fishburn [45, 46]. Farm management oriented treatments are given by Halter and Dean [54] and Dillon [36].

approach represents and ultimate degree of conservatism where the decision maker is willing to go to any length to ensure that he can effectively paln under certainty. Risk is rejected, rather than being considered a variable in making choices.

"Utility" in Farm Planning

In the following discussion of utility in stochastic farm planning models four points are illustrated:

1. Utility theory as used in farm planning models provides a prescription for individual action in a risky situation.
2. Utility models are based on axiomized rationality which may or may not be acceptable to the decision unit. However, acceptability is required if a utility function is to be derived and maximization of expected utility is to provide a reasonable strategy for group action.
3. The need for an acceptable rationality in utility models does not abate when the need for actual utility function derivation is removed via efficient set approaches.
4. Diminishing marginal utility is normally assumed.

Farm planning models incorporating utility concepts under non certainty have, in general, been non-commital about the nature of their intended decision group and thus the acceptability of axiomized rationality. In the usual case, they are as well non-commital regarding precisely which axiomatic system they propose to use in support of their use of utility. However, the notion of an individual decision maker's utility function, as an ideal choice criterion defined up to a linear transformation and on one or more goal achievement continuums appears to be implicit in reviewed models and farm management literature (eg. Scott and Baker [124], Gunn and Hardaker [52]).

The acceptance of any one of several systems of axiomized rationality permits the derivation of a utility function and supports the use of maximization of expected utility strategy in planning under non-certainty. The expected utility proposition has obvious appeal to farm planners who note on a strictly pragmatic basis, that other things being equal, farmers prefer alternatives with high expected returns, and that other thins being equal, they prefer more certainty to less. As illustrated in Figure 3.1 below, for a single goal utility function, the maximization of expected utility criteria is capable of coping with both of the above pragmatic notions.

In Figure 3.1 M is a measure of goal achievement and U is a measure of utility. The probability of $M[P(M)]$ and the probability of its utility $[P(U(M))]$ are equal probability measures since there is a one to one correspondence between levels of U and M. The expected utility of goal achievement distribution #i is denoted $E(U(M_i))$. Among alternatives with equal expected payoffs, Max. E(U) will favour narrower dispersion over wider. Among alternatives with similar distributions, Max E(U) will favour the one with the highest expected payoff.

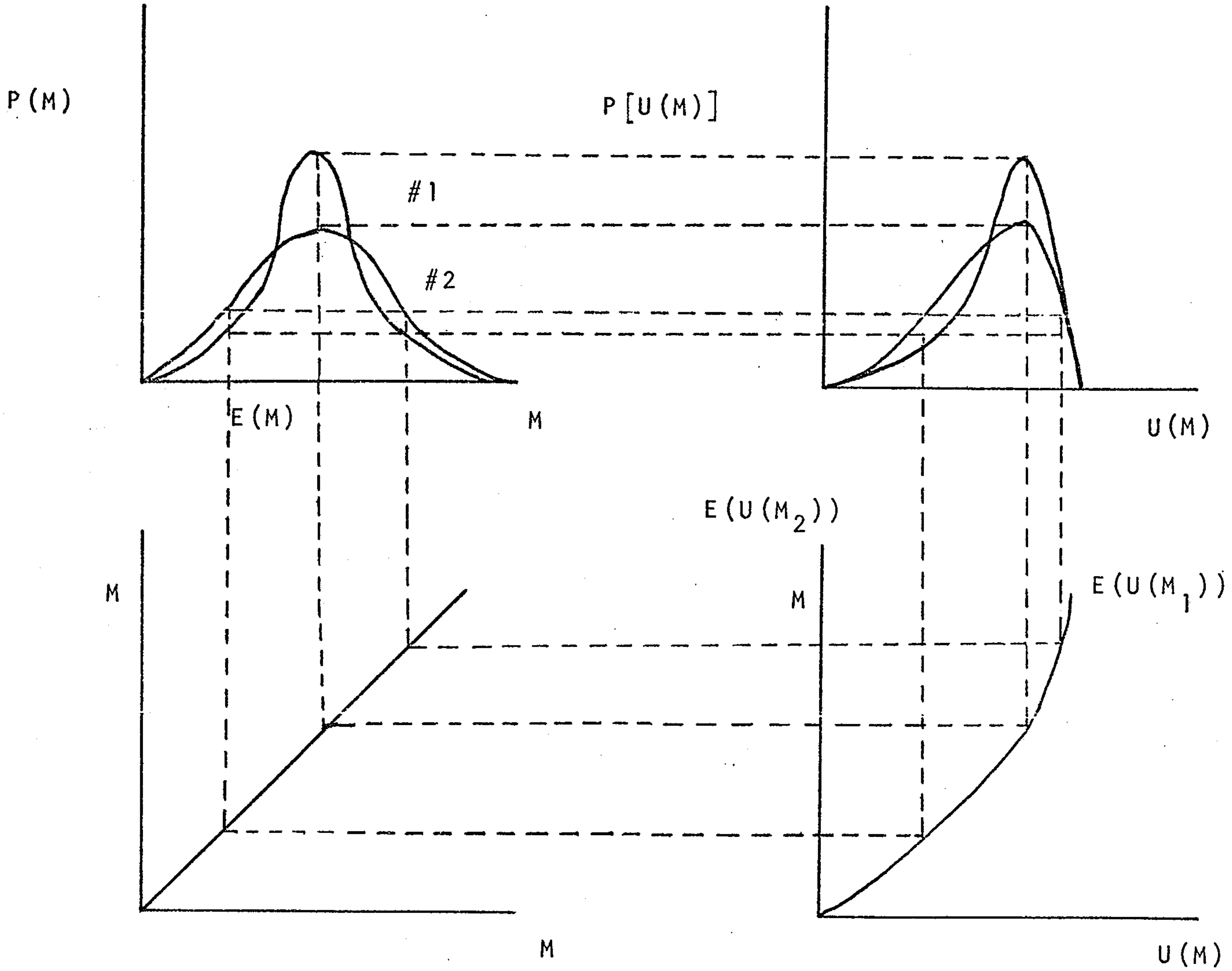

Figure 3.1 Maximization of Expected Utility and Expectation - Variance Tradeoffs.

However despite its pragmatic appeal the utility concept is fundamentally a model of individual rationality. The additional assumption that it is equally valid for the farm firm decision units is required to support its use in farm planning. The tendency to assume that a single maximizing preference function exists on the decision date has already been cited in the financial and consumption dimensions. Since the utility concept provides the only tested procedure for developing such functions it is important to note that it places the same normative limits on farm decision units as it does on individuals. To permit the use of a utility function the function itself must be static over the planning horizon. That is it must not contain exogenous variables. Even, more fundamental are requirements that a preference function exists, that it is exhaustive in its ability to evaluate alternatives and that it be quantifiable. 17/

For a large subset of stochastic farm planning models (Quadratic Programming Models), no explicit derivation of a utility function is required (Eg.[124]) . Rather, parametric variation of a risk aversion coefficient is used to solve several different problems each with a different objective function. For example, we can consider the single goal quadratic objective function;

17/ A more exhaustive examination utility axioms is in Appendix A.

$$Z = \bar{c}x - \lambda xAx \qquad (3)$$

where $\bar{c}$ is a vector of expected payoffs associated with a vector of controlled variables (x), $\bar{c}x$ is total expected payoff and xAx is the total payoff variance. A Taylor's series expansion of the utility function $U(Y)$ abount the mean $U(\bar{Y})$ where

$$Y = cx \qquad (4)$$

shows that the above objective function closely approximates a large number of concave expected utility functions.

Taylor's Series gives:

$$U(Y) = U(\bar{Y}) + U'(\bar{Y})\ (Y-\bar{Y})/1 + U''(\bar{Y})\ (Y-\bar{Y})^2\ /2 + \ldots \qquad (5)$$

Applying the Expectation Operator yields:

$$E[U(Y)] = U(\bar{Y}) + U'(\bar{Y})\ E\ (Y-\bar{Y}) + U''(\bar{Y})\ E\ (Y-\bar{Y})^2\ /2 \qquad (6)$$

$$= U\ (E[Y]) + \lambda V[Y]\ + \ldots\ ) \qquad (7)$$

Since $\lambda < 0$ by assumed concavity of U, since terms beyond the third may be assumed negligible, and since U is assumed an order preserving transformation it follow that:[18]

$$\text{Max } E[Y] + \lambda V[Y] \equiv \text{MAX } U(E[Y]) + \lambda V[Y] \approx \text{MAX } E[U(Y)] \qquad (8)$$

Parametric variation of λ generates an "efficient set" of programming solutions in the sense that for given values of λ, no higher value of $E(Y)$ and/or lower value of $V(Y)$ exists, which generates a higher expected utility for the approximate utility function. In choosing from the resulting

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[18] $\equiv$ implies equivalence, $\approx$ implies approximate equality.

"efficient set", the decision unit is assumed to be choosing the correct risk aversion coefficient and thus the correct utility function. Even in efficient set approaches however, the planning strategy is maximization of expected utility and is not normally[19] justified other than by reference to one or several systems of axiomized individual rationality.

The use of utility in planning models (as in the above example) also generally requires the assumption of a concave (risk averse) utility function for either the efficient set or given utility function approach. This mathematical requirement, although serious reservations have been voiced [69] is normally not assumed to limit problem specification.

Risk and Utility

Rae's elaboration of Cocks' multiperiod farm planning model incorporates the most general description of the decision environment of any model reviewed.[20] Although its primary contribution is to accurate portrayal of environmental information constraints a brief review is presented to show that the model is capable of coping with decision environments in which normative consideration of uncertainty is mandatory.

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[19] It is possible that the use of efficient set approaches may be justified by other than utility grounds. The normal approach however has been to use such a justification.

[20] A concise review of various possible approaches to stochastic programming in farm planning is given in [31].

The basic approach is to build on the base established by non stochastic multiperiod linear constraint systems. By allowing discrete stochasticity of up to all coefficients in the constraints, the decision unit plans at decision date "t" only on the basis of a knowledge of coefficient eventuations in t-i, t-i-1, t-i-2 (i=o,1,2,..). Future coefficients at each decision date within the time horizon are know probabilistically. The recognition and specification in a linear constraint system of this fundamental characteristic of information flow is the major contibution of the model. The addition of information constraints in stochastic framework ensures that the firm's "actions must be such that if two different environments are the same up to a given date, then his actions must be the same up to that date" [31, p. 93]. A more detailed explanation of constraint specification for i-0 can be found in [31] and for i-1 in [112, 111].

The above model shares with other less general stochastic models the need to consider a risk dimension in the objective function. The clearly established stochastic nature of the environment yields outcomes (levels of goal achievement) which are probability distributions rather than fixed points. Choice is between strategies or alternatives with associated outcome distributions rather than point outcomes. The virtually universal means for operational and theoretic support of farm management choice criteria in such situations has been provided by the maximization of expected utility.

In Cocks' illustrative model [31, Ch. IV, V], two expected utility-maximizing objective functions defined on a single goal are used. In the first case, utility is considered to be linear in Ƶ. Therefore,

$$\text{MAX } E(U) = \text{MAX } (Ƶ). \tag{9}$$

In the second case,

$$U = f\ (Ƶ). \tag{10}$$

Since f is concave; this implies that E(U) is closely approximated by a quadratic objective function,

$$E\ (Ƶ) - \phi V(Ƶ). \tag{11}$$

Since in this particular model,

$Z=(C,T)\ (1,\alpha)'$ we have in the first case (12)

$\text{Max}E(U)=E[Z]=E[C+T]$ and in the second case (13)

$\text{Max}E(U)=E\ (Ƶ) - \phi V(Ƶ) = E[C + T] - \phi V[C+\alpha T],$ (14)

where Ƶ is a relevant measure of goal achievement defined on the various outcomes specified for the decision environment,

C is consumption in period number 1,

T is terminal net worth,

ϕ is a constant coefficient of risk aversion derived from f,

E is the expectation operator and

V is the variance operator.

Over the two year horizon, terminal net worth is weighted in the "goal function" by a subjective discount of 10 per cent relative to year one consumption. That is,

$$Z = C_1 + \frac{1}{1.1} T. \tag{15}$$

In the second case where risk aversion is a significant factor in normative content,

$$E(U)=E(C_1 + \frac{1}{1.1}T) - \emptyset V \quad (C_1 + \frac{1}{1.1}T). \tag{16}$$

The level of risk inherent in any solution is assumed to be given by the variance in the level of achievement indicated by the decision unit's "goal function". Although the subjective weighting within the "goal function" is fixed (no operational means of specification is given), it is suggested that the relative E-V weighting, $\emptyset$, be determined by parametric programming on $\emptyset$, and the decision unit's choice between alternate solutions, each of which has a unique $\emptyset_k$ (k=1,2,....).

Rae [112] has used a linearly approximated (separable programming) non linear utility function in conjunction with a discrete stochastic linear constraint system incorporating known constraint coefficients in t-1, t-2,... and probabilistic knowledge only in t, t+1,..... Since the problem situation involved three stages within a one-year time horizon, goals incorporated were short-run and time discounting was considered unnecessary. The farmer expressed a desire to achieve an annual income of $6,000, a desire to avoid income variability from year to year and a desire to produce quality products. The first and second goals are introduced into the model by way of an estimate of the farmer's utility function.[21] Estimation revealed a utility function that was steeply sloped up to about $6,000 annual income where it levelled off and was also concave (risk averse) over the entire range of positive net incomes. Thus both goals were incorporated by maximizing expected utility.

Rae [11] has also suggested that this use of the utility concept can be extended to multigoal cases, where the farmer's preferences are expressed in terms of several goals, for example, net income and terminal net worth. In such a case, he suggests that one utility function be derived for each goal and that a linear combination of the two utility functions be maximized using subjective weighting factors which could be varied parametrically rather than estimated à priori.

A different approach to the normative consideration of risk in farm planning via linear programming has been suggested by Boisvert [21 55] . Rather than incorporating a risk oriented utility function as a choice criterion he suggests that normative content should focus on the ability to ward off disaster income levels. The programming model

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[21] To see this more clearly with respect to the risk avoidance goal, consider any concave utility function and two alternatives, (a) a 50-50 chance of .5x and 1.5x and (b) a certain 1.0x. Since the utility gain of an increased .5x (relative to the certain 1.0x) is less than the utility loss from a loss of .5x, the certain 1.0X will always have the highest utility as long as the function is strictly concave. If the function is linear, risk aversion is not exhibited since $U[E(X)] = E[U(X)]$.

developed incorporates the notion of chance constraints and uses a profit-maximizing objective function. In effect the decision maker is viewed as having a lexicographic utility function of the form,

$$U = g(I,\ 1-P) \tag{17}$$

where I = income and $1-P$ is the probability with which less than given resource use levels are assured.

In addition it is assumed that

(a) $g/I>0$

(b) $g/(1-P) > 0$ and

(c) I substitutes for $1-P$ at a diminishing rate.

The programming problem formulated is

$$\text{Max.} \quad \sum_{1}^{n} C_j \quad X_j \tag{18}$$

$$\text{subject to} \quad Pr[\sum_{1}^{n} a_{ij} \; x_j \; \leq b_i] \leq P \tag{19}$$

$$x_j \geq 0, \; i=1,\ldots,m, \; j=1,\ldots,n \tag{20}$$

$$\text{or subject to} \quad \sum_{1}^{n} \; a_{ij} \; x_j \; \leq \; b_i \tag{21}$$

[22]

$$X_j \quad 0, \; i=1,\ldots,m, \; j=1,\ldots,n, \tag{22}$$

where b_i' is a constant such that b_i' is exceeded with probability $\leq P$.

Based on the assumptions made regarding the decision maker's utility function an efficient set approach is elaborated since the above utility assumptions suggest an I-versus-P trade-off. Profit maximizing solutions are calculated for different levels of P (the probability of exceeding resource requirements). In Boisvert's model [21] the only resource level concerned is "available field operating time". The decision unit's choice of a solution from the efficient set generated implies a level P (a measure of security desire) given the validity of underlying utility assumptions. It should be noted here, as in the focus-loss model previously mentioned, that the decision maker does not choose to evaluate risky alternatives, but rather to outline a set of conditions under which he is willing to pretend risk does not exist.

As have previous dimensions the risk dimension suggests the existence and measurability of a comprehensive, exhaustive normative base for decision making on the planning date. However, in the risk dimension the assumed need for exhaustive treatment of normative content within the programming model is shown more clearly through the use of utility theory. The demands of utility on the make up and goal structure of the decision unit (see also Appendix III A)

22/ An alternate formulation [96] where stochastic elements are concentrated in the technical coefficients has

$E[a_{i*}]\ x - d_i\ (x\ B_i x)^{1/2} \leq b_i$ where a_{i*} is the i'th row of

technical coefficients, B is a variance-covariance matrix for a_{i*} and d_i is the normal deviate associated with P.

suggest that decsiion units possess very unified, identifiable and consistent goal structures. Even the efficient set approaches suggest that a goal structure sufficient to imply appropriate trade-offs and the selection of a correct solution from the set is in existence. Utility theory is quite specific in assuming that the decision unit is an individual and all normative assumptions are vested in a measurable utility function. At a still more specific level individual utility models reviewed make assumptions about relevant measures on which utility should be based, continuous versus lexicographic functions, and the degree of approximation achieved by efficient-set approaches.

The highly specific nature of normative concepts in risk models has been illustrated. In addition these models tend to build risk concepts on top of concepts from other dimensions resulting in even more complex normative models. The "FAT" model, the chance contrained model and the utility model are examples of radically different and very specific approaches to normative content. Chance constraints define probablistic conditions under which the decision unit is willing to plan with certainty, utility approaches assume that risk itself is valued while the "FAT" approach assumes risk must be avoided at all costs. This specificity of normative concepts combined with the size of matricies involved (eg.[31]) suggests the additional assumption that group normative standards related to risk evaluation are few and quite specific.

Suggested areas of inquiry appear to include the makeup of typical farm decision units, the consistency and exhaustiveness of existing goal structures, the measureability of normative decision standards, the development of goal structures, risk sensitive areas of goal holding and existing procedures for accommodating risk-oriented normative standards.

The Choice Dimension

All of the model dimensions discussed above cut across the choice dimension as a result of their normative focus. For this reason, discussion of certain broad issues in the coice dimension has been reserved to avoid unnecessary duplication and to permit a drawing together of similarities in normative elements from a variety of dimensions.

Two polar approaches to the development of choice criteria, each associated with a school of thought in utility theory appear in the literature. On one hand, it is argued that a super function, incorporating levels of goal achievement and appropriate trade offs for all significant goals, can be defined and maximized. This approach is suggestive of the use of a multidimension utility model (See Appendix A). On the other hand, it is often argued that a hierarchy of firm goals of varying importance exists. Only an acceptable level of achievement with respect to the most important goal will permit the second most important goal to be considered, and so on. There is no possibility of trade off between goals. In programming terms, this amounts to a planning process of starting by doing as well as possible with respect to achievement levels of the least important goal under consideration, given specified levels of achievement for more important goals. If no feasible solution exists, the second least important replaces the least important as an object of maximization and the least important goal is dropped. The process continues until an acceptable solution is reached. In a utility setting, this approach is known as a lexicographic utility model [54, Ch. 3].

In the following discussion of choice criteria, discussion is restricted to the function to be maximized without regard for its status with respect to the two above fundamental approaches. In doing so the possibility of goal constraints which decisively limit the range of the criterion function is acknowledged, but these have previously been discussed in connection with various model dimensions. The purpose here is to take a closer look at methods of specifying such trade-offs as are deemed necessary in the objective function. The objective functions reviewed may have one or several goal variables and one or several subgoal variables and appropriate methods of allowing for appropriate trade-offs between and within goal areas. In the usual case, some trade-offs are established within the objective functions and qualifying goal constraints exist as well. Most cases reviewed fall somewhere between the two polar cases cited above.

The general approach to developing trade-offs appears to have been to define (1) goal function(s) for each time period, then (2) to aggregate similar goal achievements over time using time discounting, and lastly (3) to weight discounted values related to each goal achievement series. The general scheme followed is outlined in Figure 3.2.

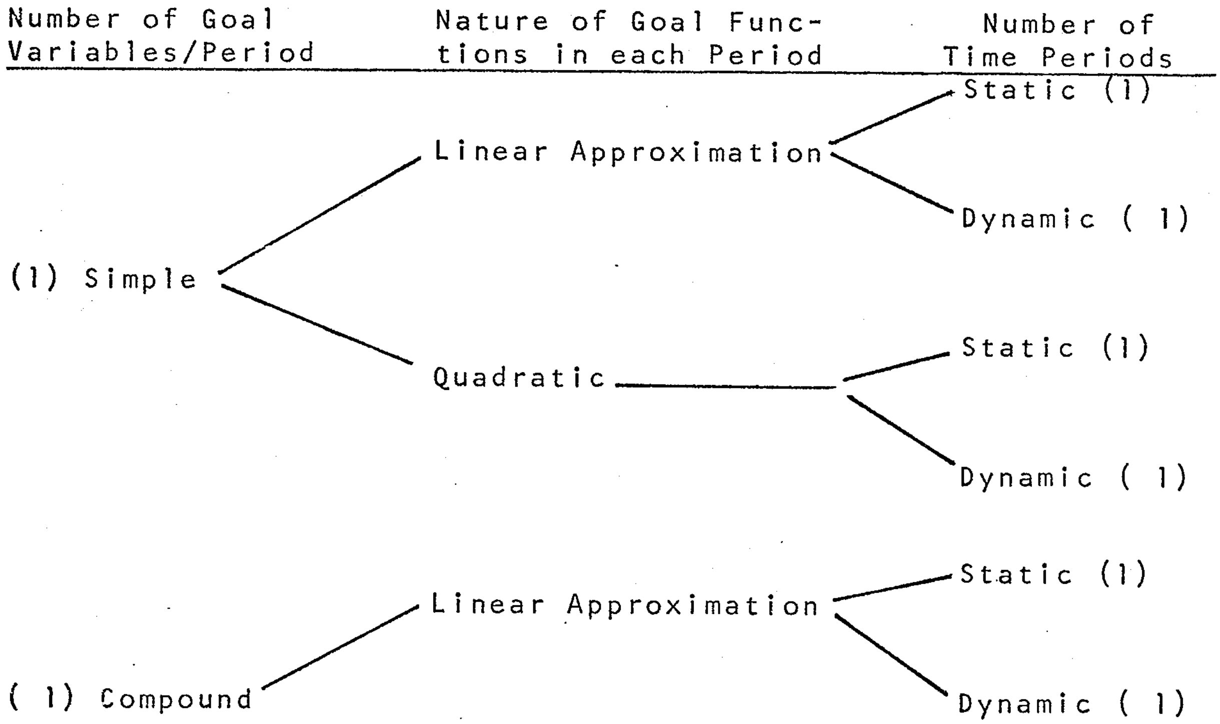

Figure 3.2 Choice Functions of Current Operational Significance

Choice functions of current operational significance appear to fall into six broad categories which are not intended to be exhaustive.

(a) A simple static linear approximation is a concave function, of a single level of achievement, which has been approximated by linear segments (may be only one segment).

(b) A simple dynamic linear approximation is a linear combination (with weights given by time preference discounting) of concave functions of a single level of achievement over time, each of which has been approximated by linear segments.

(c) A compound static linear approximation is simply a linear combination of simple static linear appoximations, with weights determined by the decision maker's preference between goals.

(d) A compound dynamic linear approximation is simply a linear combination of simple dynamic linear approximations, with weights determined by the decision maker's preference between goals.

(e) A simple static quadratic function is a quadratic function of a single level of achievement.

(f) A simple dynamic quadratic function is a linear combination (with weights given by time preference) of quadratic functions of a single level of achievement over time.

The whole farm approaches of Marceau [86], Goldschmidt [50], Harter [56], Stonehouse [128], and numerous others working with static farm planning models have used single planning period profit maximization, variously but similarly defined, as a choice function. Dynamic elements such as capital investment enter only via their effect on the single period profits. Other elements of personal preference have not usually been considered in the choice functions of these studies. The choice of some form of profit maximization in these cases is normally justified in one of three ways.

1. The model has a sufficiently specific area of application or a sufficiently short horizon that profit maximization reasonably represents the firm's preference within the given context.
2. The firm being modelled is large enough to have a rather formalistic set of objectives among which profit maximization is the dominant goal.
3. The choice of objective function is not critical, and facilitates the examination of environmental problems.

Marceau, Stonehouse and Harter have developed short run static models for which profit maximization has a reported relevance in the farmer's view. (See Stonehouse [128, pp 161-164], or Harter [56, Ch. 8]). Goldschmidt has analyzed decision making on comparitively large Israeli farms with relatively formalistic goal structures favouring the use of profit maximization preference functions. In other cases, the use of profit maximization has been justified by the fact that other plausible functions produced similar solutions.

The process of farm planning is conceived of as a more wholistic approach than that envisioned in the static whole farm approaches above and normally does not operate in the context of formal organization goals. Therefore it is necessary to examine other more complex choice functions in dynamic farm growth and planning models. In general the normative aspects of such models are of a non-empirical nature, but do illustrate the types of approaches which are technically feasible. Acton [5] following Candler and Boehlje [28] has used a mixed integer linear programming planning model to maximize a compound dynamic linear approximation. This weighted sum of terminal free cash balances, terminal assets and terminal debts is maximized subject to annual family consumption constraints. He suggests that weights be established on the basis of the firm's preference. Revision of weights is suggested if the initial solution is not satisfactory. No technique for deriving weights is specified, but reference is made to an iterative estimating technique suggested by Candler and Boehlje [28] which is discussed later in this chapter.

Martin and Plexico [88] and Martin [89] have defined several simple dynamic linear approximation objective functions in the process of studying the phenomena related to farm firm growth. They considered maximization of: (1) undiscounted gross sales, (2) the present worth of net returns, (3) the present value of land ownership, (4) acres farmed over the planning period, (5) discounted gross sales, (6) acres operated in the last production period, (7) undiscounted net returns, (8) owned capital at the end of the planning period, and (9) the present value of consumption. All are linear functions of specific yearly outcomes, most of which are directly related to net income, the remainder are income dependent. In discussing the results of their analysis, they point out that apparently dissimilar objectives often yield optimal solutions that are strikingly similar. For example, maximizing the present value of consumption over the planning period and maximizing the present value of profits (or any of 5,7,8,6,4, from the nine objective functions above) result in similar capital accumulation profiles for their test situation. Martin [89, p. 46] concludes that since most of the objective functions give similar capital accumulation results, "the objective function subject to the restrictuions of the model used in this analysis is not a sensitive variable". It should, however, be noted that sensitivity in this context refers to farm growth.

Duvick [39] has used an unweighted sum of the present value of yearly consumption and terminal net worth (another compound dynamic linear approximation) in a multiperiod study of the financial aspects of farm growth. He compared the resulting solutions with those obtained by maximization of either of two simply dynamic linear approximations, specifically maximization of terminal net worth and maximization of the present value of yearly consumption. Duvick [39, p. 92] concluded that, "increases in consumption and net worth are dependent on a high level of income and it appears that maximizing both goals will give a result near to that obtained when maximizing net worth alone and at little expense to consumption". Maximization of consumption alone, on the other hand, led to a significant decrease in terminal net worth. Considerable contrast was apparent between solutions obtained by maximizing terminal net worth and the present value of yearly consumption separately.

Smith [126] has used another compound dynamic linear approximation objective function to study the financial aspects of growth in a linear programming model of an Illinois grain farm. The objective function used is present value of terminal assets plus present value of yearly consumption above a minimum minus 1.25 times the terminal real estate debts minus terminal non real estate debts. He also used two similar function: one with the real estate weight changed to 1.0 and the other with a debt aversion weighting in each model period. No empirical justifications are given for the form of the objective function.

Cocks and Carter [32] have developed (using elements of theory of the firm and utility theory) seven, wealth-consumption oriented simple and compound dynamic linear approximation goal functions to represent possible choice functions in a multiperiod linear programming context which includes a variety of possible enterprise choices. Among choice criteria considered are:

1) Maximization of the present value[23] of future yearly consumption where yearly consumption is discounted according to timing to reflect time preference and quantity of reflect diminishing marginal utility.
2) Maximization of the present value[23] of yearly profits subject to profits being reinvested.
3) Maximization of the present value[23] of yearly profits subject to profits being withdrawn.
4) Maximization of the present value of cash flow (i.e. cash generated yearly for consumption use and terminal net worth).
5) Maximization of terminal net worth.
6) Maximization of the present value of a linear combination of (1) and terminal net worth for each of several weighting factors. (The firm is allowed to choose the weight which it feels most appropriate.
7) Maximization of the internal rate of return where return consists of the consumption flow plus terminal net worth.

They suggest a parametric treatment of wealth-consumption weights to give solutions from which the firm can apply its own preference functions. In general, they draw the conclusion "that plans are sensitive to goals and that, in setting up wealth consumption goals, choice of weightings

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[23] The discount rate used was 10 per cent.

is likely to be critical" [32, p. 408].[24] Similar results were obtained by Boehlje and White [19] who investigated the maximization of the present value of annual disposable income and the maximization of terminal net worth in a multi-period linear programming model, emphasizing production and financial processes.

The above results are not entirely inconsistent with those of others who have not found similar objective functions sensitive, since they normally have only referred to the effect on growth in citing insensitivity. The Cocks-Carter and Boehlje-White models have a greater ability to display differences between objective functions because they incorporate enterprise selection which the Martin model (previously discussed) in particular does not.

Baker [8] has illustrated a linear programming formulation which allows diminsihing marginal propensity to consume and liquidity preference to be built into the objective function. In general, the liquidity preference procedure is to place subjectively determined reservation prices which increase as reserves are depleted, on variously classified (e.g. by source or use) liquidity reserves. Diminishing

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[24] In addition they note that the maximum-internal-rate-of-return criterion forces time preference to discount at the maximum internal rate and that in view of the unique nature of the terminal state in any planning model (i.e. it is the beginning state in the next planning period), it is concluded that some weight will likely be given to this state in choosing alternatives.

marginal propensity to consume is accommodated by placing decreasing weights (MPC's) on disposable income used in consumption, as the level of consumption increases. "Consumption response to current income" is determined by applying MPC's to income from productive sources and capital gain. In addition, Baker's model makes a provision for "consumption response to the past year's income" and "consumption response to the previous year's capital gain" to be linearly determined by the income and capital gain of the previous year. "Consumption outlay" in any one year is the sum of the cited functions of current income and capital gain, the past year's income and the past year's capital gains. A weighted sum of yearly consumption outlay and terminal net worth is included in the objective function. Intertemporal equivalence is established by applying conventional discounting procedures to consumption "outlays" in each year. No operational procedure is given for the determination of weights relating decreasing marginal propensity to consume, increasing liquidity preference, the relative importance attached to liquidity, consumption and other goals, intertemporal preference or the linear influence of past income or capital gain on consumption. It is established that such weightings are within the capabilities of a linear programming formulation. However, no evidence is submitted to the effect that normative standards in these areas may be expressed in this way.

The capacity of programming formulations to permit subjective weightings of various farm goals has been noted. However these madels normally use "reasonable" weightings for illustrative purposes and no operational procedure for estimation of weights is indicated. Candler and Boehlje [28] have detailed an adaptive process of weight determination for both money and non-money goals in linear programming capital accumulation models. The procedure partially avoids à priori mapping of goals into a single preference dimension.

Their approach begins by defining a goal function for each conceivable goal. Individual goal functions are defined such that arbitrary relative values, associated with the given goals from various alternatives, are additive. That is, they give a total amount of achievement from all sources with respect to the given goal by direct summation. It is implicitly assumed here that the decision unit can agree on the extent to which each source of goal achievement contributes to a scale relating total achievement of that goal. This assumption is naturally more perilous when goals for which no standard of measure exists (for example, togetherness or pollution) and scaling is more arbitrary. If agreement cannot be reached on the specification of certain goal functions, it is suggested that the problem may be shifted from the goal function specification stage to the weight determination stage. This is possible by either breaking down goals into sub goals to yield a larger number of goal functions for which scaling procedures may be agreed upon, or by including more than one scaling procedure for given goal (i.e. by effectively defining additional goal functions) with the hope that agreement may more easily be reached in following stages in which weights associated with each goal function are determined. Once all contributions to each goal have been reduced to a single additive dimension and appropriate scaling procedures are determined, the problem of reconciling conflicting goals can begin. First, arbitrary weights (λj) to be applied to each goal achievement level are determined by or for the decision unit. The resulting choice function is then used in optimizing a linear programming problem.

Given these weights, the linear programming solution obtained gives the highest possible level of achievement of each goal that can be obtained without reducing the level of achievement with respect to other goals. In all likelihood, the resulting "efficient set" of goal achievement levels will prove unsatisfactory to some group members who are now in a better position to resume negotiations on the relative importance that can be attached to various goals. After negotiation the weights may be revised (taking note of the direction in which weight change is warranted) and the process is repeated. It is suggested that this renegotiation of weights stage may be aided by using parametric programming methods on the λj. When an acceptable efficient set of goal achievement levels is obtained, the process terminates and an "optimal" set of weights will have been obtained.

The primary focus of the choice dimension is the determination of relative weights for various farm firm goals. Plans developed appear to be critically dependent on the relative weights assigned to goals. Although many weighting procedures have been proposed, they appear to be based on three major normative propositions.

Firstly, all models reviewed based their goal selection and weighting procedure for the planning period on whatever normative standards existed at the planning date. No model incorporated an adaptive mechanism in which normative standards themselves interacted with the decision environment over time.

Secondly, normative standards existing as of the planning date are assumed to be exhaustive in the sense that they are capable of evaluating all alterntives in each time period. Some studies have shown that for a particular purpose (maximizing some specific concept of growth) a large number of simple normative propositions is equally effective. In general, however, this is not true and as a result the assumption that existing normative standards can usefully discriminate over the entire planning horizon can not be taken lightly.

Thirdly, the development of complex and often unmeasureable weighting schemes suggests and underlying assumption that all normative standards should be internalized in the model. With the exception of one model [26] no model was seriously concerned with the problem of determining intra goal, iner temporal and inter goal weights. The normal procedure appears to be establishing inter-temporal equivalences between like types of goal achievement over time and then subjectively weighting these functions. The efficient set approach proposed by Candler and Boehlje [28] suggests that a choice exists between confronting decision groups with a large number of "efficient" solutions and in effect internalizing normative standards within the model. Although this interactive model is aimed primarily at overcoming measurement problems, it does suggest that a trade off exists between internal and external treatment of normative standards.

The choice dimension has reinforced the case for a fundamental assumption of maximizing behaviour and in addition to assumptions regarding the existence and comprehensiveness of normative standards makes an additional but related assumption. Acceptance of a maximizing framework involving economic goal suggests that major problems fall in the area of relative weight determination. The existence of relatively static normative standards which imply clear, consistent and comprehensive goals and relations between goals would support this concentration on the measurement problem. The absence of these conditions would suggest that more fundamental problems regarding the nature of goals must be solved first. For example, it may be that only by utilizing goals of the economic type, subjective elements can be forced into the choice of weighting factors. In this case the assumption that significant goals are related to economic outcomes places very definite a priori restrictions on the selection procedure. Nonetheless a major concern with most models is not the basic nature of goals but which of the consumption, net worth, asset holding, debt, or other economic goals is the most important.

Three responses to the measurement problem are apparent. Firstly, it has been suggested that within relatively wide limits the choice of an objective function is not critical. This suggests that the normative standards on which they are based are not critical. However, insensitivity of model results has been seriously questioned even given goal directed maximizing behaviour. A second suggestion is that the measurement of weights in the objective function can be reduced to an iterative interactive process between the decision group and the decision model. A third approach, closely related to the first, is to assume that the weights themselves have some sort of intuitive meaning and are clear to model users. Regardless of the specific assumptions made a major normative assumption in the choice dimension is that the selection of weights is the major problem in the specification of normative standards. Whether this assumption is valid or not depends on the dynamics of group normative standards, the relations between various goals and the comprehensiveness of goal holding.

The entire area of goal selection and weighting suggests that it will be useful to examine actual family goal-value structures, to establish any uniformities which may exist in farm family goal holding and also to establish whether any sound basis for relative weight determination exists. In addition, it would be useful to examine the practices involved in various potential farm management delivery systems, since these will be responsible for putting problems in an effective quantitative form.

Other Dimensions in the Programming Context

A treatment of the virtually limitless number of ways in which normative elements have entered farm planning, programming models must be selective. In emphasizing five major dimensions, it is recognized that cursory attention has been paid to many others which have not often been treated in the literature. For instance some space could have been devoted to a technical dimension within which goal-value structures interact with the specification of modeled technical processes or to a leisure dimension within which leisure time goals are reflected. However, since these areas are not extensively developed in farm management literature and since exhaustive treatment of model dimensions is not the objective these are not considered.

Summary of the Programming Context

In Chapter III, we have illustrated several normative dimensions of farm planning programming models. As shown in Figure 3.3, the programming context has pointed to some logical connections between model portrayal of normative standards and a normative black box. The remaining chapters of this thesis are concerned with the nature and significance of the black box.

To the extent that relevant research and theory in the area of farm group decision making are available it should be possible to establish general criteria for the evaluation of the normative content of programming models.

The farm planning process in a programming context is fundamentally a goal-directed maximizing procedure. Although reference is made to abstract, and noneconomic goal virtually all model goals are measureable and economic. Planning solutions in Figure 3.3 are generated by developing a series of equations which represent the firm's preference function solely in terms of firm goals and objectives. The pervasive pursuit of models which incorporate every "conceivable" goal suggests that maximal firm goal achievement is, in some sense, an ideal for both model builders and firms. For the firm, the goal maximizing assumption implies that farm firms are motivated to maximize some function of their expressed goals. For the model builder, the assumption has one additional facet. In addition to assuming goal maximizing behaviour, it is suggested that such behaviour must be internalized into the model (exhaustiveness). This latter aspect is borne out by the fact that justifications for including given goal structures are based solely on the significance of the goals in relation to the firm and the sensitivity of solutions. Support is not generally in terms of the deficiencies of other techniques for incorporating goals into the planning process.

The maximizing assumption underlying the operational programming models does not however, imply that model solutions are always expected to achieve this objective. The presentation of solutions is in the main, accompanied by cautions arising out of inabilities to identify and quantify the relationships between modelled goals. Since weighting factors in particular are notoriously tentative, efficient set approaches and iterative goal-establishment procedures have been suggested. This does not, however, represent any weakening of the maximizing assumptions. Even the iterative weight-determination procedure suggest by Candler, although clearly cast in a goal determination as well as a weight evaluation mode, assumes the desireability of maximizing some function of achievements relative to current firm goals.

The assumption that some sort of maximizing behaviour is at play has an interesting parallel in utility theory. The minimum requirement for a utility theory approach to decision making is that each decision maker must be capable of reducing all aspects of given alternatives to a single dimension, utility, which has the characteristics (a) that it establishes a weak ordering of all alternatives, and (b) that it permits no intransitivities [119]. In both the utility and programming cases, the assumption is that all diversity can be reduced to a single dimension reflecting worth to the decision unit.

The overriding assumption of maximizing behaviour is reflected in a number of subsidiary, and in most cases implicit, assumptions. Maximization of some function of firm goals is only possible if they are regarded as a static evaluative reference. Goals must exist on the decision date and they must be valid over the decision period. For example, if a given consumption goal of spending 50 per cent of disposable income on consumer goods in year four is included in the planning model, solutions generated will be conditioned on the assumed static character of this goal. The point here is that the goal formation procedure is assumed to be complete on the decision date. Psychic and social processes which generate goals are assumed to have either terminated or reached a stable equilibrium.

A second subsidiary assumption is that firm goals existing on the decision date are comprehensive in the sense that they permit the evaluation of all possible alternatives over the palnning period. This implies that there are no impediments to the generating of goals in any area which is of significance in selecting between alternatives confronted. In general goals included in planning models are of the operational type; this implies that the firm is able to establish a comprehensive set of operational goals without precise knowledge of the environments in which they will function.

In general models go farther than requiring measureability of firm goals. Model convexity requirements force a more rigorous set of constraints on model specification. In the consumption area, it was noted that consumption functions are maximized in models rather than used in constraints, while another function is maximized because of convesity requirements.

Another assumption required to support the maximizing objective is that the degree of overall goal achievement must be measureable. Models reviewed have restricted goals to quantitative economic goals in response to relative weighting schemes which have been preposed to reconcile risk, consumption, time, liquidity and other goals.

In terms of figure 3.3, maximizing behaviour is assumed to proceed on the basis of known, exhaustive, and measureable goals and interrelationships. Given the additional assumption that the required mathematical representations are tractable in programming terms, the set of normative constraints and the choice criterion can be defined and solutions can be generated and made available to the decision unit. No feedback mechanism which would relate the decision taking process to the generation of firm normative standards is specified as indicated by the dashed line in the illustration.

Figure 3.4 further clarifies the presentation of normative assumptions implicit in the programming context. Three levels of abstraction are reviewed. As indicated by the arrows at the top of the page, specific normative

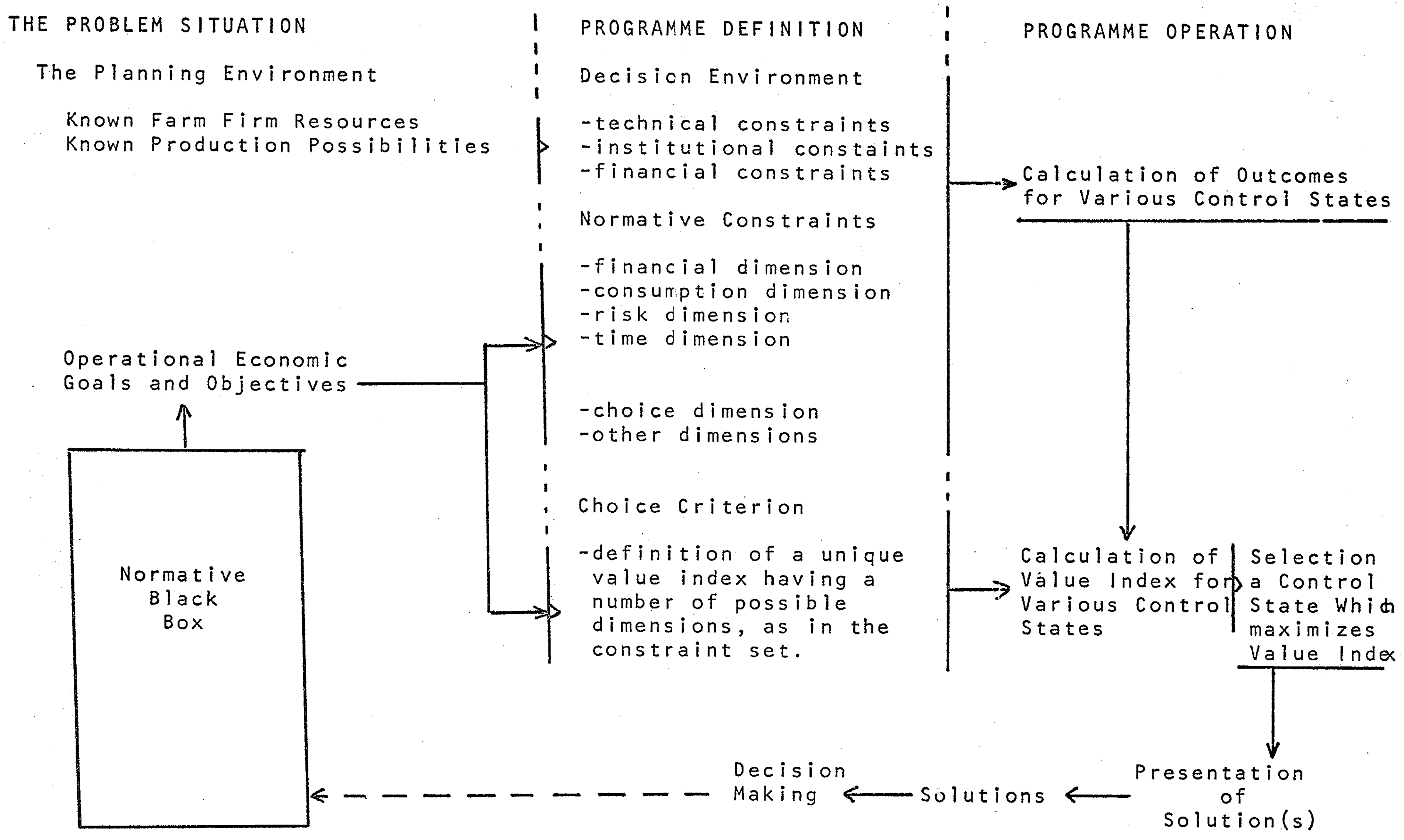
THE PROBLEM SITUATION
The Planning Environment
Known Farm Firm Resources
Known Production Possibilities
Operational Economic Goals and Objectives
Normative Black Box
PROGRAMME DEFINITION
Decision Environment
-technical constraints
-institutional constaints
-financial constraints
Normative Constraints
-financial dimension
-consumption dimension
-risk dimension
-time dimension
-choice dimension
-other dimensions
Choice Criterion
-definition of a unique value index having a number of possible dimensions, as in the constraint set.
PROGRAMME OPERATION
Calculation of Outcomes for Various Control States
Calculation of Value Index for Various Control States
Selection a Control State Which maximizes Value Index
Presentation of Solution(s)
Solutions
Decision Making

Figure 3.3 Normative Elements of the Farm Planning Process In An Operational Programming Context

propositions which have been discussed under five separate model dimensions collectively imply more general and implicit model assumptions which in turn imply a number of implicit assumptions regarding group normative standards. The assumptions in the main body of the figure show that assumptions made at each of levels 11 and 111 are, in turn, supported by or complemented by more abstract assumptions.

The following groups of questions relating to mdelled normative propositions are indicative of the areas in which existing theory and research in farm decision making can contribute to the development of evaluation criteria. No indication that theory or research sufficient to provide answers for all is intended. As will become apparent, many require detailed explanations in areas for which little or no data are available.

(a) The Nature of Group Normative Standards

1. Do group normative standards relevant to selection between farm planning alternatives normally exist on a planning date?
2. Can existing group normative standards be identified and measured?
3. It it possible that existing group normative standards relate more to the selection of decision making alternatives than to the selection of farm plans?

Level of Assumption	1 Group Normative Standards	11 Model Normative Propositions (General)	111 Model Normative Propositions (Specific)
	-Imply that all significant dimensions of alternatives can be reduced to a Value Index to be maximized.		-Specific Normative Propositions -Choice dimension -time dimension -consumption dimension -financial dimension -risk dimension
Assumptions	-Exist or can be made to exist in the form of firm goals -formation processes are static or in equilibrium	-Quantifiable in terms of economic goals -tractable	
	-Form a comprehensive evaluative reference for alternatives faced -no impediments to goal formation exist	-Exhaustive evaluation of goal achievement is necessary	
	-Can be identified and measured		

Figure 3.4 Normative Assumptions Implicit in the Programming Context

4 Do existing group normative standards comprisc a comprehensive base for decision making for the farm firm or any of its sub sets?

5. Are there common areas of group goal holding? If so, what are they?

6. Whose normative standards are relevant in farm planning situations? What are the relationships between individual and group standards?

7. Are there significant areas of non goal holding?

8. Is maximizing behaviour possible?

(b) The Nature of Model Normative Propositions (General)

1. How many major goal holding standards can be quantified? How credible is the quantification process?

2. Are the results of research on goal holding inter relationships consistent with the tractability requirements of programming models?

3. Is it necessary to include normative propositions in a formal analytical procedure? If so, to what degree?

4. How are normative propositions handled in existing farm management analysis procedures?

5. Do standards of equivalence between goals exist within the decision group.

(c) The Nature of Model Normative Propositions (Specific)

1. What time horizons are involved in group goal holding? Are group goals long run, short run, both?

2. Are there cyclical changes in goal holding?
3. What are the determinants of individual and group time preferences? Can they be quantified?
4. How is risk accomodated in existing decision processes? Can risk preferences by expressed in terms of "risk coefficients"?
5. In what decision areas are risk oriented goals important?
6. How widespread are liquidity goals? Can these be expressed as liquidity preference functions? Are liquidity goals independent of risk-oriented goals?
7. What are the major determinants of consumption relationships? Can meaningful marginal propensities to consume be determined?
8. Can standards of equivalence between goals be quantified in terms of weighting factors?

CHAPTER 1V

A CONCEPTUAL FRAMEWORK FOR FARM FIRM DECISION MAKING

Introduction

The acceptance of a principle of optimization in Chapter 11 implies that the planning process should, to the fullest extent possible, optimize something inherent in the socio-psychological makeup of the decision unit. In Chapter V, V1, V11, the concept of normative standards for farm firm decision making is developed to provide a base for evaluating normative elements in programming models.

Particular interest is in the nature of normative standards at a point in time and their generation over time. In addition, interest is in implications regarding the degree and manner in which normative standards should be internalized into formal planning models. Since the socio-psychological functioning of individuals in a group decision situation is the basis for acceptability of normative standards for group decision making and remaining chapters examines research related to individual and group operates in the context of an extension service, an examination of the impact of extension involvement on group goals, values and their formation is also conducted.

A conceptual framework for farm firm decision making based on concepts and theories from a diverse group of disciplines is presented in Chapter 1V. The framework is presented in four parts. In the first, Goals and Values basic goal-value concepts are presented at both the group and individual level. The second section, Conflict Resolution, presents the process of joint decision making or integration. A third section, The Family As A Decision Making Group, specializes the framework developed in the two previous sections by presenting certain idiosyncratic information on the family group. The fourth section, Farm Planning Decision Making, specializes the framework still further by integrating the role of extension personnel.

Goals and Values

Early in life each individual develops an abstract set or normative standards for action called values, which are continually changing in the long run, but stable in the short run. Goals, on the other hand, are desired ends resulting from individual values and beliefs. That is they are the ends set for action in the light of a perception of what is true in the decision environment.

Goals may also result from the compulsion of external pressures or motivational forces, both inate and learned. Katona [69] has pointed out that non problem oriented action directives are in fact the normal case in everyday behaviour. Habitual behaviour for example is the most usual occurence. However, since they reflect action directives involving little or no possibility of choice, it is not necessary to consider such goal sources in a framework for normative standards except to the extent that they interact with values in goal formulation. For instance, impulse motivations are translated into normative standards through the process of socialization.

It is important to distinguish between the concept of a goal as simply an end implied by a value in a given existential contex and what may be called an operational goal (this is similar to March and Simon's terminology; see Cartwright and Zander [29, pp. 409]) which is a goal of sufficiently low level abstraction to be used in determining degree of success in actual decision making.[1] Action is likely to be directed at operational goals. In the sense used in this thesis, all values imply goals or ends in some existential context, although they may not be of operational significance. A given high level value may imply any number, including zero, of lower order goals since as Neilsen 101 states,

> "an individual's values might indicate that something was desireable but he would not set it up as a goal to work for if his perception of circumstances led him to the conclusion that the object was unattainable". (Underline mine)[2]

For our purpose, a value system can be defined as an individual, abstract set of long standing standards relating to the preferability of possible actions. J.D. Schlater [123] defines values and lists additional definitions as follows:

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[1] In general usage, "goal" is equivalent to an operational goal leading often to the conclusion that goals are to be distinguished from values via their lower level of abstraction.

[2] This distinction between operational goals and more basic standards of value is particularly significant as a result of the heavy reliance of model builders on operational goals in developing choice criteria.

> "Values are conceptions of the desireable which affect an individual's choice among possible courses of action. Accordingly, values are abstractions, organizing principles or normative standards which have a regulatory effect on behaviour.
>
> This definition of values is in close alignment with those developed by Jacob and Flink, Kluckholm and Smith. Jacob and Flink identify values as 'normative standards by which human beings are influenced in their choice among the alternative courses of action which they perceive.'
>
> According to Kluckholm, a value is a 'conception, explicit or implicit, distinctive of an individual or characteristic of a group of the desireable which influences the selection from available modes, means and ends of action.' For Smith, values are 'conceptions of the desireable that are relevant to selective behaviour.'"

The above definitions clearly establish a cathetic[3] dimension as a primary distinguishing characteristic of values.

As is often the case in defining complex social concepts, additional precision can be obtained by specifying what values are not. They are distinct from a number of physiologically founded and/or learned motivations of an impulsive type, which influence action without regard to the individual's conception of reality (examples are biological drives and certain psychological needs), as well as attitudes and opinions.

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[3] Cathexis is defined by Parsons and Shils [106, pp.5] as "the attachment to objects which are gratifying and rejection of those which are noxious". The difference between cathexis and valuing can be clarified by distinguishing between the desired and the desireable. Many things may be desired by a conception of social and physical reality (e.g. a social sanction) may prevent outward expression of this desire. Cathexis is a relation between motivation-drive, need, wish, impulse- and an object [106, pp.69].

Values do not include motivations of any type which allows little or no room for individual choice. Choice is the basis of value theory. In the words of Jacob and Flink [62]

> "Homo sapiens is physiologically capable unlike other species of a wide variety of mutually exclusive responses to given stimuli. This capacity for choice is the essential physio-psychological basis for the development of what we identify as "values", namely, standards of the desireable which men apply in making choices". (underline mine)

Values are to be distinguished from the attitudes through which they are often studied. Sargent and Williams (McGuiness [85] have stated that, "Attitudes are treated (by psychologists) as fairly consistent and lasting tendencies to behave in certain ways - primarily positively or negatively - toward persons, activities, events and objects". In this sense, attitudes are tendencies emanating from value orientations (see Parson and Shils [106, pp.358, 423, 453]).

Values are not necessarily part of the individual's[4] conscious personality, but may be held subconsciously. Those which are explicit in the sense that they incorporate some elements of belief, and provide a general systematic approach to the individual's environment may be termed value

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[4] It should be noted at this point that there is no single, scientifically accepted concept of "value". Rather, several concepts which are scientifically valid in their own rights are recurrent in behavioural literature. For a quick review, see P.E. Jacob and J. J. Flink [62]. Value concepts used in this thesis are those proposed for use in decision situations similar to those presented in farm management.

orientations. Kluckholm [106, pp. 411] states, "a value orientation may be defined as a general and organized conception, influencing behaviour, of nature, of man's place in it, of man's reaction to man and of the desireable and non desireable as they may relate to man-environment and interhuman relations". This belief-value structure or value orientation, is shaped in large part by a socialization process during which the individual comes to hold certain role expectations for himself and others.

The distiction between values and value orientations has often been made, the latter having a distinct existential dimension. It should be noted, however, that this distinction relies heavily on a static conception of "value" given currency by long-run stability of certain elements of belief structures. In a larger sense, however, even values have an existential content. As Kluckholm [106, pp.392] has stated, "Values themselves are constrained within the framework of what is taken as given by nature." Values themselves exist in both the cathetic and cognitive domains. In this sense then, the distinction between values and value orientations becomes one of temporal stability of the existential propositions involved, values having relatively stable existential elements, and value orientations having less stable existential elements.

While this study is primarily concerned with the cathectic domain, it must be focused clearly in the light of information states of the cognitive domain. Individual values cannot be abstracted from the cognitive domain no matter what length of run is considered. What emerges then, is a cognitive hierarchical structure of values having various existential contents. We can speak of abstract values with little existential content and, at the other extreme, of operational values with a heavy existential content. The hierarchical structure is, however, not of a straight-forward type; ultimate values do not each imply a series of operational values. A complex psychological process of interations involving beliefs and values results in an operational individual value structure.

In the sense of this cognitive hierarchy, there exists an infinite number of values. Considerable evidence is available, however, to support the notion that a relatively few values reflecting modes of conduct and end states of existence (that is highly cathectic values) and applying across objects and situations, exist as a base on which less stable value orientations are built [119, Chapter 7 , 122, Chapter V]. If this is true, we can expect to find operational goal-value structures in farm families which are relatively poor indicators of relevant normative standards when environmental factors are relatively unstable, as in major planning situations. Fundamental values should provide a more relevant base because of their relative stability.

In terms of the programming context presented in the last chapter, the operational nature of the goal structures developed in programming models implies the existence of a special class of situation dependent values, described here as operational, on the planning date. The existential content of operational values existing on farm firms is therefore an important question in determining the validity of normative standards used in planning.

At the group level, individual values are at the basis of social interaction. As noted by C. K. Kluckholm [106] a stable and to some extent common value system is required by individuals in any social system to provide a basis for group existence in addition to providing a base for individual action. In an abstract sense, we can refer to this commonality as a group value system. The degree of commonality is thus a dimension of group values. As Kluckholm [106] says:

> "...it is possible and useful to describe the actual tendencies (of value holding) abstractly and to impute them to the group rather than the individuals". (brackets mine) (See also Cyert and March [34, Ch. 3].)

The above should not be taken to imply that a group is simply a collection of individuals and that group values are simply a collection of individual values, although this is partly true. Golembiewski [51, pp. 23] states: "A person's very conception of himself and the preservation of that self-conception, indeed are very often group products." While group values reflect a commonality of individual values, those values involved will be affected by the individual's membership in the group [51, ch. 2].

Values[5] have several important dimensions in addition to the cognitive, cathectic, and group distribution dimension discussed above. These dimensions also result in structures reminiscent of hierarchies with stratification by levels of the several dimensions. Values which reflect individual <u>intent</u> by relating to the achievement of means for further ends are called instrumental values, while goals or ultimate values are related directly to ultimate ends. It is possible for an ultimate value in one time period to be an instrumental one in a larger perspective. Paralleling the above user's-intention classification is one of situational classification or <u>generality</u>. Some values relate to very specific situations, while others are quite general, applying to a wider class of situations. Values are held with varying degrees of <u>intensity</u>. Some will be adhered to with great fervour while others receive little more than lip service.

As previously mentioned, values may not be consciously held. A continuum of <u>explicitness</u> ranging from easily verbalized to indirectly inferred values is possible. Values can also be classified with respect to

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[5] The following discussion draws heavily on Kluckholm's discussion of dimensions of values in Parsons and Shils [106, pp. 44, Ch. 2].

their consistency. For example, they may be entirely independent of others, part of an inter-locking and entirely consistent system, or they may be entirely or partly inconsistent with others.

Conflict Resolution

Groups do not have values in the sense that individuals do, however groups do from time to time formulate goals toward which action is directed. In group conflict resolution we are faced with two basic problems. First, how does the group resolve individual goals into group goals? Second, failing resolution, how does the group accommodate apparent inconsistencies between individual goals? Conflict resolution is the group of processes involved in group goal formation and goal accomodation. Group goal formation involves a complete process of resolution. The other group of closely related processes, resulting in a quasi resolution of conflict, consists of accommodation procedures which stop short of group goal formation. Conflict resolution is discussed below in three broad areas, roughly, the nature of interaction between group members, quasi resolution of goal conflicts and resolution of goal conflicts.

As Jacob and Flink [62] state, an individual's orientation toward action is influenced by his values, beliefs and impulses. It is unlikely in any given situation that these determinants will be entirely consistent in their implied magnitude and direction of influence. In such a situation, internal resolution of conflict is required before effective action can be taken. In farm management, we are particularly interested in the interface of this internal conflict of interest and more obvious interpersonal conflicts of interest and the way in which this process translates itself into actual farm firm decisions.

Conflict among individual goals in a group situation will be the normal course of events. Kelley and Thibaut [72][6] suggest a classification of three distributional conflicts regarding information, outcomes, and response which are inherent in individual problem solving in a group context.

They conclude after an exhaustive review of literature that even in situations where other group members are entirely passive in the decision process, that:

> "Research by social psychologists has shown that the aquisition and exercise of those various skills, (distinguishing of and discriminating between alternatives, a perceptual skill; responding in a discriminable manner, a behavioural skill; understanding alternative-outcome relationships, a cognitive process), is affected by the sheer presence of other persons". (Brackets, mine) Kelley and Thibaut,[72, pp 2-3]

In farm planning however, we can confine ourselves to the more pronounced case where there exists some degree of active involvement by more than one group member and where social interaction is clearly important.

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[6] This entire section on group problem solving draws heavily on the compendium presented by Kelley and Thibaut [72]

At the individual level, Kelley and Thibaut [72, pp 8-15] suggest that individuals focus on a certain information state regarding particular states of their environment and on a certain level of particular outcomes. Outcome levels below a focal point initiate information-gathering activities which in turn initiate response when a focal information state is reached. Group decision making requires certain outcome distributions.

In group problem solving, the outcomes achieved by one individual will be partly determined by others. When maximum outcome levels for each one are consistent, we may speak of perfect outcome correspondence; otherwise, we may speak of non-correspondence or conflict of interest and resulting outcome distribution problems and negotiations. In similiar manner, conflicts may arise in the distribution of information. Individual information states (at the minimum, information or others' preferences is required) will be partly determined by other members of the group. Except in the case where information is completely ubiquitous, individuals will be able to exercise power over others by negotiating the transfer of vital information. Response distribution may also result in conflict as a result of the need to coordinate activities to produce a new solution. Individuals may exert power by way of the importance attached to their responses. In short, the extent to which any one individual's goals will translate themselves into group goals will be determined by the resolution of group outcome, information,and response distribution problems.

This group conflict resolution situation bears a remarkable resemblance to that described by Cyert and March[7] [34] in their organization theory approach. Within the organization presented by modern corporations, they theorize a coalition of members (groups and individuals) having different goals.[8] In this context, they portray a "quasi resolution of conflict" in which they argue that "most organizations most of the time exist and thrive with considerable latent conflict of goals". This approach is contrasted with the classic resolution which "is to posit an exchange of money from some members of the coalition to other members as a way of inducing conformity

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[7] Two major schools of thought regarding the psychological and social foundations of economic decision making are considered in this thesis. Utility theory has been rejected for the purposes of this study due to its failure to incorporate gorup decision processes. Behaviourist approaches on the other hand, provide an alternate psychological and social base which doe not necessitate the assumption that something is being maximized. By describing the actions of individuals and groups as they move from one decision to another (for example 100 Chapter 1)a decision process which has conflict resolution at its core is developed.

[8] Despite the obvious differences of collectivity size, and homogeneity of individual purpose imposed by their organization theory approach, the similarity of the goal conflict situation in an entrepreneurial framework makes their analysis of significance.

to a <u>single</u>, <u>consistent set of goals</u> - the organizational objective" [34, pp. 117].

Within the context of the farm firm, we can think of the decision unit (in the usual case, a family farm) as a family coalition. Family goals become conditions of coalition emanating from a dynamic process of bargaining carried out largely in the context of everyday social interaction. The collective aim is to achieve satisfactory levels of social, psychological and economic achievement for each of the individuals concerned. Each individual to some degree is successful in maximizing his individual satisfaction. That is, he must curb his individual desires if the coalition is to survive and prosper. In such an environment of conflict resolution, it is not logically necessary for bargaining to produce goals composing logically consistent set capable of reduction to a common dimension.

Cyert and March [34] describe a process of conflict accommodation which allows the organization to proceed in the face of less-than-consistent set of organizational goals by way of "local rationality", "acceptable-level" decision rules and "sequential attention" to goals [34, pp. 117]. This conflict accommodation serves the purpose of providing individual members with sufficient inducement to maintain their membership in the coalition. "Local rationality" allows some members to directly impose their own goals in decisions of particular importance to them. The acceptance of "acceptable level decision rules" requires only a weak consistency (i.e. decision need only be based on goals which are globally acceptable levels) between local decisions." Sequential attention to goals" allows apparently conflicting goals to be pursued by agreeing on the expedient of pursuing only one at a time.

To the extent that processes of accommodation are a deep seated fact of group existence, they are not subject to prescriptive analysis. It is pointless to argue that collectivities should resolve conflicts in a certain manner if in fact they exist by way of accommodating them otherwise. The important point to be noted here is that the introduction of the concept of quasi resolution brings with it limitations on the group's ability to plan, since the group may be effectively barred from establishing goals in some areas and manners.

Throughout this section on conflict resolution, the emphasis has been on the interaction of individuals in the generation of group goals and decisions. It can hardly be expected that individual goal-value structures will remain stable through the process. At the same time the decision unit is working toward a decision, individual goal-value structures are continually shifting as a result of changing beliefs in a manner which facilitates the continued existence of the group.

Little is understood about the dynamics of individual goal-value structures [29, pp. 406, 139]. Some preliminary research in social psychology does, however, point to a very complex and fluid process. Zander [29, pp. 418-429] has reviewed research on group aspirations which suggests that the relation between individual motivation and group goals is not straight forward one of strong motivation toward a certain goal implying high group aspiration levels with respect to that goal. Those strongly motivated toward a given goal continuum, say profit, are not always moved to promote high profit levels as group goals as a result of group-oriented motivations. Zander suggests in this respect that group members are motivated by "a desire for group achievement of success", and "a desire to avoid group failure". Reviewed research suggests that individuals who strongly desire group success will be moved to promote mid-range goals which present a strong likelihood of achievement yet a degree of difficulty sufficient to result in individual satisfaction. Those with relatively low interest in group success appear to select goals at both extremes of difficulty. Individuals strongly motivated by a desire to avoid group failure are reported as disposed to select goals at extreme rather than intermediate levels. Easy goals reduce the chance of failure while difficult goals reduce the dissatisfaction associated with failure. It is also suggested that failure-avoidance-oriented groups will tend to respond to failure by jumping to more difficult group goals thus reducing the embarrassment potential of future failures.

According to Cartwright and Zander [29, pp. 408] outside groups and particularly their level of performance may have a significant affect on group goal formation. This outside influence could be of a coercive nature, but from a farm management point of view, it is interesting to speculate on the non-coercive influence of the performance of other groups on farm family goal formation. Neighbours, friends, institutions, and management advisors may play an important role in goal formation (discussed further in the next chapter).

Cartwright and Zander [29, p. 408] also suggest, on the basis of review of pertinent literature, that certain group decision processes may be important in determining the amount of risk bearing favoured. They suggest that the often observed shift to greater risk bearing in group situations (the risky shift phenomena) may be related to the diffusion of responsibility inherent in joint decision making.

The Family as a Decision Making Group

Since typically the farm decision unit is of a specialized type, a family, it is possible to further elaborate a conception of the group goal-value structure. The introduction of family relationships adds a kinship role dimension to the group goal-value structure.

The family unit itself plays a number of roles which are likely to have a significant effect on the amount and resolution of conflict. Socialization, education and possibly other functions of the family serve to bring about a commonality of purpose which is uncommon in other entrepreneurial groups. In this connection, Elkin [42] reports Bruck's [25] conclusions that members in democratic families "are more likely to find satisfaction within the family unit and are more likely to accept some common definition of the good of the family" [43, p. 99].

The kinship dimension adds an element of continuity to firm decision making [48, p. 90]. As a result it can be expected that both the family goal-value structure and its conflict resolution process will be of a specialized variety as a result of the long-term nature of the group involved. Long-run goals relating to security and retirement are likely to be of considerable importance, particularly in view of reduced familial support as the extended family is replaced by the nuclear family. (i.e. father, mother, son, daughter). Decision making processes are likely to become standardized, and perhaps member value structures more similar over time.

It is nevertheless possible to overrate commonality of purpose in the family as a decision making group. In this connection, Schlater [123] has suggested that kinship roles in the nuclear family have an important effect on the individual value system. If this is true (as research suggests it is, and as the significance of familial[9] socialization in value formation suggests that it is), the family decision unit has a degree of built in dissimilarity of value structures as well as a degree of built in similarity of value structures.

After a study of 51 families, chiefly from professional and managerial classes, Schlater [123] evaluated each individual's value system on a traditional- autonomous continuum and concluded that,

> "Since family members seem to have characteristically different value profiles, assumptions can not be made, in assessing values that the wife (or any other family member) will be representative of the entrie family. Data from other family members as well must be obtained."

A family role orientation occurs in decision processes as well as value structures. Kenkel [48,p 144] has noted after reviewing theories of small group interaction in view of the two generalizations

> "that (1) two broad sorts of behaviour need to be performed (task or goal-related behaviour, and social-emotional or expressive behaviour), and (2) there generally emerge specialists in each of the behaviour types, we should expect that there would be a tendency toward dichotomization of roles in husband-wife decision making."

The suggested dichotomization of roles in decision making is viewed as evolving from the "very nature of social interaction". However, the determination of which family member is assigned to which decision role is largely a function of role assignment in society. In North American

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[9] Familial socialization is socialization carried on within the family.

society, females have traditionally been assigned to roles oriented toward instrumental leadership.

Spheres of decision-making influences in many cases are at least partially predetermined by role assignment and can therefore be expected to change as role assignment varies over time and from society to society. In reviewing class differences in family decision making on expenditures Komarovsky [48, pp 255-265] has noted the apparent effects of a rigid segregation of roles among lower-class Londoners which resulted in clearly defined autonomous decision making. At the other extreme, Komarvosky also notes the association of flexible role assignment and cooperative decision making in the "companionship marriage".

In recent decades, a continuing shift to a more democratic North American and Canadian family power structure has been reported in the literature[10][11] Elkin, [42, pp. 95-136], Burchinal and Bauder,[27]. However, several social scientists have reported a continuing sex orientation in spousal decision making with the wife displaying a greater tendency to play an integrative, supportive role by keeping things going smoothly and the husband playing a more active, decision task-oriented role

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[10] For a general review of the growth of spousal equalitarianism, see Ogburn and Nimkoff [104, pp. 167-191].

[11] For Example, recent decades have also revealed trends to a more democratic spirit in the parent-child relationships, thus suggesting an increased influence of children's values in family decisions.

by suggesting ideas, supplying information, analyzing alternatives, etc. Indications are that the distribution of task and supportive integrative actions has some effect on individual decision influence (i.e. the power structure) but that the relationship does not appear to be strong [Kenkel, 74, Elkin 42, pp. 95-136, Kenkel, 75].

Although decisions may often be taken by a husband or wife, the individual involved often has only a hazy understanding of the social processes involved in taking that decision and thus cannot predict accurately decisions to be taken in a given decision situation. If this is true, as Kenkel Foote,[48, p. 155, also p. 159] indicates it is, the task of determining group-acceptable alternatives is complicated. A decision maker cannot simply be asked what his preference would be since he knows only that he will arrive at a decision after considering the actions and reactions of his fellow group members.

Farm Planning Decision Making

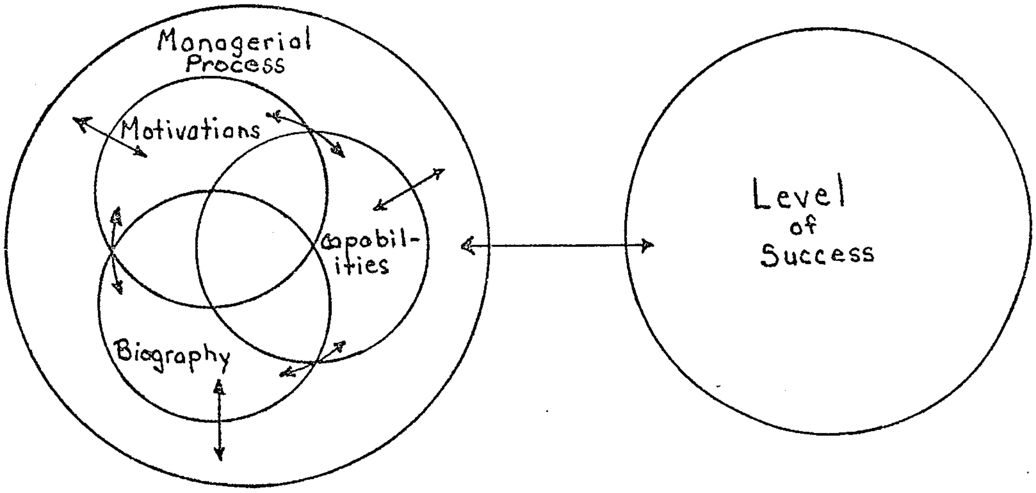
In Chapter 11, group normative standards were referred to as the sense of direction in decision making of a farm firm decision unit. In the light of the conflict resolution model of managerial decision processes presented thus far, this section develops a final component into our conception of these standards.

The distinction between the indivdual goal-value structure and group goal-value structures has been made. What "ought" to be done from an individual point of view is transformed into group action antecedents by complex processes which to some extent may be beyond the control of the individuals involved. To the extent that group goals are established they form a base for what "ought" to be done at the group level. What "ought" to be done from the point of view of medl builders and users must include what "ought" to be done from the group perspective (given a principle of optimization) and must also include allowances for adaptive processes which will lead to decision making by the group, given that group acceptance is required. The main point to be made here is that normative standards are being cast in terms wider than those imposed by existing group goals. Normative analysis takes a dynamic perspective of group motivation and as a result of doing so considers that acceptability of the planning model to the decision group will be best assured by allowing for the requirements of group decision processes in generating model solutions.

Thus far, this chapter has presented the process of managerial decision making from the prospective of conflict resolution in small groups and behavioural theory of the firm. Still another useful perspective has been provided by Krause and Williams [76] who have presented a behavioural model of the farm firm decision unit Figure 4.1) the model describes the influences of three overlapping and interrelated components of a managerial process within a family farm firm. Motivations (any entities which serve to organize and/or direct a person's behaviour, including values, drives, beliefs attitudes), biography (past experience), and capabilities (management ability) form an interrelated base which provides inputs to the managerial decision process. All three inputs directly affect the level of success achieved and in turn are influenced by it. In terms of our previous model of conflict resolution, three components of these processes are isolated. In particular, the influence of management abilities and past decision making experience are explicitly introduced.

In terms of this model, what is done in any situation requiring response on the part of management depends on the interaction of three components (experience, motivation and managerial ability)? What ought to be done, as before, depends on perspective. From the group point of view, there will be a degree of resolved conflict of any point of time. The way in which these established goals and remaining unresolved conflicts ought to be integrated into

Figure 4.1 Components of a Managerial Process Within a Family Farm Firm



a managerial decision process will depend on the managerial ability, experience and motivation components existing within the decision unit. In terms of our previous presentation of conflict resolution and behavioural theory of the firm, this model has gone one step further by making explicit components in the managerial process. A process of management decision making having three basic components, motivation, management ability and past experience has been introduced. In the light of these basic components, we can consider the use of farm planning models in a system made up of a farm family and its management advisors.[12] These advisors will have an impact on the farm firm decision process through their effect on the basic components. We can consider the use of planning models to be an expansion of the services provided by consultants.

Since in the Canadian context these management consultants are most likely to be extension agents, it is useful to link the managerial process more closely to consultants by considering a diffusion theory model developed by Rogers and Shoemaker [118]. In their model of decision making associated with new ideas the decision

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[12] The possibility that a consultant may not be physically involved in the use of all models does not significantly alter the argument since the existence of a consultant's role (facilitating the improvement of existing decision processes) is all that is required. Where a consultant's role is not required, that is in cases where conflict resolution has resulted in an entirely satisfactory and explicit group goal structure, there will be no need to consider normative processes beyond that group goal structure. This will not be the case in a general sense.

process is seen as passing through four stages: Knowledge, persuasion, decision and confirmation.[13] The extension agent's role is to bring about the adoption of desirable practices as rapidly as possible by interacting with communications channels involved at each stage.

The total conceptual framework can be drawn together to consider the determination of feasibility of planning models. Models are to be used to enhance the activities of consultants in" (a) improving the managerial abilites of farm firms, and/or (b) effecting the motivational structure of the firms, and/or (C) influencing the experience component of the firm's decision processes. In providing for the improvement of the management process, models must be acceptable in terms of what the consultant is trying to achieve in his interaction with the system. It has been stated previously that the modelbuilder will want to include in his normative standards those which must be made to permit acceptability in terms of model acceptance by the group. The adviser will, of course, desire no less. However, he may require other restrictions to achieve his ends of improving the decision processes to the extent that he is a part of the process in question.

The role of the consultant in "improving" managerial ability, the motivational base, and the experience component, has provided the final component in

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[13] These stages and the role of the extension agent are discussed more fully in Chapter VIII.

the concept of normative standards used in this study. Its three components, (a) the group goal structure, (b) conflict resolution processes, and (c) the role of the adviser describe group normative standards with which the normative content of any farm planning programming model must be consistent.

Summary

To sum up, the conceptual framework has presented individual goal-value structures as being the foundation for individual choice. Value orientations are the fundamental elements in determining individual actions in a group context. Goal-value structures have been defined and are portrayed as having a number of dimensions (cathectic, existential, intent, explicitness, generality, intensity, consistency) which will bear directly on the normative standards apparent in any planning situation.

Group goal-value structures have been distinguished from individual goal value structures by way of a commonality dimension, and a number of theories relating to the generation of group goals from individual goal-value structures have been reviewed under the general heading of Conflict Resolution. Conflicts among individual goals are viewed as the normal course of events and are considered as arising in three basic areas: outcome, response and information distribution conflicts. Conflict resolution has been portrayed after Cyert and March [34] as consisting of two sets of processes: complete resolution and quasi resolution of goals. The possibility that a particular set of goals, personal-group orientation goals, are important in determining group goals, has been considered. Group goal formation is presented as a two way street where both individual and group goals are antecedent, each to the other.

Since the basic farm decision group is the farm family, some special implications of kinship roles for group decision making are considered. Family life is viewed as: contributing to both uniformity and specialization in individual goal-value structures, and at the same time contributing to differentiation of individual goal value structures and decision roles. Long-time associations, and family socialization are likely to lead to similar values and a specialization of areas of value holding. Role orientations on the other hand lead to fundamental differences in individual values. In addition a sex orientation in decison making, with wives playing an intergrative-supportive role and husbands playing a decision task-oriented role, may have some effect on the group power structure.

The concept of a managerial process having dynamic inputs subject to some degree of external manipulation via educational programs in the farm management is also introduced. Specifically the possibility that value-orientations and other motivational factors, managerial abilities and experiencial antecedents may be affected by the role played by farm management advisers is considered.

Up to this point, we have considered a basic conceptual framework for normative standards in farm firm planning in the light of theories of group and organizational decision making. At this level of specificity, it is possible to draw some conclusions which will be useful in interpreting following chapters and developing evaluation criteria.

[14]Individual value orientations are primary motivational elements in group decision processes. IV 1

Inconsistencies among individual goals for the group are likely to be the rule rather than the exception. IV2

Because of the position of value orientations at the cognitive end of the cathectic-cognitive continuum, individual motivation will vary as individual belief structures change.

Goal conflicts (regarding outcome and/or response, and/or information distribution conflicts) are likely to lead to group accommodation procedures which deal with conflict without taking a global view of all individual goals at any one time. Basic individual value structures are the result of indivual experience. This uniqueness of individual values plus differing individual beliefs ensures that goal conflicts are the rule. IV 3

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[14] This indexing procedure (chapter in Roman letter, generalization number in lower case) is used in this and following chapters to emphasize points which are used to support conclusions reached in Chapter VIII.

Many individual goals are reflected at the group level by quasi resolution processes. IV4

In part, these accommodation procedures are deep-seated elements of group decision making and not subject to external manipulation. The interaction of individual value orientations during the decision making process must ultimately produce a consensus if the group is to survive. Consensus will take the form of acceptance of a mix of common group goals and conflict avoidance or quasi resolution processes. If this is true, many individual goals will not be apparent from a casual examination of group behaviour.

Theory suggests no means of directly inferring group goals from individual goals. IV 5

While a useful beginning has been made in establishing a theory of group goal formation, few concrete results have been produced. In the main, social researchers have been interested in social institutions and thus group goals, goal hierarchies and who sets them. Students of motivation on the other hand have been primarily concerned with personal motivation not on the interaction with group influence [149].

Purposive behaviour of groups appears to grow out of the dynamic interaction of individual personal goals, individual group goals and outside influences. IV 6

In this generalization, outside influences are recognized as significant factors in group decison making. Processes of group goal formation and conflict avoidance proceed within the conditioning influences of outside intervention.

IV 7 Family life contributes to both uniformity and specialization in individual goal-value structures and at the same time contibutes to differentiation of individual goal-falue structures and decision roles.

For the most part, decision groups are families. It is important to recognize that the family structure does not, in general, imply any lessening of the dynamic quality of group purposive behaviour.

We can now profitably continue on to a more specific level by examining the particular goal-value structure of farm firms to more clearly identify areas of goal conflict, the extent to which accommodations are a necessary part of conflict resolution and the part played by non-conflicting individual goals.

CHAPTER V

Goals and Values of the Farm Firm

It has been established that certain normative propositions are pervasive in programming models proposed for use in farm planning. In particular a fundamental, normative assumption of goal-directed, maximizing behaviour on the part of farm decision units and several supporting assumptions are inherent in proposed farm planning models. Goals for the planning period are regarded as a static evaluative reference with regard to basic social and psychological processes. They are assumed exhaustive in their ability to discriminate between all alternatives to be confronted. All significant goals are assumed to be some quantifiable function of measureable levels of economic goal achievement. In addition, many more specific assumptions operating within the scope of these fundamental assumptions are often required either by traditional, analytical procedures or the mathematical requirements of current optimization procedures.

The conceptual framework for group decision making suggests serious conflicts between fundamental normative assumptions of programming models and group decision theories. Group decision making and group goal formation are portrayed as dynamic and simultaneous processes. Hazy, ill-defined and underdeveloped operational group goals are suggested as the normal course of events and some mechanisms of avoiding maximizing behaviour are suggested.

The incomplete nature of theories relating to the dynamics of individual and group normative standards suggests that quantification to the level required for inclusion in models is impossible. Special characteristics of the farm planning decision group suggest that family and adviser-farmer roles will have significant modifying influences on group goal formation and decision making. However, there is no indication that basic conflicts are reduced in any way.

The Chapter begins by considering briefly the evolution of farm goal-value structures and their current statistical makeup. Basic goals and values are then classified and discussed under income dependence, functional dependence and long-run goals. A final section on goal dynamics serves to relate the previous static discussion of goals to the dynamic process of goal generation presented in Chapter VI. The chapter is closed with a summary of implications which may be significant factors in planning model feasibility.

Evolution

Before beginning, it is useful to recall that farm family goal-value structures are not fixed entities but are continually shifting according to secular trends. Several studies have attempted to catalogue general changes in the farm family goal-value structure as its Canadian historical-institutional context has changed.

McKie [94, p. 6] summarized the general flavour of these studies in stating that, "the traditional farm family, characterized by intensive kin relationships, large size, relative geographic isolation and the ability to perform most tasks with a high degree of self-sufficiency is no longer the typical mode of family organization. Family farms which do persist have been transformed and families operating them are often committed to values not unlike those associated with urban families, such as the importance of higher education, economic rationality and the desire for consumer goods".

Under settlement conditions in the 1800's, the basic subsistence nature of farming was probably important in developing a tradition of work-role oriented decision making. As Abell notes, boys assisted father in securing food, fuel, and shelter, while the girls assisted mother in household duties and some farm chores such as milking cows and feeding poultry [1. p. 16]. As mechanization proceeded in the 20th century, the farm wife's role as a producer was becoming less important but it was still significant. Abell [1] reports of a 1959 Ontario representative sample of 352 families in which virtually all wives performed some farm tasks. Concomitant with this change in producer roles, there evolved a pattern of some degree of joint decision making in both farm and household.
In 1959, Abell [3] reported that one-half of farm oriented decisions in the sample cited above were jointly made by

farmer and wife or children or other persons. Household decisions were shared jointly by husband and wife in one-half of the families. Joint decision making appeared to be quite common in the purchase of durables, at least with regard to the establishment of priorities. (In this respect, see also Burchinal and Bauder [27]).

The Decision Unit

It has been customary in farm planning decision theory to consider single person decision making units. Given this assumption, the appeal of economic, utility-based maximizing approaches to decision making is tenable.[1] In fact however, the major decision making unit on the farm may well be described as the nuclear family. To establish the primacy of this decision unit in agriculture, this section presents a statistical review of its composition and distribution relative to other farm decision units.

Although the figures presented below do not relate precisely to farm decision groups, nor do they relate to a subset (often considered of primary interest in farm decision making) which might be called "commercial farms", they do serve to point out the predominance of the nuclear family in the distribution of farm households. This is of particular importance in the case of an analysis of farm decision making in view of the often-cited

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[1] In view of the discussion in Appendix A, a psychological base for utility is much more appealing than a sociological one. (see also [122] Ch. IV).

interdependence of nuclear family members in decision making.

In 1966,[2] there were 427,238 Canadian households with an average of 4.5 persons per household living on census farms (rural holdings of more than one acre and having gross agricultural sales of more than $50). The vast majority of census farm households (403,924 of 427,239) consisted of either single person or single-family households, while the remainder consisted mainly of more than one family or more than one single person. A total of 399,886 census farm families (including those in multi-family households) were reported in the 1966 census. Of this group, 373,876 consisted of a husband and wife and children remaining at home. The remaining single parent families consisted mainly of (in order of magnitude) widows, widowers, female single parents and male single parents. The 399,886 census farm families had a total of 973,092 children (an average of 2.4 per family) under the age of 24 living at home. By age groups, they were distributed as follows: less than 6 years of age, 241,308; 6-14 years, 454,537; 15-18 years, 178,382; 19-24, 98,865.[3]

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[2] This statistical review is based on data from 1966 Census of Canada [37].

[3] A recent (1971 representative sample [120, Chap. III]) of Alberta farm households substantiates the significance of family farms. Farms were typically operated by family groups with very little outside help.

In view of discussion thus far, the following generalization appears warranted.

The predominant, primary, farm decision unit is the nuclear farm family. V 1

Basic Goals and Values

Although any attempt at categorizing basic goals and values must run the risk of overlapping categories, varying definitions, and non-exhaustiveness, several themes are sufficiently recurrent in the literature to draw some conclusions. Farm-family goals and values relating to land ownership, income maximization, standard of living, freedom from debt, technical achievements, prestige, income satisficing, farming as a way of life, family life, traditionalism, risk aversion, independence of action, cooperative action, and community are commonly reported in the literature.

Numerous studies in rural sociology and related disciplines in recent years have dealt extensively with the distribution of goal holding patterns and value orientations in various farming populations. A review of concensus opinion resulting from these studies will serve two purposes at this point. Firstly, it should indicate the more permanent elements of goal structures with which normative elements must be consistent; and secondly, it introduces goal-value orientations whose nature will be discussed more fully in later sections.

A classification of goals is included at this point for the specific purpose of establishing a natural division of subject matter into areas which can be discussed more or less independently. For farm planning purposes, it is useful to classify goals and values of farm families on the basis of their association with farm planning variables. Thus we can speak of:

(a) Independent Goals as those which can be pursued entirely independently of actions taken in the farm business;

(b) Functionally Dependent Goals as those whose achievement requires the specific manipulation of farm management variables (for example, personal preferences for breeds of livestock, labour management practices or cropping practices);

(c) Income Dependent Goals as those whose achievement is dependent on the income distribution (over temporal and probability space) provided by the farm business and thus is only indirectly dependent on the manipulation of specific farm management variables (for example, a wide range of consumption goals, security goals, or retirement plans). Almost all goals in existing programming models are of this type (Chapt. III).

Clearly, independent goals are not relevant in farm planning, except to the extent that their elimination from consideration allows a clearer focus on relevant goals and values. Income dependent goal fulfillment requires the provision of financial resources such as credit, insurance, net worth, and net income at various points in time and under various eventualities. On the other hand functional dependence may arise out of valuing farming as a way of life.Status goals of specific asset ownership are examples of this dependence.

In the course of a study of major farm decision makers on Iowa farms Beal, Bohlen and Warland [10] defined a number of basic values which had been identified by previous research or reported in the literature on rural sociology, and record and attempt[41] to determine their prevalence. Although their primary concern was with measuring the importance of values relevant to farm policy matters, several of the values (defined in appendix V A) investigated have significant farm management implications. They [10] conclude that the traditional rural values of traditionalism, debt avoidance, fatalism and to a lesser extent, farming as a way of life have diminished considerably in importance in recent decades, while the value of risk aversion continues to be very strongly held. Newer values such as scientific orientation have come to be held more strongly by a large segment of the farming population. They also note that some degree of inconsistency is apparent, in that many farmers strongly hold the values of risk aversion, and risk orientation; and collec-

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[41] They analysed a sample of major decision makers on 186 Iowa Farms of over 100 acres.

tive action and independent action. The overall picture appears to be one of farming emerging as a means of achieving goals suggested by value systems similar to those held by other members of society (i.e. risk orientation, maximization of income, scientific orientation).

A study by Neilsen [101] also suggests the development of market-oriented farm business values and goals. A sample of Michigan farmers identified a group of income-distribution-oriented and technically-oriented farm goals. Farm ownership, income maximization and providing an adequate standard of living were often cited as being the most important farm goals. The same study, in a further attempt to determine important areas of goal-value holding, defined six goal orientations into which each farmer was placed as a result of his replies to open-end questions regarding farm goals. Approximately equal numbers of farmers were oriented toward three major goal areas: "security" or freedom from debt, "high level of living", and "technical production". "Success or prestige" was of lesser but still significant importance as a goal area, while "average level of living" and particularly "farming as a way of life" were common. Predominant family goals as opposed to farm goals expressed by farmers in the Neilsen study were related to children's education, the family's community status and future security, which are to a large extent dependent on instrumental farm income achievements. With respect to dominant family goal orientations, the farmers were closely divided between those who were dominantly "family or children" oriented and those who were material household-comfort oriented with only a few primarily oriented toward "security", "ultimate happiness or salvation", or "social status".

In a 1969 analysis of farm asset conversion problems of retirement age Michigan farmers, Lee [80], has noted the prevalence of certain goals held by farmers of retirement age and has illustrated a more basic "going concern" philosophy followed by the majority of his respondents. Most respondents did not appear to strongly desire either keeping the farm in the family or high retirement income levels. However, a variety of continuing debt avoidance, liquidity preference, and risk avoidance goals were expressed. The vast majority was strongly motivated by a desire to remain on their farms where community ties could be maintained and living costs were low, while farming on a full-or part-time basis and pursuing a variety of relatively inexpensive leisure time activities. The approach of most individuals appeared to be one of avoiding formulating goals and planning for retirement. Rather, they attempted to maintain the status quo, operating their farms as a going concern (to the limits of their physical ability) until circumstances forced them out of farming.[5] No consistent approach to

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[5] A similar pattern in retirement goal formation is indicated by an Alberta study [120]. Almost half of a representative sample of farmers had not formulated any retirement goals and of the half who had thought about the matter, most wanted to remain on the farmstead and maintain a farm life style in their retirement years.

problems of estate planning, insurance coverage, or retirement income was common in the sample group. The over-riding tendency in decision making at retirement age (60 plus) appeared to have the maintenance of some semblance of an operating farm as an ultimate goal even though, as Lee [72] points out, a considerable sacrifice of retirement income is involved and often some other goals such as liquidity preference are clearly in conflict.

In a socio-economic analysis of the goals and attitudes of Arizona ranch owners, Smith [127] concluded that eleven goals and attitudes relating to ranch ownership commonly exist. These are listed [127] as:

> "Land fundamentalism, family fundamentalism, rural fundamentalism, resource protection goal (range use), conspicuous consumption/ speculative attitudes (toward ranch ownership), income satisficing, wealth satisficing, agricultural orientation, immobility, local orientation and local social satisficing.

By using these commonly held goals in a discriminant analysis, Smith was able to predict with considerable accuracy the answer to a sell or not sell the ranch proposition, thus indicating the significance of these goals in farm decision making.

The literature cited above refers to the farming cummunity in general. Some idea of the goal-value structure which will be encountered in the initial stages in any attempt to implement programming models as decision aids can be gained by reviewing generalizations from diffusion research. Rogers and Shoemaker [118] in their analysis of over 1500 research reports of diffusion research have listed 26 frequently noted characteristics of early adopters of new ideas. In the main, their 26 characteristics point to progressive commercially-oriented goal-value structures in contrast to the traditionally-oriented goal-value structures of later adopters (See Appendix D). As the adoption of various concepts proceeds from innovators through to laggards, the value systems into which they are introduced change dramatically.

A review of studies of broad areas of farm family goal holding reveals some areas of commonality. As a result of varied definitions used and limited scope of many studies, it is not possible to develop definitive lists which might be compared to obtain some assessment of the distribution of various goal value structures. Nonetheless, there appears to be a sufficiently large number of goals held (even at relatively abstract levels) to warrant requiring any general approach to farm planning to be consistent with a variety of operational goal orientations. Necessary areas of consistency with normative content would appear to include both those associated with the strong market business orientation often assumed by economists and the traditional and non-business areas often noted by extension personnel.

Specifically, goal holding in the income area tends to focus on income, risk and consumption levels. Goal holding in the non-income area tends to focus around "going concern" goals, credit use, community life, social status, and fatalism. As noted by adoption theorists, the exact nature of goals held in these areas by "decision aid" users is likely to change as adoption proceeds.

Generalizations V2, V3, and V4 appear warranted on the basis of the above discussion of basic goals and values.

> A large variety of goals, both income dependent and functionally dependent, exist in the farming community. V2
>
> Goal holdings reflecting both modern and traditional value systems are widely held. V3
>
> A commercial agriculture orientation is more prevalent among farmers in the early adopter stage. V4

Many other studies aimed at identifying farm goals and values and their distribution could be cited. However in the main these simply re-emphasize goals or values discussed.

Income Dependence

Recent decades have seen a significant increase in the number and importance of income dependent goals and thereby increased emphasis on instrumental income distribution (i.e.security) goals. Increased production specialization, increased outside input dependence, emergence of the small nuclear family and increased materialism have all played a part in this process.

This increasing emphasis on income distribution can be expected to have a major effect on farm decision making since farm families have a particularly explicit control over their income distribution via their control of productive investment processes. Many recent studies have pointed out the importance placed on instrumental income distribution goals (for an overview, see Willis [148]). However, relatively little literature bears on the specific topic of group-admissable income distributions over time or probability space. However the widespread use by farmers of income distributing tools such as life insurance, asset insurance, savings, off-farm income opportunities, credit, risk altering production techniques further demonstrate the importance of such goals.[6]

It is interesting to speculate on the personal characteristics of decision makers with respect to their relative emphasis on income dependent and functionally dependent goals. J.M. Bohlen [20] in a discussion of adoption and diffusion[7] of ideas in agriculture has noted that "innovators and early adopters are more ends oriented while those slowest to adopt tend to be more means oriented". If this is true generally, it suggests that farm planners

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[6] Jensen and Halter et al. [65, pp 109] reported of a sample of midwestern farmers that 77 per cent had collision insurance, 70 per cent had life insurance and 95 per cent had fire insurance. Informal insurance schemes such as liquidity reserves, credit reserves, hay pasture reserves, and feed reserves were reported by 69 per cent, 56 per cent, 64 per cent, and 60 per cent respectively.

[7] Note also the previous reference to Rogers and Shoemaker [118] in connection with basic goals and values.

(i.e. generally those who see the future as something to manipulate) are likely to emphasize goals of the income-dependent type. They will tend to be less interested, for example, in land ownership for its own sake and more interested in its potential to allow achievement of non-farm, family goals.

Ladewig and McLean [77] speculate that major farm family goals are income-dependent and as a result of this, profit seeking is pervasive throughout the farming community regardless of economic or social status. In this context, they hypothesize that age, education, farm tenure, gross income, and farm size (each a measure of economic or social status) are not related to a "rationality index" (constructed to reveal relative degree of emphasis on monetary gain). Their results support the conjecture that income-dependent goal holding is pervasive. In the same study, the hypothesis that leisure is negatively associated with the monetary gain index was also accepted, implying that a relation may exist between the holding of means-dependent goals and leisure goals.

A survey by Purcell and Dunn [108] attempts to determine more specifically the nature of instrumental income goals rather than determine their significance relative to other goals. Forty four feeders were asked to choose a single best fitting goal from a list of four specific goals or to reply to an open-ended question on their goals or objectives. The results were:

1) 57.1 per cent chose profit maximization for each feeder lot,
2) 19 per cent chose profit maximization for entire operation,
3) 14.3 per cent chose some form of satisficing, and
4) 7.1 per cent chose other goals.

In order to measure attitude toward risk, each feeder was asked to choose one of five monthly price patterns which he would prefer to face year after year. Most of the feeders preferred high expected returns in spite of associated highly variable monthly prices.

In choosing between another five patterns with equal expectations, producers did not uniformly choose price patterns with low variability, indicating that some were willing to shoot for the high prices indicated in some months of the pattern. Large feeders displayed more of a tendency to ignore price variation and depend on expected values. In general, a large variety of values relating to income distribution was evident.

A study by Harman et al. [55] examines the nature of eight major income-dependent and functionally dependent goals of farm operators. "Making the most annual profits", "maintaining or increasing family living", and "avoiding years of low profits or losses" were selected by 32 per cent, 27 per cent and 22 per cent respectively as the most important goals. One of the two functionally dependent goals "control more acres" and "increase leisure time" was cited as being least important by a large majority of sampled operators. Debt, net worth and bankruptcy goals were shown to be of intermediate importance. This study also points to significantly different goal hierarchies between subgroups classified by age, education, farming experience, family size, off-farm income and crop acres. Although differences in the hierarchy of income-dependent goals are apparent between subgroups, there is a relative consensus that the functionally dependent goals are least important in all subgroups.

Neilsen [101] has examined the attitudes of Michigan farmers toward credit use when profitable opportunities exist. In general, the vast majority of farmers revealed that they would borrow if profitable land, fertilizer, livestock, or machinery investment opportunities existed. Some farmers did, however, express varying distrust of credit use in one or all of the four areas of credit use specified. Farmers who were "Success or prestige" oriented or were in earlier or later stages of the family cycle, or were frequent organization participants or were high extension participators, generally had the most favourable attitudes toward credit use.

In general, available studies point to an increasing emphasis on income-dependent goals for the farm family. As well, some specific areas of income-dependent goal holding imply the holding of specific instumental income goals. In view of the large and growing number of income dependent goals held by the farming community, it appears strategically efficient to require any serious candidate for widespread use as a farm planning model to allow for a variety of instrumental income goals.

> Instrumental income-oriented goal holding is pervasive in the farming community and is particularly strong among more innovative farmers. V5

Functional Dependence

While a number of studies have pointed out the income-dependent nature of a large number of farm family goals, there exists a strong functionally dependent or "non-economic" element in many basic farm goals.

In a study dedicated to discovering what goals motivate a group of Washington and Oregon ranchers and what their relations to economic behaviour are, Rodewold and Bostwick [117] could determine only one major goal, "to maintain a life style". The major goal expressed by these ranchers was not to ranch for profit or to produce beef but to do those things which they saw as compatible with a ranching life style. This goal was carried over into retirement years as well as being held during active ranching.

They have also shown the association of this goal with a number of previously discussed basic values. As a group, the ranchers placed an average value on benevolence, a low value on leadership, a high value on independence and a high value on conformity. Independence reflected a desire for independence from the non-ranch community while conformity was to each other thus, in part, explaining the low value placed on leadership. A check on ranchers' children in local high schools indicated their acceptance of value systems not materially different from that of their parents.

The Alberta Farm Management Study [120] also supports the notion that functionally dependent goals may be of considerable significance. Only six per cent of a large representative sample suggested that they would pursue another occupation simply because they could make more money. Sixty-four per cent indicated that farming as a "way of life" was extremely important and that they would continue to farm as long as a minimal standard of living could be earned.

Several studies have directly indicated the significance of functional dependence while other studies have pointed to the holding of functionally dependent goals.

> Goal holding which is functionally dependent on the way the farm business is operated is widespread and sometimes of primary importance. V6

Long-Run Goals

A preponderance of farm goals tends to be short run with only a few long run or continuing goals, as would be expected given the importance of the temporal dimension in information acquisition and conflict resolution. In the study by Fitzsimmons and Holmes, [47] a general conclusion was that reported family goals appeared to be based mainly on short-run thinking. Considerable uncertainty was attached to the exact timing and nature of goals projected beyond five years. They did not speculate on to what degree this uncertainty arose as a result of the nature of the family conflict resolution processes or as a result of the nature of the planning environment. However, all families did report some long-run goals. In addition, many goals tended to be neither short-run nor long-run in the usual sense, but of a continuing variety such as thrift and debt avoidance.

Neilsen's study of goals of Michigan farmers [101] also points out the short-run emphasis in farmers' goal structures. In comparing sample areas within his master sample, he states that few farmers emphasize exclusively long-run goals and in addition that,

> "Almost no farmers in any of the samples verbalized short-run goals that appeared to be integrated with their long-run goals. Of those who emphasized both long-run and short-run goals, only a few expressed short-run goals that could be considered means of attaining the longer-run goals that they listed."

Vagueness, underdevelopment and inconsistencies appear to be the hallmark of long-run goal structures. Neilsen [101] also states that farms dominantly oriented toward some form of "average level of living" or technical production goal areas tended to also emphasize short-run goals. Those dominantly oriented toward "security", "success or prestige" and " farming as a way of life", appeared to place more emphasis on long-run goals, while a dominant high level of living emphasis appeared not to be associated with any particular length-of-run emphasis. As well, those emphasizing long-run goals to a greater degree tended to have more clearly formulated goal structures; short-run goal orientations tended to be associated with hazy, ill-defined goal structures. Neilsen also reports a tendency for higher education to be associated with long-run goal emphasis.

Goal Dynamics

It is interesting to speculate on the nature of goals in the long run as well as on the nature of long-run goals. It has often been noted for instance in group research that levels of group aspiration have a strong relation to recent group performance. Success tends to lead to higher levels of aspiration. Failure to achieve group goals on the other hand leads to lowered aspirations; however, the propensity to lower seems much less pronounced than the propensity to raise [29, pp. 418-429]. Neilsen [101] has pointed out an interesting association between farm management extension and goal dynamics, noted in a survey of Michigan farmers subjected to intensive extension assistance and a matched control group.

He states that,

> "Farmers in the experimental areas who perceived that their goals were not being fulfilled in agriculture tended to either get out entirely or to strive harder to

make a go of it in farming. Control farmers, on the other hand were more apt to adjust their goals downward, hang on, and make the best of it, or to seek a part time job off the farm."

It appears that family goals in the long run, are very susceptible to outside influences.

Studies by Fitzsimmons and Holmes[8] [47], Oomen [105], Ross [120] and Neilsen [101][9] have reported on the relation of farm family goal holding to stage in its life cycle, and to a lesser extent the importance of certain areas of goal holding. In general, these studies revealed expected and significant dynamic aspects in family value holding.

The study by Fitzsimmons and Holmes [47] investigated goal holding in six areas: farm business, financial (family income), family activities (including education and health), family housing, community participation and recreation, and household facilities and equipment; by grouping specific reported goals. Families in three stages, pre-school, grade school and high school were included in the study. Apparently for the most part, husbands and wives agreed on reported family goals and therefore no attempt was made to determine how the goals were established. There exists, however, the possibility that only goals for which a certain degree of conflict resolution had been achieved, were reported.

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[8] The sample (using open-ended questioning of husbands and wives) consisted of 70 farm families operating full time commercial farms in Tipton County, Indiana.

[9] Neilsen's brief analysis tends to reinforce the others discussed below, as does Ross.

In commenting generally, the authors report a number of conclusions related to family goal holding and goals held.

> "In general, the families scored relatively higher on farm, financial, and household facilities and equipment goals than goals relating to family education, health, and community participation and recreation.

On a specific goal basis, farm ownership and education goals were reported by all families while the majority of families reported health care and debt avoidance goals. With respect to the obvious conflicts between reported land ownership and debt avoidance goals, Fitzsimmons and Holmes [47] report that land ownership was sufficiently important that most families were willing to forego debt avoidance goals.

The above appears to indicate that considerable emphasis is placed in goals depending on both the income distribution and technical matters relating to farm operation. However, it is not clear to what extent the farm goals cited were viewed as instrumental to the achievement of ultimate financial goals or were themselves considered ultimate goals.

After reviewing study results relating to life cycle and goal reporting, Fitzsimmons and Holmes [47] concluded that:

> "Goals of families with preschool children centre on accumulation of goods for obtaining income and making the home convenient and comfortable.
> ... Goals of families with children in grade school stress the improvement of income to care for the growing needs of the family........

Goals of families with high school children showed the greatest concern with providing for future as well as present needs of the children".

Also, "Income, education and family size did not appear to affect family goals consistently at different stages of the family life cycle."

Some more specific comments were made with respect to the relation of life cycle stage to specific goals reported in each of the six categories. Pre-school families more often expressed housing and increased income oriented goals and had fewer immediate community participation goals. On the farm side, pre-school stage families often reported land improvement, machine purchase and enterprise change goals. In the grade school stage, increased ownership or acreage goals were more prevalent than in other groups. Buildings improvement goals occurred more often amongst families in the high school stage.

A large number of families expressed instrumental savings goals with ultimate uses depending to a considerable extent on life cycle stage. Pre-school families saved relatively more often for land purchases; high school families more often saved for education, retirement and emergency oriented goals, while grade school families more often saved to pay debts.

A.K. Oomen [105] sheds some light on the relation of family goals and the family life cycle in analysing relation of family goals reported by a sample of 204 North Central and South Central Iowa farm wives. Among goals showing a significant association with the wife's age were those relating to land ownership and family education. Family education goals were specified considerably less often by the older age group (48 years and over) than by the young and middle age groups. Land ownership goals also were specified more often by the younger groups who were least likely to own their own land. Some other goals were significantly related to wife's age in one of the study regions but not in the other. Goals relating to land improvement, and farmstead extension and appearance seemed to increase in importance with age. Relatively fewer middle-aged, than younger or older, wives specified family savings goals, while relatively more middle-aged, than younger or older, wives specified family recreational goals.

The above discussion of goal dynamics suggests the generalizations that:

Farm family goals tend to be short run rather than long run. V7

Vagueness, underdevelopment, and inconsistencies vis-a-vis short-run goals are commonly occuring characteristics of long-run family goals. V8

Farm family goals appear to be positively related to levels of achievement experienced in the past. V9

Farm family goal holding in several areas is strongly related to the family life cycle. V10

Goal hierarchies vary greatly from one family to another in ways that are only partially predictable on the basis of family and farm characteristics. V11

Summary Observations

Secular trends in farm family value structures point to the continued evolution of values not unlike those of urban families with emphasis on economic rationality, higher education and a desire for consumer goods. Traditional work role orientations in decision making are seen as giving way to comtemporary democratic ideals. Statistically speaking, the basic farm decision unit is the nuclear family. In a farm planning context, the role of the farm management consultant may be a significant outside element.

A number of basic values and goals are sufficiently recurrent in the literature to suggest that they are widely held among the farm population. Examples are those relating to land ownership, income maximization, standard of living, freedom from debt, technical achievement, prestige, income satisficing, farming as a way of life, family life, traditionalism, risk aversion, independence of action, cooperative action and community life, A large variety is apparent in goals held.

Income dependence is a common characteristic of many strongly held goals and secular trends point to an increasing emphasis on these goals. Some specific instrumental income goals are associated with particular areas of income-dependent goal holding. On the other hand functional dependence may often occur among goals of fundamental importance. Goal areas related to maintaining a particular life style have been cited.

Most goals held by farm families tend to be associated with the short run. Only a few long-run or continuous goals represent the normal state of affairs. Short-run goals are not normally well coordinated with existing long-run goals. Cyclical patterns appear prevalent in farm family goal holding, with certain goals being more common in each stage of the life cycle.

Evidence available on the nature of farming goals is clearly shallow in many areas of interest to farm planners and difficulties are involved in generalizing from existing sources. In particular, it has not been possible to make conclusive statements in many areas related to the more specific types of assumptions reviewed in the programming context. Problems in generalizing arise out of the differing research purposes of the research reviewed, the large variety of populations in these studies and the persistant tendency of researchers to concern themselves with the goals of individuals rather than of families. Nevertheless, useful generalizations have been made in several areas, particularly those related the most basic normative assumptions in the programming context.

Research into farm family goal holding reveals a normative structure which contrasts in many areas with the assumptions contained in prospective programming models in spite of the fact that many of the operational goals included in models are, in fact, commonly held by farm people. The growing commercial orientation of farm goal structures supports the type of quantifiable goals normally found in programming models. Two factors, however, suggest that the relevance of these goals in choosing between alternatives must be questioned. Firstly, the holding of non-economic goals, particularly non-income dependent goals, appears to be pervasive and in many cases these goals appear to be of primary importance in decision making. Secondly vagueness, incompleteness and inconsistencies appear to be the common elements in most goal structures. This supports the concept of an exhaustive evaluative base only at the level of abstract values as presented in the framework for group decision making.

Farm operational goals with their heavy belief content appear to be too situationally oriented to serve as an exhaustive evaluative base for decision making. The fact that farm decision making appears to proceed in the face of seemingly inconsistent and incomplete goals suggests that other factors are at play in the taking of choices. Goal-holding areas such as estate planning suggest that there may be deep-seated impediments to the making of relevant goals. Consistent patterns of goal holding in cross-sectional analysis of families at various stages of the family cycle suggest that even though families appear unable to formulate complete and consistent goals for long-run planning, they are none the less part of a cyclical pattern of goal evolution.

The family farm has been portrayed as having a very large range of goal hierarchies on both a cross-sectional and a dynamic sense. Modern and traditional, income dependent and functionally dependent, commercial and non-commercial orientations have been reported. The vagueness, inconsistencies and short time horizons often reported in these farm goals have important implications for models which do not make allowances for these characteristics. Assumptions of measurability, goal existence and goal exhaustiveness are clearly in doubt, given the generalizations presented in this chapter. In addition, the absence of any clear relationship of goals to previous preformance (except V9) implies that it will be difficult to justify the use of models which attempt to build a normative base rather that assume it is available as a parameter. In general, available evidence on farm goal holding supports the theoretical framework for group decision making.

CHAPTER VI

CONFLICT RESOLUTION

INTRODUCTION

Chapter V has reviewed research related to the nature of farm goals without regard for the processes which have generated them. As pointed out in Chapter III, normative standards implicit in programming models go farther than postulating goal structures. Firstly, they assume that the group normative standards which will operate in decision making over the planning horizon exist on the planning date. Secondly, they assume that this set of standards forms a comprehensive set of choice criteria in the sense that all alternatives can be evaluated. This chapter examines research related to the dynamics of farm family normative standards in an attempt to determine the validity of these two propositions and in so far as possible, examine evidence relating to some of the less general assumptions reviewed in Chapter III.

In general, it is shown that the evidence available supports the implications of the theoretic framework in Chapter IV. Normative standards relevant to the types of choices which have to be made in farm planning are generated over the planning period as they are needed. The conceptual framework implies that this process of generating normative standards will proceed according to more basic individual values whose relation to operative group goals must be accomodated at the planning date. Where evidence is available, an attempt has been made to spell out these processes in some detail. However, as Zander [149 Chapter 1] has pointed out, little scientific evidence is available on the processes involved in setting group goals. In the main, available evidence relates to the nature of the farm family power structure.

We can think of a farm family as a group of individuals having some degree of commonality in individual goal-value structures. A central issue in prescriptive analysis of farm management problems is the validity of hypothetical conflict resolution rules which might be used to resolve conflicts between individual goals. The basic question is: "What degree of freedom exists for prescription after allowance is made for the necessary social elements of decision making?". Some decision processes (for example, localized decision making, and intertemporal decision making) may be necessary elements in conflict resolution and therefore not subject to prescription. However, not all decision processes are necessary element of group social interaction since this amounts to saying, "Whatever is, must be". Farm planning models must attempt to describe and exploit whatever degree of freedom to prescribe exists. This requires prior allowance for necessary decision processes.

In Chapter V, several generalizations regarding the nature of farm family goal structures were developed. In general, these goal structures appeared to be vague, incomplete and often inconsistent. On the basis of this farm family goal research and social decision theories, we are led to expect a certain amount of conflict of interest and therefore a number of ways of accommodating conflict in the generation of group objectives. Boehlje [17], for example, has pointed out that in one particular area, estate planning, the potential for decisions to grow out of conflict is particularly acute.

This chapter examines some of the processes involved in arriving at decisions by illustrating the nature of conflict resolution in the farm firm. Its major thrust is to examine questions related to the generation of group normative standards for the purpose of evaluating model assumptions relating to their generation.

Conflict resolution is presented in three subsections related to the nature of processes involved: power structures in the farm family, decision roles in the farm family, and consistency of goals for the family. Also included is one subsection relating to conflict resolution involving an instrumental goal of particular importance, income distribution.

Before beginning a review of research on resolution of goal conflicts in farm families, it is useful to place the entire family power structure in historical perspective. A general consensus presented by most research points in the direction of increasingly equalitarian power structures within farm families. Traditional goal-value structures in North America were exemplified in large, self-sufficient, patriarchal farm families. With the coming of the technological revolution, this way of life began to disappear as the population migrated to urban areas. The resulting social revolution affected not only the growing populations of urbanites, but also more slowly the remaining rural population. A resulting rural-urban cultural lag has developed which has allowed sociologists to predict evolving, equalitarian farm goal-value structures on the basis of urban experience [26 and 79].

Power Structures in the Farm Family

A study by Burchinal and Bauder [27] of non-business family decision making (relating to children, family finances, family changes and social relationships) presents some interesting results relating to the social nature of family decision making. They contrast the prevailing belief "that semipatriarchal patterns characterized rural family life 100 years ago" with the equalitarian decision making patterns implied by their survey of Iowa farm families. In the main, they found no significant differences between the typically equalitarian decision patterns in Iowa non-farm families and those of Iowa farm families. Although a distinct traditional sex orientation of decision roles was evident in some areas, shared responsibility in decision making between husband and wife was the rule. Krause and Williams [76] have also noted this strong overall influence of both husband and wife in decision making. They note that the wife's personality factors (motivational, biographical, management ability) were about as useful in predicting ability to achieve net worth growth goals as were the husband's personality factors. They also report that a combination of both husband's and wife's personality factors leads to the most accurate prediction of success level.

A study by Wilkening and Guerrero [145] sheds some light on an important aspect of modern farm family power sturctures. They have analyzed the role of spousal concensus of business aspirations in decisions to adopt improved farm practices. In this analysis of concensus in aspirations (degrees of goal striving) in 500 Michigan farm families, they have scaled aspirations in several areas relating to farm management decisions and classified each spouse as having either a high or low motivation toward farm improvement. In general, they note the strong positive influence of spousal consensus on adoption of improvements. Neither spouse tended to be able to translate strong business aspirations into effective decision influence in the absence of spousal concensus. Where both spouses had high aspirations, adoption of improved farm practices was significantly more frequent than where conflicts or acquiesence were indicated by only one spouse having high aspirations. By implication, lack of concensus may have a considerable modifying effect on the influence of individual business aspirations.

Power is the potential to exert influence in group goal formulation or ability to translate personal goals into group goals. Several studies indicate that power is related to many factors, and especially that work roles are of particular importance in determining power distribution. For example, a study by Ernest [Oomen, 105] reported a strong work role orientation of goals with wives showing a household-family goals orientation, husbands a farm enterprise orientation, and relative agreement in the social aspects of family life.

A statewide study of 510 Wisconsin farm families by Wilkening and Bharadwaj [143] reports the expected work role orientation of decision making and resulting power distributions regarding income goals. They report that,

> "The data presented here support the principle of differentiation in decision making in farm families as compared with non-farm and urban families and families in other cultures. Furthermore the differentiation is along the lines expected on the basis of the functions performed by husband and wife in the farm family complex. The husband (as manager of the farm enterprise) dominates in farm decisions. The wife supervises household areas, and there is a sharing of decisions of mutual concern. Child rearing and major economic decisions involve considerable expenditures of time or money and require commitment of both spouses."
>
> "Joint decision making in major farm decisions is strained in the direction of the husband's dominance; in major household decisions and in children's activities, it is strained in the direction of the wife's dominance. Apparently, the realities of farm, household, and family activities are such that the person present and most closely involved in the activity tends to make decisions with or without consulting the other spouse even though there is the feeling that this should be done."

Decisions having a major effect on generation or use of the income stream are reported as being joint (for example, decisions relating to land acquisition, borrowing money and major machine purchases). In a similar vein, Abell's 1968 and 1961 studies [4, 2] of Ontario farm families have indicated a high degree of joint decision making (usually spousal) in matters relating to the household (mainly consumption decisions) and to financial planning of the farm business.

In the Wilkening [143] study the related topic of family involvement in the power structure is touched on. Sons' involvement in farm decision making was often reported as starting at an early age. One-third of those surveyed felt sons should have some voice in decision making at 17 to 18 years; and one third felt an earlier age was appropriate; while one third felt an older age was in order.

A cross-cultural study of 505 Wisconsin families and 227 Hessian families (Western Germany) by Wilkening and Lupri [146] reasserts the importance of work roles in the family power structure and hints at a connection between individual motivation as well as external status seeking and the family power structure. Wilkening and Lupri state on the basis of previous research that,

> "there is evidence that decision making between the spousal pair can be explained in part by each of the following: interest in the goals or outcomes of the decisions, status in the larger society (eg. extra family status in economic, political, and/or religious affairs) and involvement in the work roles". (Brackets, mine)

The cross-cultural data analyzed provide further support for these hypotheses, particularly the work-role hypothesis.

For example, Wisconsin women are more active in farm accounting and take a larger part in decisions to purchase producer durables; Hessian women are more active in livestock care and take a larger part in decisions to sell livestock; Hessian wives are more active in household activities and play the larger part in decisions to purchase consumer durables.

Aside from the support given to hypotheses regarding power structures in farm families, the research results provide a quantative picture of the predominance of non-singular decision making. Statistics presented show that neither farm (with the exception of some technical decisions) nor household decisions are often reported as made by an individual.

Another report on the study by Wilkening and Bharadwaj [142] reports that the role of strength of individual motivation in determing influence is small.

> "Work roles appear to have a more consistent effect than do aspirations on the relative involvement of the husband and wife in decisions"[142].

Motivation in an area appears to have little to do with influence in that area.

> "There is little support for the hypothesis that involvement in decisions is a result of aspirations in that area...., it appears that consumatory aspirations for the home tend to affect major involvement in major instrumental decisions of the farm family, but aspirations in the farm area are not as likely to lead to involvement in decisions in that area. Also contrary to expectations, aspirations for home improvement do not appear to affect the relative involvement of the wife in household decisions"[142].

That is, the degree to which family consumption goals are desired, for both husband and wife, appears to be significantly and positively related to relative influence in farm management decisions, while the degree to which family goals are desired, for both husband and wife, within an area (farm or household) appears not to be significantly related to relative influence over decision making within that area.

Another study by E. A. Wilkening [140] of joint decision making in 614 Wisconsin farm families presents some indications of the relative contribution to major farm and family decisions of each spouse and its relation to role and status variables. It was found that while joint decision making was frequent among middle income families it was relatively infrequent at both income extremes. In addition it was noted that no significant association was found between jointness of decision making and the wife's level of education. There was, however, a tendency for wife's participation in socio-educational associations to be associated with greater joint participation at relatively high income levels. A significant positive relation was also found with respect to joint decision making and indebtedness, but its importance decreased with gross income. Increased levels or standards of living were significantly negatively associated with jointness of decision making with the association growing weaker with higher levels of gross income. Overall status variables (standard of living, group participation, education levels) were associated with jointness of decision making when income and social participation were high, while increased specialization of spouse roles as indicated by increasing commercialization (debt, as indicated by gross income) was strongly related to jointness of decision making.

The tendency was for more localized, role-dependent decision making by both spouses under opposite income extremes. Wilkening draws the implication [140] that,

> "the roles of husband and wife in decision making for this sample of young farm families are determined more by their perceived needs of farm and household (related to income) than by culturally determined patterns (e.g. status). (Brackets, mine).

In a later study by Wilkening and Bharadwaj [142] a similar phenomenon is reported. They note that indications of social and economic status do not appear to be associated with decision involvement, with the exception that increased levels of income and education appear to be associated with increased specialization in decision making.

Straus [129] has noted that in the farm family context, the non-linear association of degree of joint influence over major decisions and family income has often been explained by tradition-based, work-role oriented, decision making at low income levels and complex, technical decision situations, requiring specialized knowledge and competence, and thus work role oriented decision making at high income levels.

Although the family power structure is an important element in farm family decision making, it does not appear to greatly affect the degree of technical success in farming. Evidence presented in a 1954 article by E. A. Wilkening [139] suggests,

> "that family relationships as indicated by integration (coherence of group), familism (degree of putting group interest first), and father centred decision making have little direct influence upon the acceptance of innovations or improvements in farming". (Brackets, mine).

However, where such influence was exhibited, it was usually at higher levels of acceptance. In another report on the same study, Wilkening [138] notes that this effect may depend on the type of innovation or improvement being considered. Evidence of decreased acceptance of improvements when decision making is highly father-centred and when these improvements constitute major changes in current practice is presented. They also suggest that the degree of father-son decision cooperation may be positively related to acceptance. The author concludes on the basis of then current (1954) and past research that,

> "goals and values of the farm operator and his wife are more highly associated with acceptance of innovations and improvements in the farm than are the structural factors (integration, familism, father-centred decision making)".

On the basis of research on the farm family power structure it seems reasonable to make the following generalizations:

Some degree of joint decision making is the rule in farm family business. VI 1

Decision making power in the farm business has strong work role orientation. VI 2

Joint decision making in areas relating to determination of the shape of the disposable income stream appears to be the rule. V1 3

Joint decision making is less common at high and low farm family income levels than at intermediate levels. V1 4

Decision Roles in the Farm Family

Previous discussion indicates that spousal dichotomy in decision roles is to be expected with the wife playing an integrative, supportive role and the husband playing a task-oriented role. A study by Straus [129] of 903 wisconsin farm families has examined the association between the wife's success in playing an integrative-supportive role and the husband's technological competence. In general, he found a significant positive relationship between the wife's ability to play the integrative-supportive role and the husband's degree of technological competence, but did not analyze any possible association between influence and the decision role. Kenkel [75] in a controlled experiment approach has noted an association of wife's level of intergrative-supportive role playing and her influence or control over ultimate decisions. He also noted an association between level of task performance and influence. The amount of talking was positively associated with influence for both husband and wife, while the level of husband's contriubtion of ideas was positively associated with his influence.

The limited information available on the relation of decision roles and decision making leads to the following generalization.

Decision making roles in the farm family appear to have a significant but poorly understood influence on ultimate decisions. VI 5

An extensive analysis (1969) by Bjergo [14] of 21 New York state farm families has also dealt tangentially with the subject of decision roles. His analysis revealed a considerable number of impediments to family goal formation, one of which was a basic lack of understanding of other family members' desires and needs. Often family goal formulation was stilted by the use of quasi-resolution procedures, ill-suited to the purpose of any family member. Procrastination and ignorance regarding consumption preferences, leisure desires, and estate planning were often noted areas of these misunderstandings. In connection with this problem Bjergo, [14, pp. 112-119] developed two simple games for the purpose of creating an environment where basic family preferences could be brought out into the open and reconciliation into family goals attempted. Although insufficient information on decision roles is available to warrent generalizing it seems possible that planning situations may involve not only questions of what goals and values are relevant but also how the individuals involved should influence final goal selection.

Consistency of Goals For the Family

In view of the families' known kinship dimension it is reasonable to expect a large degree of commonality in goals that individual members hold for the family; but on the other hand, the influence of societal role assignment on individual values suggests that a considerable conflict of interests is likely.

As an outgrowth of his detailed study of decision processes in 21 New York State farm families, Bjergo [14] has given four considerations in developing a workable family goal structure as basic conflict between individuals, uncertainty of future goals, behavioural conformity to various peer groups, community, societal, religious, etc., norms and hesitancy to consider goal formation in some areas. He describes in some detail how these considerations combine in many families to yield patterns of behaviour inconsistent with what family members, under improved circumstances, would consider rational.

If a consistent goal structure is to be developed, the processes described in Chapter IV as quasi-resolution processes must be replaced, if possible, by a more consistent family goal structure. Bjergo has described (although not in the terms used here) in some detail, how many of the 21 families proceeded in their decision making with vaguely conceived and inconsistent goal structures primarily by way of sequential attention to goals, localized decision making. Achievement in certain goal areas was ignored until critical achievement levels were reached and the ensuing crisis forced a decision to move to more group acceptable levels. Inconsistencies of individual goals for the family were concentrated in the non-business area of family decision making. Major differences appeared in the household area where "women and children perceive that non-farmers around them are enjoying cultural or material advantages they do not have". Farmers in general, tended to be more reluctant to spend money on housing, household improvements, and leisure activities than other members of their family.

The inability to evolve a unified family goal structure appeared to be compounded by the highly interdependent nature of the farm family. Several illustrations of the critical interdependence of labour supply and interpersonal income distribution [14, Ch. 4] are cited. In general, farm families are highly dependent on family labour and limited amounts of hired labour.

> "Even the danger of losing labour, as when teen-agers prepared to leave home, or hired workers appeared less satisfied to remain on the farm, was sufficient to cause most of the farmers in the study to consider capital investments to make more efficient use of remaining labour" (Bjergo [14, p. 89]).

Analysis of the dependence of income for household and personal expenditures on the division of disposable income between investment and consumption often revealed a lack of family income distribution goals. Family consumption expectations appeared to be directed toward the market economy while often the farmer appeared reluctant to spend in the personal consumption area[14, p. 97] . Decision making, at times, appeared to be controlled by the non-existence of an acceptable family goal structure.

Quasi-resolution processes involved in farm V1 6
family decision making may lead to the following of, what appears from the outside, inconsistent group goals.

Resolution of Income Conflicts

In view of the large and growing number of income-dependent goals pursued by farm families, it is to be expected that the resolution of income distribution conflicts will be a significant factor in farm planning. A study by E. A. Wilkening of 170 Wisconsin farm families [138] sheds some light on the means dependent nature of family consumption goals. He concludes that the adoption of income dependent housing, home equipment and other practices is highly associated with the adoption of improved[1] farm practices. Adoption of income independent family preventive health practices (a health goal), on the other hand, was not significantly associated with adoption of improved farm practices.

Since adoption is likely to have been directed

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[1] "Improved" is generally interpreted as employing improved efficiency in some sense.

at goals and if the association noted here is widespread, it is possible that farm business goals are seen only as instruments and that the often cited competition between consumption and investment is more apparent than real. The real conflict is centred on the nature of the instrument, income distribution, itself. The study supports the above conjecture since the survey provided some indication that improved farm practices were seen as a means of achieving consumption goals rather than both farm and household adoption of improved practices both emanating from a higher order valuing of up-to-date practices in both farm and household.

Bjergo's study [14] provides additional information on the importance and nature of farm family decisions relating to income distribution. He noted that, while most wives did not participate in a significant way in farm business decisions, a radically different pattern was typical of household and off-farm decision making. Localization of decision making appeared to be the rule in farm business decisions with decisions being made jointly by the farmer and his working sons. Decisions made, however, were clearly understood to be aimed at instrumental income goals whose establishment was not a localized decision [14, p.89]. Off farm decisions (for example, decision to accept public or organization office) were normally jointly made by spouses, while leisure oriented decisions were taken by the entire family. Joint decision making between spouses was the norm in household decision making although women were reported as initiating less than half of the decisions. Conflict between spouses was reported to be at a minimum where the wife took an active part in the bookkeeping side of farm management. Possibly this is a result of the wife more clearly understanding the range of income distributions available through her bookkeeping. On the other hand,

> "Women who participated little in the work and management of the farm business most frequently exhibited evidence of tensions with their husbands" [14].

The following generalization appears warranted.

The shape of the instrumental stream of disposable income is a focal point of group conflict. VI 7

The concept of conflict resolution implies that the relationships between individual goals and values and group goals and values are many and complex. In part, they are associated with work roles, family roles, individual motivation and status in the community at large and dependent on the goal area concerned. Considerable research has been reviewed regarding the interaction of these elements in the process of family decision making. Two implications in addition to the genralizations cited appear warranted.

The processes involved in farm family conflict resolution are complex and not well understood. VI 8

Conflict resolution processes are important determinants in the acceptability of alternate courses of action to the group. VI 9

Summary Observations

Basic normative assumptions of programming models relate to both the goals of farm decision groups and the generation of those goals. The framework established for group decision making implies that the formulation of group normative standards and decision processes occur simultaneously as a result of processes which lead to both group goals and quasi resolution processes. A fundamental characteristic of group goals appears to be their apparent inconsistency and incompleteness.. The previous chapter supports the general framework by illustrating some characteristics of farm goals and values. This chapter has carried the examination one step further by examining research related to the actual making of farm decisions.

Few published data are available on research related to the processes of resolving individual goals and values into group goals. However, a considerable number of studies have clearly delineated the pervasiveness of such processes and their significance in making major farm management decisions in the course of investigating the phenomena of joint decision making.

Studies have concentrated on individual factors which are associated with power over group decision making and also on the importance of joint decision making in various decision areas. Thus the influence of individual education, sex, role, cultural, income, aspiration, and status indicators have all been investigated. In addition, the strong influence of joint decision making in areas related to income distribution has been noted. Little information is available on the actual processes of group goal formation, however, the little that is available supports the implication of the decision framework that the integrative decision role is important. In addition to direct evidence, this conjecture is based on the two observations (a) joint decision situations investigated almost always involve the farm wife and (b) the decision roles of husbands and wives are normally different, with the wife adopting the integrative supportive role.

At the level of individuals, value theory provides a theoretical base for normative standards and thus its meaning and requirements can be often made very explicit as in utility theory. At the group level however, normative standards becomes a more complex concept since they clearly become more dynamic. Group decision processes which lead to the generation of a sense of direction for the group tend to be much more unstable than individual values. Thus we have an essentially adaptive base for group decision making in contrast to the stable base for individual decision making provided by individual value structures.

CHAPTER VII

THE ROLE OF THE FARM MANAGEMENT CONSULTANT

In this brief chapter, two issues and a related theoretical base regarding the farm management consulting role played by agricultural extension workers are presented. They major argument developed in this chapter is that the feasibility of planning models cannot be determined independently of normative considerations in their delivery systems.[1] In dealing with delivery system considerations, this chapter examines the influence of extension objectives and methods on group normative standards and examines the potential of non-analytic methods in coping with normative considerations.

At least in the initial stages of their diffusion, decision aids are likely to be elements in farm management extension delivery systems themselves and/or their farm adoption will come about partly as a result of efforts in such systems. In the first section, it is pointed out that current trends in farm management extension are toward greater intervention in farm firm managerial processes in a teaching capacity and away from simply providing information on farming alternatives. The second section points out that involvement may take the form of a very large number of extension techniques and that the problem areas in decision making dealt with are quite diverse. It is pointed

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[1] A delivery system contains all elements in addition to the model which are required to support its operational use.

out that in many cases, techniques used are problem specific. In the third section, some concepts from diffusion theory are reviewed and their relations to normative considerations are discussed.

Introduction

Developing a farm plan was earlier described as attempting to carry out the intent of the decision unit, to the fullest extent possible, within the bounds of a decision environment. A major factor in deciding when and how to achieve the fullest extent possible is the role played by the individual extension agent carrying out farm management consultations.

After an examination of decision making in the farm family, it has become apparent that farm planning (and any decision aids used in its execution) is a very significant part of a process which results in both decisions and goals. Decision making appears to be part of an ongoing process of conflict resolution which is not compatible with the role often assigned to decision making aids, that is, taking established goal structures as an expression of intent and calculating optimal solutions accordingly.

It is clear from recent developments in Canada (for example, the CANFARM Project) and the complexity of many planning aids, that any large scale use of decision aids by farmers in the immediate future will take place (at least in the initial stages) through integration with traditional farm management extension programs. In carrying out extension programmes it is unlikely that consultants are entirely neutral in the generation of normative standards. We can expect, for instance, that if the consultant's role is primarily educational,[2] an attempt will be made in some sense to optimize the educational value of the decision-making exercise at hand. On the other hand, if the consultant's role is primarily advisory, he will not be primarily concerned with long run improvement in managerial skills, but with finding "acceptable" solutions to decision problems confronting the farmer.

Extension Involvement in Farm Managerial Processes

Extension agencies in their farm management programs aim to change behavioural processes in the farming population. In particular, the long-run objective of farm management extension appears to be to improve the managerial processes of farm families. Research and extension in agriculture have begun to consider the non-physical aspects of production and there has been an increasing recognition in recent years that managerial effectiveness is an important process in farm production. More and more programs are being developed around the concept that managerial effectiveness can be learned so that more efficient use can be made of the physical facts tradi-

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[2] That is, primarily aimed at the objective of improving decision making skills as opposed to examining alternatives in a given situation in such depth that a specific decision to be taken becomes the objective.

tionally made available through extension services.[3]

Dorner [38] has presented what might be called a classical philosophy of farm management extension in terms of three major stages in the decision process. The first is the establishment of alternate courses of action by the farm family; the second is the projection of results of these courses of action, and the third is the actual taking of a decision. The philosophy expounded sees the farm firm as an integrated and inter-dependent economic and social unit made up of both firm and household with certain information needs, and cautions the extension agent against involvement in the decision taking step. In the words of Dorner [38],

> "This education approach assumes that no one is better equipped to make decisions, given the proper understanding of relevant ideas and information than the people most closely and directly affected by the results of those decisions"(Dorner[38 p. 504] (Brackets mine)).

Extension agencies are cautioned against involvement in this stage since any involvement infers something about what is good for the family. In this way the agency avoids projecting elements into the goal structures of the farm family.

While much applied literature in farm management extension gives the impression that an important goal is non-interference with the farm family goals, a wider perspective of farm management extension reveals that it is a

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[3] For example the Manitoba Farm Diversification program has as one of its major objectives the conversion of small uneconomic units into viable economic units through the upgrading of management skills.

part of an extension effort aimed at bringing about behavioural change among farmers. This wider goal of bringing about behavioural change more compatible with some notion of "social good", proceeds within norms which vary somewhat from one society to another. To be effective, it must have some impact on decision processes. In addition it should be recalled that the distribution of information itself is a major factor in goal formation and decision making.

During the 1950's and 1960's, increasing concern was expressed by many regarding the need to increase extension efforts in developing farm management skills by going farther than the provision of information on production techniques, institutional arrangements and prices, (For example see Johnson [66]). In response, a large number of farm management programs was developed or intensified throughout North America [109].[4] The general thrust of these programs as implied by Pulver [107] was

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[4] While very little documentation is available on the directions farm management extension programmes are taking in Canada, it should be worth while to use the experiences of the North Central Farm Management Extension Committee in the U.S.A. as a guide. In general papers [32] presented at 1970 workshop indicate a continuing development of programmes which more actively involve specialists in farm decision making. More specifically virtually all of the fourteen States represented on that committee were actively developing a computer decision aid system for use with farmer clients and most were developing intensive programmes to assist small underdeveloped farms. The recent implementation of a Canadian Small Farms Development program indicates that Canadian farm management programmes are following a similar path.

to recognize the three essential elements in farm management as: the decision-making ability of the family farm decision unit: the decision tools available, and the information specifying the problem at hand; and the development of specific educational approaches to improve decision making ability and understanding. Nelson [99] has pointed out that a further increase in the need for farm management extension assistance will occur in the 1970's. The continuing evolution of a farming industry based on commercially oriented family farms brings with it many needs related to the "knowledge explosion".

Farm management extension programs are continually evolving in relation to their involvement in farm decision processes. Traditionally, the approach was one of "information only". However, even given this philosophy, a considerable involvement was inevitable.[5] In recent years, increasing recognition has been given to assisting and instructing in the making of actual farm management decisions. The increasingly apparent information explosion and commercialization in outlook of the family farm point toward an increasing involvement in farm decision making in the 1970's.

Some idea of the increased emphasis on the human element in a Canadian farm management setting can be obtained from a survey of 90 per cent of Quebec county extension agents in 1969 [22]. Some light was shed on their relative

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[5] Randall [114] has concluded in general that fundamental shifts in decision making power are inevitable outcomes of providing economic information.

ranking of their own information requirements in serving farmers and indirectly on the importance of social involvement in extension work. In general, the agents felt their need would be better served if they received more information regarding program planning, psychological and education principles, performance of educational activities and other people-oriented topics and less information on technical subject matters.

While little research on the subject is availabe one general conclusion appears warranted.

VIII 1 Farm management extension programs are committed to involvement in the decision making processes of the farm family by virtue of their role as providers of information and by virtue of their pursuit of educational objectives. The implication of the above generalization is that planning models will be used initially as educational devices in order to (a) improve managerial skills of farmers, and to (b) provide them with additional decision making tools. As those tools become more routine in their use, as farm accounting and soil testing have in the past, their roles may gradually change from the teaching of decision skills to the generation of information relating to specific management problems. Such a change may, in fact, require the development of a delivery system quite apart from current extension programs. In any case, the basic educational objectives of existing extension programs are likely to play a significant role in determining the initial feasibility of decision aids.

Areas and Techniques of Extension Involvement

Little research data on the specific makeup of farm management programs is available. However if as indicated above, planning models are likely to reach the farming population initially via such programs real conflicts could arise between model normative assumptions and extension techniques and objectives which are also based on normative assumptions. In general a large variety of areas and techniques of involvement in decision making are characteristics of farm management extension work. In effect, they form a complex inter-related farm management advisory system. For example, Heard [58] in a paper on the role of Ontario farm management specialists has indicated major areas of involvement as including record keeping and analysis, budgeting and planning, estate planning, and business agreements, financial management, and economic aspects of various technical sub-systems. In addition, he has reported a consultation procedure involving (a) both family members and agricultural representative, (b) discussing of resources available, (c) establishing family goals and (d) discussion of alternatives. After assessment of family reaction to each alternative, a suggestion of what appears to be the best course of action from a professional point of view, is made. An analysis of response to consulations by three management specialits indicated a high degree of acceptance of advice given in consultations.

Mitchell [97] also indicates the widespread use of a diversified group of delivery systems and techniques. Special purpose advisory schemes (eg. various enterprise cost accounting schemes), farm accounts analysis, marginal analysis techniques and forward planning tools are used by a variety of commercial, university, government, farmer organization and private consultant groups in providing advice to consumers of farm management advisory services in England. In general, it is shown that various agencies tend to follow particualr advisory practices.[6]

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[6] The following examples from papers given in the North Central (U.S.A.) Farm Management Extension Workshop [102] illustrate the specific problem orientation of new farm management services both from a farm and farmer advisor point of view. Examples are (a) the development of a small group discussion procedure to provide specialty crop producers with the information and skills to cost rapidly changing technologies [102, p. 87], (b) the use of mass media, meetings and individual consultation to carry out an estate planning program aimed at developing: an understanding and appreciation of the need to plan estates; a knowledge of laws, institutions and assistance available; an understanding of available alternatives, and motivation and planning goals [102, p. 89], (c) the use of two day workshops to acquaint lady landowners with farm management concepts and lease arrangements [102, p. 97], (d) the teaching of farm financial management principles to agribusiness clients in co-operation with the agribusiness agencies in one day workshops [102, p. 109], (e) the use of meetings to provide instruction on farm leases and leasing arrangements [102 p. 111], (f) the use of workshops to teach farm wives principles of financial management [102, p. 117], and (g) the use of intensive individual farm management consultations with low income farm familes [102, p. 123].

The experience of established farm management indicates a strong relationship between success of particular decision aids and established extension practices. Often used decision aids in Michigan State University's terminal based "Telplan" system [15] cover the entire spectrum of partial planning problems which had traditionally been dealt with by extension workers on an "on-the-spot" answer basis (eg. feed formulation, and machinery replacement). Their experience has indicated that extension workers are initially most receptive to familar problem formulations, and also that this use is likely to lead to changes in extension procedures.

Traditional approaches to extension have had to make allowances for calculation and data retrieval problems which are not required of computerized approaches. Use of these appears to lead extension agents to use more comprehensive analyses in their advisory work. The preliminary observations available to this point suggest a complex interaction between extension practices and model development which moves extension practice in the direction of more complex analysis of farm management problems and model development in the direction of models with a range of comprehensiveness. The availability of more and less comprehensive models of given problems appears to have the additional benefit that it gives the extension worker a wider analytical continuum within which he can place the problem and abilities of a particular farmer. Another change in technique noted is the use of computerized models in situations where "self discovery" of the solution was more important than the solution (which the agent was aware of in any case) itself. Still another change noted was that as agents gained experience, they tended to graduate to the use of EDP aids in workshop situations.

In contrast to the personal and small-group consultation type of decision aids used in the Michigan system, Purdue University has developed a series of complex workshop oriented decision aids. In taking this route, they are drawing on previous extension practices established in "top farmer" workshops which present a forum for detailed discussion of Indiana's specialized corn-soybean-hog economy. Although the use of these planning models is in contrast to the Telplan system, the role of the specialist as the interpreter of normative considerations is not. In general, normative considerations are excluded from the models used [110].

In considering problem areas and techniques relating to farm management extension, the fact that techniques are problem-oriented (in a normative sense) should not be lost sight of. For example, small group consultations may be used to zero in on some very difficult managerial situations which could not be dealt with on a family-consultant basis. Impersonal discussion with peers in a group may allow discussion of emotion laden issues within families; specialist help may be available to groups only; peers may point out mistakes that neither family members nor the consultant could; peer examples in problem solving techniques may be useful teaching devices; goals and values of other group members may provide a valuable learning experience; an understanding of the roles played in decision making by various family members may be gained by observing group discussions.

Although specific conclusions regarding the normative roles of extension workers are not warranted, available literature implies the following generalization.

The current state of the art of farm management extension has evolved generally accepted patterns of normative involvement in various problem situations within various agencies. V11 2

Diffusion Theory

Theory of adoption processes in farming presents a framework which can be useful in establishing both the role of extension agents in a particular type of planning situation (i.e. planning situations considering the adoption of new ideas) and the role which extension agents may play in the adoption of particular types of new technology (in this case a new management technology).

The adoption process has been portrayed by Rogers and Shoemaker [118] as a four stage process. Included are (a) <u>a knowledge stage</u>, during which the decision maker learns of the existence of an innovation and some details of its function, (b) <u>a persuasion stage</u>, during which some attitude toward the innovation is formed, (c) a decision stage in which activities leading toward a choice are pursued and (d) a confirmation stage during which the decision maker attempts to reinforce the decision he had taken. Farm management extension workers interact with various communication processes in order to improve the knowledge of the decision maker or facilitate a favourable outcome to the innovation decision process. The tasks of the extension agent are seen as varying with both the stage of the decision maker and the innovation under consideration.

The implication that the extension role will vary considerably from one innovation to another comes from generalizations relating the nature of innovation decision processes. Innovation comes about when the decision maker perceives that critical levels of: (a) relative advantage (economic and non-economic), (b) compatability with existing values, experiences and needs, (c) complexity in understanding and use, and (d) trialability and observability of results have been surpassed. Since these characteristics clearly vary greatly from one new idea to another, the extension agent's task in bringing about adoption will change correspondingly.

As the decision maker moves through the adoption process, the role of the extension worker changes from facilitating information flows, to assisting in bringing about favourable attitudes, to assisting in analysis and

and actual decision making, to finally reinforcing the decision maker's action. To illustrate, in the first instance, a farm management agent may require only that a model illustrate the use of an innovation. In the last instance, he may require that a model take the innovation as given in order to develop solutions that confirm that the decision maker is in a viable situation.

In addition to implying that the role of the change agent varies with the innovation at hand, and the decision maker in question, diffusion theory suggests a strategy for adoption which specializes the agent's clientel. Research has shown that the diffusion process hinges on adoption by opinion leaders whose adoption practices have a "trickle down" effect on others in their community. These opinion leaders have a number of characteristics which set them apart from the general farming population. They are reported [118, Appendix A] as being of higher social status, more socially active, more educated, and more cosmopolitan in their social contacts. The Alberta Farm Management Study suggests, in fact, that this select group of farmers may be relatively small. A representative sample of Alberta farmers showed that, for major farm purchases, they relied most heavily on dealers and their own experience to provide information. Extension workers were consulted by only 5.6 per cent of the population. The important implication here is that to the extent that extension services are the delivery system for decision aids, the normative standards of concern in determining their feasibility will be those of a very select group of decision makers who are in general, receptive to new ideas and have the confidence of their peers.

The fact that decision aids are themselves innovations suggests additional implications of diffusion theory. In his work with decision aids, an extension worker may try to assure adoption by placing restrictions of his own on innovation characteristics such as relative advantage, compatibility, complexity, trialability and observability since as diffusion theory suggests these factors are directly related to rate of adoption. He may, for example, require initially that models used by his clients be (a) developed for use in situations where payoff is large, apparent, and immediate, (b) consistent with existing decision practices, (c) simple to use, explain and interpret, and (d) concerned with often-repeated decision situations on the grounds that these factors will hasten the acceptance of decision aids in the whole population.

In summary, diffusion research suggests the following generalizations.

Extension agents work most effectively with a specialized clientel comprising opinion leaders who tend to be; of higher social status, more socially active, more educated and more cosmopolitan than other farmers. V11 3

Extension agents will be motivated to carry out a number of tasks which vary from one innovation to V11 4 another to ensure a proper perception of innovation characteristics.

Extension agents will be motivated by a desire to fit their extension tools to the innovation stage of the decision maker. VII 5

Extension agents may also be motivated to place restrictions on the decision aid as an innovation in order to assure its adoption. VII 6

CHAPTER VIII

CONCLUSIONS

This chapter integrates material presented in the previous four in developing criteria for the evaluation of the normative content of programming models. It begins with a summary of criteria to be discussed. A conceptual model incorporating a large number of normative dimensions is first presented to re-emphasize major normative assumptions noted in the programming context. A presentation of criteria relating to a systems approach to normative content, normative exhaustiveness, utility theory, model goal orientations and the management consultant's role, takes up most of the chapter. Since the generalizations on which conclusions are based have been scattered throughout the last four chapters, they are presented together in Appendix C.

Summary

The normative content of planning models must be consistent with both existing objectives and decision processes. While it is not possible to state unequivocally that a given set of normative elements must be included in a given model, it is possible to establish general criteria regarding the strategic efficiency of some approaches to incorporating normative content. Each section below presents a criterion in whose light the normative content of programming models may be evaluated.

The major points raised in Chapters IV thru VII are presented in Figure 8.1. Contrast with an earlier Figure 3.3 which illustrated the farm planning process in an operational programming context is evident. In Figure 3.3, programming models characterized the farm firm decision making process as a fundamentally firm goal directed maximizing procedure based on known exhaustive and measureable goals and interrelationships. The single most important characteristic of the farm planning process illustrated in Figure 8.1 is the dynamic and interactive nature of normative elements.

Analytical planning procedures are seen as interacting with a dynamic process of conflict resolution both during and after the planning exercise rather than building on a base established by group goals. Goal formation is considered generally incomplete on the planning date. Choice criteria and normative constraints are implied by both group goals and conflict resolution procedures. In this sense, programming models have as their objective not simply the optimization of some function of economic goal achievement through resource allocation, but also the optimal allocation of resources between goal achievement and conflict resolution.

In Figure 8.1 the interface between family decision making and decision making assistance is made explicit. In addition, three points of interaction between the planning process and firm objectives are made explicit.

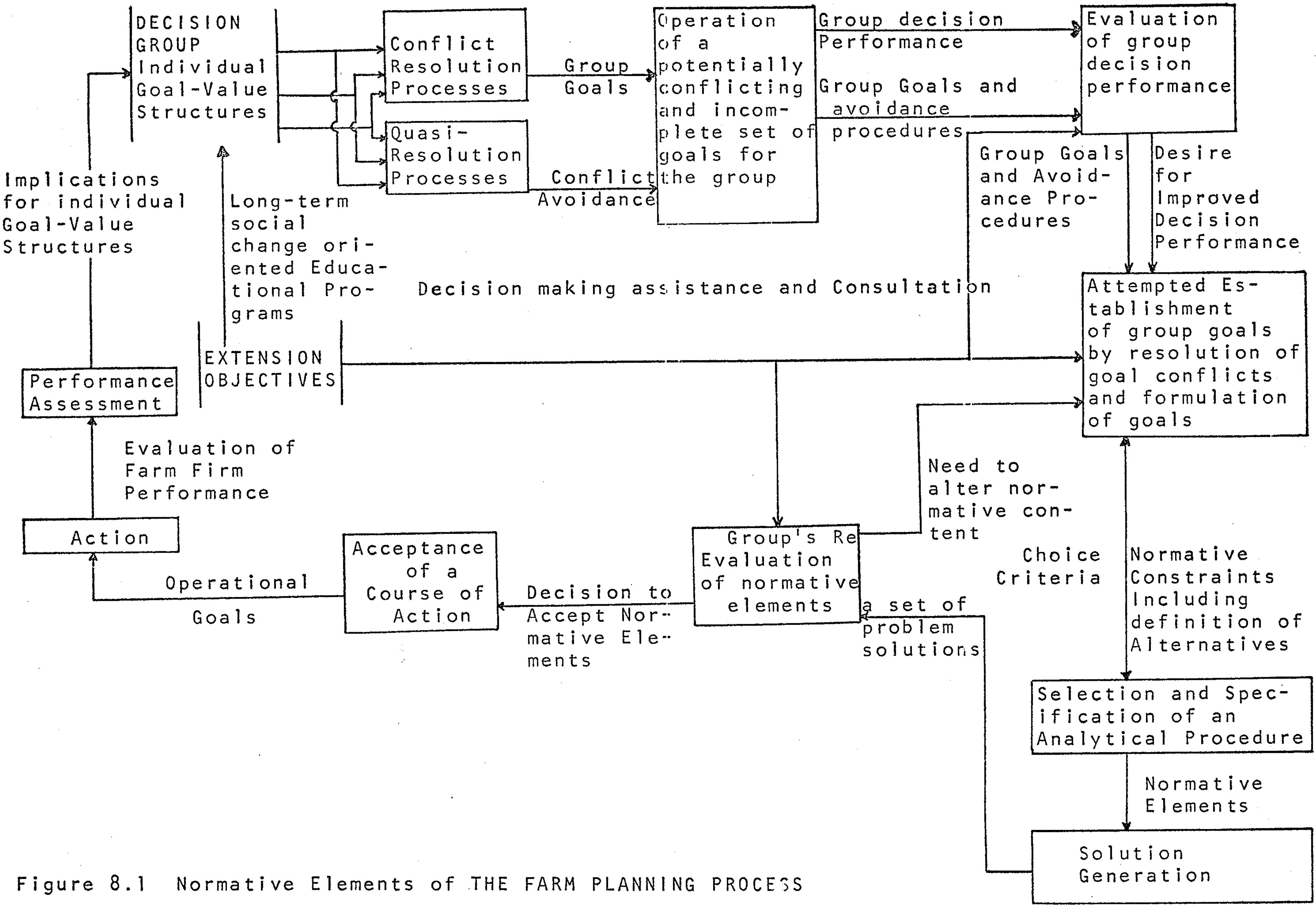
DECISION GROUP Individual Goal-Value Structures
Conflict Resolution Processes
Quasi-Resolution Processes
Group Goals
Conflict Avoidance
Operation of a potentially conflicting and incomplete set of goals for the group
Group decision Performance
Group Goals and avoidance procedures
Evaluation of group decision performance
Group Goals and Avoidance Procedures
Desire for Improved Decision Performance
Attempted Establishment of group goals by resolution of goal conflicts and formulation of goals
Implications for individual Goal-Value Structures
Long-term social change oriented Educational Programs
Decision making assistance and Consultation
EXTENSION OBJECTIVES
Performance Assessment
Evaluation of Farm Firm Performance
Action
Operational Goals
Acceptance of a Course of Action
Decision to Accept Normative Elements
Group's Re Evaluation of normative elements
Need to alter normative content
a set of problem solutions
Choice Criteria
Normative Constraints Including definition of Alternatives
Selection and Specification of an Analytical Procedure
Normative Elements
Solution Generation

Figure 8.1 Normative Elements of THE FARM PLANNING PROCESS

Individual goal-value structures are affected by individual assessments of past performance. The specifying of an analytical procedure may bring about establishment of group goals. Analytical solutions may bring about renewed attempts to develop group goals.

An Illustrative Conceptual Model

The presentation of criteria can be illustrated with the help of a conceptual long run planning model incorporating most of the normative dimensions noted in the "Programming Context".

Consider

$$\text{Max } Z = cx \approx U \left(\sum_{i=1}^{n} \frac{r_i}{(1+r)^i} + \frac{T}{(1+r)^n} \right)$$

where U is a risk averse utility function of a linear combination of yearly income and terminal net worth, r is the market rate of interest and n is the farmer's time horizon in years.

Subject to

$A_k x = b_k$, where A_k is a matrix of family consumption coefficients,

$A_l x = b_l$, where A_l is a matrix of credit restriction coefficients (liquidity preference),

$A_m x = b_m$, where A_m is a matrix of subjectively imposed technical constraints, and

$a_{i*}x - di\ (xB_i x)^{1/2} = b_i$, $i = m, \ldots, p$, where B_i is a variance-covariance matrix for a_{i*} (the i'th row of A), and di is the normal deviate associated with a subjective probability limit on a_{i*}.

As usual all b vectors can be considered sets of resource constraints.

The planning model sketched above is clearly ambitious in that it contains most of the suggested means of providing for normative elements within a farm management framework. In doing so, it is quite distinctly different from programming models which are feasible in actual farm management use.

Significant normative propositions, both implicit and explicit are inherent in current approaches to developing farm planning models. On the basis of evidence reviewed, it is possible to argue the validity of one major criterion for model evaluation and several corollaries.

The major criterion is that, "no approach to the making of farm planning decisions should assume that a maximizing or fundamentally maximizing process is necessarily applicable".

The corollaries are that

(a) exhaustive treatment of normative considerations within programming models is not justified,

(b) flexibility in adapting to situation specific goal orientations is required and traditional economic goals are often not consistent with the achievement of farm planning objectives,

(c) the use of utility functions in farm planning models is not consistent with group decision processes in farm planning, and

(d) the effect of model normative propositions should be at a minimum and the farm management consultant's integrative involvement at a maximum when the planning situation has a major conflict resolution task, and thus model normative propositions must be consistent with extension agency objectives and the professional ethics of farm management personnel.

A Normative Systems Approach

In this section, it is argued that the basic maximizing assumption implicit in many farm planning models is inconsistent with the farm firm decision process. The argument is developed in two steps. Firstly, two polar approaches to combining the resource allocation tasks and conflict resolution tasks inherent in planning situations are outlined. Secondly, by using generalizations developed in previous chapters, it is shown that conditions required by the maximizing assumption are not likely to be realized in commonly occurring planning situations.

The models reviewed in the programming context and the illustrative model presented above are examples of modeled maximizing behaviour. Firm goals are taken as given and the primary focus of attention is on the efficiency of resource allocation in meeting these goals.

Goal formation and conflict resolution processes are only considered to the extent that they form part of the social-physical environment in which the planning problem exists. For example, some minor allowances in resource use and allocation might be made to allow for inefficiencies caused by ongoing integrative practices. No attempt is made to integrate the tasks of conflict resolution with the allocation of resources to stated goals, although some semblance of conflict resolution may be involved in goal measurement.

The contrasting planning situation is one in which conflict resolution processes are expected to play a major part. In this situation, existing explicit individual values, goals, and beliefs point not to ends for action as in the previous case, but to the need for integrative tasks arising out of current or potential goal conflicts. The essential character of this situation is that it is no longer sufficient to simply make minor allowance for the continuation of workable integrative functions. Real problems of conflict resolution must be solved as part of the planning exercise. Resources must be allocated to both processes, goal achievement and conflict resolution.

Research results reviewed suggest that the first (maximizing) planning situation is representative of a relatively small number of short run, technical decisions whose income distribution effects are globally acceptable. The short run nature of the problem implies that the operational goals (and thus the dynamic belief structures on which they are based) will not present a problem. Changing goals can be accommodated without loss as long as the horizon is not lengthened by the commitment of fixed resources. The often noted independence of technical decision making limits the need to consider more than the goals of one individual. Globally acceptable income distributions (over time, probability space, between people) indicate that the decision situation is largely deterministic and that the information and task distribution results of the exercise are not likely to effect the group power structure. Such decision situations are typified by livestock nutritional planning models such as the least-cost ration model.

Given the above characteristics of decision situations with which maximizing behaviour is consistent, one would expect to see evidence of maximizing models performing effectively in such situations. A review of 1972 [78] usage of computer services routinely available to farmers bears this out. Of 35 maximizing models routinely available to farmers, all were for use in short run and normally technical planning situations that emphasize ways of increasing annual profits. Livestock nutritional models are unquestionably the most successful in terms of numbers of uses of all models for which results are available.

The second or integrating planning situation illustrates the major characteristics of farm decision processes developed in Chapters IV, V, VI and VII. Evidence suggests that such planning situations are typified by distant time horizons, by primary concern with determining the shape of the group income distribution, and by concern with the manipulation of broad non technical business variables.

The long run focus of this planning situation at a theoretical level implies that few operational goals will exist because the belief structures which will affect actual decision making have yet to be formulated. This theoretical implication of incomplete and hazy long run goals has been supported several times in studies of farm goal holding. The frequently reported inconsistency of such goals with other goals is further evidence of their transitory nature.

Conflict between individual value-belief-goal structures is seen at the theoretic level as an essential element of group decision process. Studies of actual farm goal holding substantiate the importance of conflict in many ways. To begin with, the support for sex role specialization in goal-value structures and decision processes suggests fundamental conflicts built into the family unit. Evidence that joint decision making is the rule for all major goals virtually ensures the existence of goal reconciling processes. The income dependence of a large variety of family goals suggest that in fact income distribution goals will be a focus for conflict. This is supported by the fact that instrumental income goals are seen both as very important and as instruments by most farm persons. Continuing evolvement of urban-like goal-value structures and roles suggest a continuing concentration of conflicts in the income distribution area. Long-run cycles in goal holding and their association with the family life cycle in combination with evidence of the hazy and incomplete formulation of long-run goals supports the pervasiveness of conflict resolution processes since they indicate some time related processes are involved. The very presence of a large variety of expressed individual goals suggests that conflict will be the normal course of events.

The evidence for joint influence in decision making is conclusive. A related factor, the strong role orientation of both decision making and value structures suggests that the common ground for conflict resolution relates to the distribution of income. The broad area of financial analysis allows individuals to express their desires in concrete terms and still provides for control of the making of technical decisions, for whatever reason, by a single individual.

The major objective in contrasting a maximizing and an integrating approach to farm planning has been to point out the necessity of going farther than building recommendations on the basis of established goals by treating both the integrative and resource allocating tasks within one framework. Conflict resolution is an essential element of all but a few farm planning problems. As such, its bearing on resource allocation must be provided for in the planning exercise.

If sufficient theory were available to describe the ways in which group goals and decision procedures evolve out of a given socio-physical decision environment, it might be possible to develop hybrid socio-economic models which allocate resources simultaneously to economic and social ends. It is clear however, that no such theory is avialable in spite of useful generalizations that have been derived in research regarding individual-group aspirations. It is equally clear that the absence of appropriate theory cannot stand in the way of making conflict resolution an integral part of the farm planning process.

For better or worse, the integrating task must be accomplished. Since, in fact, the dichotomy portrayed above is a continuum in which integrative tasks vary in importance from one to another and since planning situations with outside intervention are the major concern, it apprears that the management specialists will have to carry the major responsibility for deciding how planning models can enter a process which is fundamentally non maximizing. Where the task is primarily integrative, the use of medels will be entirely conditioned on intuitive, integrative procedures.

Normative Exhaustiveness

The acceptance of a maximizing model of firm behaviour leads to the corrollary that, subject to limitations imposed by the cost of analysis and technical feasibility, model builders ought to pursue a policy of exhaustive incorporation of firm objectives with in planning models. It is argued above that maximizing behaviour even in a normative sense is inconsistent with the realities of farm decision making. In particular, the types of goals assumed to exist as of the decision date cannot be considered a normative base for future choices but more properly may indicate necessary committments of resources to integrative or conflict resolution tasks. In view of the state of the art in the theory of group goal formation, it seems logical to extend the proposition presented by "A Normative Systems Approach".

Current farm management extension practice places the job of interpreting expressed current goals and translating these into a mix of integrative and traditional analytical tasks in the hands of the decision unit and its advisors. To the extent that necessary integrative activities are intuitive and not subject to quantification, resource allocation analysis by planning models must be conditioned on a previous commitment of resources to integrative activities. In addition to the extent that the process of establishing necessary integrative activities is dynamic, it will be necessary to develop a set of conditional analyses. For example, it may be necessary to observe the reaction of the decision group to one conditional analysis before a more useful one can be developed.

The major implication of rejecting the goal of exhaustive treatment of farm goals in planning models is that useful models will be those that allow model users to condition their use on non-conflicting firm goals and projected integrative activities. This suggests an iterative approach to group decision making and that few goals and particularly those related to income distributions, can be considered necessary components of planning models since these have been identified as the primary focus for value conflicts in major planning decisions. It is possible that such goals may be useful as part of the conditional base for the analysis, however their inclusion in the model must not preclude a primarily integrative and thus iterative use of the model.

The conceptual model illustrates the major difficulty in taking an exhaustive approach to incorporating firm objectives. In its attempt to be both generally applicable and exhaustive, normative elements are both abstract and varied. It is possible to consider most traditional economic goals within the scope of model risk avoidance, utility theory, family consumption, and credit restrictions specifications. In order to incorporate all of these characteristics, a very large and specialized model is required. In contrast, the model user has the task of working from a set of highly cognitive goals and integrative activities. If the model is to be used in moving the group forward in both the integrative and economic areas, it must (a) be capable of incorporating existing goals, and (b) capable of moving decision makers toward a solution in a way and at a pace consistant with their decision processes. By requiring all models to externalize all normative elements which cannot be justified in terms of these goals and integrative practices situations requiring an exhaustive evaluation of economic alternatives in terms of operational economic goals are avoided.

In terms of the conceptual model, the notion that it should not aim at internal normative exhaustiveness implies that a close look should be taken at the comprehensive nature of its normative content. Its exhaustiveness virtually precludes its use in an integrative approach. Such exhaustive treatment is available only at a large cost in terms of development time, data acquistion, and delivery system effort even assuming that a suitable goal structure and quantification procedure is avilable. In addition to being expensive, the exhaustive treatment of fixed operational goals cannot solve the basic problem imposed by the need to commit resources to integrative (i.e. conflict resolution) tasks as well as achievement of economic goals.

The often cited joint nature of family consumption decisions and inability to formulate consistent long-run goals may run afoul of the required consumption function. Similar problems are likely regarding subjective probability limits on resource levels and credit restrictions. Provision of normative capabilities in the model simply adds cost to model development unless considerations relating to their use by the rest of the farm management delivery system are considered. If there is justification for the extensive normative content in the illustrated model, it must be other than that provided by an exhaustiveness as an ideal type.

Modelled Goal Orientations

The two arguments; (1) that farm decision processes are fundamentally non maximizing in terms of operational goals; and (2) that exhaustive analysis of normative considerations within planning models is not feasible, present a quandary for model builders. On one hand long-run non-technical planning situations present operational goals which must be translated into normative premises for analysis. On the other hand many questions regarding the proper relation between existing goals and objectives and planning models must remain unanswered because of the lack of adequate theory relating individual operational goals to group decision processes. However, enough is known to suggest that existing modelled goal orientations based on conceptions of economic rationality or on a rigid structuring of certain operational goals, are not likely to succeed in a farm planning setting.

A variety of normative contexts for decision making are implied by farm goals and decision processes, and extension practices. A case can be made for the development of models with a high level of flexibility of normative content. Generalizations presented in previous chapters indicate (a) that family goal structures are very diverse (V2, V3, V4, V9, V10), (b) that a variety factors determining normative standards are generated over the planning period (IV 4, IV 3, IV 6, VI 2, VI 11), (c) that normative standards evolve over the planning period (V7, VI 1, VI 4, VI 9), and (d) that extension involvement varies from one application to another (VIII 2). This variety of normative contexts implies that, either model normative content will have to be flexible, or that a special model will have to be built for each normative context.

Matrix size [31] and resulting usage and data assembly costs place limits on the amount of normative and environmental detail which can be included in any model. Chapter III has illustrated that increased model detail on a particular normative aspect, say consumption, is only available at the expense of either model size, or at the expense of other aspects either normative or environmental. For example, it has been shown by Baker [8] and Cox [31] that the illustrative model incorporating both utility and liquidity preference concepts is theoretically possible.

However, very large matricies are needed to represent even trivial production environments [31].

Given the need for normative flexibility it is interesting to note the rigidities built into programming models. For example a number of normative dimensions which appear to have widespread currency among model builders and in some cases among farm management extension personnel have no justification in terms of group decision making. In particular, market rate discounting practices fall into this category.

Farm goal structures provide no magic formulae for arriving at a subjective time preference. Since goal formulation for future periods is particularly hazy, and since family goal structures are dynamic, time weightings are at the same time extremely important and difficult to establish. The usual procedure in determining time preference weightings has been to use traditional "objective" market rate discounting procedures. Even given the required assumptions of, (a) goal achievement defined in terms of stream of money, (b) a perfect capital market, and (c) single valued expectations, it appears most unlikely, in view of the widespread nature of liquidity preference and debt avoidance goals, that groups have the flexibility in converting streams of money into desireed streams indicated by discounting procedures. Subjective weightings have been proposed as a solution to the problem.

In conclusion the variety of planning situations implied by firm goals and decision processes suggests the need to cope with a large number of normative contexts. The need for such flexibility is consistent with the use of a large number of models each specialized in a normative sense or with the use of generalized models with very limited normative content. Preliminary evidence [15] on the use of planning models by extension agents further suggests that the latter alternative is most likely to succeed because of the tendency of agents to limit the number of models used. This procedure shifts the basis for the model goal orientation from a concept of economic rationality to implicit assumptions about relations between operational goals which evolve over time.

The implications of these comments to the illustrative model are clear. Discounting on an "objective" market rate basis may bias model results in a way that has no particular relation to existing normative standards. More important however, is the rigidity built into the model goal structure. While it is true that operational consumption and credit goals may be important in given situations it does not necessarily follow firstly that they have the structure imposed by the model[1] and secondly

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[1] The discussion of Bakers [7,8] model of liquidity preference and consumption in Chapter III displays one way of structuring such goals in its choice of measures of performance, functional forms and weighting factors.

that the inclusion of these goals is consistent with necessary integrative processes.

Utility Theory

Utility theory has often been a guiding light in the model builder's search for more useful farm planning aids and as a result model building strategies have often been justified by referring to normative parallels in utility theory. For example, efficient set risk preference models incorporated in a quadratic programming framework have often been suggested because of the logical relation of such models to a one dimensional concave utility function, rather than because of any empirical justification arising out of observed desires to determine trade-offs between risk and expectation in particular farm management applications.

In a sense, utility theory runs afoul of the very thing with which it is supposed to cope most effectively. That is, risk and uncertainty. As Dillon [36] has noted, a succession of analytic techniques in Agricultural Economics has been developed but none have played substantial roles in real world decisions. He pinpoints their fault as one of ignoring risk and uncertainty in the decision environment. While, as he notes, utility theory does manage to cope with the dynamics of real world environmental risk and uncertainty, it does so by building on a base of assumed <u>static</u> and <u>known</u> real world normative standards.[2] This base that must be rejected on the basis of generalizations IV 2, IV 3, IV 5, IV 6, V 8, VI 1, VI 3, VI 6, VI 8 and VI 10.

To illustrate, the validity of the utility function in the illustrative model is dependent on, established exhaustive normative standards covering the set of income outcomes and on some method of achieving group compliance with utility axioms, being available.[3] Appendix III A has

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[2] The most substantial theoretic finding of this thesis has implications which lead beyond the topic of major interest. The rejection of classical economic theory of normative intent, "utility" theory, in the case of the family farm firm, raises questions regarding its validity in other spheres. One is led to ask questions regarding the number of substantial economic decisions which can be viewed as those of solitary decision makers with the exhaustive goal structures and consistency required in axiomized decision behaviour. The recognition of normative standards as part of a process in the farm family group points out one more case in a pattern established by Arrow, Fishburn, and others in their attempts at providing an analystic base for group decision making and by behaviourist theories of the firm such as that developed by Simon.

[3] It is assumed here that no method of aggregating individual utility functions is available.

pointed out that both possibilities are remote as a result of evidence of shared decision making, incomplete goal structues, and inconsistent goal structures presented in Chapters IV, V, and VI.

In practice (See Chapter III) utility functions have been the "farmer's" utility function and have been based on his replies to questions relating incomplete lotteries. The illustrative model proposes to evaluate a stream of income on the basis of such a function. Evidence presented on the nature of actual farm decision process (Chapter VI) implies that at the very least, decision making in the income dependent areas on consumption and investment are a joint responsibility of all family members. At worst, these are primarily the wife's area of responsibility in decision making and the farmer's utility has little to do with actual decision processes related to income distributions. Utility theory does not have strong theoretic support for use in farm planning. It represents an untried hypothesis which may have some validity quite apart from the validity of axioms used in its derivation.

Questions regarding the validity of utility theory in a group decision context suggest as well that the declining marginal utility assumption which is often invoked to support the use of declining weights (for example, in risk assessment, consumption functions or in liquidity reserves assessment) in programming models may not be valid in some cases. Social phenomena such as "risky shift" make it perilous to project individual risk behaviour to the group level.

The Management Consultant's Role

The fundamentally integrative nature of decision tasks to be performed in major planning situations has been cited as a major reason for rejecting models which assume some form of maximizing behaviour. Since in all but their most elementary aspects, the processes involved in integrative functions are themselves deeply rooted in abstract personal goals and only intuitively understood, it is not possible to model the development of normative standards within the overall resource allocation model. The allocation of resources to meet apparent management objectives can be regarded as an analysis conditioned on the requirements of a particular set of integrative activities. Under "Modelled Goal Orientations", it was concluded that a varied and flexible normative base is required to accommodate existing group goals in this conditional analysis.

While it is possible for decision groups to carry out the type of conditional analysis suggested during the course of reconciling conflicts and establishing group decision standards and practices several factors suggest that farm management extension agents will play a decisive role in the process.

The status of decision aids as an innovation, the role of decision analysis in the acceptance of ther innovations, and the orientation of farm management extension programmes toward teaching and supporting improved farm decision making all suggest extension involvement in the utilization of acceptible programming models. However, at the consultant level, little is known of the methods which are or may be used in developing better managerial decision processes. In many cases, it appears that too little is known to permit even the posing of questions relating to whether or not to internalize normative intent. In these areas, the most apparent answer is to obtain the best available information from those who have been working with farmers in management decision making.

Until we know more precisely what the farmer wants, how well he knows what he wants, how the consultant carries out his role of assiting in the determination of goals and establishing means to achieve these ends, it will be most difficult to answer questions of the type: (a) How long should the time horizon be? (b) Is gross margin a relevant criteria? (c) What types of constraints should the farmer and his consultant be permitted to impose on in the model? (d) Should a consumption function be internalized? (e) Is the model to be used in an on line mode for workshops or for personal consultations? Questions of this type are important and must be answered if programming models are to be developed and operated at a reasonable cost.

The role of the consultant presents a virtually unlimited number of normative contexts depending on the problem at hand, the overall objectives of the extension agency, and the techniques used. The influence of the consultant, however, is likely to be much less dynamic that that of the decision group itself as a result of highly structured farm management extension goals, and specialized training in problem solving and extension techniques. In view of these factors, it appears reasonable to conclude that models which are to be feasible in decision situations incorporating the role of farm management extension specialists must be consistent with (a) the overall objectives of the agency involved (b) must be consistent with the problems addressed by the agency, and (c) must be consistent with extension techniques considered suitable by the agency.

Conclusion

On the basis of the major criterion presented and its four corollaries, it is concluded that the original hypothesis is acceptable. That is, (a) it is possible to establish criteria which distinguish between the normative propositions of programming models which will be usable in farm decision making and those that will not, and that (b) such criteria are implied by existing research results and theory.

While an empirical test of the above hypotheses has been deliberately avoided some empirical evidence exists which supports the criteria developed as extensions of farm family decision making theory. Recent statistics on the usage of computerized planning aids by farmers indicate that models of the type supported by the criteria are being utilized to some extent while other models are not at all.

All 35 maximizing models reported in Table (8.1) meet the five proposed criteria as a result of their limited normative content. In general, models in current use have short time horizons and deal with technical decision making in a way that has a clearly favourable effect on income distribution. The result is a weak test of the criteria since major planning situations are not involved. Five financial analysis models (one year) are available however and it is noteworthy that none incorporate sophisticated noramtive concepts. They appear to be used in a manner similar to ordinary budgeting procedures and are clearly not regarded by their users as a source of "optimal" solutions, and thus maximizing behaviour is not assumed. Their generality allows the inclusion of a large number of operational goals on which analysis may be conditioned and the incorporation of farmer goals is at the discretion of extension agents who use the models as part of their ongoing farm management extension activities.

TABLE 8.1

MAXIMIZING MODELS[1] USED IN U.S. AGRICULTURAL EXTENSION PROGRAMS, 1972

CODE NAME	UNIVERSITY	ALGORITHM	USES	TIME HORIZON	SUBJECT MATTER		
					TECH.	FINANCE	NUTRITION
Dairy Ration	Auburn	LP	75	S. Run			✓
Poultry Ration	Auburn	LP	432	S. Run			✓
Dairy Ration	Georgia	LP	150	S. Run			✓
Crop Optimizing	Iowa	LP	120	1Yr.	✓		
LP-Farm	Kentucky	LP	150	1Yr.		✓	
Feedcow	Main	LP	60	S. Run			✓
FM Man LP	Massachusetts	LP/QP	200	1Yr.	✓		
Fertilizer	Massachusetts	LP	30	1Yr.	✓		
Dairy Feed	Massachusetts	LP	40	S. Run			✓
Optima (Dairy)	Massachusetts	LP	100	1Yr.	✓		
LC Dairy Ration	Mich. (Telplan Syst)	LP	3836	S. Run			✓
LC General Ration	Mich. (Telplan Syst)	LP	263	S. Run			✓
BF Feeder LC Ration	Mich. (Telplan Syst)	LP	300	S. Run			✓
Corn Ent. Plan. Guide	Mich. (Telplan Syst)	LP	140	1Yr.	✓		
Corn Soy. Plan. Guide	Mich. (Telplan Syst)	LP	49	1Yr.	✓		
Corn Lvstk. Plan. Guide	Mich. (Telplan Syst)	LP	197	1Yr.	✓		
Feed Lot Ration	Minnesota	LP	30	S. Run			✓
BF Swine Ration	Mississippi	LP	130	S. Run			✓
LC Dairy Ration	Mississippi	LP	40	S. Run			✓
Animal Prod.	Ohio	LP	Hundreds	S. Run			✓
LP Farm	Oklahoma	LP	60	1Yr.		✓	✓
Feedmix	Oklahoma		80	S. Run			✓
A3 (Corn Prod)	Purdue	LP	60	1Yr.	✓		
A4 (Corn Prod)	Purdue	LP	80	1Yr.	✓		
B6 (Crop Prod)	Purdue	LP	300	1Yr.	✓		
Swine Ration	Purdue	LP	800	S. Run			✓
Poultry Ration	Purdue	LP	400	S. Run			✓
Dairy Ration	Purdue	LP	100	S. Run			✓
Rapid Adjust	Tennessee	LP	25	1Yr.		✓	
Feedmix	Texas	LP	78	S. Run			✓
Dairy LP	Vermont	LP	30	S. Run			✓
Dairy	VPI (CMN System)	LP	60	S. Run			✓
LP	VPI (CMN System)	LP	100	S. Run		✓	✓
LP002	VPI (CMN System)	LP	80	1Yr.		✓	
LPFR	VPI (CMN System)	LP	50	N/A	General Purpose		
LP Farm	West Virginia	LP/QP	50	1Yr.		✓	

SOURCE: U.S.D.A., Extension Service, Inventory of Farm Management EDP Programs (Washington D.C., 202050,1973).

[1] Models reporting > 25 uses, use in extension, and

The validity of criteria presented is primarily dependent on a logical connection to several well supported generalizations regarding decision making processes of farm groups. A stong case has been made for the rejection of any model aimed at a major farm planning problem which fails to recognize the central role of integrative activities by concentrating on the achievement of apparent goals. Such a criterion is rooted in the nature of individual values, value orientations and conflict resolution processes. Based on this criterion, two strongly supported corollaries are possible. Firstly, the recognition that maximizing behaviour in terms of the firm's goals is not desireable indicates that model builders should focus on integrative requirements rather than normative exhaustiveness. Secondly, the large variety and dynamic nature of goals suggest that models should be capable of analyses conditioned on a wide range of firm goals.

Weakly supported corollaries are possible in two additional areas. Firstly utility theory is rejected as a base for farm firm decision making since it represents a typical maximizing model and in addition focuses on individual decision making. This corollary is weakly supported however since few data are available regarding the strictly pragmatic value of results presented by utility models in situations of conflict resolution. Secondly it is suggested on the basis of some literature on extension agency objectives and techniques and on diffusion theory that the conditioning base on which models should build will be defined within the context of individual extension practices and objectives.

At the outset of this thesis, the need for a theoretic base for farm firm purposive behaviour, on a more fundamental level than that provided by traditional normative concepts was stressed (some of the reasoning behind this stress is established more clearly in Appendix A). The search for a theoretic base for farm firm purposive behaviour was conducted in those areas of small group decision making which are of special interest to farm firm decision making. Supporting and specializing generalizations were sought in the areas of rural sociology and extension education.

This study has been a limited success. While no better theoretic base than that used seems available, it must be recognized that research in areas of particular interest to farm firm decision making has been extremely limited in both breadth and depth. In many cases, we simply do not know the nature of the decision processes involved (considered further in suggestions for further research). For this reason, it has only been possible to develop model evaluation criteria at the non-specific level of previously cited conclusions. Although these criteria make useful suggestions, a more adequate theoretic base would no doubt provide additional guidance for increasingly expensive model development projects.

As the use of decision aids in farm firm management expands, continuing effort to establish an adequate normative theoretic base for farm firm decision making must continue. The continuing development of management aids will bring with it its own supply of rules of thumb, generalizations, pragmatic vindications and the like as substitues for more adequate theory. The temptation to rely on these must be resisted if an efficient long-term development strategy is ever to be developed.

CHAPTER 1X

FUTURE RESEARCH

The nature of this inquiry has led to many more questions than it has answered since no direct empirical verification has been involved. The stand was taken that criteria, in the sense of supportable generalizations, are needed for the evaluation of normative elements in programming models. One more empirical model developed for a specific application and test was not likely to result in such general criteria. Farm firm decision research and theory offered an approach to obtaining such general criteria as an extension of already tested generalizations. Criteria developed in such a way are untested hypotheses in many of their aspects. The following chapter develops research implications arising out of suggested criteria in two broad areas: (a) Suggested Research in Farm Firm Decision Making and (b) Suggested Research in Normative Model Development.

Suggested Research In Farm Firm Decision Making

If mathematical decision models are to have the impact on farm practices that many believe possible [120], much research remains to be done to establish the nature of the system in which these models must operate. Both fundamental research into decision processes and research aimed at a more efficient operation and development of delivery system elements are required.

Farm Firm Decision Processes

The absence of a significant normative content in the vast majority of proposed programming farm planning models has been noted in the discussion in Chapter 111 of programming models. Contrast with the extensive development efforts in the area of environmental description is striking, but hardly surprising. In recent decades the focus of farm management research has continued to narrow to the point where it is virtually undistinguishable from that of production economics. This focus has contributed to the generation of a complex body of theory describing the interaction of production processes, economic institutions, notably prices and markets, and decision units in the form of axiomized profit seekers. Farm planning model development projects based on established production economic theory have resulted in numerous programming models which have done an excellent job of describing the physical and institutional decision environment.

On the other hand, a dirth of research into the nature of economic decision making in farm firms has resulted in a correspondingly shallow and tenuous body of theory which has not generated an enthusiastic following amongst operationally minded researchers who are primarily interested in applying theory rather than developing it. A reemphasis on basic decision making research may in the long run, provide a body of theory which will permit the development of useful normative content in farm planning models.

If farm planning models are to be efficiently developed and deployed, it is crucial that research be done to determine the nature of farm decision systems and specific problem areas inherent in them. A major problem in carrying out this study has been that there is very little factual information available on farm decision systems. The distribution and significance of problems inherent in these systems must be known if priorities in development and deployment are to be established. Such research must get down to specific issues. We must know more than the number of farmers who face, for example, machinery replacement problems. We must know why machinery replacement is a problem. Is it such an imposing technical dilemma that most farmers cannot calculate the likely outcomes of alternate courses of action? Is it because overall planning goals have not been defined sufficiently to establish replacement goals? Is it because consumption flow conflicts are involved? Is it because risk potentials are difficult to guage? Is it because physical performance information is unavailable? Is it because the relationship to whole farm planning presents a dilemma to decision makers? Is it because decision makers compartmentalize their decision processes in order to arrive at workable solutions?

In concentrating on the nature of farm decision systems, attention should be directed primarily at the group decision making aspect. The need to consider group decision processes has been presented in several instances. Viewed in a group rather than an individual context, the development of decision criteria for optimizing approaches to farm planning takes on an entirely dirrerent perspective. We are not trying to develop a functional model of a rational preference system after the manner of the axiomatic relative value systems of von Neumann-Morgenstern [136], and others. Research should be directed at trying to develop models of the relations within and between individual goals which result in the objectives and conditions emanating from a family decision group. From this model of family social interaction and a consideration of delivery systems problems, it should be possible to develop decision criteria which are consistent with the conditions of group decision making and, in some sense, the highest possible degree of individual satisfaction within the group context.

In addition to inquiry into farm firm decision processes, there needs to be more inquiry into the commonly used utility theory foundations for establishing firm decision criteria. Although there appears little theoretic support for using utility concepts in farm planning models, some aspects may still be considered valid hypotheses and worthy of empirical testing. For example. the efficient-set approach generally taken by farm management model builders may allow some elements of group decision making to enter, by making assumptions regarding the nature of the utility function sufficiently broad that they are essentially valid for all group members. In choosing from the efficient set thus derived, group members may pursue a process of reconciliation which allows for necessary elements of group conflict resolution. The point is that the validity of suggested efficient approaches remains to be empirically established for the group context.

Although it is far from operational, it may be useful to conduct research into the validity of the welfare function approach as a basic model for normative analysis in farm management. In a broad perspective, the difference between utility oriented approaches to farm management and group decision approaches is in the method used in resolving conflicting family interests. At best, the utility approach leaves what constitutes "fair" resolution rules up to a single participating individual. At worst, the resolution rules are de facto, the largely unrecognized psychic processes involved in the individual's value formation. The group welfare approach, on the other hand, recognized the role of conflicting individual values and explicitly formulates "fair" rules for conflict resolution which can be considered by the participants in the group decision process. It attempts to rectify a major failing of utility theory and should provide a useful avenue for future research.

The Delivery System

A delivery system strategy must go beyond the problems of model building to consider the problems of both farm management extension programming and model building. In this sense, decision aids become part of a delivery system which transports management education and services to farm decision units. The fundamental problem is one of determining an optimal mix of computer oriented and other types of management programs. A related question is to what degree normative elements should be internalized in decision aids and to what degree they should be left to other agents in decision processes.

A great deal of research must be done in finding the best ways of integrating decision aids into farm decision processes. That problems are inherent in integrating this new technology is clear from the adoption research done by extension educationists and rural sociologists over the last 50 years. The problem is even more complex in this case, however, since this new technology involves changing the nature of the decision process itself. Adoption and other social research gives some indication about the relation of goals and conflicts to the acceptance of new technical matters and in a sense has allowed the generation of some form of an optimal strategy for extension workers. What this optimal strategy involves in the case of decision aids is another matter. Many empirical studies are needed relating the acceptability of individual aids in various family decision situations. At an even broader level, studies must be done to determine the distribution of various extension techniques, goals and conflict resolution processes if models are to be developed, to serve individual farm consultations in a strategically efficient manner.

Suggested Research In Normative Model Development

While the literature abounds with models claiming to have some degree of relevance, it is rare to find one which has been subjected to a rigorous testing procedure particularly with respect to its normative precepts. From a farm management point of view, what we need is not more research aimed at conceptual model development (particularly in the area of accommodating the decision environment), but more research aimed at determining the validity of model normative content in various decision processes.

Several major elements of modelled normative intent cited in Chapter III suggest themselves as candidates for more rigorous testing procedures in view of theoretical questions regarding their validity suggested by Chapters IV through VII. Utility, time horizon, and choice criteria concepts appear to be among the more important areas for future inquiry.

Utility

The validity of utility as a theoretic base for normative intent has been placed in doubt by the social context of farm decision making. The worth of utility functions as an operational decision aid is another question. Serious research regarding the validity of utility as an aid in decision making has been limited to a few studies (for example,[134, 80, 94]). These studies have been aimed primarily at assessing validity in a positive sense. Questions relating to the validity of utility functions in various normative systems and decision making contexts have yet to be framed, let alone answered. Roles[1] must be defined for utility in these various systems and contexts and the performance of these roles assessed through empirical studies which include derivation, use and assessment of normative performance.

Time Preference

While considerable evidence exists which suggests that the distribution of family income is a focal point in farm family decision processes, little attention seems to have been paid to the role of time discount rates in determining the income distribution obtained from programming actual problems. In the usual case, it has either been assumed that (a) "the" market rate as estimated by the farmer, approximates in some way his

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[1] We have established that this role is not likely to be a complete internalization of normative elements in decision models.

time preference, or (b) that outcomes are not particularly sensitive to the discount rate used. It should be profitable to investigate both the sensitivity to discount rate change of relevant outcomes in actual decision situations, and the development of operational procedures for establishing time preferences which have some foundation in actual decision processes. Many current uses of time preference lend a magical, black box aura to proposed farm models that have credibility in the decision unit's eyes as one of their basic objectives.

Time Horizon

The usual approach to time-horizon specification in operational farm planning models can be classified as a going concern principle. For some period in the future, the decision unit establishes a set of normative restrictions which, for it, constitute sufficient consideration of time periods beyond the time horizon. There is a need for research to specify more precisely the effect of various going concern formulations on model outcomes.

Choice Criteria

The question of how to establish trade-offs in choice criteria is still with us, in spite of suggested parametric solutions, since in many cases there may be too many combinations. More study of the situations under which trade-offs are required and of efficient means of establishing what those trade-offs are is required. This question is particularly apparent in the risk area. If risk is to be incorporated into multi-goal farm planning procedures, more research on the techniques to be used in establishing trade-offs is required, for example in what situations an efficient set approach would be legitimate.

APPENDIX A

OPERATIONAL UTILITY THEORIES IN FARM MANAGEMENT

The importance attached to uncertainty in planning environments and pervasiveness of utility theory in the development of risk planning criteria leads us to conclude that useful criteria must in some measure aim at the applicability of utility concepts involved in programming models. For strategic reasons it has been decided, in developing a programming context, to consider only those models which have some claim to operationality. The ease with which a great many utility concepts can be incorporated into a wide range of programming models, and their extreme historical significance in economic theory, however, suggest that a relaxation of this strategy might be useful in the case of utility. This appendix considers the nature of utility models, which have been suggested in the literature as operational in any farm management context. A still wider examination of the entire range of utility models and their usefulness in firm group decision making could of course have an important bearing on criteria development. Such an examination has not been made to date, and is beyond the scope of a single research project aimed at a more general subject matter.

A second reason for dealing with utility theory at a more comprehensive level in this Appendix lies in the rejection in this thesis of accepted analytical value theory as a datum against which normative content in programming models might be measured. As will become apparent in this appendix, the grounds for rejection lie not in the logic of utility or value theory but in its normative primitives.

This appendix considers questions related to the adequacy of utility theory as a theoretic foundation for farm decision making. The first section considers the logical structure and use of utility theory in farm management. The second section takes up the question of theoretic validity arising from two different approaches to utility in a group context (a macro and a micro approach). It is left to Chapter 111 in the main body to consider the more specific role of utility, as it has been used in programming models, in defining the "Programming context".

Logical Structure and Use

A great profusion of axiomatic[1] prescriptive utility models has been developed in the last two decades. If any among these axiomatic systems is accepted, then it is "rational" to assign a fixed single number (utility) to each of all possible outcomes and to assign a single fixed number (probability) to each situation or state of the world, and to choose at all times the action with the highest expected utility Becker and McClintock [11, p. 243, or Dillon, 36] .

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[1] An excellent review of the utility concept and its axiomatic development may be found in Becker and McClintock [11]; more specialized presentations are in Fishburn [41, 44, 45] while farm management oriented treatments are given by Halter and Dean [54] and Dillon [36].

The role of prescriptive utility theory in farm planning models has been primarily supportive. Use of certain broad assumptions regarding a decision maker's utility function has for example, allowed the development of an efficient set approach based on maximizing expected utility. On the other hand, the use of large numbers of parametrically varied objective function weights in models often makes it expedient to estimate rather than parametrically varying weighting factors whenever possible. In such situations the full operational specification of a utility model must be explicityly introduced into the programming model which maximizes expected utility.

Utility contributions to farm management modelling appear to fall generally into two areas. Firstly, the concept of a monotonic increasing utility function exhibiting diminishing marginal utility has often been used as support for placing a diminsihing marginal weight on goal achievement as the level of achievement in a given area increases (for examples see chapter 111). Secondly and more significantly the utility concept has been used both explicitly and implicitly in developing choice criteria in risky situations. In this case it is common to find a utility function defined on one or several monetary continuums and exhibiting diminishing marginal utility, either explicityly measured and incorporated as a choice criteria or required to validate the use of an efficient set approach. For example, Makeham, Halter and Dillon [83] have demonstrated the development of a quadratic utility function and Officer and Halter [103] have derived utility functions using three different techniques. In both cases functions were developed for use in an expected utility approach to decision making under risk. A number of studies incorporating a maximization of expected utility objectives is reported in Chapter 111.

Utility is based on the proposition that there exists for each alternative state of affairs and each individual, a dimension relating worth or value of that alternative for the individual. If, as Becker and McClintock [11, p. 107] state, "It seems reasonable to assume that, whenever a person prefers one object to another, he places a higher 'value' on that chosen, as compared to the one rejected", we can proceed on the basis of personal responses to make inferences about his underlying value orientation, assuming of course, that it remains constant during the observation period.[2] The value of a given state of affairs in conceived of as consisting of two components, the first relating to belief in its eventuation or subjective probability, the second to its utility or

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[2] The assumption of a value orientation capable of reducing a diverse group of situational characteristics to a single dimension has had a number of unresolved problems relating to how values combine and how they depend on situational changes. See for example [119, Chapter IV] .

attractiveness. In situations of absolute certainty, individuals are presumed to desire maximization of their utility. In the more usual case of some degree of uncertainty, individuals whose orientation satisfies any one of a number of closely related axiomatic systems, desire maximization of their expected utility [Fishburn, 44; Becker and McClintock, 11; Luce-Raiffa, 81, Chapt. 2; Von Neumann-Morgenstern, 136, Chapt. 1; Dillon, 36].

Utility models exist which place a wide variety of demands on the decision maker's ability to order alternatives and his subsequent decision making behaviour. In establishing a programming context for farm planning, we are interested in those utility models and concepts which have provided either operational or theoretic support for the normative content in farm management. To date these have been "exact" utility models, that is models implying a one to one mapping of consequences onto a value scale identified up to a linear transformation. The multigoal nature of utility functions has been investigated by several researchers [36]. Depending on whether or not trade offs have been possible between all goals, analysis has been based on either a one dimensional or a multidimensional (lexicographic) utility measure. This appendix does not distinguish between multidimensional and single dimensional utility measures since, for our purposes, the arguments to be presented are essentially similar save that continuity is required only over selected areas of the decision space confronted for lexicographic utility.[3] The model develped by Rae [112] (discussed in chapter 111) is capable of incorporating both types of multigoal utility functions.

Classical decision theory as developed by Von neumann-Morgenstern, Savage, and Suppes and Winnet [Fishburn, 44, p. 7] has aimed at the development of a real valued utility function, unique up to a linear transformation and capable of a weak ordering on Q, the set of consequences being considered. In general the approach of each has been to axiomize certain individual behavioural patterns and to show that these imply the required weak ordering on Q. Since behavioural assumptions in various "exact" utility models are roughly equivalent (contrast Luce & Raiffa, [81, Chapt. 2]; Von Neumann-Morgenstern, [136, Chapt. 1]; Fishburn, [44, Chapt. 4]; or note Becker and McClintock's review, [11]; or Dillon's review, [36]) only the approach that Fishburn [44, pp. 123-126] has used in illustrating problems inherent in "exact" or interval measures of utility is presented.

We can begin by defining a preference relation $\succ$ and an equivalence relation $\sim$ defined on a set of consequences $Q = Q_j$, $j = 1,\ldots,m$. The relation $\succsim$ is a weak ordering of Q. That is for every Q_j, $Q_k \in Q$ either $Q_j \succsim Q_k$ or $Q_k \succsim Q_j$ or both. In addition the relation is transitive. If it can be assumed that the decision unit is able to choose from a finite set of alternatives, Q, a most desireable consequence Q_1 and a least desireable consequence Q_r such that $Q_1 \succsim Q_r$, and that for every triplet $Q_1 \succsim Q_j \succsim Q_r$, j= 2,..., r-1 there exists a probability P_j, $0 \leq P_j \leq 1$ such that $Q_j \sim$ the gamble Q_1 with P_j, Q_r with $(1-P_j)$ (ie. Q_j (Q_1, pj, Q_r)) we can with the help of one further assumption determine a value measure for Qj. That value V(Qj) is unique up to a linear transformation. The further assumption is that $V(Q_j) \geq P_j V(Q_1) + (1-P_j)\ V\ (Q_r) \leftrightarrow Q_j \succsim (Q_1,\ P_j, Q_r)$[4]. We therefore have, given the above assumptions, $V(Q_j) = P_j V(Q_1) + (1-P_j)\ V\ (Q_r)$. After arbitrarily setting $V(Q_1) = 1$, $V\ (Q_r) =$, we have $V(Q_j) = P_j$ and we have our measure for $V(Q_j)$.

It is usual to interpret the assumptions of a utility model when used in normative analysis as a set of criteria for "rational" behaviour of the decision making

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[3] Recall that trade-offs between certain goals are by definition not possible in this case.

[4] As Fishburn notes [44, p. 124] this particular assumptions that the relative value of a hypothetical lottery is given by the expected value of its component relative values often emerges as a theorem from more primitive axioms in other models (eg. Luce-Raiffa [81], Von Neumann, Morgenstern [136], and Dillon [36]). In any case, given that a decision maker's preferences can be represented by a utility function identified up to a linear transformation and defined on a set of hypothetical lotteries, he is behaving as an expected utility maximizer.

unit.[5] Given a clearly formulated individual goal-value structure which facilitates the development of a transitive weak ordering of alternatives, and the will and ability to obey other axioms of behaviour, an individual utility function can be measured. A group, such as the farm family, however is not an individual. It cannot always will its preference system to follow axioms of "rational" behaviour (for example transitivity over time).

Validity for the Farm Firm

The aim here is not to attempt to analyse the logical structure of the utility concept in general, but to note that its primitive axioms of ordering, continuity, and independence have several disadvantages in a farm planning setting, which arise generally as a result of the fundamental social nature of decision making in farm planning.

The basic problem of applicability of utility theory in farm planning stems from the fact that it is essentially a theory of individual decision making[6] being applied in a situation involving group decision making[7].

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[5] Any decision unit which finds basic utility axiom's acceptable must, to be logically consistent, choose the alternative having the greatest expected utility. This requirement of logical consistency can of course, be questioned in its own right. (For example, see[142]).

[6] This fact appears to be well recognized by researchers of utility. The applicability of utility theory in farm planning hinges on the popularily accepted belief that, "In fact group decision making is not particularly relevant to farmer decisions" [Dillon, 36,p.54].

[7] Much of this thesis is devoted to developing the concept of group decision making within farm firms.

In extending to the group level it appears that two polar approaches to interpersonal conflict resolution are possible. In the first instance (macro approach) we can accept individual models of acceptable normative standards and attempt to devise "fair" rules of interpersonal conflict resolution which are necessary to allow the generation of a model of group normative standards. In a special case noted below, this set of rules is a null set. In the second instance (micro approach) we can attempt to achieve conflict compromise at the level of individual normative standards and build a unitary "group acceptable" model for which individualistic, expected utility axioms are valid. The second approach differs from the first in that individual normative standards are not accepted at face value, but rather are viewed as fertile ground for compromises necessary to allow development of a "group acceptable" uitility function.

Macro Approach

Conflict resolution then is at the root of differences in approaches to utility in group decision making. It is illustrated below that the macro approach takes individual normative standards as fixed and either ignores conflict (dictatorial functions), builds around conflict (Pareto efficient set approach), or builds a complete system of group choice based on "fair" rules of conflict resolution (social welfare function approach).

A micro approach meets the conflict problem head on and attempts to develop a compromise at the individual level which allows group acceptance of expected utility based rationality.

A basic difficulty in applying the macro approach to utility theory in farm planning can be illustrated by assuming for the sake of argument that a utility function can be defined and represents accurately the preference system of each of several family members. Each individual in facing his unique Psycho-socio-physical environment is willing to accept one of several available axiomatic systems which imply the existence of a utility measure. For each family member we therefore have a unique yardstick which measures the relative value of each alternative.

In the above farm planning situation we are clearly faced with an insurmountable problem in choosing an appropriate alternative for the group unless we can somehow aggregate individual utility functions to a group level or in some sense develop a "group acceptable" utility function (this is the micro approach to be discussed later). We could, in the first instance, assume that all functions were sufficiently similar that only one dictatorial utility function need be chosen to reflect the group normative intent. This is objectionable on at least three counts: (1) It is clearly running in the face of current democratic ideals, (2) It implies a completely unsupported use of interpersonal utility comparisons and (3) It completely ignores well documented evidence regarding conflicts between individual goal-value structures.

The second objection above suggests in fact that much of the analytic power of the assumed "exact" utility measures is superfulous in a group planning situation. Without a standard unit of utility measure for all individuals there is simply no way of taking direct advantage of information regarding relative strength of preference. That is to say it is not generally possible to use the preference strength information provided by exact utility functions in directly forming a super utility function which determines compromises on the basis of greatest interpersonal benefit. It may however, be possible to use such information in the form of individual utility functions and a Pareto optimality rule [113, Chapt.8] to develop Pareto efficient sets (having n tuples of expected utilities as elements) each defined on an interpersonal division of outcome from each possible alternative or lottery. A final choice from these sets can be made after necessary conflict resolution via "fair" rules of conflict resolution. In the special case of exponential individual utility functions the choice of a unique "best" efficient set and thus a unique alternative is clear - no conflict in choice of alternatives exists, although the problem of outcome sharing conflicts remains. In this special case, in effect, a group exponential utility function exists and is defined entirely on individual functions quite independently of outcome sharing. As Raiffa [113 Chapt. 8] has illustrated, it is not generally possible to develop a group utility function in the above sense even when outcome division is possible. Usable information is reduced to a set of say n, ordinal rankings of group alternative.

Von Neumann-Morgenstern [136, Chapt. 1, pt.3] Luce-Raiffa [81, Chapt. 2], Fishburn [44, Chapt. 2, 42, Chapt. 1] and countless others who pioneered the utility concept were careful to establish the uniqueness of their utility measure to a decision unit having a clearly unitary motivational structure. In fact decision making by several individuals may be more aptly protrayed in a game theoretic framework incorporating several competing utility functions. Conflict between individual goal-value structures is not accommodated within utility theory. It has however been recognized by the analysis of Arrow [6] in 1951, Luce-Raiffa [81] in 1957 and Fishburn [46] in 1969 and others who have taken individual ordinal preerence rankings and attempted to develop methods of aggregating to the "social welfare function"[8] level

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[8] In the words of Luce and Raiffa [81, p. 368] "Given the preference ranking (ties allowed) of m alternatives by the members of a society of n individuals, define 'fair' methods for aggregating this set of individual rankings into a single ranking for the society. Such a rule for transforming an n tuple of rankings - one for each individual - into a ranking for the society is called a social welfare function". The author knows of no farm management application of the social welfare concept.

without imposing interpersonal utility comparison by defining "fair" rules of conflict resolution. As with utility theory the primary objective is to establish a weak ordering on the set of alternatives open to the decision unit. "Fair" rules of conflict resolution define a procedure for going from individual orderings to a group ordering and are an area of current research in social welfare functions [46, 11].

In summary, the difficulty of operationalizing a macro approach to utility theory in farm planning is that the welfare function and Pareto approaches have not yet reached the stage where they are even being suggested as a possible useful tool in farm planning. Additionally three objectives to the use of dictatorial utility functions have been cited. The usual approach to utility in farm planning models appears to be founded on either a dictatorial utility function approach or at best on a macro approach for which no operational conflict resolution procedure has been specified - the group is simply assumed to find necessary rationality axioms acceptable. We now turn our attention to consideration of the acceptability of "rationality" in the group context.

Micro Approach

The micro approach can be thought of as using a utility function as a "group acceptable" preference function. The group itself accepts one of the available "rationality" prescriptions implying maximization of expected utility. We turn now to the consideration of certain commonly axiomized "rationality" rules for which it is argued that compliance is much more difficult to achieve for a group than for an individual decision maker.

In considering further the applicability of utility models in farm planning we can consider the mapping of certain basic rationality axioms into the decision processes of the farm firm, particularly as they are affected by conflict and its resolution. In addition it is useful to briefly review some problems inherent in obtaining the subjective probability data required to make use of group utility functions if they can be derived. We consider below, in order of presentation: basic ordering assumptions, including transitivity; continuity assumptions implying lottery certainty equivalence; the expected utility assumption and the diminishing marginal utility assumption.

Ordering Assumptions

Pairwise Ranking

Farm families by their very nature have members holding both common and conflicting goals which may translate themselves into common and conflicting demands on the farm firm. To the extent that conflicting demands exist, either conflict resolution or quasi resolution processes will play a part in what firm decision can be made. Many studies(reviewed in chapter V and following chapters) have reported a void in various areas of family goal formation, notably in retirement and estate planning, which may be as much a result of social inhibitions to considering various possible outcomes, as it is a result of weak personal preferences in these areas.

In view of restrictions imposed by the strong existential content in farm family conflict resolution and quasi resolution processes it appears most unlikely that anything like the required group ordering can be generally assumed at a given planning date. Conflicts do not disappear when the need to plan arises. In order to state preferences between various dynamic outcome sets, it would be necessary that either no conflict exists or the outcome of resolution precesses is known with certainty (in which case conflict would be most unlikely in the first place). Only given the possibility of a complete commonality of purpose, in which case the group would effectively be reduced to a single individual, could the firm carry out the required ordering.

The above argument can be illustrated by considering a young farm family whose individual goals for the farm firm are characterized by income dependence. Given income dependence, distributions of family income over time will be a focal point of goal conflicts between individuals. At any one time it is not likely that either all conflicts are resolved or have, for the individuals concerned, a determinate resolution. From a strictly positivistic point of view, it is clear that family education needs and estate planning requirements will force themselves on the group at some point in time. But for the present, family members may logically choose not to rank alternatives associated with meeting these needs because of deep seated elements of group conflict. Consideration of educational needs may have always in the past resulted in a bitter religious quarrel in the mixed marriage, and estate planning attempts may have commonly degenerated into a quarrel concerning the family's needs should the husband die and the husband's refusal to consider its repugnant possibility.

The argument here, is that ranking of outcomes is not always something that exists independently of actual choice between alternatives. To the contrary, ranking may be to a large extent impossible before a decision is taken. The ethical question of whether a decision group can be brought to a point where prior ranking is possible is a very significant one for farm management consultants. Where such ranking conflicts exist, consultants must take on a very real role in removing impediments to ranking and in the process accept, in possibly large measure, responsibility for resultant rankings.

Therefore in addressing ourselves to the feasibility of utility models in farm planning we must consider whether or not acceptable ethical standards and farm decision making realities permit the creation of a situation in which compliance with model rationality is possible.[9]

Intransitivities

Clearly, intransitivities will exist over time as individual and group goal-value structures change and as conflict resolution processes work themselves out. However, since planning must take place at a single point in time, a projection of group normative intent must necessarily be hypothetical. What we must ask is: Is it possible to form a group acceptable hypothesis of normative intent at a given planning date which permits no intransitivities? This is equivalent to the group deciding: (a) that it must have a static group goal-value structure and (b) that all members will behave in such a way that no intransitivities will exist during the quantification process.

In assessing the difficulty of group compliance with transitivity assumptions we could develop an argument along lines similar to that used in connection with ordering assumptions and conclude that there exist deep-seated social processes which render it unlikely that the group

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[9] The importance of this aspect is underlined by communication difficulties which have been encountered in establishing utility functions for individuals. Officer and Halter [103] report for example McCarthy and Anderson's [90] result that it was only possible to develop utility functions for 17 of 66 beef cattle farmers because of communication problems. Officer and Halter's study [103] of Australian farmers also points out the important practical implications imposed by the consultant's involvement. Different derivation techniques produced quite different utility functions.

can simply will intransitivity on itself. We could consider as we did there, the role of an outside advisor who might intervene in the group planning process in such a way as to remove impediments to group transitivity.

Support for the case against transitivity appears to be stronger than that against pairwise ordering. Many of the studies reviewed in this thesis have indicated that inconsistencies commonly exist at a given point in time, particularly between long-run and short-run goals. Harman, Hatch, Edman, and Claypool [55] in investigating the holding of eight major economic goals by Texas, Oklahoma, Kansas and Colorado farm operators found intransitivities to be the rule rather than the exception. Out of a possible 20 intransitivities, 89 percent of those interviewed committed at least one intransitivity and 45 per cent committed at least five.

Behavioural theory of the firm suggests that these inconsistencies are the normal course of events, and are in large part associated with certain quasi resolution processes. Processes such as local rationality and sequential attention to goals appear relevant here. A may logically be preferred to B, B to C and C to A in many situations where either different individuals have authority over the various preference orderings or there is agreement for one reason or another to simply follow different goals at different times. For example, consider a "local rationality" case where the husband has primacy in the business decision area and the wife has primacy in the consuption area. She decides on the basis of family consumption needs that outcomes are ranked $A \succsim B$. He, on the other hand considers that the ranking $C \succsim A$ is appropriate for technical reasons which bear strongly on his reputation as a good farmer. Their oldest son ranks $B \succsim C$ since these outcomes bear particular relevance to his area of authority. Each individual responding in his own area carries sufficient weight to establish that $C \succsim A \succsim B \succsim C$ which is, of course, intransitive. On pointing out the intransitivity, a consultant would, in effect, be arguing for a change in fundamental family power structures. If, for example, the husband relinquished authority in his area it could possibly be established that $A \succsim B \succsim C$.

Continuity Assumptions

A continuity assumption requires that there exist a hypothetical procedure for bringing about indifference between a know outcome and an incomplete lottery.[10] Briefly, the continuity axiom states that if $Q_1 \succsim Q_j \succsim Q_r$ then there exists a subjective probability P_j, $0 \leq P_j \leq 1$, such that $Q_j \sim (Q_1, P_j, Q_r)$. In considering this assumption, we are confronted by a problem in the interpersonal comparibility of two subjective notions, utility and subjective probability. It is argued here that the methods of utility used in farm management are here faced with difficulties similar to those previously considered with respect to

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[10] Incomplete implies that some element of the lottery is allowed to vary to bring about equivalence.

ordering and transitivity of outcomes.

Both the probabilities and the utilities involved in the continuity axiom are highly subjective. Each individual makes his own assessment of the worth of outcomes and his degree of belief in their eventuation. There is no logical justification for assuming that any two individuals will affix either the same probabilities or the same relative values on any given set of outcomes. Yet for a group-acceptable utility function, it must be possible to define something corresponding to subjective probability and relative value at the group level. It is difficult to conceive of the meaning of "degree of belief", or "relative value" at the group level. Are they modal, consensus, arbitrated, dictatorial or compromised in their relation to individual subjective probabilities and values?

For example, a farm family faced with hypothetical choice between a certain but moderate income level and the gamble between a higher and lower income must unequivocally select a single probability of achieving the higher income, which makes the gamble indifferent to the certain alternative. It is clear here that a whole range of family income goal conflicts and differing subjective notions of probability are likely to prevent complete agreement on a correct probability. Even if conflicts over a correct probability can be agreed upon, there still remain the problems imposed by differing notions of subjective probability and the relevance of this sort of "forced" conflict resolution. We could repeat this illustration using utility as the point of arbitration, and come to similar conclusions.

Raiffa [113, Chapt.8,pt.2] has considered some problems inherent in maximizing expected utility for a gorup-acceptable utility function. In the main, he notes problems revolve around the determination of compromising subjective probabilities for future states, compromise utility evaluations of various outcomes and maintenance of independence between these two sets. In a farm family situation with a considerable joint experience with on the farm stochasticity, it is possible that agreement on a large number of conditional probabilities may be reached (e.g. yield per acre given good weather). A greater difference of opinion may exist, however, on subjective probabilities of conditioning states such as weather, which, from an individual point of view, appear much less predictable. If extra information on state probabilities is available,[Raiffa 113, Chap.8] has suggested that individual differences may be resolved either at the prior or posterior probability level (that is either before or after the integration of such information).

Before leaving this analysis of utility it is useful to consider a broader perspective and its relation to farm management consulting. Raiffa [113, Chapt.8] has touched on the complex problem of relating utility functions to advice regarding utilities and subjective probabilities supplied by experts. He illustrates a process whereby a group utility function is arbitrarily formed by the decision maker by separately formulating his own utilities and subjective probabilities, say, by averaging on the basis of utility and subjective probability specifications of individual experts. It is noted that the use of such a process can lead to a group decision which agrees with no expert judgment. In this respect Raiffa reports Zeckhauser's proof that "no matter what procedure you use for combining the utility functions and for combining the probability functions, so long as you keep these separate and do not single out one individual to dictate the group utility and probability assignments, then you can concoct an example in which your experts agree on which act to choose but in which you are led to a different conclusion".

Maximization of Expected Utility Assumptions

The concept of expected utility is crucial to the utility concept, both as an operation which permits empirical determination of utility functions and as an operation which permits utility function analysis of risky alternatives. In the first instance probabilities are held to rationally establish a >, < relation between hypothetical lotteries[11] when applied to the various hypothetical outcomes in the manner of mathematical expectation. In the second instance, the same notion is used to establish preference between risky outcomes of various alternatives on the basis of the magnitude of outcome utility combined in the manner of mathematical expectation.

Maximization of expected utility is a rationality axiom based on two subjective elements, utility and subjective probability, and a linear expectation operation defined on them. In a group context the feasibility of the expected utility concept lies in the group acceptability of the implied independence of subjective probability and utility. Subjective probabilities for each individual indicate beliefs regarding future states of nature, while utilities relate the attractiveness of various outcomes.

In the course of applying utility theory to actual problem situations, it is usual to invoke some form of diminishing marginal utility. In a group setting, it is arguable that this assumption has all of the problems which have been defined at the psychological level plus additional ones. At the individual level, Katona [69] has noted that this assumption is not in agreement with psychological research relating to goal directed behaviour, primarily because of the dynamic nature of

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[11] The continuity assumption previously discussed asserts that these lotteries have certain properties which permit determination of utilities for given outcomes.

individual aspirations. A similar argument appears to hold in the micro cases. Zander [149] has pointed out that group aspirations are clearly dynamic, clearly affected by past performance, and clearly affected by the interaction of group members during the planning period.

An alternative to a micro approach based on group acceptability of axioms could consider one individual in the group who, unlike the dictatorial approach, was "all seeing" in his treatment of the normative intent of other group members. In essence, the validity of this utility approach would depend upon this individual decision maker's ability to impartially observe the outward manifestations of the private fact of other group member value structures, his ability to impartially and accurately interpret them, and on the "fairness" of the rules he applies to resolve inherent value conflicts. In this connection, it should be recalled that observable public manifestations of values reflect the interaction of values and the individual's belief structure, and that the decision maker has a more or less important stake in decision making which may bias his actions as observer, interpreter, and adjudicator. No individual's preference system is likely to meet all of the necessary requirements. At best, he has a preference system that will have an important bearing on the way he responds to the preferences of others as the decision situation unfolds and a joint decision is taken.

Summary

Utility may provide an accepted body of theory of individual normative standards in the economic sphere. Applications in farm management to date have concentrated on exact utility measures of either the single dimension or lexicographic (multi-dimensional) type. Three basic axiomatic requirements, ordering, continuity, and independence, have been illustrated. Approaches to utility in a group context can be classified as either macro or micro. No generally acceptable macro approach appears to be available although some special cases have been cited.

In the absence of an acceptable macro approach to group "utility", it is necessary that axiomized behaviour be group acceptable. It has been argued here that group acceptablility is most unlikely. Utility theory appears not to provide an adequate normative theoretic base for decision making in the farm firm.12) Research reviewed in this thesis substantiates the nature of group decision processes and emphasizes the predominance of group decision making on farm firms.

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12) Note that this is not the same as saying that utility theory has no potential value in farm management. It may in fact prove, on a strictly pragmatic basis, to be a very valuable tool in working with farm firm decision groups.

Appendix B

MAJOR FARMER GOAL-VALUE ORIENTATION AS DEFINED BY BEAL, BOHLEN AND WARLAND [10]

(a) "Independent action: a value stressing that everyone should make his own decision and run his business unimpaired by any external force".

(b) "Collective Action: a value advocating that problems should be solved and business decision should be made through cooperation with others".

(c) "Debt Avoidance: a value advocating that capital should be accumulated rather than borrowed before purchasing any goods, services and property for either maintenance or expansion purposes".

(d) "Traditionalism: a value advocating that 'Past Tested' methods rather than relatively new, untried methods should serve as guides for decision making in farming".

(e) "Farming as a way of life: a belief that farming is the most 'natural' and desirable way to live and is an end in and of itself".

(f) "Fatalism: a belief or personal philosophy maintaining that events and man's destiny are determined by external forces in advance, so that man has no control over what happens to him".

(g) "Risk Aversion: a value advocating that a farmer should use assured and predictable practices in his farming operation to reduce risk as much as possible".

(h) "Scientific orientation: a value advocating that scientific findings should be applied to all aspects of our everyday life and that scientific findings and the scientific method should serve as the criteria for the selection among alternative courses of action".

(i) "Maximization of income: a value advocating that farming should be considered primarily as a business operation and a means to economic ends, such as yield and profit".

(j) "Risk orientation: a value placing emphasis upon using methods perceived as involving elements beyond the individual's control for purposes of gaining certain predetermined ends".

Appendix C

GENERALIZATIONS

IV 1 Individual value orientations are primary motivational elements in group decision processes.

IV 2 Inconsistencies among individual goals for the group are likely to be the rule rather than the exception.

IV 3 Goal conflicts (regarding outcome and/or response, and/or information distribution conflicts) are likely to lead to group accommodation procedures which deal with conflict without taking a global view of all individual goals at any one time.

IV 4 Many individual goals are reflected at the group goals from individual goals.

IV 5 Theory suggests no means of directly inferring group goals from individual goals.

IV 6 Purposive behaviour of groups appears to grow out of the dynamic interaction of individual personal goals, individual group goals and outside influences.

IV 7 Family life contributes to both uniformity and specialization in individual goal-value structures, and at the same time contributes to differentiation of individual goal-value structues and decision roles.

V 1 The predominant primary farm decision unit is the nuclear farm family.

V 2 A large variety of goals, both income dependent and functionally dependent, exist in the farming community.

V 3 Goal holdings reflecting both modern and traditional value systems are widely held.

V 4 A commercial agriculture orientation is more prevalent among farmers in the early adopter stage.

V 5 Instrumental income-oriented goal holding is pervasive in the farming community and is particularly strong among more innovative farmers.

V 6 Goal holding which is functionally dependent on the way the farm business is operated is widespread and sometimes of primary importance.

V 7 Farm family goals tend to be short run rather than long run.

V 8 Vagueness, underdevelopment, and inconsistencies with short-run goals are commonly occuring characteristics of long-run family goals.

V 9 Farm family goals appear to be positively related to levels of achievement experienced in the past.

V 10 Farm family goal holding in several areas is strongly related to the family life cycle.

V 11 Goal hierarchies vary greatly from one family to another in ways that are only partially predictable on the basis of family and farm characteristics.

VI 1 Some degree of joint decision making is the rule in farm family business.

VI 2 Decision making power in the farm business has a strong work role orientation.

VI 3 Joint decision making in areas relating to determination of the shape of the disposable income stream appears to be the rule.

VI 4 Joint decision making is less common at high and low farm family incomes than at intermediate levels.

VI 5 Decision making roles in the farm family appear to have a significant but poorly understood influence on ultimate decisions.

VI 6 Quasi resolution processes involved in farm family decision making may lead to the following of, what appears from the outside, inconsistent group goals.

VI 7 The shape of the instrumental stream of disposable income is a focal point of group conflict.

VI 8 The processes involved in farm family conflict resolution are complex and not well understood.

VI 9 Conflict resolution processes are important determinants in the acceptability of alternate courses of action to the group.

VII 1 Farm management extension programs are committed to involvement in the decision making processes of the farm family by virtue their role as providers of information and by virtue of their pursuit of educational objectives.

VII 2 The current state of the art of farm mangement extension has evolved generally accepted patterns of normative involvement in various problem situations within various agencies.

VII 3 Extension agents work most effectively with a specialized clientel comprising opinion leaders who tend to be; of higher social status, more socially active, more educated and more cosmopolitan than other farmers.

VII 4 Extension agents will be motivated to carry out a number of tasks which vary from one innovation to another to ensure a proper perception of innovation characteristics.

VII 5 Extension agents will be motivated by a desire to fit their extension tools to the innovation stage of the decision maker.

VII 6 Extension agents may also be motivated to place restrictions on the decision aid as an innovation in order to assure its adoption.

APPENDIX D

CHARACTERISTICS OF EARLY ADOPTERS

Early adopters are noted by Rogers and Shoemaker 118 as:

(a) being more highly educated,
(b) requiring shorter periods to complete the innovation decision process,
(c) having a higher social status,
(d) being more socially mobile,
(e) having larger-sized farms
(f) having a more favourable attitude toward credit,
(g) having more specialized operations,
(h) being less dogmatic,
(i) having greater ability to deal with abstractions,
(j) having greater rationality as defined in terms of their own goals,
(k) having higher intelligence,
(l) having a more favourable attitude toward change,
(m) having a more favourable attitude toward risk,
(n) having a more favourable attitude toward education,
(o) having a more favourable attitude toward science,
(p) being less fatalistic,
(q) having higher achievement motivation levels,
(r) having higher aspirations,
(s) being more socially active,
(t) being more cosmopolitan in their social contacts,
(u) having greater exposure to mass media,

(v) having greater exposure to interpersonal communication channels,

(w) seeking more information about innovations,

(x) having a greater knowledge of innovations,

(y) being more likely to be members of groups within modern rather than traditional norms, and

(z) being more likely to be members of well integrated groups.

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