DECISION MAKING PROCESS FOR CULTIVAR CHANGE ON CITRUS FARMS

—Theoretical Approach—

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CONTENTS

I. INTRODUCTION

(1)

This paper is published with the following two intentions. One is intended to suggest to farm management researchers a new methodological development for solving the managerial problems of long-term production farms. That is, the development in the scientific management tradition should not be as usually confined to the data or calculation base, but it need be freshly made to a behavioral science for making decision base or a theory construction and its test base.

The other is intended to warm citrus growers against the future failure of cultivar change in their farms; and at the same time, to appeal them to raise their competence of strategic decision making.

Because they are unlikely to be avoidable to the expectation bias against such a long future outcome of cultivar change in citrus farms, under the present unforeseeable and changeable environment. Moreover, the expectation bias will be made against the increasing obsolescence of innovative or strategic measures for changing mandarin-orange into other cultivars. Most of these measures are today diffused all over mandarin-orange production areas as promising measures for improving the worse situation of farm management; upon the opportunity when the national scale adjustment project of mandarin-orange production was implemented by cutting its orchard trees at the same 20% rate simultaneously throughout the country during the three years period or 1979~1981.

(2)

In this paper, the cultivar (cultivated varieties) change problems among citrus farms is discussed as decision making problems of citrus growers. Most of them now behave in thinking about times and ways of making

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decisions for cultivar change. Because it is very doubtful whether, in future they will succeed in the managerial improvement of citrus farms as much as they can survive farms as going concerns under the present unforeseeable and changeable environment. It is very difficult for citrus farming to adapt to the environment, because it is one of long-term production patterns among Japanese main crop farmings.

Then, most of citrus growers have no sufficient time to see the perfect outcome of doing the previous plans in the present environment. On the contrary, they will be obliged to do one new plan after another, according to their environmental change. In short, the management cycle[1] of 'plan-do-see' is broken at the feedback system from 'see' to 'plan'; so that the management cycle of long term production farms is to be amended by non-routine decisions or strategic decisions (Figure 1).

It goes without saying that, in making such decision, there is a high degree of uncertainty regarding the outcome, and as a consequence there is a need for a far greater element of judgement and creativity involved in predicting the outcome.

Therefore, this paper can be said to be theoretical and positive study for analysing the decision making process of farm management, instead of analysing the managerial cycle function[2]. To be concrete, the paper is a managerial study of Japanese citrus farms for constructing and verifying a theory of the behavioral phenomenon of expectation bias. Through the theory, the writer will describe and suggest why or how citrus growers are now going to select cultivar change among other action courses for improving the managerial situation of their farms. The framework of this theory is 'bounded rationality' or 'partial ignorance', based on the behavioral science of decision making, while the theory is complemented with two normative sub-theories, a dynamic theory of orchard tree replacement, and a theory of selecting measures to avoid risks and uncertainties.

The construction and verification of the theories are treated in Part I. Theoretical Approach and in Part

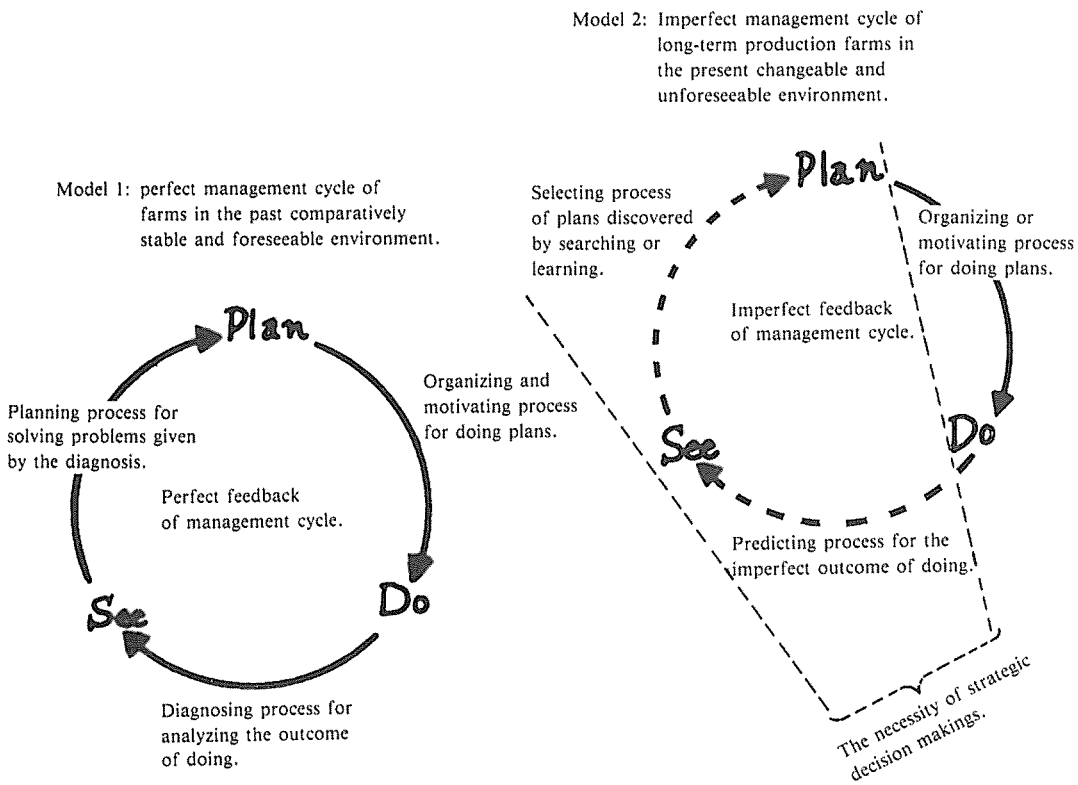


Figure 1. A new model compared with the traditional management cycle model

II. Analysis respectively. Theoretical Approach is rendered for the core concept or theoretical framework of decision making in citrus farm management. This study was written in English with the generous assistance and instructive advice from Prof. A.H. Maunder of Agricultural Economics Institute of Oxford University, when the writer studied in England from February to March of 1982. Part II, the analysis of this study, is now being prepared. In publishing Part I, the writer would like to express appreciation for the thoughtful, helpful, and outspoken criticisms offered in comprehensive reviews made by Prof. S. Uraki of Mie University and Prof. Y. Kawamura of Ryukoku University.

II. THEME OF STUDY

The theme of this paper is to clarify the question as to whether it is subjectively possible for citrus farming, as agricultural sector with prolonged production, to exist as a business management under the present circumstances involving many unpredictable changes.

The reason for this question is that many citrus growers can no longer be indifferent to the management crisis that endangers their existence in business: resulting from the gap (a behavioral phenomenon of expectations bias) between the actual results of their selective expansion of mandarin-orange production practiced under the Agricultural Basic Law and the expected result when they decided on this practice. Further, although the behavioral phenomenon of expectations bias is also predictable about the results of the cultivar change, a breakthough in citrus farms is now possible.

So, the present prevailing cultivar change and the past selective expansion of mandarin-orange production are both long-term measures to rear or replace trees with prolonged production life. When making a decision on the practice of these long-range measures, it will be impossible for growers to foresee with certainty the effects of the practice for a long time after the decision. Therefore, growers cannot avoid the behavioral phenomenon of expectation bias derived from any immediate measure of cultivar change. This must be the premise. And it is important for citrus growers to develop opportunities for management advancement by working on this premise and by not incurring a management crisis in citrus farms from the behavioral phenomenon of expectations bias but, on the contrary, by taking advantage of this phenomenon.

In particular, in orchard replacement for cultivar change in citrus farming, it is technically and economically impossible to correct briefly and continuously whenever the behavioral phenomenon of expectations bias occurs. When deciding on the practice of this correction, producers must be most careful and make a timely decision. However, the act of decision making can be continuously repeated in advance for any number of times before deciding to take an action. Indeed, this is an important step in the approach to the study theme of this paper.

III. BASIC PROBLEMS OF CITRUS FARMS

1. Long-time issue of farm production

It is sometimes said that we are at a turning point from an industrial society evolving on the basis of matter and energy to an information society evolving on the basis of information founded on knowledge and ideas[3]. This paper does not purport to clarify whether the future society will be so. However, as far as productive characteristics are concerned, an industry of inorganic production is remarkable for its ability to artificially control the time and space of production. For this reason, such an industry is capable of instantaneous production (as such when it wishes) and free from the restriction of land and space. Whereas, agriculture of organic production is not free from either the time problem of production or its space problem[4]. Therefore, agronomy and the science of farm management must solve these problems.

2. Cultivar change problems in citrus farms as a long-term production issue

Among all farm enterprises, a citrus farm is characterized by its long production period. It involves the use of trees with a long production life. In particular, the productive power (yield) and the earning power (net profit) of these trees differ according to age. It is, therefore, extremely difficult to replace citrus trees

in accordance with today's rapid changes in the economic environment. Thus, to farmers who must solve the problem of production time in agriculture, studies on the problem of tree replacement in citrus farm are extremely important.

Citrus farming is characterized not only by the time problem of production but also by its space problem. Since citrus trees are grown, taking advantage of land and space, the shape and the height of trees are important for the production technology. Generally, the problem of space in farm management means the problem of land ownership that is spatially occupied. Citrus farming is an upland cultivation in Japan and is relatively free from the problems of use rights which are often controversial in the recent reorganization of paddyfield and agricultural land-use promotion[5]. In this paper, therefore, the space problem in citrus farming is omitted from the scope of research.

As for the time factor, the recent problem of orchard replacement for cultivar change may be taken as an applied problem of tree replacement in citrus farming.

First of all, this problem stems from the fact that mandarin-orange production was selectively expanded by the agricultural policy under the Basic Law and, as a result, the trees include many young ones that have just been planted. The question is whether it is economically rational to make these young trees a target of cultivar change in view of the recent changes in the economic environment. Generally stated, the problem is that a "decision-criterion" set for the economically optimum time to replace trees of existing cultivars and systems greatly alters with changes in the economic environment.

The second problem is that producers desirous of cultivar change have more uncertain and objectively unpredictable factors, concerning trees of new cultivars and systems, than those presently existing. Generally stated, this is the problem that, in the process of decision making, namely, in the process of planning and selecting what is the best for cultivar change conforming to the purpose of management, producers may not get what they want, because their information is unreliable. This is a problem that arises from the fact that the results expected when deciding to carry out measures will be different from those that will actually come about in the future.

The above two problems mean that the selection of rational action is extremely difficult due to the long production time in citrus farming, because expectations and realities often differ, under the quickly changing conditions of the present time. In other words, the problem is that although "agriculture is a rational and purposive act of men to acquire a vital organism[6]", this is belied by the realities of citrus farming.

3. Methods to solve the problems

In view of their causes, these problems seem to have the following three general solutions: the first one (1) is the method by which the present environment with many unpredictable changes can be controlled more than now, at least on the part of citrus producers. A practical example is the "mandarin-orange farm switching plan" executed throughout Japan in 1979~1981. In future, it will be necessary that the information activities relating to production and sales of products are organized on a national scale. The second solution (2) is the method by using technical innovations to drastically shorten the period of rearing citrus trees after their replacement, so that growers of citrus and other perennial crops can achieve much the same adaptability to changing conditions as farmers who raise rice and other annual crops or livestock farming of medium duration (two or three years). This technical innovation is exemplified by the fact that the planning of high density-plantings, which has been disseminated in recent years, and the top-grafted replacement, which is now being disseminated, can greatly shorten the rearing period of trees, compared with the traditional practice of planting at the spacing required for mature plants[7].

However, the organizational and technical methods, mentioned above, will not necessarily solve the problems of cultivar change in citrus farming and other crops that require producers to make unusual decisions. In citrus farming in which a long-term 'plan' to rear or replace trees is carried out, the results of implementation (namely 'doing' of the 'plan') cannot certainly appear until after ten years or so. Under these circumstances, new plans are successively carried out in keeping with unforeseen environmental changes without being able to 'take into account' a feedback of the results of what was already done. In other words, citrus producers lack the business management cycle of 'plan-do-see' shown in the theory of business management. So, they

cannot but follow anomalous business management where they decide to 'do' on the basis of nothing but the long-range tree plan and have no self-diagnosis (namely 'see or control') of what they did.

Therefore, as the third method of solution (3), this study is mainly to clarify how the improvement of the decision making ability of citrus producers can induce the reformation of this important aspect of business management. This is especially important to fruit farms requiring long-term plannings for the rearing and replacement of trees, as exemplified by cultivar change in citrus farming. Since reaction to short-term perennial crop farming, business management can best be helped by studies which improve the ability to predict future market developments. Concretely, the ability is that of farmers' decision making to select methods or develop varieties which will be suited to such future markets.

IV. BACKGROUND FOR CITRUS GROWERS' BEHAVIOR STUDY

1. A typology of citrus growers by their innovative behaviors

Here, a 'managerial citrus grower' making decisions is discussed, as called a 'citrus grower' briefly. The number of managerial citrus growers in Japan, if regarded as the number of citrus farm households, can be now roughly estimated at about 300,000 citrus growers.

Probably, less than 10% or the minority of them, may be classified into innovative citrus growers who have today succeeded in cultivar change. This successful type of them is mainly seen at advanced cultivar change areas, e.g., Onsen area in Ehime Prefecture, Tensui area in Kumamoto Prefecture, and Inno Island area in Hiroshima Prefecture; where mandarin-orange was mainly changed into Iyokan, Sweet Natsu-daidai, and Navel Orange respectively. Most citrus growers of this type determined to carry out their own plans of cultivar change during the first half of 1970's. But, from an innovative viewpoint, citrus growers of the successful or advanced type must be discriminated between innovators who discovered new cultivars or technologies and early adopters who introduced them in the earliest opportunity (Table 1).

At that time, an enormous majority of citrus growers acted with either prudence or easiness. Citrus growers of a prudent type already began with watching slightly the over-production circumstance of mandarin-orange in the very near future. But they did not yet make any decision for adapting their farms to the environmental change. On the other hand, citrus growers of an easy attitude type determined to carry out still more expansion plans of mandarin-orange production. Since citrus growers of these two majority types selected the wrong

Table 1. A typology of citrus growers by their innovative behaviors

Attitudes	Innovativeness	Behaviors
Advanced type	Innovator	They desire the venturesome, but prepare assets for the risk of innovation and try to apply high-technical knowledge.
	Early adopter	They have the greatest degree of opinion leadership in their production areas, and serve as roles of model growers to introduce new ideas or innovations in concert with officers of farm cooperatives or municipalities.
Prudent type	Early majority	They adopt new ideas or new techniques just before the average growers in all over the production areas. They follow the advices of farm cooperatives or municipalities.
	Late majority	They adopt just after the average growers. They can be convinced of the utility of new ideas or new techniques but the pressure of peers or official advisers is necessary to motivate adoption.
Easy attitude type	Laggards	They tend to be frankly suspicious of innovations, new techniques and new guidances; so that they, if adopt, are the last adopters. Decisions are usually made in terms of what has been done in previous generations.

By reference to Rogers's adopter categories, the innovativeness of citrus growers' behaviors are classified. See E.M. Rogers; "Communication of Innovations", The Free Press, New York, 1971, pp.163 ~ 185.

action courses or plans on the process of decision making, they are now willy-nilly driven under the pressure of making decisions for either cultivar change or other action courses; such as crop diversion, non-agricultural land use, and occupation change by leaving citrus farms. However, if they desire to manage citrus farms to survive or develop according to their final objectives, they must determine any alternative plans or measures of cultivar change.

To be remarkable, there is an alternative of waiting strategic decision opportunities or more suitable times for improving managerial situations apart from cultivar change. In other words, when the greater part of fellow citrus growers perform any cultivar change, a waiting behavior against the stream of the times is regarded as one of unique or strategic action courses for the minority. But the waiting behavior, as discussed here, is a waiting action for searching adaptively on the process of decision making and we call carefully it a 'remarkable action of laggards'.

Here, let us remember the behaviors of lemon growers. Lemon orchard trees in Japan were almost replaced into mandarin-orange trees, in a year or so just before the free trade of lemon began in 1966. A large majority of growers who followed the general trend were identified as bad decision makers acting against their own interests; whereas an extreme minority of growers who left lemon orchard trees exceptionally were regarded as excellent decision makers gaining unexpected advantages. Because the lemon price has revived but the lemon production at home has scarcely recovered after that time.

However, most citrus growers of both a prudent type and an easy attitude type are now behaving toward choosing copies from successful action courses rather than remarkable action courses of laggards. This behaving trend of the majority was accelerated by the opportunity, when the 20% cutting of mandarin-orange trees was simultaneously implemented by all Japanese citrus growers during the 1979～81. And the trend will closely be connected with the way of promoting the cutting throughout the organizations and the groups of citrus growers, in particular, agricultural cooperatives. At the same time, the trend must be observed to arise from two behaving trends of the early majority and the late majority.

The early majority tend to follow positively advices and extension services from change agents, such as agricultural cooperatives and municipalities, when they adopt new ideas or new techniques on the diffused stage but no longer at the innovative stage. On the other hand, the late majority tend to follow negatively, so that the pressure of peers or official advisers is necessary to motivate them to adoption (Table 1). However, they both make decisions for adopting new ideas and new techniques of cultivar change, as they judge it is better to follow the advice and the guidance from change agents or the same action courses of peers, than to choose unique or innovative action courses. Because they both will expect peers 'mutual guarantees and change agents' subsidies to absorb the loss or risk due to the future failure of cultivar change or its new techniques.

By the way, laggards do not expect so, while they do not follow so. They tend either to be frankly suspicious of innovations, new techniques and new ideas, or to give up citrus farms as hopeless. Therefore, if laggards adopt, they are the last adopters. In many cases, they leave their citrus farms, while they are engaged in other jobs.

Accordingly, the criterion for categorizing citrus growers who are now confronted with the cultivar change problem, is innovativeness in their behaviors of decision making[8]. Innovativeness, as said here, is the degree to which a citrus grower is relatively earlier in adopting new ideas or unique visions toward products market and technology than others in a citrus production area. According to this degree, behavior types and categories of citrus growers can be classified as Table 1 shows. The table indicates that, the success or the failure of cultivar change are generally dependent on whether its decision opportunities and its times are early or late, according to the innovativeness in decision making behaviors. In other words, if there are the early time and the late time between decision opportunities for exploiting or introducing the same alternative or cultivar change, then there is also a great difference between the degrees that the real results agree with those expected in making decisions. The long-term success of any citrus farm is determined to a very large extent by the degree to which its management maintains a balance between environmental opportunities and farm resources (particularly, orchard trees). And citrus growers' decision making behaviors exert good or bad effects on the balance.

2. Background for citrus growers' behavior study

So far there have been many literatures and works for analysing a balance of the environment and the citrus

farm's resource base, viewed from the objective point, particularly, from the economical rationality of resource use. But there is practically nothing about an analysis of the behavior in citrus growers' making decisions for maintaining the balance delicately, viewed from the subjective point, particularly, from their own intuition and judgment in anticipation of the long future outcomes. Most citrus growers, with the intuition and the judgment, are obliged to make strategic decisions to practice (or do) one new or innovative plan or another for adjusting their managerial situation to the environmental change; very early before they will obtain a perfect feedback of the outcome in a need for the diagnosis (namely 'see').

1) Here, we shall warn ourselves that, the managerial cycle of plan-do-see is now still generally used as the traditional approach of management theory for improving the farm management. Because the cycle has no longer been applicable to such the long-term production farm problem of why citrus growers do and how they should make strategic decisions for cultivar change, as they expect its long future outcome. In short, the cycle application is considerably limited in the study field, where it is used as a traditional approach to farm management problems solved by an analysis of the management process.

In Japan, however, farm management researchers have scarcely as yet ascertain this methodological limit of the traditional approach of management theory. Nevertheless, to overstep the limit, some of them are recently prone to make the positive study centered on survey and data approaches, or to make the formulation and algorithm study centered on calculation and computer approaches. In those two study fields, there is commonly one more proneness that, no attempt is made at a new development for constructing the theory of farm management, based on the exploitation and the test of its hypotheses.

2) In the positive study field, Yoshioka's paper in 1964 and Yamamoto's paper in 1966 are memorable to initial presentations of the earlier replacement age of citrus orchard trees in the real world, based on the separate surveys of citrus production areas in Ehime Prefecture where the planning of high-density plantings was generally carried out[9]. In such areas, the real replacement age proved to be a little (5 ~ 10 ages) earlier than the final age of the economic tree duration, indicated by the "standard evaluation of agricultural fixed assets" of the Ministry of Agriculture, Forestry and Fishery. Second, Mori's book in 1979 is an analytical work based on surveying actual condition of why the cultivar change was threaten to prevail all over the citrus production areas[10]. Third, Wakabashi's book in 1980 is aimed at warning citrus growers to a significance of developing their own innovativeness, e.g., novel techniques of cultivar change, enlargement of a new market and new producing organizations for reorganizing production areas[11].

However, well citrus growers may know the earlier replacement age, the knowledge is not available for them. Because whether or not any innovative cultivar change becomes a strategy for surviving and developing citrus farms is dependent upon the timing when they will make decisions for its practice. Likewise, only the knowledge about the actual conditions needed for cultivar change and other innovations will not be available for their making such a strategic decision.

3) In the calculation and algorithm study field, Kamegaya's book in 1971 and Yori's book in 1971 are epoch-making works in the following sense; according to the traditional capital investment theory (short for 'CIT'), the optimum replacement age of citrus orchard trees is shortened to some degree, due to the investment value discounted by the interest rate for evaluating the present value of a future value stream correctly[12]. Moreover, Kamegaya pointed out that a rise (fall) in the interest rate of return will cause investment period (namely the economic duration of orchard trees), to shorten (lengthen) for any given scale or decrease (increase) in scale. Tamonin's paper in 1972, is aimed at solving the problem involved in the risk and uncertainty of investment value of citrus orchard trees[13]. In the paper, the procedure treats each individual uncertainty quantity (price, cost and interest rate) entering into citrus growers' calculations as reducible to a certain quantity.

All these studies are generally called "the theory of orchard tree calculation" by Kamegaya and Tamonin, but are substantially approximate to its procedures. Each of them is commonly deficient in an unfeasibility of the optimum replacement age. First, the procedure for calculating this age is based on the impracticable model that only one long-term profitability over the economic lifetime of orchard trees is assumed as the decision criterion or the evaluation yardstick of citrus growers strategic behaviors, like the cultivar change activity. The model is not equipped either to handle a few objectives conflict between each other (profitability, growth

and stability) or to search alternatives which meet one of these objectives. Second, if the optimum replacement age is appropriate to the real world, any citrus grower has no ability to calculate the age and to know the perfect information about it. Third since the optimum replacement age is not described by a dynamic model, citrus growers can not use it as an available signal for finding or perceiving strategic decision opportunities. In other words, if citrus growers are watching such a dynamic model depicting how the replacement age is continuously changing in association with the economic and technical change, they can judge a decision opportunity when the unusual shortenness of the age means the urgent situation of citrus farms.

3. The need of new development

As discussed above, not only the traditional management process, but also the survey approach and the algorithm approach for supplementing, it is no longer appropriate to strategic decision problems, such as the citrus cultivar change problems. The problems are concerned about how opportunities for determining an action courses in long future, how to make the good timing decision by foreseeing the environmental change in the future, and how to succeed or fail at the outcome beyond expectations.

However, recently the formulation and algorithm approaches have considerably been developed in OR (Operation Research) or Management Science. These procedures and techniques are best suited to well-defined and simplified problem areas. On the contrary, these are not suitable for ill-structural and more complex problems, so that since many relevant variables may be non-quantitable, a greater element of intuition and judgment are required. The more complex the present foreseeable and changeable environment makes citrus farms problems, the more increasingly a far broader decision making perspective is desired.

Among farm management researchers in Japan, 'decision making' has scarcely as yet been recognized as an essential component of farm management. And so, a great deal has been studied and written about citrus farm management, but few or no about the decision making behavior of citrus growers. However, in this paper, against the study background, decision making is treated as the central concept of farm management. Furthermore, its process of arriving at an outcome which meets an objective is analyzed as a theoretical and positive study for improving the managerial situation on the basis of rules and procedures about the decision making behavior of citrus growers. Thus, we seek to modify the behavior of citrus growers in order to improve the performance of their decisions. We do it by modifying their behavioring rules and procedures in the decision making process, but not by modifying their farm structures.

Accordingly, the originality in this paper, to sum up, is a fresh development for solving not only the optimum decision problem treated on the normative theory of decision making but also the satisfying decision problem treated on the behavioral science of decision making. Both of the problems are related to how a citrus grower obtains the managerial situation improved by such as cultivar change in his or her citrus farms, and can be generally said problems for improving the managerial situation of long-term production farming patterns. The managerial cycle of plan-do-see in the scientific management tradition have not recently become appropriate to such patterns' problems.

V. NEW APPROACHES TO CULTIVAR CHANGE DECISION

1. Behavioral science approach to the decision making process

1) Theoretical approach

Thus, the approach to this paper's theme is the theoretical and positive method, by which citrus producers approach the immediate problem of orchard replacement for cultivar change from the standpoint of deciding on a long-range measure for the rearing and replacement of trees.

Here, the study is to construct a theory of decision making suitable for the "hypothesis of the behavioral phenomenon of expectations bias"[14], where the prospect of results foreseen by citrus producers, (when they decide on long-term policy measures for trees according to the expected changes of environment), differs from the actual realities. This theory of decision making is a management theory attaching importance to the increase of the subjective capabilities of citrus growers; on the assumption that the key to their business existence under the present circumstances, where they cannot avoid the behavioral phenomenon of expectations

bias, lies in the improvement of their decision making capacity. This decision making capacity is to discover and develop long-term policy measures for trees that can cope sufficiently with unpredictable environmental changes for a long time to come and in a timely fashion any of these measures as appropriate.

This management theory is identical to the theory of decision making in the management science of general enterprises and in studies concerning behavioral science in that it is a theory that has systematized decision making as a central concept of management[15]. But the theory of decision making in this paper is characterized by the fact that it explains and foresees the "behavioral phenomenon of expectations bias" in the decision making of citrus growers and controls this phenomenon, according to the ultimate purpose of business existence.

2) Positive approach

Therefore, a positive study is to prove the theory of decision making comprised of a hypothesis: the behavioral phenomenon of expectations bias by citrus growers who are urgently required to solve the problem of orchard replacement for cultivar change.

As the first step in this approach, the "cause and mechanism" as to why and how the problem of cultivar change in citrus farms has occurred must be proved by verifying the above-mentioned hypothesis. It can be generally explained that this problem has arisen from the need for control measures for the selective expansion of mandarin-orange production, because the results of these measures have turned out to be unexpectedly poor in profitability. Further, the mechanism in the behavioral phenomenon of expectations bias will continuously exist because of interaction between the inability of producers to exercise complete control and the environment of unreliable information: thus, it can be predicted that the problem of cultivar change due to this phenomenon will reoccur in the future.

In other words, the "cause and mechanism" in the problem of orchard replacement for cultivar change can be approached through the method of behavioral science in order to describe (explain, predict) and control empirically and realistically reasonable causalities and interactions of behavioral phenomena between decision making and its result. A descriptive method in this study must be equal to the general method of science to explain, predict, and control the phenomena. In this case, the hypothesis of decision making that the problem of cultivar change is caused by the behavioral phenomenon of expectations bias is verified and the theory is, in effect, proven as empirically and realistically reasonable.

2. Normative approach to the decision making process

1) Theoretical approach

Then, what is the problem of orchard replacement for cultivar change in citrus farms and how can it be solved? As the second approach, the behavioral science approach to prove the theory of decision making through directly verifying the hypothesis of the behavioral phenomenon of expectations bias is not effective to determine the "nature and proportions" of this problem and its improvement plans (solution measures). So, a dynamic theory of orchard tree replacement[16] is first constructed as a subordinate theory related to the theory of decision making which is comprised of this hypothesis, and the nature and proportions of the problem is studied by a factual analysis and economic calculation in accordance with this theory. Then, a theory of selecting measures to avoid risks under uncertainties[17] is second constructed, and measures of solution of the problem are thus discovered, developed and selected according to the purpose of management.

2) Positive approach

The positive study of the first subordinate theory clarified the optimum criteria on economically optimum timing in orchard tree replacement to be observed as the norms of action of citrus producers. And the positive study of the second subordinate theory clarifies solutions that are appropriate to their managing purpose. In this sense, these studies are verifiable by normative approaches to the theory of decision making. They are not only to clarify subjective possibilities in the business management for the existence of citrus farms but also to show, as models, the judgment criteria for the economically rational actions of producers and their practical actions of management.

In particular, positive studies of 'the dynamic theory of orchard tree replacement' are necessary in the case of producers on citrus farms who function as managers of orchard tree capital in an economically rational

manner under the quickly changing environments of recent years. From this standpoint, it can be questioned whether or not it is economically rational that the policy of cultivar change due to changed environments includes mandarin-orange trees newly planted under the Agricultural Basic Law, in spite of the fact that these trees are still young or fully bearing and, by age, they are in a rather young group. Specifically, orchard tree replacement for cultivar change in citrus farms is different in nature from that in rice farms, because citrus cultivars cannot be changed with regard only to the relative superiority of cultivars and without regard to the age of trees. Thus, measures for solving this problem must be considered to involve the possibility that, depending on the behavioral phenomenon of expectations bias, farmers may produce business crisis so great after the execution of these measures that it can endanger their business existence.

The positive study of "the theory of selecting measures to avoid risks under uncertainties" is necessary from the position of citrus growers as entrepreneural managers, even if they understand the economic rationality of the policy to change young and adult trees under the present conditions. This sub-theory is a practical theory on which the way to avoid the most risky plan or measure will meet the goal for attaining objectives. The theory can be applied to such a case where an entrepreneural producer who devotes himself to exploit or discover strategic measures for cultivar change will select them in setting a "stable growth" of citrus farm as the interim goal or target (the basic action course) necessary to accomplish the ultimate objectives, namely, the survival or prosperity of citrus farms. For attaining the stable growth, there will be required a positive study about scales for performing cultivar change, cultivars combination, and new technique introduction, based on the optimum rules (or criteria, procedures) of decision making behaviors in implementing strategic measures for cultivar change.

However, the positive study of the sub-theory is confined to the scope of normative theory of decision making. Since the furthermore positive study beyond the scope will be concerned with the enhancement of abilities to make strategic decisions, it must be made under the scope of behavioral science theory of decision making. And so it will be discussed after the sixth chapter.

Accordingly, the sub-theory purports to prove that an imperfect knowledge farmer under uncertain information circumstances will have better select as dominate alternatives of cultivar change the following plans or measures; (1) a small scale of steady-steps changing cultivars rather than a large scale of all-at-once changing cultivars, (2) novel replacement techniques developed at a little tested stage rather than an unknown or innovative stage, (3) a cultivar change for combining a promising one and others rather than only one promising cultivar change.

In this paper, "Decision Analysis" approach based on the Bayes theory will be used so as to prove that the above-mentioned strategic plans (or measures) will be the best ways to convert non-promising cultivars or strains into some others adaptable for the future changes of citrus farm circumstances. Because any citrus grower will be now driven to make decisions for cultivar change under such uncertain circumstances as requires that he must use his judgment and experience about its future events. Thus, even in the absence of objective probabilities and on the basis of subjective probabilities about possible outcomes, the decision process based on the theory will be very available for a logical procedure to apply to business decision making with risky choices. It is most important for the process to recognize the personal element in decision making (personal beliefs about the risks involved and personal preferences for possible consequences). The keypoint of Decision Analysis is a mechanism to load all values (or even risk preference) into a well-defined utility function, particularly subjective expected utility function. In this mechanism, there is an assumption that a decision maker can splendidly solve the question of how different values are to be compared.

However, a positive study about "the theory of selecting measures to avoid risks under uncertainties", as described above, is eliminated in the theoretical approach of this paper.

VI. A THEORY OF BEHAVIORAL PHENOMENON OF EXPECTATIONS BIAS

1. Purport, test, validity and characteristic of theory

Purport: This theory purports that, no farmers will generally be avoidable to 'the behavioral phenomenon

of expectations bias', in long-term production farmings, such as citrus farming under the present unforeseeable and changeable environment. The bias is made by the long future outcome against their expected outcome in the process, in which they are making decisions for improving farm situations adaptable to the environmental change.

Test: On the basis of this theory, first, we can explain that the cultivar change problem which citrus growers confront now has arised from the behavioral phenomenon of expectations bias; between the failed outcome of their selective expansion of mandarin-orange production performed under the Agriculture Basic Law, and their expected outcomes when they decided this performance. Second, we can predict that in the present no plans or no measures of cultivar change for covering the failure will generally be avoidable to the behavioral phenomenon of expectations bias in the future. Third, we need control that the present cultivar change will result in the future success beyond expectations. For this need, citrus growers must develop and raise their competences for timely decision making, in order to practice much foresighted and strategic plans or measures in advance of the environmental change in the future. Because, if there are early time and late time between decision opportunities for the same long-term production plan (or measure), the early time plan is very different from the late time plan. And because the successful case in the present does not mean that of the future.

Validity: In the theory, as mentioned above, there is not only a descriptive science phase to explain and predict citrus growers' behaviors in making decisions for cultivar change, but also a practical science phase to contribute to their overriding objectives, such as the existence and the prosperity of citrus farms. Because the theory is constructed on the basis of Behavioral Science Theory of decision making with the descriptive and practical science phase, for explaining, predicting and controlling generally. Accordingly, citrus growers can know not only the practical phase of strategic cultivar change, but also the descriptive phase about decision rules (or procedures) in arriving or failing at its strategy, due to the behavioral phenomenon of expectations bias. In behavioral science, before a decision is made in practice, the process of decision making is generally described as an 'adaptive search method' process called by Ansoff[18]. In this process, alternatives of cultivar change need not be one-time choices on strategies for satisfying decision, in which each sub-choice will be made only at a specified time using the information available at that time. Thus, the process is also described as a 'successive limited comparison method' process, called by Lindblom[19].

Its remarkable characteristics are (1) a 'cascade' procedure of successive narrowing and refining the decision rules, (2) partial feedback between stage in the cascade, but not comprehensive and perfect feedback, (3) a gap reduction process within each stage caused by expectations bias, and (4) adaptation of both objectives and starting point evaluation. This successive adaptation procedure will be useful for citrus growers, because it is nearly related to the real world decision making process for setting objectives and searching strategic alternatives[20].

2. Constructing the theory

Assumption:

1) A managerial citrus grower is assumed to be an "administrative person" who succeeds or fails in farm management, due to his bounded rational behaviors in the decision making process[21]. Because in the real world, he or she is very much bounded by the situation (or environment) and by his intelligence activities and computational powers.

2) The theory's framework is 'bounded rationality' defined by Simon or 'partial ignorance' defined by Ansoff[22]. It is not rationality for which a citrus grower can maximize the personal preference or can obtain the outcomes which meet objectives perfectly.

3) In the real world, a managerial citrus grower under bounded rationality is assumed to behave in conformity with a 'satisfying' rule, rather than an 'optimum' rule. At the same time, he or she is assumed to make 'quasi-resolution' of conflicted problems or objectives, such as the survival, the crop diversion, and the non-agricultural land use of a citrus farm. Therefore, strategic cultivar change for the survival is assumed to be accomplished through an 'adaptive search' method based on searching and learning rules, rather than through an comprehensive and rational method based on 'one choice' at a decision time and based on 'routine decision'. And he or she is assumed to succeed on fail in the long future outcome, due to an 'expections bias' rule. Thus, it is very

significant for him or her to 'perceive' foreseeably strategic opportunities for making good timing decisions as well as strategic measures or plans themselves.

4) Quasi-resolutioning, searching, learning and perceiving are assumed to be respectively involved in sub-rules of the satisfying rule which stem from the framework of bounded rationality. In addition to evaluating and choosing sub-rules which are in common with those of optimum (or normative) rules, all the above-mentioned sub-assumptions and sub-rules are mainly discovered and developed by Cyert and March as a heuristic method (or heuristic programming)for solving the operating problems under the constant posture of product market and technology[23], but not the strategic problems under their changing environment.

5) To broaden and supplement the limits of perceiving (monitoring) and searching strategic decision chances, a managerial citrus grower is assumed to be able to modify a usual serial decision system into a parallel decision system, if he or she focuses attention to strategic problems or decisions. In the parallel system, daily operating decisions in parallel with strategic decisions are made within the same process of decision making. In the real world, he or she has almost a body of serial decision making system in which, firstly operating, secondly administrative, and thirdly strategic decisions are made habitually. Because operating problems which are daily arising in the producing process will absorb his or her attentions to strategic problem or decisions about long future outcomes.

6) Optimum rules (or sub-rules) and satisfying rules (or sub-rules) are assumed to be respectively the upper limit and the lower limit to decision making behavior rules (or sub-rules) for solving problems. In a theory of behavioral phenomenon of expectations bias based on satisfying rules, there are its two sub-theories based on optimum rules.

Premises:

1) The rules and the procedures of administrative behaviors in a big business will be true of those of managing behaviors in a very small family farm, because both the former and the latter involve in the human's decision making behaviors, irrespective of scale and individual or organization.

2) Each of the above-mentioned assumptions or sub-assumption involved in the rules or the sub-rules of decision making behaviors will be available for a descriptive and practical theory of making good timing decisions for long-term production farmings; after it has been tested empirically or in case studies, if it maintains the real validity applicable to the behavioral phenomenon of expectations bias.

3) The assumptions or sub-assumptions treated in the behavioral science theory of decision making are almost discovered and developed as those of behavioral rules or procedures in making short-term (3～5 years) decisions sequentially. However, the assumptions or sub-assumptions are applicable to citrus growers' making long-term (more than 10 years) decisions for such as cultivar change.

Elements and a mechanism:

"A theory of behavioral phenomenon of expectations bias" is a management theory about a mechanism of managerial behaviors caused by various elements interaction in the decision making process as follows;

1) General elements common to all types of enterprises

A general element outside the citrus farm

(ⓐ the imperfect information environment which is changeable and unforeseeable)

A general element inside the citrus farm

(ⓑ imperfect knowledge in cognition, and an unstable value system in evaluation)

2) Special elements restricted to the citrus farm

Special elements outside the citrus farm

(ⓒ the over competitive structure among many small growers and their unflexible marketing)

Special elements outside the citrus farm

(ⓓ high-paced generalization of innovations and slow-paced response in these outcome informations)

Special elements inside the citrus farm

(ⓔ no clear-cut lines of the annual net income streams returned from orchard trees, but these lines necessary for the basic data of long-term plans or measures)

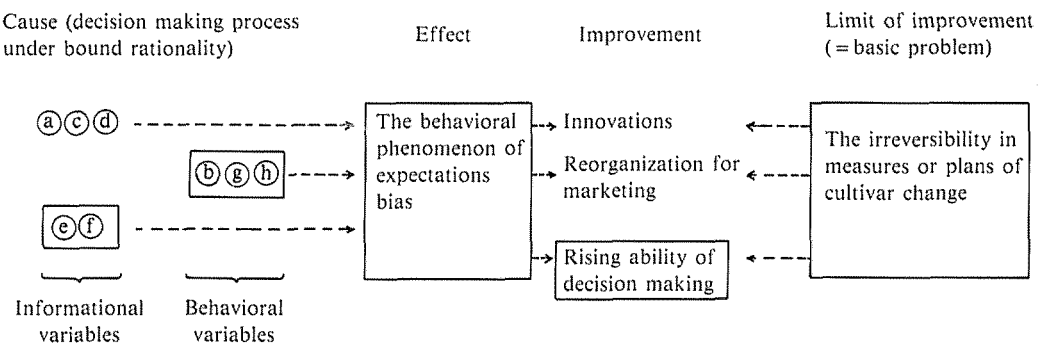
Special element inside the citrus farm

(ⓕ imperfect feedback of producing process information requisite for managerial diagnoses)
Special element inside the citrus farm

(ⓖ unfixed managerial goals or basic action courses under the pressure of the changeable environment)
Special element inside the citrus farm

(ⓗ imitated or followed choices which the majority of growers make as their peers do or as change agents advice)

Table 2. A mechanism of behavioral phenomenon of expectations bias



Legend: ( ) bracketed passages are the keypoints in this study.

3) A mechanism of interacting elements is depicted in Table 2

A mechanism in which informational variables (or objective variables ⓐ, ⓒ, ⓓ, ⓔ, ⓕ) and behavioral variables (or subjective variables ⓑ, ⓖ, ⓗ) interact, will incur the behavioral phenomenon of expectation bias, in the process of making decisions for long-term production plans or measures, such as those of cultivar change. Behavioral varia-bias include greater elements of judgment, intuition and idea, based on 'the rule of thumb (experience)' or 'emotion'[24]. Intuition exploits the knowledge citrus growers have learned through their past searches. And sudden discovery (e.g., the 'aha!' experience) tends to evoke emotion, it is hot cognition. Sometimes ideas come to them when they are excited about something. Emotion has particular things (e.g., cultivar change problems) in their environment as the focus of their attentions at particular times. Since the mechanism holds in the decision making process from informational activities to final (implemented) decision, it can not be represented by normative (optimum) models or algorithm formulations but by behavioral (satisfying) models or verbal (protocal) formulations. Thus, any rational decision approach stemming from traditional usage in the disciplines of economics, statistics, and mathematics is not available for such as cultivar change problems which cannot but be solved by intuition and judgment finally.

In the real world, the principal ways to improve and advance citrus farming are now muddling through three new fields; innovations, large scale grower reorganizations for marketing, and a development of decision making abilities (see the right side of Table 2). But, it is most important for an individual citrus grower, how not to incur a managerial crisis in his or her citrus farms from the expectations bias phenomenon, on the contrary, how to take advantage of the phenomenon. So, of these three ways, his or her rising a competence of decision making will be most suitable for such an important way. However, while a citrus grower may develop the competence, he or she should carefully investigate some limit to a managerial improvement or advance, in making decisions about long-term alternative plans (measures) for rearing or replacing orchard trees, such as those of plans or measures is bounded by an irreversible for a citrus grower to repeat successively a short-term (2~3 years) replacement of orchard trees against their several decades economic duration.

4) Main verifications of the theory

Of ⓒ, ⓓ, ⓔ, ⓕ (special elements outside the citrus farm), ⓒ and ⓓ are eliminated from verification, due to the structural and environmental problems outside of citrus farms, but not the behavioral problems directly related to citrus growers. First, ⓕ is mainly verified in the statement and Figure 1 of Chapter I~IV. Second, ⓔ will be verified in a separate positive study about the theory. Since an obscurity of the annual cost-return streams of orchard trees has already been verified by analysing the data surveyed in 1966, it will be published before long. This verified keypoint is a methodological conversion, by which the optimum replacement ages are used as new perception yardsticks rather than as the prevailing choice yardsticks, because the ages are calculated on the basis of the streams.

The informational variables (ⓔ, ⓕ) give only new knowledges to citrus growers. On the contrary, the behavioral variables ⓑ, ⓖ, ⓗ suggest to citrus growers a behavioral diversion from the general trend followers to the self-objective oriented decision makers. At the same time, for treating the variables as appropriate to the real world, the variables implicate that farm management researchers will have better convert methodologically the traditional management theory base and the survey or calculation base into a behavioral science base.

VII. A FRAMEWORK AND COMPONENTS OF THE DECISION MAKING PROCESS

1. A framework for making different types of decisions

On the one hand, the normative approach, as mentioned in Chapter V, is to answer a question of whether the decision making for cultivar change in citrus farms is economically rational or nonrational. That is applied solely to the choice itself in the decision making process. On the other hand, the behavioral science approach is to describe only the behavior of citrus growers as they proceed toward the selection of a preferred alternative plan in the decision making process for changing varieties of citrus.

The behavioral science approach is the process-oriented approach which provides a means for citrus growers to evaluate and improve their own performance as decision makers. It is to focus on the decision making process rather than the decision maker or the decision itself[25]. The decision making process itself should be to provide a comprehensive framework for students interested in farm management, as well as a means for citrus growers to improve their own managerial competences. What is needed for citrus growers is a meaningful definition of a rational choice which meets growers' managerial objectives, rather than an economically rational choice.

Therefore, the decision making process on this paper must be combined with a profile of how citrus growers will have their searching and learning behaviors to arrive at a choice that fits the definition. More concretely, according to citrus growers' overriding objectives,(such a survival or a growth of citrus farms), strategic decisions on the process provide a framework for the future defined in terms of the following alternatives; development of existing varieties of citrus fruits, opportunities for cultivar change, new product market areas, and new production methods (e.g., the top-grafting tree replacement spreaded gradually in recent years). Within this framework, it is then the role of both periodic control decisions and short-term operating control decisions to ensure the implementation and monitoring of these strategic decisions[26].

Here, periodic control decisions mean principally the decisions of optimum economic tree ages of orchard replacement for cultivar change; short-term operating control decisions mean principally the decisions of optimum allocating seasonal labours during one year, product cost minimization, and profit maximization. Thus insofar as both of them are generally applicable to the business management hierarchy in companies, strategic decisions should be made by top management. Periodic control decisions and short-term operating control decisions should be made respectively by middle and low management, and could be treated respectively as administrative decisions and as operating decisions.

By the way, a managerial citrus grower in family farms prevailing in Japan can be regarded as a producer who combines top management with middle and low management; so that it will not be fruitful for him or her to classify decisions more precisely, according to such the management hierarchy. It is necessary for a

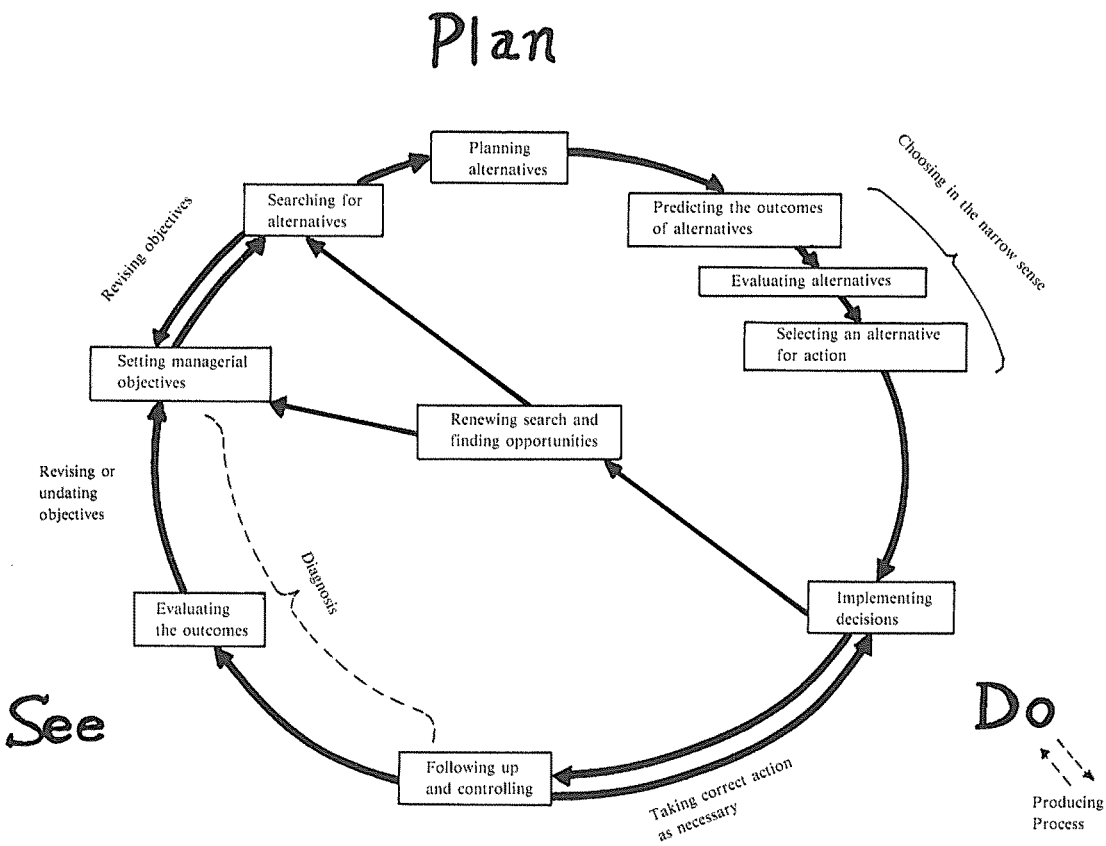


Figure 2. The traditional management cycle modified into the decision making process
—Through A behavioral science approach to citrus growers' problems—

managerial citrus grower to focus his or her attention on strategic decisions rather than to classify different types of decisions.For lack of such attentions, even an efficient farming producer will often contrive to pursue an increasingly obsolete strategy[27]. Thus, he or she will finally reach a point at which, because of falling market shares and declining profits, either the need for change becomes overwhelming or a more aggressive and dynamic competition forces him or her to fall victim. Just the managerial failure caused by paying little attention to strategic decisions was found in the consequences that most citrus growers in Japan had expected to perform as strategic decisions (e.g., the selective expansion policy of mandarin-orange production during the past two decades). Furthermore, that failure will be predicted in consequences of their now performing cultivar change in citrus farms.

2. The process of decision making

In Decision Theory, the process of decision making is defined against the structure of decision making[28].

Particularly, in behavioral science, this process is a series of process concerned with a dynamic system of decision making. It is a process of arriving at a more satisfying outcome that meets an objective, based on the human activities of intelligence, design and choice[29]. Thus, in the process, before a decision maker evaluates alternatives and chooses one of them, he or she will have to search, discover, and set objectives (or goals) and alternatives, moreover to predict the outcome of alternatives. Objectives, alternatives, outcomes are called the three decision-premises in both the process and the structure. In the process, however, for describing and controlling his or her real actions, it is very significant to analyze the premises' contexts

associated with a time order from the perception to the final choice in decision making. According to Simon's early work, the process from setting objectives to searching alternatives is a value premise and the process from finding alternatives to selecting one of them by predicting its outcomes is a factual premise[30]. Sufficiently analyzing these two premises of decisions will make it possible to explain and predict the behaviors of decision making.

On the other hand, in the structure of decision making, much attention is given to analyzing the premises' relationships either between objectives and alternatives or between alternatives and outcomes. Each of these relationships is a statical system, because one relationship is simultaneously connected with the other.

3. Components of the decision making process as functions

Managers of citrus farms as well as other types of managers of shops and companies perform several functions that form the decision making process. Therefore, whether managers make strategic decision individually or organizationally, the success of their decision making processes is highly dependent on the functions that are the components of their processes.

The initial stage in the decision making process is fundamentally concerned with identifying the objectives that are to be pursued. The process is normally sequential, rather than determined at once. First, if managerial objectives accorded the overriding purposes (namely the survival or growth of citrus farms) are not yet set, there is no basis for a search. Second, without the information attained through a search there are no alternatives to compare. Third, without a comparison of alternatives, the selection of an alternative for a particular action course is unlikely to obtain expected results. Fourth, without effective implementation of a selection, the actual outcome of decision is unlikely to be the achievement of objectives. Finally, without follow-up and control, the successful implementation of a decision is hardly possible.

In short, the components of the decision making are such functions as Figure 2 illustrates, and are highly interrelated. The interrelatedness of the process will make it good for a manager if he or she starts with any one of the functions of decision making and works forward and backward through the process[31].

However, an integral part of the functions, shown in Figure 2, is not representative of all the decision making processes of managerial citrus growers in all circumstances. First, the Figure reflects a descriptive (behavioral science) approach rather than a normative approach to explain the decision making process. In other words, it illustrates what a typical decision maker 'does' in his decision making process, rather than what he 'should' do. Second, it is shown from the recognition that decision makers generally adopt a satisfying rather than optimizing criterion for actions, not only in the setting of objectives, but also in the selection of alternative courses of action and the process of evaluation[32].

VIII. MODELS AND STRATEGY FOR THE DECISION MAKING PROCESS

1. Models and assumptions for the complex process

Needless to say, Figure 2 must be applicable to the demonstration of "a theory on the behavioral phenomenon of expectations bias". Thus, it is depicted by the open systems model but not by the closed systems model. However, real behavioral phenomena of decision making are too complex and too long-responsed for citrus growers to copy these phenomena exactly and to make relevant decisions at hand. Generally speaking, any model demonstrating a theory must be a simplified representation of some segment of the real complex process for decision making[33].

From this viewpoint, in the open systems model, the searching for objectives and alternatives is generally a far complex process, and the learning of strategic or non-routine decision making is a more adaptable process under the recent uncertain environment than in the closed systems model. The open systems model based mainly on the concept of satisfying behavior can be effectively used by concentrating upon the human elements of decision makers (i.e., personal intuition and judgment according to the rule of thumb) and by taking account of the influence exerted by environmental forces upon decision makers[34]; because this model is assumed to be model with cognitive and environmental limitations to rational decision making. In this assumption, any objective intended by a decision maker tends to be dynamic rather than fixed or unchanging,

and so, their known sets of alternatives are always incompetent because of either the impossibility of obtaining perfect information or the difficulty of using computational techniques to apply.

On the other hand, the closed systems model based mainly on the concept of optimum behavior is used by normative approaches to the decision making, and it is much indebted to the traditional assumptions of economic rationality which postulates "an economic person"[35]. To be concrete, in "a dynamic theory of orchard trees replacement" and in "a theory of selecting measures to avoid risk under uncertainty", there is the following assumption. A citrus grower is assumed to be an economic person who can calculate, plan and choose such alternative courses of an action as will permit attainment of the maximizing level of his or her preferences; because a citrus grower possesses knowledge for perfecting the information about ends-means and skills for reducing the uncertain environment.

According to the above-mentioned models and assumptions, the opportunities of decision making are times when a decision maker perceives or need predicts "the behavioral phenomenon of expectations bias". But these opportunities do not necessarily mean the best timings to allocate or reallocate effectively the resources of citrus farms, in particular, orchard trees. The optimum decision problems for rational allocation resources are solved by economic perspectives for calculating present values of citrus trees and by decision analysis (namely management science) for marketing citrus products. The economic rational perspectives are intended to prove "a dynamic theory of orchard trees replacement", and the decision analysis is intended to prove "a theory of selecting measures to avoid risk under uncertainty". In this paper, the behavioral phenomenon theory of expectations bias and the two normative theories are related to a basic theory of the decision making process and its sub-theories respectively.

2. A model for strategic decision making

In the real process of non-routine or strategic decision making, since citrus growers with imperfect information are compelled to behave under conditions of partial ignorance[36], they will be generally unavoidable to result in the expectations bias phenomenon. Therefore, they will require descriptive models which can explain, predict and control the phenomenon, on the basis of general disciplines or rules of behavioral science[37]. Such descriptive models are very useful for them, particularly, on the following stages of decision making process; to perceive a decision need or opportunities, to search objectives and alternatives, to learn new events or new behavioral rule throughout the subsequent process of decision making (all these stages are shown in Figure 2).

Nevertheless, if they make a non-routine or strategic decision based only on models of the normative theories (involved in firm or capital investment theory), they need neither explain and predict the expectations bias phenomenon between realized and expected outcome, nor the gap between their current position (achievement) and the objectives (goals). Because the models of the normative theories, as discussed above, assume that a decision maker has a single objective (i.e., profit or utility) settled in advance, can enumerate all of the decision alternatives met objectives and can measure these outcomes. However, the models are devoided of the stages for perceiving, searching, and learning, while they consist of only the stage for evaluating and choosing. Accordingly, the normative models need be broadened for a more applicable method which provide for continuing intelligence activity and for diagnosis of the strategic action need, such as cultivar change. To be concrete, the models need be broadened as a method of the behavioral science to monitor the citrus farm environment and to search for new product-market entries under condition of partial ignorance. The models need be improved to coordinate multiple-conflicting objectives (e.g., profitability and security), and need be supplemented to identify new product-market opportunities. Because, what a citrus grower requires in strategic decision making is not typical but particular course of actions which will reflect the unique competitive advantages of the product-market opportunity; such as the super quality of Iyokan (new cultivar orange), timing of product introduction by tree replacement organizing of its new product growers, and competitors' reaction[38].

However, in the real management cycle, such as plan-do-see, the lag response to strategic decisions will prevent most citrus farms from making the competitive advantage possible, for lack of the attention to strategic changes or opportunities. The lack of the attention is caused by (a) the special nature of citrus farm management

and (b) the general nature of management.

(a) In the matter of the special nature, since most citrus farms are family farms, a managerial grower is an owner-manager who must generally engage in top management (attended mainly to strategic decisions) as well as middle and low management (mainly administrative and operating decisions). Nevertheless, he or she is usually as a field labourer obliged to work on the producing process (that is low or operating management) in the real world. Under the present unforeseeable and changeable environment, he or she must essentially manage the citrus farm with attention to strategic decisions, rather than administrative and operating decisions.

Because strategic decisions non-routined under partial ignorance conditions are concerned with establishing the relationship between the citrus farm and its environment, particularly, the farm's resources (e.g., orchard trees) and product-market opportunities[39]. And the key of strategic decisions is to settle objectives and goals, to search external (administrative or finance) strategies, and to determine the timing of growth. But because administrative decisions conflicted between strategy and operations are concerned with establishing the structure and the shape of the citrus farm to organize, acquiesce, and develop its resources for optimum performance.

And the key of administrative decisions is to organize the structure of resource use (information, authority, and resensibility flows) and resource conversion (work flows, distribution system, facilities location). Moreover, operating decisions routined under risky and uncertain conditions are concerned with selecting the operating levels for the citrus farms to optimize the realization of ROI (return on investment). And the key of operating decisions is to budget and schedule resources among principal functional areas, to settle operating goals (cutting down expenses or saving labour), and to control operating levels (production schedules, inventory levels, warehousing).

(b) In the matter of the general nature, M. L. Ansoff, pointed out as follows:

The three (decision) classes must compete for the response of the firm as well as for top management time and attention. Of the three, operating decisions tend to receive priority for several reasons; first, because they are routine and repetitive; second, because they are automatically brought to top manager's attention by lower level managers; third, because they are frequent and large in volume; fourth, because many top managers find them familiar by virtue of their previous training at lower levels in the firm[40].

As a matter of course, decision needs signalled by the producing process in most citrus farms are likely to be perceived serially, initially as operating deficiencies, secondly as administrative imbalance, thirdly as strategic departure or gap; while environmental changes are perceived indirectly through impact that have on that producing process. However, the perception of decision needs or opportunities is a major issue in strategic decision making. In short, strategic decisions must be initially perceived in any citrus farm management. To show concretely, such a serial decision making as the upper model of Figure 3 will be necessarily modified into a parallel decision making as the lower model of Figure 3.

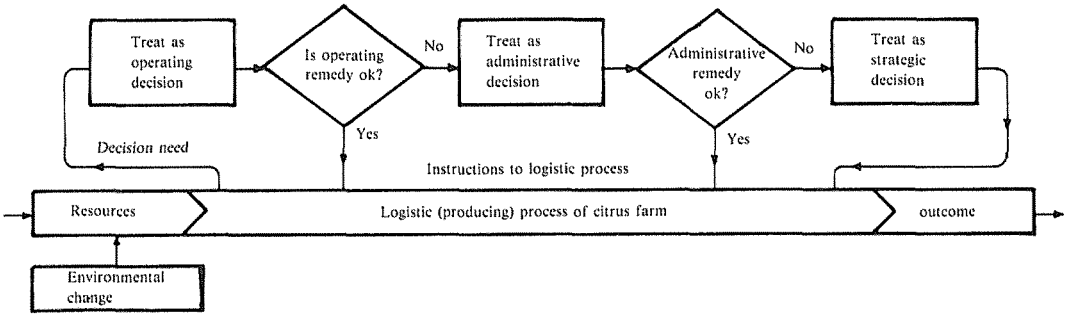
In the parallel decision making, attention to strategy is more direct and response to challenges is quicker. Here, attention to strategy can be initially paid (triggered) in two ways; first, through diagnosis of problems signalled by the producing (or logistic) process, and second, through a direct response to environmental changes.

Now, even if the lower model of Figure 3 is appropriately descriptive of the observable strategic behavior, there is raised a question of what should be the sensitivity of top management to strategic problems. The answer to the question is dependent on two major elements; objectives of the citrus farm and its product-market environment.

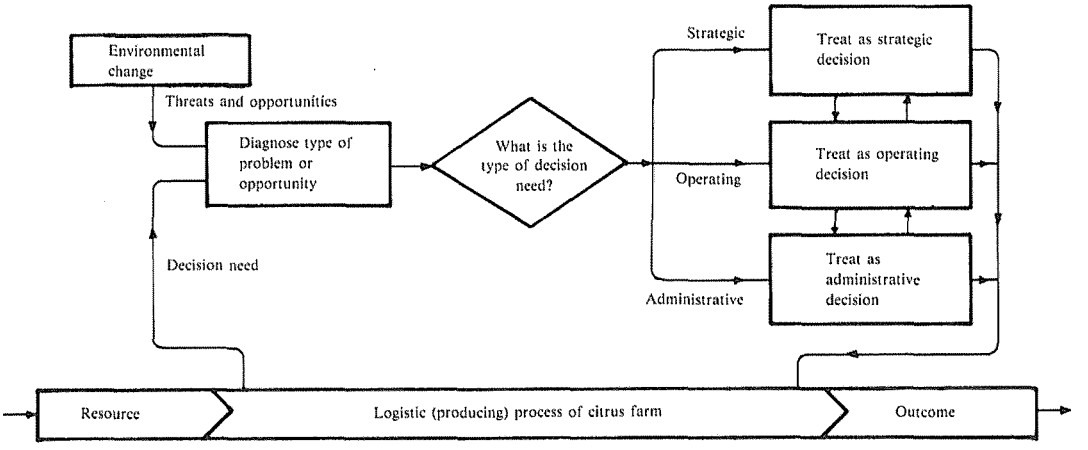
First, objectives which contain the particular attribute, they yardstick, and the goal, will vary among citrus farms, and from time to time, because the assortment of attributes and the value of goals will vary. Thus, even if the vector (attribute and goal) of objectives is settled, the sensitivity of strategy should vary between the extremes of occasional lag response and of self-triggered (or heuristic) behavior, in proportion to the difference between the goals and the potential offered by the citrus farm's present products market position for satisfying the goals.

Second, if the environment is not easily controlled and subject to changes in products markets or technology, the citrus farm still needs for response to change. In other words, the top-management immediate sensitivity

Model of serial decision making



Model of parallel decision making



See: H.I. Ansoff; "Toward a Strategic Theory of Firm" ("Business Strategy" adopted by H.I. Ansoff), Penguin Books, 1981, pp.17-18.

Figure 3. Decision making flows for attention to cultivar change opportunities

to strategy should be proportional to the instability of the environment of the citrus farm.

In the real world, the above-mentioned response and sensitivity will vary among citrus farms. To be concrete, a large number of managerial citrus growers will be later adopters or followers who make "lag response" to significant changes having already occurred; such as introduction of new cultivar products, and new markets or technical change by radical competitors (or innovators). A small number of them are classified into earlier adopters and innovators; the former number will be comparatively larger, but the latter number will be extremely small. Earlier innovators make anticipatory response, in which they seek through forward planning to foresee significant changes in the environment. Innovators or high-advanced farmers make self-triggered response in which they continuously search for growth and expansion, or diversification and synergy

opportunities.

Today, most of Japanese citrus growers are driven or willing to perform to some extent alternative plans of mandarin-orange trees replacement for cultivar change[41]; because the competitive environment began to change rapidly, after the high paced growth period of mandarin-orange production. However, without the attention to strategic decision in top management, no citrus farm will be able to tide over a managerial crisis by achieving their final objectives like the survival or prosperity as a successful citrus farm. Although strategic decision making is difficult because of the time scale and uncertainty associated with it, it is an activity that needs constant attention.

IX. SUMMARY

The cultivar change problems which many citrus growers now face in Japan are changing from the well-discussed problem of adjusting the over-production of mandarin-orange, into the up-to-date problem of pressure by free trade drives both at home and abroad. Therefore, in this study, the perspective for analyzing the cultivar change problems is characterized by recognition, approach, and model, as mentioned below.

First, these problems are recognized as decision making problems of citrus farmers. This new recognition stems from two remarkable considerations. One is the consideration that the nature of these problems is based on long-term production farming patterns such as citrus farming. The other is the consideration that even if any one of these problems can ever be solved by both structural or functional analysis of farm management and OR (Operation Research) or management science, both of these analysis methods will be successful merely in the functions of perfect management cycle of plan-do-see and in the economic person of optimum behaviors, although such management cycle and optimum behaviors are not realistic.

Second, the perspective of this study is not a direct approach to the cultivar change problems but approach through the decision making process of citrus growers to these problems. Thus, it can be said to be an original approach, in the sense that agricultural economists and farm management researchers in Japan have scarcely still discussed and studied any of the parts of decision making process or even decision making itself. They are interested, on the other hand, in the optimum decision problems. However, from the broader viewpoint, "decision making and agriculture" was discussed as the main theme of the 16th International Conference of Agricultural Economists held in 1976. The discussions or studies of this theme seemed to be confined almost fatally to the scope of public policies or strategic decisions for agriculture. Accordingly, the entire process of decision making has never been presented in the context of such an integrated and interdisciplinary framework as the approach framework of this paper. This framework fuses the traditional quantitative disciplines (i.e., the micro-economic theory, OR, management science) and the newer behavioral science into a composite theory of decision making, such as a theory of behavioral phenomenon of expectations bias.

Third, in this paper, models for the decision making process are constructed not only of the open systems model for citrus growers to copy the real process of decision making as exactly as possible, but also the closed systems model for economic persons to determine the best possible situation. The basic difference is as follows. In the open systems model, citrus growers make subsequent decisions according to the environmental change and apply the criteria to any minimally satisfactory alternative that is good enough to meet the objective. Moreover, the objective in long term production farming is changing from profit or growth under the dynamic developing circumstance into security or diversification under risky circumstances. In the closed systems model, a citrus grower as an economic person rather than as an administrative or managerial person is assumed to have all the alternatives, toward which to apply the optimum criteria.

To make the best use of the above-mentioned characteristics in this study, managerial citrus growers will have to pay more attention to strategic opportunities, such as the exploration or the entry of new products market. However much they may pay attention, they are apt to response late to strategic decision needs or opportunities which they will perceive in the serial decision making, as prevails among them. Thus, the serial decision making must be modified into the parallel decision making by which they can initially perceive strategic decisions.

REFERENCES AND NOTES

1) The concept and the perspective of such the management cycle may rise from the works of Koontz and O'Donnel who suggested plan, organize, staff, direct and control. But, Akira Yamashiro (a management process scholar) and Tadashi Tenma (an agricultural economist) adjust three functions cycle of plan-do-see. Moreover, Toshimi Urabe (an administrative behavioral science writer) adjust four functions cycle of plan, motivate, organize, control.
H. Koontz and C. O'Donnel; "Principles of Management (the 4th edition), McGrow Hill Book Co., New York, 1968, pp.47-50.
A. Yamashiro; "Keiei (Management)", Hakuto-Shoboh, Tokyo, 1960, pp.28-30.
M. Tenma; "Kindaika No Tameno Nohgyo Keiei (Farm Management for Modernization)", Meibun-Shoboh, Tokyo, 1973, pp.175-189.
T. Urabe; "Keiei Gaku No Susume (Recommended Management)", Chikuma-Shoboh, Tokyo, 1976, pp.38.
2) H.A. Simon, in his classic work on the science of management decision, treats decision making as a process synonymous with the whole process of management. See H.A. Simon, "The New Science of Management Decision", Harper & Row, New York, 1960, pp.1.
3) M. Galatin and R. Leiter; "Economics of Information", Martinus Nijhoff Publishing, Boston, 1981, pp.104-106.
M.J. Weffer; "Information Theory and Urban Special Structure", Croom Helm Ltd., London, 1979, pp.91-92.
4) Sukekata Kashiwa is a leading person among this quarter. See S. Kashiwa; "Nohgaku Genron (The Principles of Agriculture)", Yokendo Co., Ltd., Tokyo, 1962, pp.156-157.
5) For further detailed knowledge about the Japanese farmland use trend, see R. Kada; "Part-time Family Farming", Center for Academic Publications Japan, Tokyo, 1980, pp.43-57.
6) S. Kashiwa; "op. cit.", pp.254.
7) For further reading on the recent trend of agricultural technical change in Japan. See T. Yamamoto; "Regional Mixed Farming as an Agricultural Response to Recent Technical Change", the Bulletin of the Fac. of Agric., Mie Univ., No.56, pp.47-96.
8) The innovativeness of farmers is originally classified by Rogers. See E.M. Rogers; "Communication of Innovations", The Free Press, New York, 1971, pp.163-185.
9) M. Yoshioka; "Optimum Ages for Replacing the Citrus Orchard Tree", (Editor K. Yakushiji; "How to Practise the Planning of High-density Plantings for Machinerizing the Citrus Orchard Labour"), Ehime Pref. Fruit Tree Experimental Station, 1964, pp.16-25.
10) K. Mori; "The Outline of Stagnative and Unstable Factors in Fruit Farming Trend", (Editor K. Mori; "Stable and Development of Fruit Farming), Meibun Shoboh, Tokyo, 1979, pp.9-42.
11) H. Wakabayashi; "Development of Citrus Farm Structure - a Challenge to Future", Meibun Shoboh, Tokyo, 1980.
12) T. Yori; "An Economical Theory for Farm Household Management (Nohgyo-Keizai Keiei Ron)", Meibun Shoboh, Tokyo, 1971, pp.211-234.
T. Kamegaya; "An Economical Theory for Agricultural Investment", Agric. & Forestry Assoc., Tokyo, 1971, pp.144-172.
13) K. Tamonin; "A Study for Accounting the Managerial Finance and Economical Investment in Citrus Farms", The Special Bulletin of Agric. Faculty, Shizuoka Univ., 1972.
14) "Hypothesis of expectation bias" in the administrative behavior was founded by Cyert & March. See R.M. Cyert & J.G. March; " A Behavioral Theory of the Firm", Prentice-Hall, Inc. Englewood, N.J., 1963, pp.81, pp.116-122.
15) In decision theory, OR (Operation Research) and other computer-based, information-processing approaches are often closely allied, and are called "Management Science", while behavioral science approaches for the general description of individual or organizational behaviors are characterized by heuristic problem-

solving methods or simulation techniques.
See Kouzo Nishida; "Kigyo-Koudo-Kagaku No Kiso (Foundation of Behavioral Science for Firm)", Hakuto shoboh, Tokyo, 1970, pp.185.

16) This sub-theory is considerably based on Mr. and Mrs. Lutz's firm investment theory, Schneider's economic calculation theory, and Terborgh's equipment replacement theory.
See Mr. and Mrs. Lutz; "The Theory of Investment of the Firm", Princeton Univ. Press, London, 1951.
E. Schneider; "Wirtschaftlichkeits-Rechnung" (Japanese edition, T. Shimano translator; "Keizaikeisan Ron", Diamond Co., Tokyo, 1961).
G. Terborgh; "Business Investment policy - a MAPY Study and Manual", Machinery and Allied Products Institute, 1958.

17) This sub-theory is constructed on the basis of Decision Analysis with the Baysian Strategy, which is widely applied in U.S.A. as a prominent method of management science. For further reference, see as follows;
J.R. Anderson, J.L. Dillon and J.B. Hardaker; "Agricultural Decision Analysis", Iowa State Univ. Press, 1977.
I,W. Kwon; "Statistical Decision Theory with Business and Economic Applications", Petrocelli & Charter, New York, 1978.
H. Bierman, Jr. C.P. Bonn and W.H. Hausman; "Quantitative Analysis for Business Decisions", Richard D. Ivwin, Inc., Illinois, 1973.
R.W.V. Brown, A.S. Kahr and C. Peterson; "Decision Analysis for the Manager", Holt Rinehart Winiston Inc., New York, 1974.

18) The adaptive search method is called a 'cascade' approach by Ansoff. See H.I. Ansoff; "Corporate Strategy", McGraw-Hill Book Co., 1965, pp.24-26.

19) D.E. Lindblom; "The Science of Muddling Through", (Editor, H.I. Ansoff; "Business Strategy"), Penguin Books, 1970, pp.41-60.

20) H.I. Ansoff; "ibid", pp.28.

21) An 'administrative person' model is defined in Simon's earlier work. See H.A. Simon; "Administrative behavior - Study of Decision Making Process in Administrative Organization", MacMillan Co., 2nd ed. 1957, Preface Page No., pp.20-24.

22) H.A. Simon; "Reason in Human Affairs", Stanford Univ. Press, California, 1983, pp.19-24.
H.I. Ansoff; "ibid.", pp.47, 152.

23) R.M. Cyert and J.G. March; "A Behavioral Theory of the Firm", Prentice-Hall, Inc., 1963, pp.126-127.

24) Simon explains the intuitive theory as follows; it is in fact a component of the behavioral theory and emphasizes the recognition process acquired by storing experience and by recognition situation. And it recognizes that human thought is often affected by emotion.
H.A. Simon; "Reason in Human Affairs", Stanford Press, California, 1983, pp.29-35.

25) In discussing decision making, it is customary to focus on one or more of three things; (1) the decision making process, (2) the decision maker, and (3) the decision itself.
E.F. Harrison; "The Managerial Decision Making Process", Hunghton Mifflin Co., Boston, 1981, pp.2-22.

26) These three types of decisions are very instructive in Gilligan's classification; according to the degree of certainty or uncertainty (associated with the outcome and the time span), the frequency of decision needs, the extent of routine or non-routine, and the implications of decision choice.
See C. Gilligan, B. Neale and D. Murray; "Business Decision Making", Philip Allan Publishers Ltd., Oxford, 1983, pp.3-6.
However, as principal decision classes in the firm, Ansoff's three classes of decision are more famous, that is strategic, administrative, and operating decisions.
H.I. Ansoff; "Corporate Strategy", McGrow-Hill Book Inc., 1965, pp.8.

27) Simon applies the theory of bounded rationality to social instructions and human behavior, and pointed out the problem created by limited attention span; that is human inability to deal with more than one difficult problem (namely, strategic decision problems) at a time.

H.A. Simon; "Reason in Human Affairs", Stanford Univ. Press, California, 1983, pp.20-21.

28) K. Nishida; "op. cit.", pp.88-96.

29) H.A. Simon; "The New Science of Management Decision", Harper, 1960, pp.55-56.

30) H.A. Simon; "Administrative Behavior - A Study of Decision Making Processes in Administrative Organizations", MacMillan Co., 2nd ed. 1957, pp.13-20.

31) Among behavioral scientists' works or literatures, the components of the decision making process are composed of somewhat similar functions as described above, but the flows to which the components are interrelated, are considerably different with those in Figure 2. Compare Figure 2 with the following literatures.
C. Gilligan, B. Neale, and D. Murray; "op.cit.", pp.8.
E.F. Harrison; "op. cit", pp.25.

32) In the words of March and Simon, most human decision making, whether individual or organizational, is concerned with the discovery and selection of satisfactory alternatives; only in exceptional cases is it concerned with the discovery and selections of optimal alternatives.
J.G. March and H.A. Simon; "Organizations", John Wiley and Soms. Inc., 1958, pp.140-141.

33) There are only a few study on the explanation of "the role of models" describing the decision making process in agriculture. The following studies are rarely the cases.
M. Petity; "The Role of Models in the Decision Process in Agriculture" ("Decision Making and Agriculture", Papers & Reports of the 16th International Conf. of Agric. Economists), Oxford Agric. Econ. Institute, 1977, pp.62-74.
D.H. Kim; "Coordination in Models Representing Different Decision Making Levels in Agriculture" ("Decision Making and Agriculture", Papers & Reports of the 16th Intern. Conf. of Agric. Econ.), Oxford Agric. Econ. Inst., 1977, pp.77-86.

34) The open systems model, discussed here, is called 'the open systems decision model' by Cilligan or 'the open decision model' by Harrison, but all of them are in common use to apply the adaptive search method to complex and ill-structured problems in the real world. The adaptive search method on the case of satisfying behaviors is a heuristic (self-triggered) approach through which decision makers search and learn their better preferred measures applicable to environmental changes.

35) In the words of Simon, the concept of "an economic person" optimizing behaviors is based on the microeconomic theory of firm, while the concept of "an administrative person" satisfying behaviors is based on the behavioral science.
H.A. Simon; "Administrative Behavior - A Study of Decision Making Processes in Administrative Organizations", 2nd ed., 1957, Preface page No., pp.20-24.

36) "Partial ignorance" defined by Ansoff is equivalent to "bounded rationality" defined by Simon.
H.I. Ansoff; "op. cit.", pp.47, 152.
H.A. Simon, "Reason in Human Affairs", Stanford Univ., Cali., 1983, pp.19-24.

37) If we regard a science as being a body of general laws governing a particular aspect of nature, then behavior science is a misnomer and general disciplines or rules, as discussed here, may not be necessarily impartial. For further reference to the study regarded as scientific, see R.O. Boot, A.G. Cowling, and M.J.K. Stanworth; "Behavioral Sciences for Managers", Edward Arnold Ltd., 1977, pp.2-3.

38) Even among farm management researchers in U.S.A., there is the view point that the ability to make decisions is related to appropriate timing. To be concrete, "The profitable manager may make more mistakes than another, but by making more decisions and by taking action, he will be more successful than the procrastinator. By avoiding a decision an opportunity may be last". See E.N. Castle, M.H. Becker and F.J. Smith; "Farm Business Management - The Decision Making Process", MacMillan Co., New York, 1972, pp.8.

39) Strategic, period control, and short-term operating decisions in the citrus farm can be said to approximate respectively strategic, administrative and operating decisions in the firm, defined by Ansoff. See the note No.26.

40) H.I. Ansoff; "Toward a Strategic Theory of the Firm", ('Business Strategy' edited by H.I. Ansoff), Penguin Books Ltd., 1969, pp.15.

41) If a managerial citrus grower is not necessarily confined to such objectives as the survival or prosperity of citrus farms, outside of (1) replacement for cultivar change; he or she can make the following two strategic decisions, (2) diversion for non-citrus crop farming and (3) cutting for non-agricultural land use.

摘　　要

柑橘作の品種更新のための意思決定過程
—理論的接近—

山　本　太　一

（Ⅰ）

この論文は，以下の2つの意図から研究したものである。1つは，わが国の柑橘作生産者が，近年の生産過剰と低収益のために行き詰った温州みかん中心の経営を存立（存続・繁栄）させる有力な改善策として，品種更新を実施する経営行動に対して，「予想はずれの行動現象論」の展開によって警鐘する意図である。と同時に，彼らに対して，戦略的意思決定能力の向上が必要不可欠なことを示唆する意図もある。というのは，柑橘作の品種更新のように長い将来の成果を予想（期待）してその実行を意思決定する場合，今日の変化しやすい不測の環境（a）では，いかなる生産者も制約された認識能力（b）しかない。このため，意思決定過程の予想結果が実行後の成果から外れる「予想はずれの行動現象」を避けられない，とみる方が現実的に妥当する。環境的・能力的な制約要因は，柑橘作以外の人たちにも共通する一般的要因であるが，柑橘作の生産者には，その他に特殊な要因のために「予想はずれの行動現象」が強く作用するものと考えられる。特に，市場での零細な生産者の過当競争（c），革新的技術の一般に公開され速やかに普及する農業独自の制度や習慣（d）など，わが国の農業全般に共通してみられる要因のために，品種更新のいかなる方策も，その実行の成果は予想結果ほど長続きも高くもならないであろう。そのほかに，柑橘作が長期生産農業としてもつ特殊要因も作用する。例えば，品種更新のような長期的計画（方策）の基礎資料として必要な「樹体の樹齢別純収益」の曖昧さ（e），経営診断に必要な生産過程の情報が十分得られない前に環境変化に対応して計画を実行する，という経営管理過程の不完全なフィードバック・システム（f）などが作用する。

（Ⅱ）

本論文のもう1つの意図は，以上のような長期生産農業の経営問題解明のために，農業経営研究の新しい方法を展開するものである。というのは，柑橘作の品種更新のように，数10年の生産寿命をもつ樹体の育成や更新を伴う改善策（計画 plan）では，その実行（do）の結果を経営診断（see）に必要なだけ十分フィードバックさせずに，環境の変化に対応して新たな改善計画（plan）が次ぎつぎと実行される傾向にあるからである。このため，経営の plan—do—see という、経営管理論の伝統的な管理方式の循環機能が低下して，経営改善の効果が十分あがらなくなっている。この不足分を補足するために，近年は，ORの線型計画法や投資決定論など，最適決定問題を解く理想的・規範的な意思決定論にもとづく研究が少なくない。さらに，一部生産者の優良事例を調査して経営構造と経営機能（経営能力や技術力）との関係を分析した実証的研究も盛んである。だが，規範論的な意思決定モデルの最適基準は，現実離れした改善策になりがちである。また，不測の変化の生じやすい現代の環境では，既存の成功事例の延長線上に将来の成功があるものでない。

それゆえ，柑橘作の品種更新のように，長い将来の不確実な成果を予想（期待）して意思決定する行動が経営的存立を運命づける経営問題の解決のためには，一般的に説明・予見・コントロールできる行動理論の構築が必要である。それにもかかわらず，現状では，計算中心の定式化やコンピュータ化した規範論的な研究や，データ中心の実証的・調査的研究に追われて，仮説の開発と検証にもとづく理論の構築による研究への展開が蔑ろになりがちである。

（Ⅲ）

本論文は，以上のような農業経営研究の現状から1歩でも出て，長期的生産農業の経営改善に貢献できるために，「予想はずれの行動現象論」を展開したものである。この理論は，上記の一般要因（a，b）や特殊要因（c，d，e，f）が相互に作用しながら，情報活動から実行（action）に移るまでの意思決定過程の行動にはたらきかける結果，目的合理的な意思決定を阻むメカニズムを形成するため，予想はずれの行動現象が生ずるという仮説によって構築されたものである。

なお，この理論は，3つの前提からなる。1つは，この理論では，予想はずれの行動現象が，なぜ，どうして意思決定過程で生ずるかを説明・予見する記述論的な究明にもとづいて，いかに改善するのかの実践論的究明を行う，行動科学的意思決定論の方法が妥当する，という前提である。この点，規範的意思決定論の方法が，この現象を改善する最適解を求める実践論的究明しか行わないために，現実離れした改善策になりがちである。第2の前提は，行動科学的意思決定論が，企業や官庁の組織における人間の意思決定行動を究明するものであるが，零細な柑橘作生産者の意思決定行動にも基本的には適用できる，という前提である。すなわち，その理論の概念体系（フレームワーク）である「制約された合理性」と，「開放モデル」（環境への適応する過程で自ら問題や目標を発見するモデルであり，与えられた問題のみを1回で解決する閉鎖モデルでない）とによって開発された行動原理の仮説のうち，基本的なものは，次のように適用できる。環境的・能力的に制約された柑橘作の生産者は，「矛盾の暫定的解決（コンフリクトの準解決）」しかできないため，逐次的に，「問題中心の探索」を続け，受容可能な「満足基準」以上の解決策であれば実行する，なお解決策のうち短期的には「不確実なものを回避」する傾向にあるが，長期的には「探求と学習による合理性追求」が基本になる。

第3の前提は，上記の行動原理の仮説が，行動科学的意思決定論の場合いずれも比較的短期に限って逐次的に意思決定する行動に関するものであるが，一応それらは，柑橘作の品種更新のような長期的改善策を実行する意思決定行動にも妥当する，というものである。

（Ⅳ）

以上の仮定と前提をもつ「予想はずれの行動現象論」は，行動科学的意思決定論にもとづいて演繹的に構築できる。だが，もともと，本研究の理論は，わが国の柑橘作生産者の経営行動を調査した結果にもとづき帰納的に導いたものである。それゆえ，この理論によって，まず，今日，当面する品種更新問題は，基本法農政下で意思決定した温州みかんの選択的拡大策が実行後の生産過剰と価格低迷という環境の変化によって経営状態が予想はずれに悪化したために生じた問題だ，と「説明」できる。つぎに，この理論によって，その解決策として目下実行されつつある品種更新のいかなる方策も，将来において予想はずれの行動現象を一般に避けられない，と「予見」できる。第3に，この理論から，生産者が長い将来の環境変化にも適応できる先見性の高い戦略的方策をタイミングよく意思決定する（戦略的意思決定）能力の開発向上によって，品種更新が予想はずれの成功になるような「コントロール」が要求される。なぜなら，柑橘作の品種更新のような長期的方策では，仮に同じ戦略的方策でもその実行を意思決定するタイミングの相違によって，将来の環境が異なるために，必ずしも戦略的意思決定にはならないからである。

（Ⅴ）

「予想はずれの行動現象論」は，柑橘作のような長期生産の農業が，現代の環境下で，政策的助成なしに，生産者の独力で経営的に存立できる主体的可能性はあるか，という疑問への解明を主に課題としている。この課題接近としては，上記の説明・予見・コントロールから，論理実証的な究明が一応なされている。しかし，目下実行されつつある柑橘作の品種更新には，基本法農政下で増植した若木が大半であり，植え付けて間もないものまで更新の対象にして，はたして経済合理的行動といえるか，という疑問が残る。また，柑橘作の生産者は，環境の悪化に対しては飛躍的な革新よりも安全な改善を望む保守的行動様式を一般にもっている。このような生産者が品種更新する場合の最適策はどのようなものか，という問題が現実には強い。

これらの疑問や問いへの解答として，本研究では，次の2つの下位理論が補足的に展開されている。前者の疑問に対しては，価格や技術の変化する動態的環境では，農林水産省の「農畜産用固定資産評価標準」に示す育成期間や経済的耐用年数にかかわりなく，品種中心に育成や更新をしても経済合理的なことを，「動態的な樹体更新論」の構築と実証によって解明する。後者の問いに対しては，「不確実性下の安全策優位論」によって，更新対象の全面一斉更新よりも部分的分割更新の方が安全であり，更新品種の組合せは単一優良品種よりも複合優良品種の方が安全であることを論理的にも実証的にも解明する。また，更新方法（技術）は，高接更新の方が改植更新よりも収益性は高いが，安定性についてはいづれともいえない。前者の下位論は，投資決定論や設備更新論のモデルを使った静態的な樹体更新論を展開したものである。後者の下位論は，ベイズ決定論の戦略モデルを応用して展開したものである。それゆえ，双方とも，規範的意思決定論に属する。しかも，理論だけで論理実証的に上記のような結果は得られないため，調査資料のデータを用いた計算結果から導いたものである。これの計算手続きや計算結果は，本論文の理論的研究ではぶかれている。

（Ⅵ）

本論文の特色は，まず第1に，伝統的な管理方式であるplan—do—seeの循環機能を，情報の入手から，方策の実行に入るまでの意思決定過程の自己発見的（heuristic）なシミュレーション（模擬実験）モデルで置き換えた点にある。柑橘作の品種更新を意思決定する問題は，数値で表わせるほど明確でなければ，達成すべき目標が目的関数で表わせるほど単純でもない「よく構造化されていない問題」である。このため，その分析方式として，数学モデルよ

りも，人間が目的や方策を経験や勘にもとづいて探求と学習を繰り返して発見するheuristicな意思決定過程のシュミレーション・モデルは，現実妥当的である。具体的には，そのモデルは，情報活動にもとづき，目的や目標と現状とのギャップの大きいものを問題設定し，その解決策を探索して，実行後の結果予想から判断・評価して最終的に選択する，というものである。このモデルは，最適でなくとも満足できる方策で環境の変化に適応させて，順次選択して実行に移しては評価・改善する開放体系のモデルである点で，実現性が高い。

第2の特色は，戦略的方策と戦略的意思決定とを区分して理論が展開されている点である。長い将来の市場状態や技術進歩に適応した「戦略的方策」の開発は，ORや経営科学など規範的意思決定論からのアプローチでも可能であろう。だが，同じ戦略的方策も先見性の高い生産者が将来に適応させてタイミングよく実行を意思決定する場合とそうでない追随的に意思決定する場合とでは，経営成果に大きな開きが生ずる。今日，温州みかんから伊予柑への更新で成功した先進産地を模倣した品種更新が全国で普及しているが，それが将来成功するかどうかは疑わしい。

第3の特色は，柑橘作生産者が情報から方策を実行する意思決定過程を1つのシステムだとみる場合に，戦略的意思決定の機会を逃さないために，並列型のシステムが必要なことを明らかにした点である。普通一般には，生産者が日ごろ，生産過程の作業的決定におわれ，ついで，資金繰りなどの管理的決定に忙しい。このため，将来の市場対応の機会を開発する品種更新の戦略的意思決定が環境の相当悪化を伴わないかぎり一番後廻しになる，という直列型の意思決定システムになりがちである。これでは環境の変化に適応する機会を見逃すため，作業的決定や管理的決定と同時に，戦略的決定をいつでも行なえるように並列型の意思決定システムへの変換が必要である。具体的には，戦略的方策を発見した場合に，その実行を思い切ってタイミングよく意思決定できるために，柑橘作以外の作目との複合経営の状態にして，予想はずれの失敗が生じても，経営的破綻におち入らない方法が決定システム変換の有力な方法の1つであろう。