TRADEOFF IN THE MANAGEMENT OF THE CULTIVATION SYSTEM IN THE AGRICULTURAL PRODUCTION UNIT OF CHARDONNAY VINIFERA.

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SUMMARY

The study analyzed the variables that interfere in the choice of the soil cultivation system, using conventional and/or biodynamic agricultural practices for the production of Vitis vinifera grapes. The method was an exploratory and descriptive quali-quanti analysis study. The intentional sample, for convenience and non-probability, included 26 vineyards of Vitis vinifera Chardonnay, 19 of which were conventional vineyards and seven in transition to the cultivation system using biodynamic farming practices. It was concluded that economic variables are the driving force in decision making, rather than environmental or social issues in the management of the cultivation system, as well it has also been noticed that some properties are seeking new cultivation practices. In the case of biodynamic agriculture, however, there is a faint signal that environmental issues may gain greater value in equalizing alternatives for decision-making in vineyard management and especially in soil care.

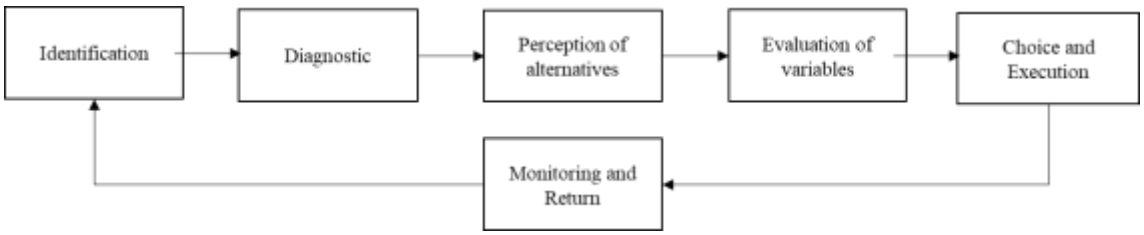
Keywords: Biodynamic; conventional; intuition; cognitive; rationality.

1. INTRODUCTION

The present study consists in analyzing the variables that interfere in the choice of the soil cultivation system using conventional and/or biodynamic agricultural practices for viniferous production. To this end, the data under analysis consisted of two bases, as follows: a) the reports in the interviews, relating them to cognitive biases and errors arising from the limitation of rationality; and b) technical information during the participation in field activities in the vineyards participating in the study. The theoretical framework was based on the Theory of Limited Rationality (SIMON, 1955; 1970; 1991; 1979a); and the Theory of Contingency (CHANDLER, 1962; DONALDSON, 2001).

The identification of the variables that influence the tradeoff in the management of the agricultural production unit is of paramount importance, which is justified by the need for the manager to be able to find mechanisms that allow for a more satisfactory decision making or in line with the objectives proposed for the business. Many times the scenarios show that the objectives proposed are adverse, and the manager needs to make choices that best meet the cost-benefit ratio for his property. These are alternatives to what is known as the classic model of rational decision-making. Cognitive and bias influences can, however, privilege decisions based on intuition which, at that moment, are enough to meet the expected results. In that case, one is in a situation that may be associated with the model based on the theory of contingency (SIMON, 1955; 1991).

Figure 1 - Decision-making process



Source: Adapted from Sobral and Peci (2008).

The process, whatever the reference model, is a sequence of at least six phases or steps (Figure 1), becoming, at the moment the decision result is evaluated, systemic. Phases or steps can be sequential or present internal systems to the process when, for example, a step presents a limitation or inconsistency due to a previous step, and when the alternatives prospected in the next step do not satisfy the decision maker, it would be the case to redo the diagnosis more often and more thoroughly. It is important to raise this alternative of internal subsystems to the complete system, of six stages, because it approaches the way in which the process of organizational decision making takes place, mainly, in the process involving agricultural activity, where the number of intervening variables is, theoretically, infinite. In this scenario, the decision maker needs to choose those variables he considers relevant at that moment and for that situation, dismissing the others so that he can respect the time he has to make that decision.

The difference in the processes lies in the way the information is used. The balance between the information gathered and the choices made by managers is what can guarantee an optimal or sub- optimal outcome of the decision-making process. In parallel, the manager's perceptive, reactive and adaptive skills

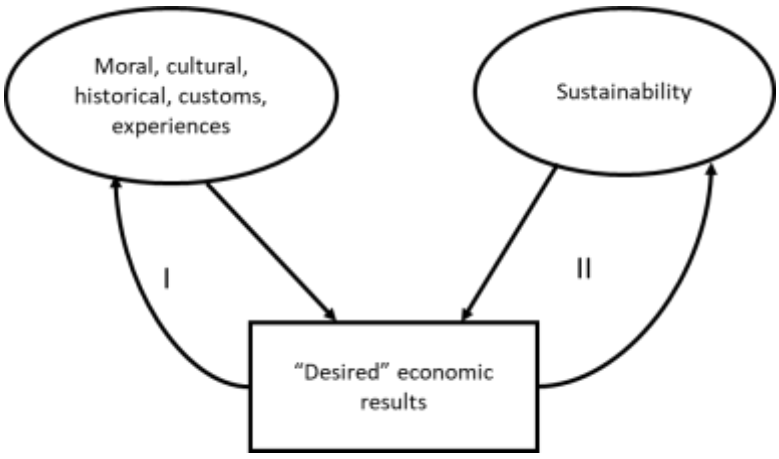
can contribute to the decision-making process when making choices in the management of the agricultural unit, including those related to the management of agricultural land use in vineyards.

The management decision process is influenced by variables that can be classified as internal and external influences on production units. The important thing is to equalize the opportunity cost before the trade off of the internal variables that are the questions: a) what to produce? b) how to produce?, and the external variables that are represented by the questions: a) how much to produce? and b) when to produce? It is observed that the use of sub-optimal choice can be seen as the result of a rational cost/benefit approach to strategy selection (CHRISTENSEN-SZALANSKI, 1980).

Tversky and Kahneman (1974) call attention to human limitations in the decision-making process, because both the emotions before the facts and the lack of knowledge can influence the understanding of the facts. In this case, the search is for a satisfactory solution rather than an optimal one.

The decision should be seen as a set of aspects that can be controlled and others that cannot. These aspects are identified as internal and external variables and serve as indicators for weighing the alternatives to make the choices in driving the soil unit. These aspects compete with each other and some of them end up weighing heavily at the decision-making stage. At the same time, the decision-making process never fails to prospect the possible and likely results related to the choices. This is the step that can be called "result". The process and the prospected result, in turn, influence each other, forming at this level a system that is also flexible and dynamic. These two systems reinforce the personal aspects of the internal decision making of subsystem “I”, as well as their convictions as to the internal sustainability of subsystem “II”, as can be seen in Figure 2 below.

Figure 2 - Variables involved in the decision-making process



Source: Prepared by the authors (2020).

For Andrade et. al (2007), in certain situations, decision makers may be acting on the basis of restricted information. In addition, they may be conditioned on the ability of the human mind to process, formulate and solve complex problems. A rational and structured decision, in this case, would lead to the use of specific, systematic and directional biases to make choices. It is therefore argued that a satisfactory solution will be adopted with a high frequency.

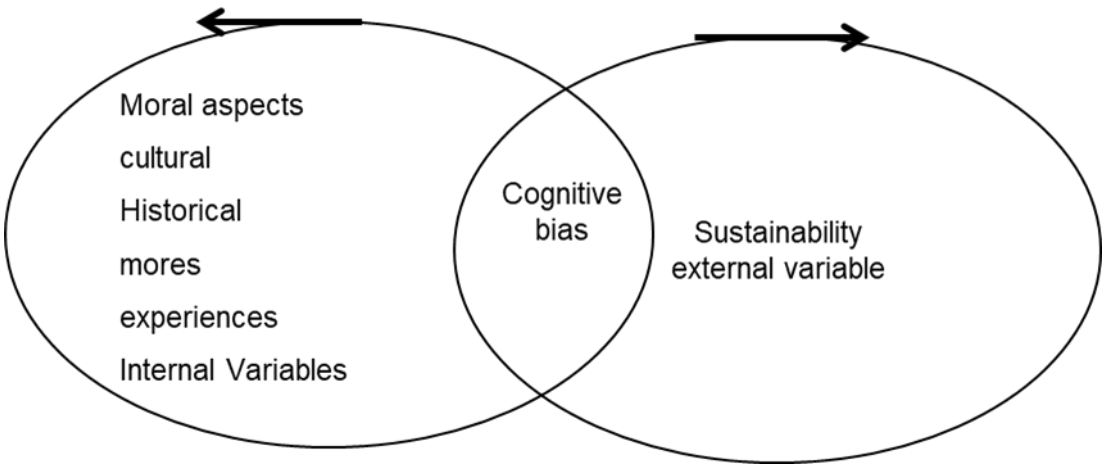
Because of this, the matter in question that underlies this study is: how can the evaluation of the variables interfering in the decision-making process help in the choice of the cultivation system in the agricultural unit? For this, internal and external variables that are part of the opportunity cost will be evaluated, which are present in the equalization of alternatives in the decision-making process of any organization. These, theoretically, are independent of the economic segment or its size. Later on, it was applied to *Vitis vinifera* production units.

2. CONTINGENCY THEORY IN THE CONVERGENCE OF DECISION MAKING

Contingency Theory allows the understanding of organizations in a dynamic environment, requiring an interpretation of the variables external and internal to the system, as they are mutually influenced in the behavior of organizations in the macro environment. For Donaldson (2001), internal and external variables interact dynamically, which makes it difficult to accurately predict the results of choices, making it necessary to measure the risk and the ability to be predisposed to uncertainty. In order to understand the functional relationship between environmental conditions, Contingency Theory seeks to be effective in identifying environmental conditions and administrative practices so that they are always in harmony (DONALDSON, 2001).

The dynamics of the indoor and outdoor environments show that nothing there can be considered absolute, because everything is relative and everything depends. This means that the techniques and the environment provoking influences are not related to cause and effect, but as a system, because regardless of cause or effect the choices are justified by "it all depends" without a methodological sequence. Because in the theory of contingency, everything will depend, including the adaptive or reactive capacity the cognitive biases may have a preponderant influence on the choices of the manager, resulting in new effects and causes that influence the environment that will present adverse or favorable reactions to the objectives and results expected in the decision making.

Figure 3 - Cause effect system in decision making



Source: Own elaboration (2020).

According to Donaldson (1999), the Structural Contingency Theory developed as a puzzle in which the insights of various theorists contributed to its empirical support. Burns and Stalker (1961) analyzed the mechanical and organic external environment, Woodward (1958) approached technology as a contingency factor, Lawrence and Lorsch (1973) studied the relationship between structure and environment, Hage (1965) and Perrow (1967) wrote about technology and structure, and Chandler (1962) analyzed the strategy - structure relationship, providing the background for this theory and offering support from real organizations.

The organizational structure has been continuously adapted to its marketing strategy. In Chandler's perception (1962), the time of decision-making processes in a company's internal environment, as choices of raw materials and production processes, remains relatively invariable, business decisions have less impact on the corporate structure due to greater control of internal environmental variables that are "what to do? ", and how to do it,". However, when technology, markets and sources of supply change, which are considered the external variables "when to do?" and "how much to do?, the structure dysfunctions become more evident and strategies end up focusing on the architecture of the organizational structure (CHANDLER, 1962).

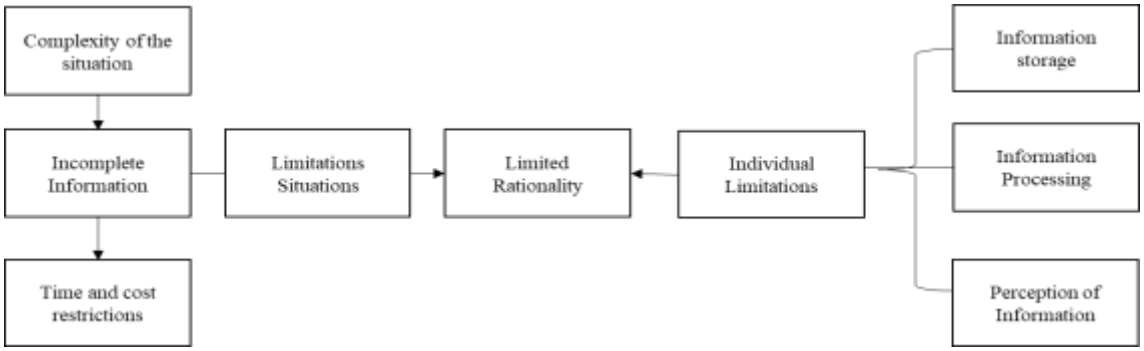
Contingency Theory can help farmers in their relationship with care in the agricultural unit, improving their ability to choose in the face of the uncertainties of the external environment and the exposed risks of the internal environment. Beach and Mitchell (1978) identify the steps that allow a decision maker to be guided, and they are related to the following questions: a) what to do?, and b) how to do it? These questions allow one to look at the internal environment of the property and thus not only assess his strengths and weaknesses, but direct its efforts to achieve the established objectives and purposes as well.

Other questions that allow a perception and quantification and qualification of the variables that are present in the environment outside the organization are: a) how much to do?, and b) when to do? These enquiries allow the potential and threats of the external environment to be analyzed. They show alternatives to market behavior over a given period of time. At the same time, decisions can interfere with the organizational microenvironment and vice versa. For Beach and Mitchell (1978), the categories of opportunity cost variables are based on a strategy to realize the choices in the unit's soil care with the aim of achieving maximum utility in agricultural cultivation systems. Information gathering, as well as costs and benefits provide an attractive framework because it considers task efforts and contingent processing behavior (PAYNE; BRAUNSTEIN; CARROLL, 1978).

Thus, the process that makes the permanent interaction of internal and external aspects opportune is in the four issues of opportunity cost: What to do?, How to do it?, When to do it?, How much to do?, which somehow sustain the interaction of purposes and direct prospects of possible results.

Contingency Theory is very similar to Limited Rationality. The first one uses the "all depends" of "n" variables that, in this case, could result in an "optimal" or sub- optimal" decision. The role of decision can be seen as the result of a rational cost/benefit approach related to strategy selection (CHRISTENSEN-SZALANSKI, 1980). In particular, it assumes the existence of Simon's Limited Rationality (1955) on the part of the decision maker.

Figure 4 - Limited Rationality



Source: Adapted from Sobral and Peci (2008).

A decision process conditioned by Limited Rationality requires choices with a certain degree of certainty, a certain degree of limitation of information, time, cost and cognitive ability as well, which, many times, can cause ruptures in the alignment of objectives and purposes. The individual believes limitations are part of the contingency and, at the same time, from his decision everything will depend on the new actions that are not yet possible to realize.

In this situation, the decision maker is limited to the time and information available in a state of *trade off where it* is possible to rationalize the usefulness of the choice for the desired results. This being said, the Limited Rationality is constituted by: a) situational limitations, which are a function of the complexity of the situation itself and of the set of restrictions; and b) individual limitations, which are a function of the capacity of the decision maker with regard to the perception and processing of information. Thus, decision-makers try to be rational, but they can hardly manage and act with full rationality which is due to factors such as incomplete data and even the inefficiency of technical advice. The decision-maker, in opting for an alternative in the resolution of the issues, abdicates others that could be better, if the knowledge of the variables was greater.

For Schneider (2003), decision making in agriculture results from strategies that occur conditioned by social, cultural, economic and spatial factors. These factors exert constant and variable pressure on the agricultural production unit. Therefore, the decision-making process has a benchmark that, in exercise, materializes through the social, cultural and economic relations constituted between people. Thus, the author ponders that, although they are conscious and theoretically rational strategies, this awareness is mediated by a rationality informed by the reality that is both the expression of the material relations present and those inherited and transmitted culturally.

Therefore, it is feared that the strategies are not causal or teleological, but rather the result of human action in the face of objective contingencies (SCHNEIDER, 2003). The author also points out that among the factors that seek social, economic and cultural reproduction resulting from the relationship between individuals and their families are: a) improvements in housing; b) well-being; c) progress in the production unit; and d) material possibilities of achieving certain objectives. This shows that social reproduction in family agriculture is the result of a set of factors that can be reinforcing or antagonistic that vary over time and have flexible relative weights.

2.1 *TRADE-OFF*, A QUESTION OF LIMITED RATIONALITY OR INTUITION?

The *trade-off*, an equalizing question between present and future results in a decision-making process, can be used to quantify and qualify the alternatives in the choices made in the management of the cultivation system.

Decisions in farm management can be formulated as multi-stage decision making. The process is characterized by a sequence of decisions taken to meet the objectives of the business. The choices are linked to periods of time that divide the decision-making process, and which can be called stages, representing the moments in which decisions are made.

Decision-making is a dynamic process sustained over time (BELLMAN, 1954; MJELDE, 1986; OSMAN, 2010). Each stage requires a choice of alternatives, so, the technical coefficients need to be updated and reassessed for the next choices. In the face of this, there is a behavior of adaptation and reaction of the farmers.

The *trade-off* variables in agricultural land use decisions, for Slovic et al. (2007), affect heuristics, "risk as feelings". According to this theory, intuitions about risky decisions are linked to previous experience by feelings or affective states (e.g. the feeling that if I do not carry out the pest treatment, it can influence the amount of grape produced). In the use of the decision maker's cognition, Kahneman and Tversky (2012) emphasize heuristics and biases in the decision-making process. They are: a) an intuitive and or emotional, rapid response, little effort (System 1); and b) another of "laborious mental activities", "complex calculations", "choice and concentration" (System 2) considered rational.

The Theory of Limited Rationality, on the other hand, has the advantage of "providing satisfactory descriptions of real human behavior" (SIMON, 1979a). With it, it must be considered the factors that influence decision making such as: a) past experiences; b) a variety of cognitive biases; c) an escalation of commitment and unrecoverable outcomes; and d) individual differences, including age, income, beliefs, and local customs. All these factors influence, to different degrees, the decision- making process and the decisions taken. Thus, both intuition and limited rationality participate or can participate in the *trade-off*, forming systems that reinforce themselves simultaneously.

2.2 THE CHOICE OF VARIABLES IN THE DECISION-MAKING PROCESS

For Simon (1970), the selection of information for decision making can be influenced by both the internal and external environment of the organization. The decision maker is often limited by his or her cognitive ability, and the decision-making process is also limited by this ability (SIMON, 1970).

For Juliusson, Karlsson and Garling (2005) past decisions influence the decisions people make in the future. It is expected that when something positive results from a decision, people are more likely to decide in a similar way given a similar situation. On the other hand, people tend to avoid repeating past mistakes (SAGI; FRIEDLAND, 2007). This is significant in that future decisions, taken on the basis of past experience, are not necessarily the best decisions.

For Marques et al. (2019), the influence of information on the decision also depends on the management characteristics of farmers and more specifically on their theoretical models, formal or otherwise. The authors believe that:

> "...the decision maker, when making a decision, expects a certain result, or rather: a set of results associated with a set of probabilities and objectives. It is therefore feared that the consequences of a decision, be it 'to do' or 'not to do', can be considered as 'predicted' (MARQUES et. al, 2019).

The decision-making process is complex and requires multiple assessments, with the formulation of variables and biases to parameterize the decision making. This process takes place through decision making models. Models exert considerable influence on decisions, as individuals decide on the basis of specific mental models (PEREIRA; FONSECA, 1997); however, they should not be seen as a recipe to be followed but rather as a tool for understanding complex elements.

When several complicated decisions come together and interact, the variables are difficult to quantify or weigh against each other. Decisions become complex, such as deciding what type of farming practice to adopt for a viniferous system. For this, it is necessary to consider some variables such as: a) type of climate; b) soil; c) grapevine; d) driving system; e) equipment; f) technology; g) available manpower; h) market demand; and others. This involves risks and uncertainties that may be present both in the conventional agricultural system with synthetic and chemical treatments and, in the case of biodynamic agriculture, with its phototherapeutic and non-conventional treatments with the use of a calendar based on astrology that seeks a balance of the forces of nature. The variables are many and extremely difficult to equalize in a simplified way.

A choice about the type of cultivation system that, at the very least, leads to a desired result needs to consider the choices made in conducting grape growing and, at the same time, the expectations of producing wines with identity. It is also desirable to have and consider information on the natural, human and financial resources available and appropriate to the type of vinifer growing system chosen, which would facilitate the management of the production unit, regardless of the type of cultivation system to be used to assess the potential for proper use of natural resources. What the business requires are decisions that, at the very least, meet moral requirements with environmental sustainability and that the economic and social results meet the purposes of the actors involved in the production chain. Choice issues can also be an expression of reaction or just a condition of adaptation of the farmer to the issues of the production chain macro system.

Therefore, the decision making takes place through action in the choices of alternatives that best fit the characteristics of the business and the profile of the manager who brings in his perceptions cultural and social factors, economic desires and concerns with natural resources. With this, it is possible to perceive the need for alignment of the perceptive, reactive and adaptive capacities in a harmonic and dynamic way in the management of *Vitis vinefera* cultivation.

Gasson (1973) shows that the personal characteristics of the producer influence his decision-making process. Brandt (1980), in his studies on agricultural product supply, points out economic, technological, ecological, institutional factors and uncertainties (arising from externalities beyond the farm gate). These factors and the information between them refer to the decision making circumstances of producers, which are often sources of uncertainty (e.g. climate, biological aspects, pests, diseases, etc.), and market conditions.

Uncertainties subject to misalignment in the prediction of results in the agricultural sector, in the decision-making process, such as the accentuated complexity of agrarian systems, have their origin in soil chemistry and physiology as well as the technologies employed. This also reinforces the differentiation of productivity and market performance of farmers (KAUTSKY, 1972). Some strategies may be appropriate to minimize uncertainties when using an adaptive and reactive profile in the face of complexity and uncertainty, as, for example, to seek people to exchange experiences and guidance. Often this person can be the cooperative's technician, the consultant, a neighbor, experiential courses, or technical trips. Seeking help and not someone to transfer his/her responsibilities and penalties for choices can be a desirable behavior for the decision maker.

3. DECISION MAKING IN THE CULTIVATION UNIT MANAGEMENT

Decision-making in the management of the cultivation unit requires experience, knowledge, as well as clarity of objectives. For Choo (1998), the objectives have an impact on priorities, choices and the amount of information about the methods and processes by which tasks are to be accomplished, as well as the objectives that need to be achieved. In other words: decision making is hardly the result of a structured, sequential, solution-oriented process. In this case, Nutt (1986) considers the opinions of people who can intervene in the decision-making process, since their experiences and choices lead to an acceptable decision-making process.

March (1994) considers decision making an objective-oriented and problem- driven act in which the behavior of choice is guided by norms and routines, leading organizations and individuals to act in a procedural and intentionally rational manner.

According to Simon (1965), there are six basic elements to be considered in the decision making process: a) the decision maker: it is the individual who makes a choice among several action alternatives; b) objectives: what the decision maker wishes to achieve with his or her actions; c) preferences: or criteria used to make the choice; d) strategy: the focus of the action that is chosen to achieve the objectives according to the available resources; e) situation: all aspects of the environment in which the decision maker is inserted and directly interfere in his/her choice; and f) result: the immediate effect of a decision strategy. Therefore, there is a systematic or random order, technical or intuitive, which will lead to a final choice.

For Carrieri (1992), rural producers, as agents of a production system, need to be aware of their agricultural reality and understand their real situation in alignment with business objectives. The objectives can be rationally defined as focused on profitability, but indifferent to the choice of the agricultural cultivation system. Many farmers consider agriculture to be a people-based industry with a family history. These characteristics are present in the properties that cultivate vines in the region of Serra do Nordeste, southern Brazil.

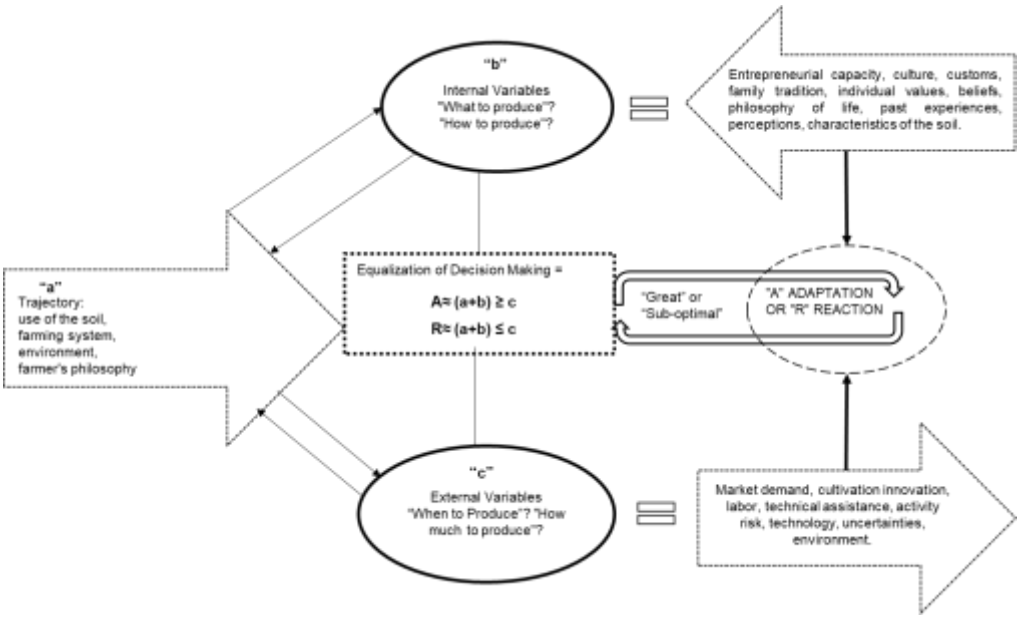
The history of the vineyards is confused with that of the families living there, being more than a simple business with a lucrative purpose. The practice adopted in the execution of agricultural activities in the vineyard portrays very much the relationships of friendships, social coexistence among neighbors, family members, the values and customs of ancestors. Thus, the trajectory of the people who live there connects with the history of each grape harvest. Then, the decision profiles have as a basis of information the global

vision of its environment, which means to be in accordance with the objectives it intends to achieve. So they take action and manage their production system by giving it a logic, which is in line with a rationality of its own and conditioned by a physical, environmental, social, political, and economic environment.

Decision making in this way, can be based on the influence received from social groups, neighbors, relatives. It can be said it is based on beliefs and/or based on "facts" or faith and acquired from various sources, including formal information such as education, experience, colleagues, and cultural environment (e.g. religion, education). This decision-making profile is close to the behavior of wine growers who make use of biodynamic agriculture, since they form a system of interpersonal and collaborative relationships for the elaboration of compounds and nutrients to carry out the care of the crop and the soil on their properties. To do this, the component elements of every decision must be understood.

For Simon (1965, p.53), "... every decision is made up of two types of elements, called elements of fact and elements of value, respectively". In Jones' view (2006), decisions made by farmers are influenced in part by an expectation of financial gain and in part by family and cognitive factors. In this case, Ocaña, Vecino and Avilés (1998) emphasize that the farmer, as a decision maker, is the result of a profile that is defined by the junction of socioeconomic factors (age, income, schooling, information, associative, management time, the succession process and others) and psychosocial factors (values, customs, religiosity, beliefs).

Figure 5 - The variables in a decision-making context



Source: Authors (2020).

The decision making context is one in which the farmer tries to equalize the variables in order to find a more relevant and satisfactory solution in a given time and which represents a great opportunity for the expected results of his vine growing system, such as: the relation with "what" to plant. This choice is often limited to crops that have been proven to produce good yields in the region or that ensure their subsistence under soil-based climatic conditions. Alternatives can also be defined in "how to", being a reference to the infrastructure of the property. According to MANDELLI (2003), the cultivation of the

grapevine goes through several stages from sprouting, pruning, phytosanitary treatments, flowering, and ripening of the grapes, which allows the organization of field work.

The decision-maker also considers situations of externalities that depend on the market behavior at a given moment that are "when to plant", which indicates the most appropriate period for the planting or increase in the cultivation of a certain vine which is classified as a perennial plant, but requiring attention to the climatic conditions in the regions of production, as well as the question of "how much", which becomes a guideline for the amount of area to be dedicated to the cultivation of vines. If the ideal is the quantity of kilos of grapes or the degree of sugar or slime in the vineyard that will be responsible for the added value that will indicate the expected financial result at the time of the decision-maker in the management of the land use of the vineyard.

The farmer, in many cases, is able to develop the adaptive capacity to cope with the high levels of uncertainty and risk offered by the environment, elements that, in most cases, are not controllable by farmers. These and other factors can be internal and/or external to the property, which is an open system (DUTRA; MACHADO; RATHMANN, 2008). Farmers need to know that a defective decision is as damaging to a vineyard as a contaminated vine graft and/or a type of vine that is not adaptable to the type of soil.

In the case of the use of intuition for decision making, the individual adopts conceptual representations and the use of logic that makes sense to a context, but with processes similar to perception, giving speed, little effort and even the ability of the individual to devote himself to multiple tasks while using this system. When this individual uses rationality (SIMON, 1955), the process is slower and demands more effort. This is where criticism happens, for example, since his/her ability to identify logics in different contexts makes him/her capable of doubt, which is nothing more than the ability to think two or more alternatives of divergent choices, which does not happen at times when the individual uses intuition (KAHNEMAN, 2003).

4. MATERIAL AND METHODS

As for typology, the research can be considered an exploratory and descriptive quali-quanti analysis study. For Gil (2008), the main objective of the exploratory research is to develop, clarify, and modify concepts and ideas. The sample was intentional for convenience and not probabilistic. This type of data collection of a sample is used in exploratory and descriptive studies (FONSECA, 2002).

The steps of this study were: a) bibliographic data collection; and b) data collection to analyze the choices in view of the criteria of weighting the opportunity costs in the inquiries for the choice of the conventional or biodynamic cultivation system regarding the care and treatment of the soil and with the vine in the vineyard. The criterion for the choice of the sample was the willingness of producers of *Vitis vinifera Chardonnay* to participate. Obeying this delimitation, 19 vineyards were found in the conventional cultivation system and 07 in transition to the cultivation system using biodynamic agriculture practices, totaling 26 vineyards.

The interviews were conducted individually, with visits to winegrowers on their properties from 6 to 28 June 2018. With this, it was possible to make a direct and extensive observation. The questionnaire

used was structured, formed by questions that help in the equalization of *trade off*, such as inquiries about the opportunity cost. This collection tool was adapted from the validated study in Dalcin (2010).

The data treatment was performed using the *Statistical Package for the Social Sciences* 18 (SPSS) with correlation tests for analysis of the data obtained from the collection of interviews performed on the properties of conventional and biodynamic viticulture systems.

5. ANALYSIS AND DISCUSSION

According to the rational decision-making model, individuals decide in a mechanistic manner, delimited by a guiding objective which, in commercial and productive organizations, is profit. This objective also serves as a thermometer to signal the vitality of the business. However, in every type of enterprise, especially in the agricultural sector, decisions based solely on this factor do not guarantee the longevity of the natural resources that are necessary inputs to actually promote profit.

Thus, most managers now consider other variables in the decision-making process, such as the ability to intuit as well as to know that their choices "depend" on contingency situations that lead to the expected results. According to Schneider (2003), rural producers are conditioned by social, cultural, economic and spatial factors that put pressure on their production units. Inherited expressions such as fears and care in their choices in the conduct of farming, for example, are present.

With the results of the research carried out in the field, it was possible to perceive the mechanistic way in the behavior of the grape growers, both those who still make use of the conventional system of treatment of their vines and those who opted for a non-conventional system of soil care. The results gathered from the interviews and direct observations made show that the use of biodynamic farming practices is still incipient. It can be said that those who are migrating to this system of cultivation practices are in a process of adjustment in every way. These adjustments can be perceived from the conduction of soil care, as well as in the transformation of the wine growers' behavior in the approach to the philosophy behind biodynamic agriculture, which is anthroposophy.

It is noticeable that, until now, in the vineyards that have migrated to the practice of biodynamic agriculture in the production of *Vitis vinifera Chardonnay*, there has been "an adjustment of agricultural cultivation techniques". This means a concern for the balance of the ecosystem, fertility and good soil quality. It was possible to perceive the concern of the production units' managers to make use of less aggressive techniques and treatments to the environment, mainly in soil treatments.

Table 1 - Tradeoff of winegrowers in weighting the Cost of Production Opportunity

Correlations

		QtoP_ Ambiental-Recursos_ Naturais	QtoP_ Econômico_ Recursos_ Financeiros	QtoP_Social _Recursos_ Humanos	QdoP_ Ambiental-Recursos_ Naturais	QdoP_ Econômico_ Recursos_ Financeiros	QdoP_Social _Recursos_ Humanos
OQP_Ambiental-Recursos_Naturais	Pearson Correlation	-,106	-,170	,039	-,067	-,446*	-,077
	Sig. (2-tailed)	,606	,407	,851	,746	,022	,710
	N	26	26	26	26	26	26
OQP_Econômico_ Recursos_ Financeiros	Pearson Correlation	,223	,352	-,332	,117	,000	,308
	Sig. (2-tailed)	,275	,078	,098	,571	1,000	,125
	N	26	26	26	26	26	26
OQP_Social _Recursos_ Humanos	Pearson Correlation	-,234	,084	-,229	-,220	-,506**	,113
	Sig. (2-tailed)	,250	,683	,261	,279	,008	,583
	N	26	26	26	26	26	26
CP_ Ambiental-Recusros_Naturais	Pearson Correlation	,437*	,155	-,184	,048	-,147	,295
	Sig. (2-tailed)	,026	,450	,369	,816	,473	,143
	N	26	26	26	26	26	26
CP_Econômico_ Recusros_ Financeiros	Pearson Correlation	,050	-,028	-,086	,047	,502**	,054
	Sig. (2-tailed)	,809	,890	,675	,820	,009	,793
	N	26	26	26	26	26	26
CP_Social _Recursos_ Humanos	Pearson Correlation	,090	-,328	,303	,028	,302	,032
	Sig. (2-tailed)	,663	,102	,132	,891	,134	,875
	N	26	26	26	26	26	26

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Research Data (2020).

As it is observed in the data of Table 1 for the correlation of the Economic variable in the item “financial resources” in relation to "how to produce" for "when to produce", the result was a moderate correlation of $R^2 = 0.502$, positive perfect. This means that the decision maker concentrates on evaluating the economic variables at 50.2%, and reserves 49.8% for the other variables. The other variables are related to Environmental and Social issues. Thus, for a given time and type of farming, the decision maker’s concerns are balanced in assessing the opportunities to make the choice of farming system.

As for the equalization of the manager in "how to produce", $R^2 = 0.437$ was found, perfect positive. The variables constituting the Environmental-natural resources issues is 43.7%, correlated with the variable "how much to produce", also the relevance is for the Environmental issue, being one of the important factors to consider when deciding how to reach the amount of kilograms of vinifers.

The opportunity cost variable of "what to produce", Environmental and Social factor, in relation to the variable "when to produce", Economic issues presented a negative correlation with R^2= -446, and R^2= -506, variables implying the social issues. Biodynamic vineyards are formed by young vines, because the soil needs to undergo a detoxification process with biodynamic treatments (IBD CERTIFICATIONS, 2019) to receive a crop according to the guidelines of biodynamic agriculture. What has also been noticed is that some winegrowers of conventional systems have migrated to the use of biodynamic treatment. In this system of cultivation, in some cases, a reduction of the planted area may occur, as this system requires greater care and involvement of the human being, which implies more work force as well as an area with fewer vineyards per hectare. As consequence, there was a reduction in production volume in

kilograms of grapes from conventional to biodynamic. On the other hand, the latter may, in theory, achieve greater added value, on the market, as well as better quality in the characteristics of the fruit.

According to the winegrowers of the biodynamic cultivation system, "it is a question of changing the way of thinking and seeking better quality fruit" (statement of the vineyard manager SCBD 004), and for the vineyard manager SCBD 005, "... by producing grapes with biodynamic practices and preserving the soil pattern, biodiversity, and human health is not a unanimous reality yet, but with the intention to improve".

Decision-making, regardless of the cultivation system adopted in the agricultural unit, presents risks and may also arouse uncertainty, due to some shortcomings in the decision-making process, such as the lack of reliable information and adequate tools that allow a correct evaluation of available resources and adequate technical guidance; add to this the limitations of cognitive capacity, inherent to human beings, and what is obtained will be a suboptimal choice for the moment (Limited Rationality). At the same time, intuitive ability can also lead to choices converging on a pessimistic or very optimistic scenario that happens because of past experiences or beliefs or cultural imperatives. In this scenario, the choice is also only satisfactory.

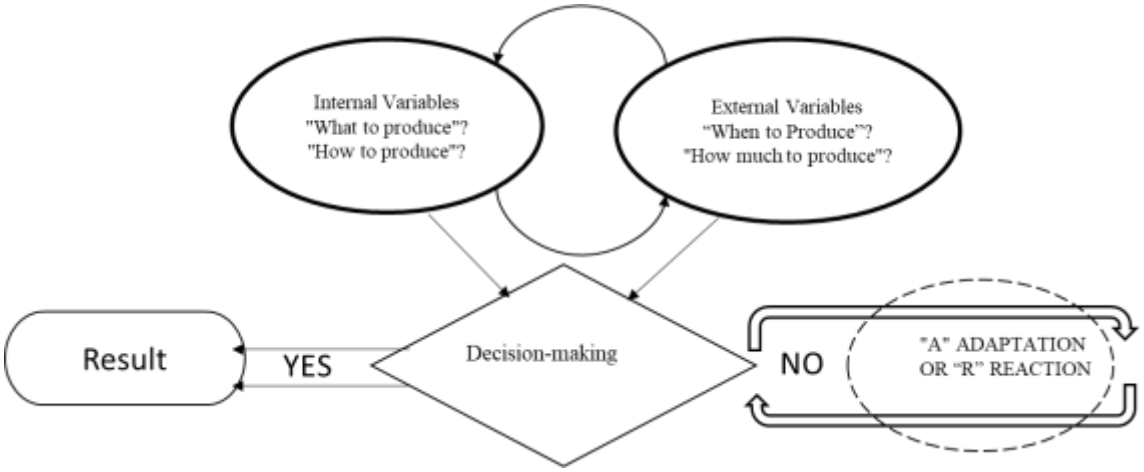
The profile of the decisions shown in the study is related to the characteristics of the vineyard model. Thus, for example, as to the size of the cultivated areas, it is stated that the planting area is on average one hectare, many of which are family- owned, and present a strong appreciation of beliefs, guidance received from their predecessors and sharing of experiences with neighbors, technicians and suppliers, being considered of significant value in establishing the criteria for decision-making.

Deciding, when faced with complex situations in the management of the vineyard unit, requires the winegrower to innovate, including in the way he acts. There must be a detachment from beliefs and habits that do not contribute to the desired results, and focus on process innovation, as well as commitment to issues where it is necessary to follow procedures requiring planning for long-term results and denoting many uncertainties and learning in the face of the new. In this sense, to enable the improvement of the management process, the need for adequate technical tools, information, monitoring, and learning is perceived.

Decision making is at the root of any organizational process. It is important to develop effective skills and strategies that enable problem to be solved, cost-benefit assessment, and an examination of possible choices (WESTER et al., 2008). The decision-making process can be complicated and "overwhelming". As a result, the model that was perceived in the decisions, both daily and long-term, of the sampled winegrowers, has two sets of variables: internal and external.

The internal variables answer the questions: "what to produce" and "how to produce"; the external variables, "when to produce" and "how much to produce". These issues are often interinfluenced and not clearly defined for decision making, as they are strongly influenced by different external actors, or by local culture, or family values. A third process perceived in the interviews was the systematic relationship between what is being called here internal and external variables. Decision-making can be represented by alternatives of producing or not producing, and rethinking the investment (adaptation or reaction).

Figure 6 - Model of decision making of the cultivation system in agricultural production



Source: Prepared by the authors (2020).

The decision-making process can be facilitated by three decision support routines in order to arrive at a satisfactory alternative: a) control routine; b) communication; and c) policies (CHOO, 1998). Corroborating, Daft (2008) includes the subjective variables of the intuitive field such as experience and common sense, because intuition is not despotic or irrational; it is based on years of practice and direct experience, speeding up the decision-making process.

March and Simon (1975) make it clear that most decisions, whether of an individual or organizational nature, involve the discovery and selection of satisfactory alternatives. Choo (1998) explains that, for the most part, these alternatives are motivated by the occurrence of a problem, oriented to the symptoms or to an old solution and conjecture: the training, the experience and the objectives of the decision participants.

Decision makers in the agricultural unit seek to be rational through their individual behaviors; however, because it is a complex process, they are subject to limitations, often of information and training. In this dimension, the farmer needs knowledge and agility in the search for competitiveness and even survival. In agricultural production, the complexity of the processes is accentuated due to the particularities of the activity, such as the influence of climatic variations, soil type, management and care of the crop. It was possible to realize in the interviews that all these elements are present in the decision questions, although with different weights and a little disarticulated.

Finally, the analysis of the results shows that decision making required management of a flow of information that would lead to a result that was not only satisfactory for a certain period of time, but a choice that would lead to the sustainability of the business. It needs to be a choice that generates reliability and allows the farmer to have an adaptation reaction or to react to an internal or external context. Their choices, in parallel, need to be in line with the longevity of the use of natural resources. Their decisions need to be consistent with maintaining the good quality and fertility of the soil in their vineyards.

Choosing a conventional and/or biodynamic farming system goes beyond the capacity of a rational or intuitive choice. It is a choice that "all depends" (in line with the Contingency Theory). In this specific case, knowing the physical and chemical characteristics of the soil allows the use of a technical tool that will assist in decisions on planting vines, the analysis report allows one to know the soil profile and its

nutrients, and thus the type of crop that best fits, such as what, how, how much and when it should be cultivated in a given territory and season, which can greatly assist the decision in the choice of treatment management and vineyard management system as well as indicate regions with soil profile, climate and natural conditions that best adapt to certain agricultural cultivation systems.

With the results found, it was noticeable that the winegrowers do not have a knowledge or do not take into account the compatibility of the characteristics of the soil and the type of culture that will be introduced in the place, but the economic result that has equivalent weight to the sum of all other variables that are part of the complex decision process, and, often, today's decisions can lead to unsatisfactory long-term results and even environmental and human health consequences, due to the choice of soil care and highly intensive fertilizer treatment systems.

6. FINAL CONSIDERATIONS

Information is the limiting factor in decision making. Transparency and speed of data flow contribute to improving the efficiency of all components involved in the process, resulting in better management and consequently efficient use of productive resources. Faced with the challenges of *trade-off*, the decision-maker needs to access and appropriate the tools and techniques that guarantee him/her to achieve or approach the desired results for that moment, given the conditions that present themselves in the context.

The relevance of valuing choice must also be intrinsically linked to the cognitive capacity of the decision-maker. With this, the influences absorbed in a trajectory of activities and coexistence in the environment are present, which may be to equalize the decision making with more or less emotional or intuitive content due to experiences in previous facts.

The time factor and environmental conditions for decision making are part of a dynamic and complex context that is not always considered to assess the ability to choose an optimal or sub-optimal decision. The overall knowledge of the problem and the individual's ability must be related to the objectives of the business and aligned with his/her purposes. It means that his/her capacity for rationality acquires a wider range of perception, which facilitates access to alternatives that guarantee, at a minimum, choices that keep the objectives aligned with the expected results.

Growers who work with *Chardonnay* vinifera mostly decide with restricted information and often do not meet the needs of the business or family. It was verified that the choice for an alternative cultivation system, with management and use of alternative techniques, in most of the properties participating in the research, was, in the first place, due to the economic factor and, in the sequence, come the environmental concerns, represented by the care with the soil. This is due to the sequels the soil in the region shows in technical reports of quality analysis and soil profile, such as the high levels of: a) copper due to treatments with "Bordeaux mixture"; and b) other chemical additives influencing the vegetative process of the vines (MARQUES et al, 2020).

Therefore, Guerra et al. (2003) indicate that soil properties influence mineral elements, organic acids, phenolic compounds, and aromas, which are factors closely linked to the characteristics of the grapes

grown in each soil of a region, leading to changes in the sensory and chemical properties of the wine, interfering in the result of a good "*terroir*".

According to the vineyard manager SBD002, the difficulties encountered and the concerns to adapt in a less conventional cultivation system "are due to the climatic conditions and soil profile of the wine-growing regions in the Serra Gaúcha region, which present many variations that do not always favor the cultivation of *Vitis vinifera*". Even so, the reduction of the use of chemical treatments in the vineyards has been occurring gradually in the properties participating in the study, until it is possible to carry out all the care and treatments of the cultivation with the techniques of biodynamic agriculture. On the other hand, conventional vineyards are still heavily dependent on the use of pest control chemicals and cleaning between grapevine lines.

The pertinent question was to analyze the variables interfering in the choice of the soil cultivation system, using conventional and/or biodynamic agricultural practices for viniferous production. The results showed that decisions are influenced by the economic variables, in this case, demand and value paid by the market or financial profitability. Thus, the valuation of economic issues is the driving force in decision making, rather than environmental or social issues in the management of the vineyard system independently of the system, that is, conventional or biodynamic.

The tendency of some properties is the search for new cultivation practices, in the case of biodynamic agriculture; however, it signals, in a still tenuous way, that environmental issues may gain more weight in the equalization of alternatives for decision making and, mainly, the concern with climatic conditions and the adequate use of the soil.

It should be noted that the study has its limitations in analyzing only some of the variables that imply the *tradeoff* of opportunity costs, making it impossible to analyze more variables that may be interfering in decision-making in vineyard management. Another limiting factor is the lack of a database with the technical information of the properties and treatments and care with the soil, which occurs with the two systems of grapevine cultivation, also including the winegrowers linked to the local cooperative.

Finally, biodynamic agriculture is still a subject that needs to be studied, tested the treatments, even if its use had begun in the 20th century (1924), by Steiner (1861-1925), and, even today, it requires studies and scientific deepening, because its application is based more on facts, accounts and based on beliefs, customs and philosophy than on scientific evidence and techniques recognized and validated, requiring care as well as signaling possibilities for studies and research.

For future work, it is suggested to carry out a comparison of decision making in the cultivation and soil care system in vineyards in the south of the country with the other Brazilian wine-producing states in order to validate the variables that interfere in the manager's choices.

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