# ECONOMIC EVALUATION OF AGRONOMIC RESEARCH IN AGRICULTURAL COOPERATIVES: PROPOSAL OF A DYNAMIC SCORECARD MODEL

## Abstract

The scope of this work is to develop an instrument for the economic evaluation of agricultural research in the productive chain of wheat and its impact in the profitability of agricultural cooperatives. A conceptual model was developed using the balanced scorecard and system dynamics methodologies. In the development of the model all processes involved in the productive chain of wheat agricultural research were initially mapped. Furthermore, a BSC strategic map was developed, explaining the objectives and indicators of the cooperative. Finally, using the system thinking approach, a modeling was driven seeking enlargement of the problem systemic vision. The resulting model developed in this work allowed a better understanding of the complex relationships between research and agricultural production, making it easier to analyze the process and the decision of new investments in research on the part of managers and analysts of agricultural cooperatives.

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## 1. INTRODUCTION

The cooperatives are constituted as people's societies, which are part of the organization, seeking satisfaction of common needs. Unlike mercantile societies, where the power is proportional to capital, in cooperatives the power is equalitarian, and each cooperative member has the right for a single vote, independently of capital possession (BIALOSKORSKI NETO, 2001). These organizations play an important role in the Brazilian economy regarding the generation of jobs and participation of results in the country trade balance, with a 27.87% participation in the result of GDP in 2005 (ABAG, 2006).

The impact of the changes in the economical and political sceneries affects the agribusiness organizations, which are the focus of this research. As a significant part of the production supplies foreign markets, any change in the world scenery or in the Brazilian economical politics results in modifications of those organizations performance. In this sense it is important to punctuate that the cooperative members show peculiarities in their legal constitution, with consequent adoption of principles and doctrines, with significant impact on their organizational structure, in the delegation and in the exercise of power and, consequently, in the way the decision making process is included in the planning and execution of their strategies.

Thus, in terms of strategic administration, it is certain that the agricultural cooperatives face the same challenges of any organization. One of these challenges is converting the strategy into a continuous process, where the implementation of the strategy becomes a task for all.

With the Balanced Scorecard (BSC) popularization, developed by Kaplan and Norton in 1992, a discussion about a different way for the strategy implementation in the organization started. This approach tries to incorporate a new vision to the strategy modeling problem, seeking explicitness through a strategic map, where the strategy objectives are designed multi-dimensionally.

Although the BSC has already constituted in a very useful tool to managers, some limitations are found in the explicitness of the formal strategy. It was due to these limitations that (FERNANDES, 2003) proposed the job of the Dynamic Systems (DS), an approach thoroughly used in the explicitness of the reality thinking. The integration of the Dynamic Systems (DS) to Balanced Scorecard, denominated for (FERNANDES, 2003) as Scorecard Dynamic, seeks widening of BSC borders for a systemic vision with different unfolding in terms of decision and strategic evaluation.

Therefore, due to the problems that agribusiness cooperatives are facing to evaluate the results reached with the agricultural researches, this work proposes and discusses the development of a conceptual model of Balanced Scorecard integrated to the Dynamic Systems, trying to explain the relationships and interdependences among

the relevant variables, which helps managers to evaluate the results of investments in agricultural researches.

## 2. AGRIBUSINESS AND AGRICULTURAL COOPERATIVES

The agribusiness concept represents a modern and systemic focus, involving all companies which manufacture, process and distribute agricultural products. This group of processes and linked institutions for common objectives constitute a system, which includes other smaller systems, or subsystems. The larger system is called agricultural business, or agribusiness (DAVIS e GOLBERG, 1957 apud CASTRO, 2000).

The agribusiness includes productive chains and, among their components, the productive systems that operate in different ecosystems or natural systems. In that context, a conglomerate of support institutions exists, including credit, researches, technical support and other institutions, and a legal and normative apparatus, exercising strong influence in the acting of the agribusiness (CASTRO, 2000).

The perception on the great economical potential of the agricultural cooperatives grows, globally, as the Brazilian agribusiness is conquering important markets in a progressive way. The commercial agribusiness surplus was approximately US$ 35 billion, accumulated during the period of May 2004 through April 2005, a number resulting from the exports of US$ 40.6 billion, corresponding to 22.4% above the value reached in the previous period, from May 2003 through April 2004 (ABAG, 2005). Besides, the agribusiness section contributed with 27.87% of the gross domestic product and 24% of the jobs generated in Brazil in 2005 (ABAG, 2006).

Cooperatives, in the State of Paraná, congregate more than 348 thousand people, distributed in 209 cooperatives of the following branches: agricultural, credit, work, education, health, housing, consumption of goods, transport, infrastructure and tourism. The total incomes for cooperative members reached R$ 18 billion in 2004, against R$ 15.5 billion in the previous year, which is more than 18% of the gross domestic product (GDP) in the State of Paraná. This number grew 15% in 2004 (OCEPAR, 2005).

The agricultural cooperatives represent approximately 53% of the agricultural economy in the State of Paraná and they are a significant part in the production, improvement, storage, industrialization and commercialization process, including 74 cooperatives distributed throughout the State of Paraná, which social composition added, in 2005, 106,211 cooperative members with a total of 40,673 employees (OCEPAR, 2007).

## 3. BALANCED SCORECARD

The first article published by KAPLAN and NORTON about BSC was "The Balanced Scorecard - Measures that Drive Performance" (Harvard Business Review, January-February of 1992). From that date on the number of studies and applications of the system in the industrial, public and service areas has grown.

Balanced Scorecard looks for translating the vision and the strategy of the companies in an including group of objectives and acting measures, serving as basis for a system of strategic administration. The whole development of BSC will happen starting from the modeling to translate the strategy of the organization in a group of

objectives and indicators. Such objectives will be thought starting in 4 perspectives: financial, customers´, internal processes and growth & learning.

Thus, all selected objective or indicator for a scorecard should be an element of a chain of cause & effect relationships, communicate the meaning of company strategy. Therefore, the translation of the organization strategy will be summarized in a group of hypotheses on cause relationships and effect that should be tested along the counting process and evaluation of results. For the complete development of scorecard the definition of goals and relative strategic actions to each strategic objective is necessary. The modeling and construction strategy stages of the scorecard will result in an outline, serving as a road guide to be pursued for reaching the organization main guidelines.

In spite of the BSC success there is an agreement among the authors (RICHMOND 1999) (RICHMOND 2001), (FERNANDES 2002), (AKKERMANS & OORSCHOT 2002), (LINARD et al 2001), (TODD & PALMER 2000) that the modeling process that originates the BSC strategic maps (strategy maps) shows little flexibility for explaining the consequences of external events, or even the adverse effects of certain options or strategic decisions. Although BSC tries to support in the systemic paradigm, it is a consensus that the language used in the process of strategy modeling has two limitations: it does capture neither the passage of time, nor the responsible systemic structure for the behavior of the performance of strategy. Seeking to overcome the lineal and static outline of BSC language, (FERNANDES 2003) proposed the incorporation of Dynamic Systems (DS) to the process of modeling of strategy with BSC.

## 4. DYNAMIC SISTEMS

It has been 46 years since Jay Forrester published the Industrial Dynamics book, starting the Dynamic Systems (DS). Ever since the field expanded, to contemplate researchers and apprentices in several areas of the knowledge, such as, medicine, economy, sociology, military planning, not mentioning the several application areas in the domain of the businesses. Historically, DS integrates three fields of knowledge: 1) control engineering, feedback concepts and self-regulation; 2) the cybernetics and the role of information in control systems; 3) the human organizations decision theory.

The discovery that mental models influence the form in which people see the reality has, without any doubt, guided the job of Dynamics of Systems much more towards the explanation of the thought about reality than obtaining numeric answers for well structure problems. In this sense, the most important in the process of using the Dynamic Systems is the insights production during the modeling process, idea strongly identified with the creation knowledge which, according to De Geus (1994), a former Shell executive, constitutes one of the central elements for the innovation and for the perception of new opportunities. According to him, the DS used in the study of sceneries has contributed decisively to accelerate 3 to 4 times the learning speed and implementation of new internal systems at Shell, enabling the company to be well prepared to face the changes that happened in the beginning 1980´s. Such fact puts the Dynamic Systems in a different perspective from the traditional analytical and econometric methods, placing in the heart of the practice and theory of organizational learning, as Senge postulates (1990) in the book "The Fifth Discipline".

## 4.1 The Dynamic Systems Modeling

In Dynamic Systems two modeling forms are used to characterize a system: the soft and the hard approach. One of the soft modeling results (qualitative) of DS is the visualization possibility of any system, through the identification of their structural characteristics, of the relationships cause-effect-cause and of the feedback structures. Such task is performed through the Causal Loop Diagrams), as seen in Figure 1.

A second operation way, of quantitative nature, is the use of Causal Loop diagram features to develop a system simulation model, using the Flows and Stocks language (Figure 2). The simulation models can be used to investigate and to understand why a specific system behaves to this, enabling the finding of better ways to operate it, once one can know the consequences beforehand that certain events will be started in the system. In short, the job of the DS modeling consists in the elucidation of collective mental models concerning a situation, that later will be used to support any process of strategic evaluation where it is important for the group to understand the consequences of certain decisions or politics.

**FIGURE 1 – CAUSAL LOOP DIAGRAM: RESULTING FROM A SOFT MODELING**
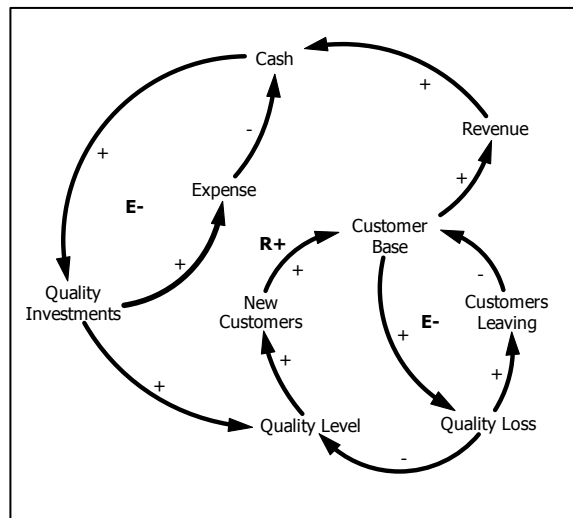


(Source: the authors)

**FIGURE 2- FLOWS AND STOCK DIAGRAM: HARD MODELING RESULTANT**
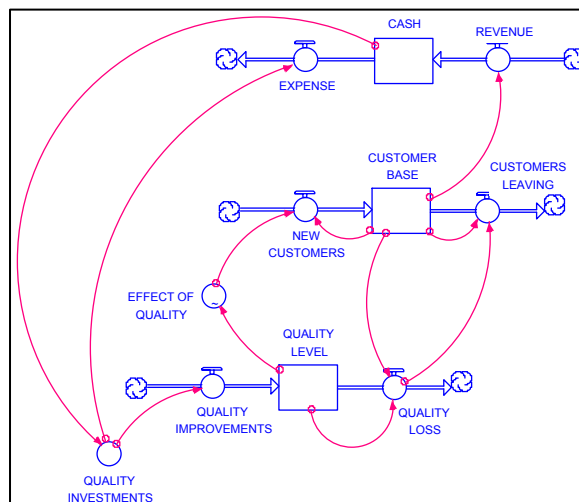


(Source: the authors)

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## 5. METHODOLOGY

The problem referred to in the present work is about investments in agricultural researches of an agribusiness cooperative and its impact in their members' profitability. Now the managers of the unit negotiate the agribusiness cooperative being analyzed, and that are directly involved with investments in agricultural research and the measuring of results, they don't possess a system that demonstrates the impacts of such investments in the profitability of cooperative members. For the lack of an administration system that gets to consolidate all of agricultural research information unit, presenting the results and impacts along the time in the structure of the referred Cooperative unit, a conceptual model was developed for integrating BSC and of DS methodologies for explaining the variables and the relationships for controlling and monitoring investments in agricultural research and their impact on the profitability of cooperative members.

The methodology adopted in this study was the research-action participation, in which all of the linked actors of the Agribusiness Cooperative chain being analyzed located in the central-southern area of the State of Paraná, they participated intensively of the discussions that culminated in the elaboration of models. The following research itinerary was used to present four phases to develop this study, which are:

**Exploratory Phase:** In this phase three visits were made in the subject organization, with the objective of getting to know the participants and the units that would be included in the research. It was also presented, on the part of the organization, the problems and the difficulties of administration in the unit in charge of agricultural researches within the organization. In these first visits the concepts of the two methodologies, Balanced Scorecard (BSC) and Dynamic Systems (DS) were also presented. They also presented and discussed the research projects of the process, their objectives and possible financial profitability for the Cooperative in focus.

**Deepened Research Phase:** With the definition of the case to be studied, of the theme and of the objectives of the research and of the Units of Businesses involved for the development of this project, it began the first risings regarding the structure of the organization as a completely. Firstly, all of the internal processes were discussed and verified with the objective of developing a map of those organization processes, and of business units researched, verifying how decision process is conducted for new investments in agricultural research, their stages and their peculiarities.

**Action Phase:** In this research phase, the stages for the development of instruments for defining the objectives and goals of the necessary organization for creating the BSC were put in practice which, according to Kaplan and Norton (1997), would be: explain the strategy to reach the mission and vision; develop strategic objectives after the strategy translation; classify the objectives; verify the existing inter-relations; develop the strategic map; unfold the objectives of goals; define the indicator; create an itinerary for implantation of Balanced Scorecard. With the characterization of productive wheat chain of the referred Cooperative, the strategic map was developed according to the vision of Cooperative members. With the validation of a strategic map for the people involved in the work, the construction of causal and stock&flow diagrams to integrate the Dynamic Systems (DS) to Balanced Scorecard (BSC) was started.

**Evaluation Phase**: The scope of this phase was to verify the effectiveness of the work in relation to intended objectives, as well as the rescue of knowledge that was acquired during the development process of this work.

## 6. WHEAT CHAIN CHARACTERIZATION THROUGH THE VISION OF COOPERATIVE MEMBERS

In this work the productive chain of the wheat, through the vision of the agribusiness cooperative members under study, was analyzed. The main links of that chain were detected and studied, as shown in Figure 3. All the "links" that tie the process of agricultural research to the customer-market were observed. The agribusiness chain can be defined as the sequence of activities that transform a commodity into product for the final consumer, not worrying about the variable price in the coordination process, considering that the borders can be modify along the time (ROSSI; NEVES 2004).

**FIGURE 3: WHEAT CHAIN CHARACTERIZATION THROUGH THE VISION OF COOPERATIVE MEMBERS.**
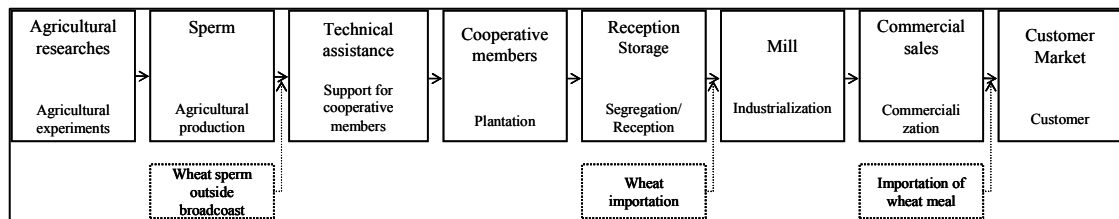


(Source: the authors)

In Figure 4, the wheat chain is presented according to Rossi and Neves (2004). It can be verified, among the main elements of the chain, the agents, the relationships among them, the sections, the support organizations and the institutional atmosphere (ZYLBERSTAJN 2000).

**FIGURE 4: THE WHEAT CHAIN IN BRAZIL**
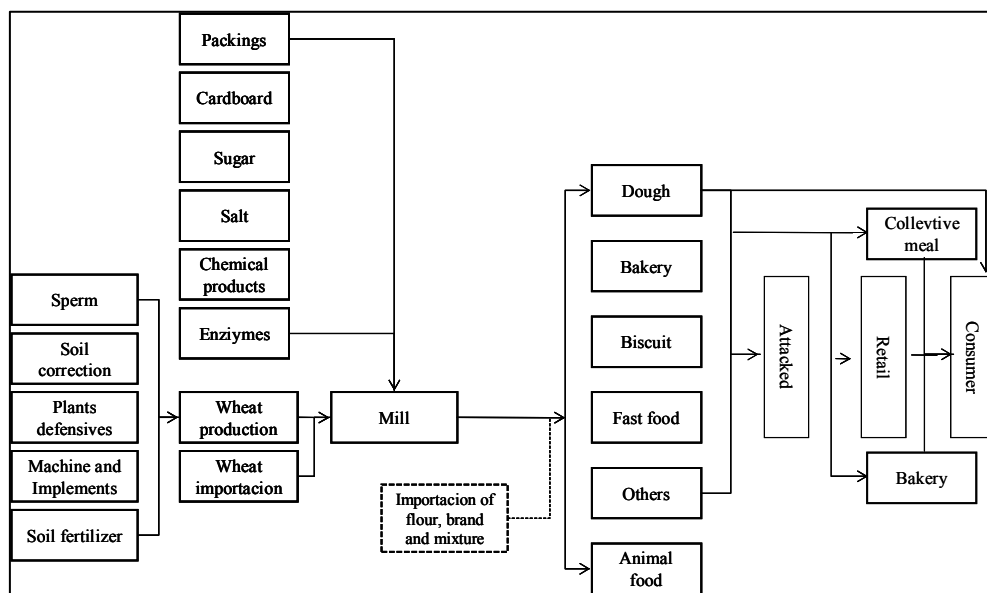


Source: Rossi and Neves (2001) p. 59.

The difference between the wheat productive chain, in the vision of cooperative members, developed in the referred Agribusiness Cooperative in relation to the chain presented by Rossi and Neves (2004), it is in relation to the link of "Agricultural Researches" that is not illustrated in Figure 4.

## 7. BALANCED SCORECARD STRATEGIC MAP ELABORATION

This stage has the main objective to design a strategic map for modeling the wheat productive chain, explaining the strategic objectives of the organization and providing support for a control system, attendance and evaluation of the strategy being developed, based on BSC conceptual structure. The result was the elaboration of a map with connected objectives for cause relationships and effects, according to KAPLAN and NORTON methodologies.

**Interviews for the construction of BSC**: In interview with the person in charge of the research department of the Cooperative and with the wheat chain researcher, for describing the processes for accomplishment of researches, the existing connections between "links" of the wheat chain and its importance as a cooperative business unit were evaluated. That interview took place in June of 2006 and lasted approximately three hours. After the accomplishment of the present work, an interview was made with the person in charge of the industrialization unit regarding the wheat mill of the Cooperative. This interview had the objective of understanding the wheat industrialization process, the contact and relationship with the customer and the identification of critical processes for industrial production. The first information obtained for the development of a wheat chain strategic map, an interview was held with Cooperative financial work group. That interview had the objective of understanding the Cooperative vision in relation to investments in agricultural researches and the profitability of cooperative members in formulating a strategic financial map.

**Construction model:** As the definition of the purpose of the wheat chain strategic map is to understand the impacts on the cooperative profitability, starting in agricultural research investments, it was defined that the group should begin the work regarding Investments in Research, starting with the learning and concluding with the cooperative profitability. Having the debates been concluded with definitions including objectives and indicators, the researcher compiled the information, obtaining a final strategic map. As it can be seen in Figure 5, 32 indicators were defined.

The BSC strategic map provides a model that shows as the strategy ties the intangible assets to the process that generates value for the organization. The cause and effect architecture interconnects the objectives in four dimensions, turning clear the strategy multidimensional relationship (KAPLAN; NORTON, 1997). The financial dimension describes the tangible results of the strategy in traditional financial terms. The measures of the financial dimension in the defined wheat productive chain were: profitability of Cooperative, profitability of the industry, cost of industrial production and cost of agricultural production. These are numbers that show the defined strategy for the organization directive plan. Customer's dimension defines the proposition of value for the customers, creating a context, so that the intangible assets create value for

the organization. The dimension customers' measures are: customer's satisfaction, customer's need, quality and industrial productivity. The dimension of the internal processes identifies the critical processes that directly influence the design of a strategy. The measures in the dimension for internal processes are: industrialization, agricultural productivity, of agricultural production control and technology diffusion. The learning dimension defines the considered intangible assets for the organization strategy. The objectives of that dimension should be coherently connected to the other and aligned to internal processes of the strategic map. The measures in the learning dimension are: research of the agribusiness, qualification, turnover and investments in researches. The objectives in the four dimensions are linked to the other ones regarding cause-effect relationships. The strategic map begins with the hypothesis that, with financial results, just the main customers will be conquered in their assisted needs and satisfied with services rendered. Internal processes were developed and their values for customers were accomplished, and their learning objectives sustain the basis of a strategy designed by the organization (FERNANDES, 2001).

**FIGURE 5: STRATEGIC MAP OF THE WHEAT CHAIN - PROPOSED STRUCTURE**
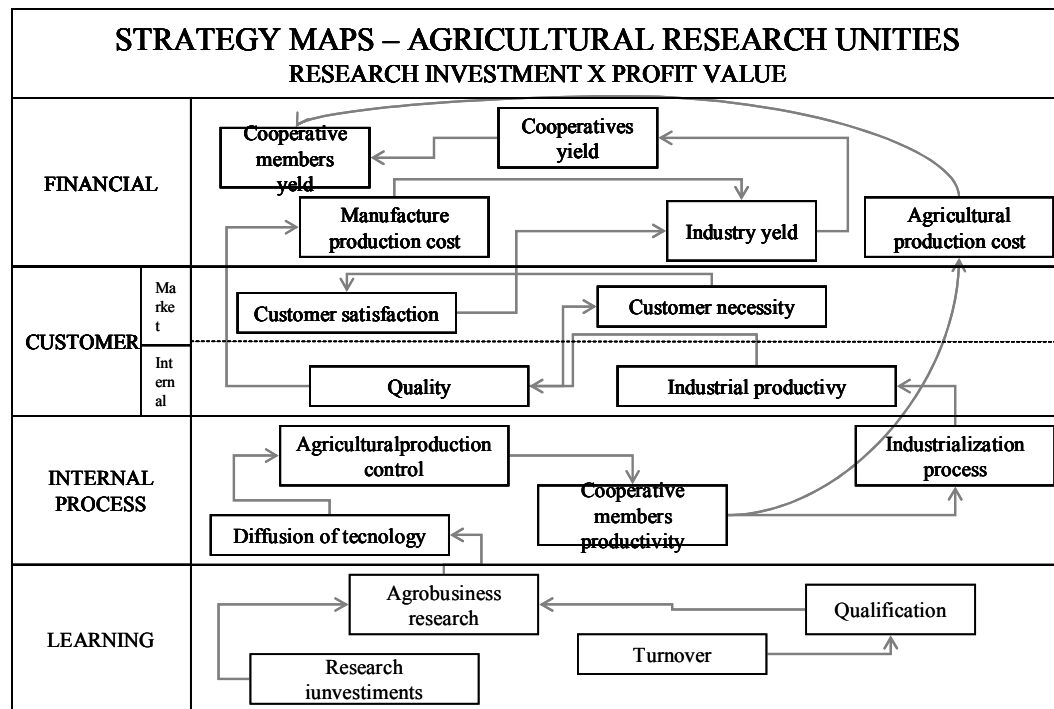


(Source: the authors)

## 8. CONSTRUCTION OF THE CAUSAL CONNECTION DIAGRAM

The causal model presented in the Figure 6 was developed based on the perceptions of people involved in that work. The developed model is an abstraction of the reality lived in the study atmosphere. In agreement with Senge (2004) all of the models are simplifications of reality, observations and of knowledge acquired along the time within the study atmosphere. To understand the wheat chain structure, a qualitative map was developed in the DS concepts structure.
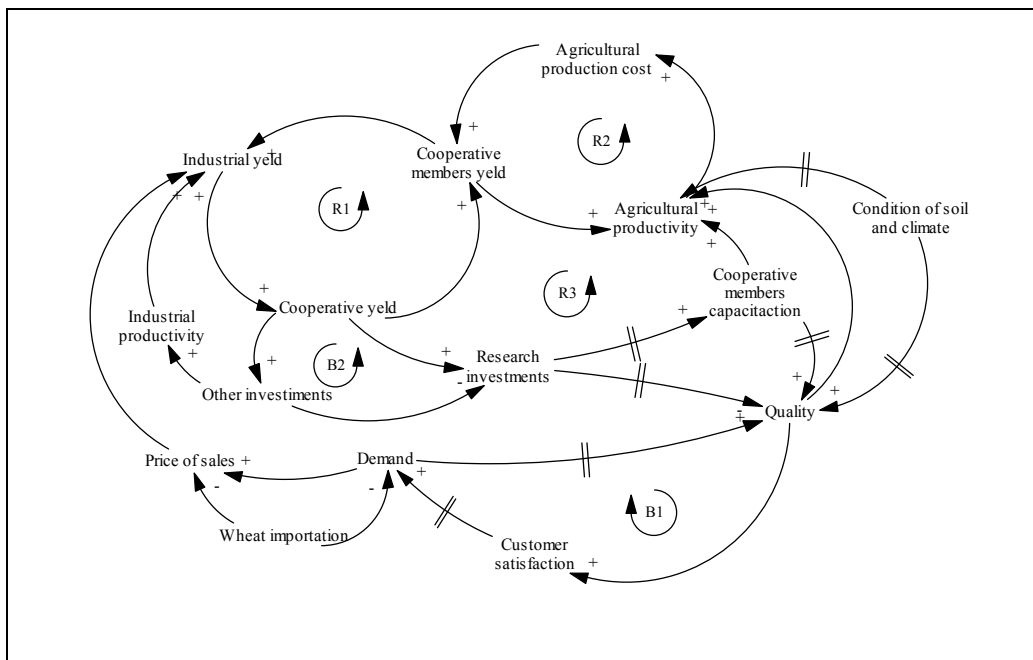
The Causal Connection Diagram presents the mental model of the wheat chain, as the existing inter-relations are in the study context, their positive and negative causes

check the existing delays in the system. According to Senge (2004), the organizations that work with causal models, initially needed to develop learning abilities for the implementation of organizational innovations in daily practice.

The mental model was developed starting from the perception and the events experienced by the individuals, and it is considered an internal interpretation in the way to analyze a new event (DE GEUS, 1998). In that way the organizations are able to evaluate their management models, generating a vision of all business for supporting the decision making process.

However, the mental models don't get to process or to interpret complex systems with a variety degree and complexity, being considered non-linear and time delays between cause and effect make it difficult to find intuitive solutions for specific situations (LOURENZANI, 2006). The wheat chain, on the cooperative members point-of-view, can be considered a complex system and of difficult intuitive resolution. Thus, in the work sequence, a model was developed based on the Flows & Stocks structure, with the purpose of verifying the variable keys that influence the system behavior and the cause connections and existent circular effects.

**FIGURE 6: MENTAL MODEL PROPOSED FOR THE WHEAT PRODUCTIVE CHAIN**



(Source: the authors)

## 9. CONSTRUCTION OF THE FLOWS & STOCKS MAP

Based on the Causal Connection Diagram, the Flows & Stock diagram, shown in Figure 7, was developed to check the main wheat chain variables on the cooperative members point-of-view. In that figure the variables that connect the stages or links of the studied wheat chain. In the conceptual model proposed for the productive wheat chain presented in the Stock & Flow structure it is possible to verify how the existing interconnections among the variable keys, the taxes that control that structure and the stocks that manage the chain links affect the financial results of the Cooperative and its Industry-mill.

**FIGURE 7: STOCK & FLOW IN WHEAT CHAIN DIAGRAM**
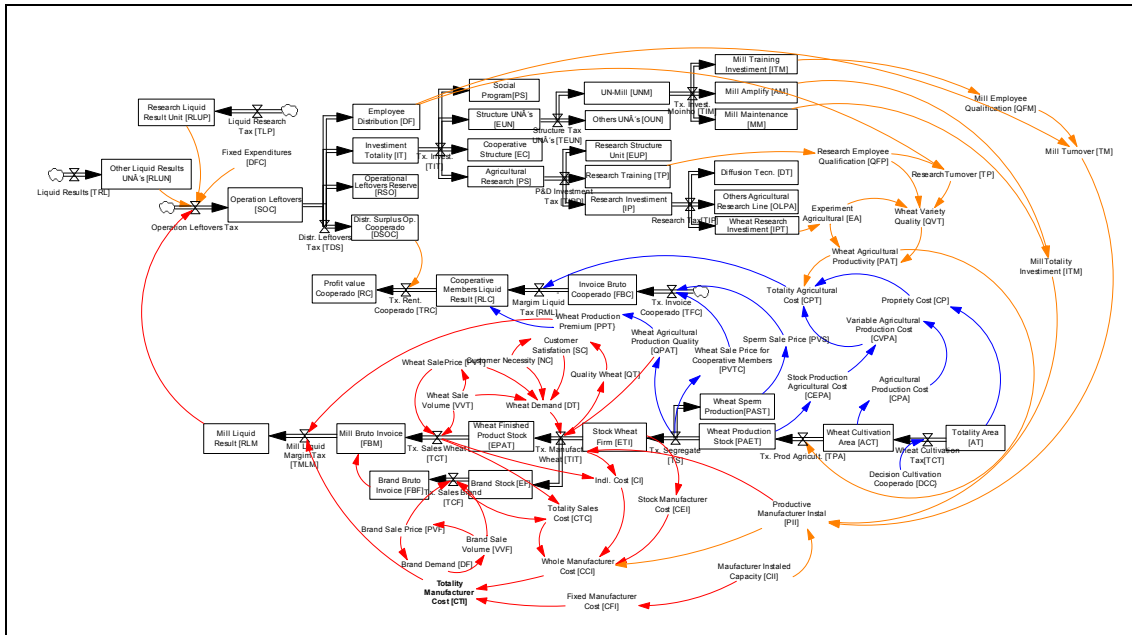


(Source: the authors)

Therefore, that map has the main objective of helping understand the systemic consequences of the Cooperative member's decisions for defining the distribution of Cooperative operational surpluses. According to the observed pattern, the decision taken in the Cooperative general assembly and its reviews regarding destination of resources for investments in agribusiness research can affect the whole wheat chain directly impacts on the Cooperative profitability.

## 10.  INTEGRATION OF DYNAMICS OF SYSTEMS (DS) TO BALANCED SCORECARD (BSC)

In order to connect the strategic objectives of Cooperative Scorecard with the dynamics of system structure, Figure 8 model was elaborated. It is noticed that all the objectives and indicators of BSC are generated based on the results of variable keys, in accordance with the system, and the structure presented based on the concepts of Dynamics of Systems (DS).

**FIGURE 8:** **INTEGRATION OF DYNAMICS OF SYSTEMS (DS) TO BALANCED SCORECARD (BSC)**
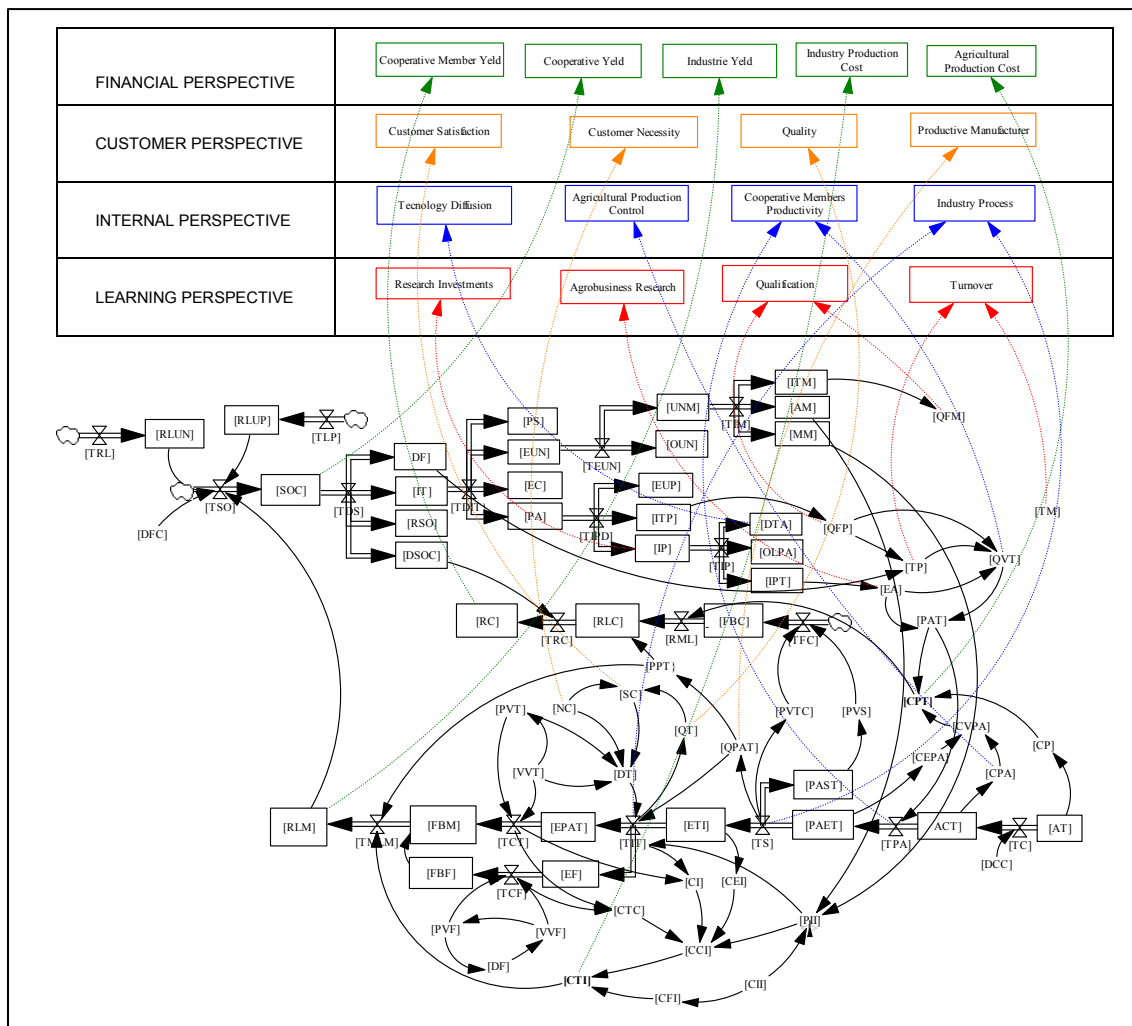


(Source: the authors)

## 11. DEBATE ON THE PROPOSED CONCEPTUAL MODEL

The first operational stage defined as an answer for the general objective of this work was getting to know the organization structure under study. That guided the execution of other stages, because it provided a better understanding of the universe in which the studied unit is inserted, enabling a better understanding of their peculiarities regarding the Cooperative structure.

The wheat chain mapping, under the cooperative member's point-of-view was fundamental for understanding the system as a whole, verifying the existing links and their inter-relations with the structure. With the progress and deeper studies in the organization, along with participants involved in that work, new variables arouse, and established connections that aided the system behavior project. After the wheat chain mapping, under the cooperative member's point-of-view, some inter-dependence situations between the Agribusiness Research Unit and the Industry-mill were detected.

As the strategy modeling was progressing, it was noticed that the BSC map is relevant for controlling and monitoring investments strategy regarding agribusiness research. For each perspective, strategic objectives were developed for controlling and they monitor partial results of the wheat chain for maximization of the Cooperative profitability financial purposes. The objectives of the strategic map were linked to four perspectives with the intention of analyzing the impact of results of a certain objective on another. Those observed inter-relations and validated by the agents involved in the work were important for identifying the processes key or critical for the strategic map to be success in the wheat chain as a whole.

For a better representation of the reality, customer's perspective was subdivided into Industry-mill and Market. The industry mill sub-division depends on the supply of agricultural production with quality on the part of the cooperative, so the wheat industrialization process follows the quality patterns and expected productivity levels. The raw material (wheat) that the cooperative members sends to the Industry-mill needs to follow defined internally quality patterns and others defined by the own customer, following the purpose of maintaining an acting the expected objectives of Productivity and Quality Level. In case both perspectives, Client - Industry-mills, don't present results according to stipulated goals, the impact will be negative on Customer-market relations. The lack on providing Customer's Needs and the acting in the objective of Customer's Satisfaction will be on this side of the expectations. The results below the expected to reach customer-market objectives impact negatively on the presented Strategic Map financial goals.

As the budget destined to the agricultural research is limited, the managers need to evaluate all research projects and decide which can generate a better result for the Cooperative as a whole. With the destination of investments for agricultural researches, the Cooperative is able to progress in varieties to be cultivated in the area where they act, improving the indexes of agricultural productivity, reducing costs of agricultural production and mainly reducing environmental impacts. Through the modeling it was possible to verify that the investments in research will be innocuous if there is no corresponding technology diffusion, primordial so that Cooperated get them close indexes of agricultural productivity to the obtained experimentally. The responsibility of the technology diffusion is providing Technical Support that will provide control and monitoring from the decision of choosing the variety to be cultivated in a specific process to attend agricultural production with the Cooperative members.

This process is very important, for the Industry-mill receives the wheat from the Cooperative members with the necessary quality to provide the needs of its group of customers.

The industry-mill, when receiving the agricultural production, has to segregate the production as classification interns. After this segregation the process and stockpiling of agricultural production, the wheat industrialization stage begins. This industrialization stage follows the customer's need to follow rigorous quality standards, not providing the customer with a product out of the specifications initially requested.

With the development of objectives in the proposed perspectives, two critical processes were identified in the strategic map developed in the chain of the wheat that will negatively be able to influence in the profitability results. The first critical process involves the stages of the technology diffusion, control of production and agricultural

and agricultural productivity. And the second critical process identified affects the stages of wheat Industrialization and the Industrial Productivity. If the result of the first critical process in the wheat chain, through the cooperative point-of-view, is not the expected, the results of the other objectives will also be influenced. As the objectives are inter-related, any acting below the goal will address for a possible reduction of the cooperative profitability index.

With the formalization of the strategic wheat chain map, the people involved in this process noticed the importance of developing a new administration model to measure the possible impacts of the investments on agribusiness research in the cooperative profitability. The management earnings that the wheat chain strategic map generated enabled the visualization of cause relationships and non-linear effect among strategic objectives of the organization and these inter-related objectives include macro indicators, increasing the cooperative profitability. With that, actions taken without the perception of all wheat chain can generate positive results in certain objectives in a short period of time, but in the future the impacts on results and on other objectives cannot be reached, resulting in a behavior totally different from those initially foreseen.

With the conceptual flows & stocks model, it can be more clearly noticed how the main variables influence in the system behavior and how the investments accomplished by the Cooperative take to the industry mill and the cooperative earnings. In relation to the investments destined for to industry mill, it is verified that starting from the existent inter-relations among the variable keys of the system, it is possible to dimension the impact on the acting in the industrial productivity, caused by investments in the structure accomplished for maintenance of the current industrial park and also for the enlargement of installed wheat processing capacity.

These decisions for investments in maintenance and improvement of the industrial park can take to a reduction in cost of production. Another factor that influences directly in the increase of the index of industrial productivity is the qualification and the employees' of that Unit of Business (UB) motivation researched.

Another verification from the modeling is that the industrial earnings result of the investments accomplished along the time tend to take to a better operational acting, that influences the final result of UB directly. However, this better result in the operational acting doesn't happen immediately, some exist arrears (delays) in the system, until that the operational indexes reach the wanted levels or drawn initially.

But the investments accomplished by the Cooperative reviewed the Unit of Research in Agribusiness are destined for structure of the laboratories and appropriate agricultural equipments to the handling of the experiments, training of employees and lines of current researches. Such investments influence the quality of the experiments or agricultural training accomplished by the researchers, in that case in the line of the wheat. The investments in training impact in the agricultural variable experiment that for instance influences in the behavior of the quality variables of the wheat variety and agricultural productivity of the wheat that it is interrelated with the variable rates of agricultural cost and in the tax of agricultural productivity. The quality variable of the variety of the wheat also influences in the result of wheat production.

Besides the investments in the employees' of the Unit of Research for their qualification level improvement, they also motivating, reducing the turnover index. The distribution program of operational surpluses for employees also impacts on the

behavior of the variable turnover researches. If the agricultural wheat researchers segregate, their re-union will take an average of two years to form a new researcher's team with the same knowledge level that the previous one possessed on wheat culture. As information reviewed by the Unit of Research person in charge is a concern among managers of the Research Unit in keeping their talents in various research lines, with the objective of avoiding results on this side of the expectations with the agricultural experiments. If the results with the agricultural experiments are below the expected, it impacts directly on the wheat chain, reducing cooperative and industry mill profitability and, consequently, the Cooperative´s.

## 12. CONCLUSION AND FINAL CONSIDERATIONS

The present work has the purpose of proposing a conceptual model for explaining the variables and relationships, aiding the managers in the decision process in relation to investments in agricultural researches and in the evaluation of results generated, directing these investments for the cooperative. The researches accomplished with the objective of understanding the interdependence of several variables and factors in the organization of the case resulted in the construction of Balanced Scorecard's models and of the System Dynamics for the productive wheat chain.

It was possible to observe that such models generated a change on people involved for the development of the work, in relation to the vision of the productive wheat chain, as the existing inter-relations between the links of the studied chain and its importance for the growth of the Cooperative were noticed. With the BSC strategic map, the participants noticed the importance of measuring the impacts of investments in agricultural researches in the financial results of the whole studied chain. With the development of the System Dynamics model, it was possible to explain the cause connections and no-linear effects and the identified delays in the cooperative structure.

The proposed BSC model for the wheat chain also contributed for the people involved in the work to develop a new strategic vision on the productive wheat chain. With the strategic map they can measure the results of investments in agricultural researches and the cooperative profitability, some identified critical processes should be controlled to generate a sustainable strategy in the markets where the cooperative acts.

With the Flows & Stocks map of the wheat chain, through the vision of the cooperative members, the structure and the existent connections were presented among the variable keys, the taxes that govern the flows, the stocks and the delays of the studied system, creating the conditions for the simulation of strategies. With the parameterization of the stock diagram & flow it will be possible to create a platform that can support the simulation of investments in agribusiness researches, allowing managers to evaluate the impact of these investments in the cooperative future profitability.

Finally, the group of people involved in the cooperative research issued the following opinion: "for the Cooperative and the Research Unit, getting to know new production administration tools is very important. The study was necessary to have a detailed vision of all wheat productive chain links, as well as the implications between them and the importance of all for the Cooperative. We are sure that the use of these tools will be vital for the materialization of the Mission and Vision of the Cooperative".

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