



**THE INFLUENCE OF INSTITUTIONAL AND ORGANIZATIONAL
ENVIRONMENTS ON IRRIGATED AGRICULTURE DEVELOPMENT IN BRAZIL**

CAMILA BENATTI MOURAD
INSPER – Instituto de Pesquisa e Ensino
camilabm@insper.edu.br

MARCO ANTÔNIO CONJERO
FACCAMP – Faculdade Campo Limpo Paulista
marco.conejero@gmail.com

TIAGO FISCHER FERREIRA
INSPER – Instituto de Pesquisa e Ensino
tiagoff@insper.edu.br

Abstract

Irrigation is an ancient technique that makes the agricultural production feasible in arid regions and reduces the risks related to crop shortfalls. In Brasil, the use of this technology has grown, but this rate has been decreasing over the last four decades. Considering this context, the main objective of this paper is to understand the institutional and organizational environments in the irrigation sector and the way they stimulate or restrict the adoption of technology by farmers. The theoretical framework used to analyze the institutional and organizational environments on irrigation sector will be based on the classic authors North (1990) and Olson (1965) from New Institutional Economics approach. The results show the irrigation sector is naturally multi-sector, as it involves the agricultural business, social development, the use of national resources and environmental impacts. Hence, the institutional environment is made of the interaction of several policies and different organs responsible for the execution of its instruments. Considering the complexity of institutional map, to the development of irrigated agriculture, the coordination among the governmental entities is fundamental to offer the appropriate incentives related to credit, environmental license, water allowance, electricity high voltage and technical knowledge in irrigated agriculture. However, it can be noted a disarticulation among these entities and low level of interaction with the private sector. Therefore, the lack of studies and systematized information on irrigation makes it difficult for regulatory agents to act. The private interest association in irrigation sector (CSEI) has faced the difficulty of dialogue and communication with this variety of ministries and departments involved in the sector. Furthermore, has supported the formation of an information system through the funding of specific studies.

Key words: irrigation, institutions, collective actions

THE INFLUENCE OF INSTITUTIONAL AND ORGANIZATIONAL ENVIRONMENTS ON IRRIGATED AGRICULTURE DEVELOPMENT IN BRAZIL

1. Introduction

Irrigation is an ancient technique that makes the agricultural production feasible in arid regions and reduces the risks related to crop shortfalls. Nevertheless, according to the 2006 Agricultural Census of the Brazilian Institute of Geography and Statistics (IBGE – as per its acronym in Portuguese), only a share of 15% of a potential irrigated land of almost 30 million hectares in Brazil is really irrigated. The use of this technology has grown, but this rate has been decreasing over the last four decades.

In the last decade, the federal government invested an amount of R\$ 1.5 billion in the development of irrigation in Brazil, mainly by means of irrigation public projects. Although these projects concentrate most of governmental investments, they represent only 5% of the total irrigated area, whereas the remaining 95% are private lands.

In this sense, studies indicate that the excessive focus of public policies on building irrigation infrastructure rather than on the establishment of proper incentives for private agents to invest in the irrigated agriculture is one of the main causes to explain why irrigation grows in such low rates in Brazil.

In a study developed by PENZA (2010), some agents from the irrigation sector were interviewed so as to identify the main obstacles in the expansion of the irrigated agriculture in Brazil. Results pointed to the grant of water, the environmental legislation, the lack of preparation of the agents and the lack of infrastructure in the irrigation sector. The main cause pointed out for these obstacles was the institutional environment, in which institutional frailty, poor emphasis of public policies and institutional pulverization had a high index of agreement, both by the interviewed companies and by the producers.

In light of the institutional insecurity, the coordination and the involvement of all agents who compose the chain are needed to achieve changes in the institutional environment. The results of the study developed by PENZA (2010) reveal that there is a divergence of perceptions regarding who the coordinating agents of the chain are, which complicates the collective actions towards the development of the sector. Nevertheless, some associations of representation of the private sector got organized in favor of the mitigation of the institutional insecurity and the development of strategies to promote the sector.

According to Farina (1999), the competitiveness of the companies is a result of the individual and collective, public and private policies, and does not depend only on the excellence of their administration. Public organizations and private corporations (employers' associations and unions) contribute with the systemic competitiveness by acting in the change of the current competition standard in the industry. This change takes place by changing the institutional environment and/or the technological environment, which will consequently have an impact on the competitive environment (Farina, 1999).

Hence, the provision of public and collective goods whose proper supply depends on the action of the government or private organizations, such as associations and unions, becomes fundamental for the systemic competitiveness.

Therefore, this study was guided by the following questions:

- How can the institutional environment in the irrigation sector stimulate or restrict the adoption of technology by farmers?
- How has the private sector prepared itself so as to promote the development of the sector?



In this sense, the main objective of this paper is to understand the institutional and organizational environments in the irrigation sector and the way they stimulate or restrict the adoption of technology by farmers.

2. Methodological Procedures

This paper may be classified as a qualitative exploratory research, which ensures a better understanding of the phenomenon under analysis. Most papers presented at conferences - even published in academic journals - in the management area develop an exploratory study as an initial step for a further complete descriptive or causal research.

Ikeda (2009) characterizes the qualitative research as per its inductive character (from particular to general, from the observation of specific examples to analytical generalizations, from the empirical reality to the development of a theory), interpretive approach (aimed at understanding and explaining a phenomenon, human experience, in its context), and its validity (accuracy, credibility and authenticity), which is reached through triangulation (analysis of a phenomenon with different theories, methods and data sources).

The method of data collection was limited to a literature review (desk research), a secondary data collection and in-depth interviews with experts. The theoretical framework used to analyze the institutional and organizational environments in the irrigation sector was based on the classic authors North (1990) and Olson (1999) from the New Institutional Economics approach. The first author focused on the importance of the institutions to explain the performance of organizations and the existence of a feedback process of institutional change, whereas the second focused on how social groups organize themselves to collective actions for lobbying the institutional change.

The methodological procedures used to answer the study guiding questions and to meet its objectives are: 1) Mapping of organizational environment, 2) Secondary data collection, 3) Preliminary analysis of institutional environment, 4) Interviews with experts, 5) Final analysis of institutional and organizational environment.

The first step taken was towards mapping the organizations involved in the irrigation sector. Next, secondary data were collected from laws, published reports and official websites of governmental entities related to agriculture, environment, social development and infrastructure issues. The third step was a preliminary analysis of the strengths and weaknesses of the institutional environment. The fourth step involved the conduction of interviews to obtain different opinions and perspectives, from public and private sectors, and from industry and farmers' associations, regarding the gaps and opportunities to improve the institutional and organizational environments. Finally, the fifth step was the final analysis of the institutional environment, considering incentives and restrictions for the adoption of irrigation technology by farmers.

3. Theoretical Framework

The systemic approach has been a relevant study theme to strengthen the scientific knowledge in administration. Many studies emphasize the importance of understanding more broadly the environment in which a certain organization is inserted.

Brazilian agro-industrial systems (AGS) have recently faced two major changes in the business environment. The first one was a deep change in the institutional environment, whereas the second was the intensification of the competitive environment in the organizations.

Different from the post-war period, when the Brazilian government assumed a role of intervention in the operation and development of the markets, the 90's were the time to take over a regulatory role. The coordination of the productive systems that was dominated by the



government passed on to the hands of the organizations, which had a learning cost as for collective actions.

Olson (1999) defined an organization as a group of individuals with common interests. Organizations develop, thus, collective actions aimed to maximize the value of their partners and to increase their competitiveness. As examples of collective actions that may be developed by an organization, Olson (1999) mentioned: i) providing public or collective goods; ii) providing “club assets” (social aspects); iii) minimizing transaction costs; iv) changing game rules in favor of its associates; v) enabling an increase in scale; vi) solving conflicts.

Based on the logic of the collective actions, it is possible to discuss the role of the organizations in the coordination of productive systems. In the specific case of the present study, the focus is on a sector aimed at the means of production rather than the final product. Even though it cannot be considered a classic agro-industrial system, as defined by Farina (1999), the sector of irrigation interacts directly with several agro-industrial systems and is constantly influenced by the institutional changes that the Brazilian agribusiness has experienced over the last decades.

In the neoclassic economy, the coordination is basically associated with the system of prices as a coordinating element, that is, given the current relation of prices, the agents are organized to seek the best allocation of resources. The limits of the company and the process of coordination through contractual forms were approached broadly by authors of the New Institutional Economy, such as Coase (1937) and Williamson (1985).

In other words, in certain cases the prices are not enough to coordinate the production efficiently and, therefore, the institutions and organizations cannot be seen as neutral elements. Company organizations act so as to interfere in the process of coordination of the agro-industrial systems, complementing the role of the prices. Nevertheless, it is not enough to consider that the institutions and organizations are not neutral. More importantly, it is necessary to advance in terms of broadening studies and searching for explanations to the way these organizations impact on the productive systems, and the logic behind their operation.

North (1994) established a relationship between institutions and organizations: institutions are constituted in the “game rules” and organizations are the players. Saes (2000) described that, in a society, the constitution of a country or the statutes of organizations are formal rules, evidenced to maintain the order and the development of a society. The author also states that informal rules are related to the cultural inheritance, values, habits and traditions, responsible for the order and development. The connection of these rules constitutes the institutional environment, which establishes the environment in which transactions occur.

In this approach, the limitations imposed by the institutional context help define a group of opportunities and, as a consequence, the types of organizations that are being created. The organizations existing in a certain market and the way they interact are influenced by a certain institutional environment.

Therefore, a change in the institutional environment may lead to a change in the attitude of the organizations, and even in the establishment of others. Nevertheless, these organizations may also act in the alteration of an institutional environment, in a feedback process. The lobbying process is an example of how organizations may change the game rules.

Based on North (1990) and Alston et al. (1996, apud NASSAR, 2001), the path for institutional change is determined by two forces: (i) the symbiotic relationships between institutions and organizations, determined by the structure of incentives; (ii) the feedback

process that leads people to perceive and react in face of the new set of opportunities. Nassar (2001) created the following figure to explain the institutional change.

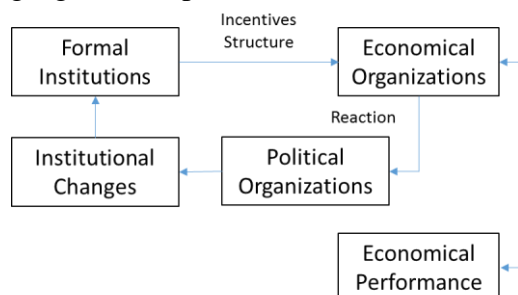


Figure 1 – Dynamics of the institutional change
Source: Nassar (2001).

Another important aspect of the theory of the institutional change is the fact that the institutions are not created to be socially efficient (COASE, 1960). At the most, formal rules are created to serve the interests of those who have the greatest power of negotiation and to design new rules. In a world of zero cost transaction, the power of negotiation does not affect results, but in a world with positive transaction costs, it forms the indivisible piece that characterizes institutions, leading long term changes.

According to Zylbersztajn and Neves (2000), the competitiveness of an agro-industrial system may be seen in three levels. The level of public policies, collective strategies and that of private strategies. As chart 1 shows, the scope of the public policies is a responsibility of the government in its several levels (national, state and municipal); being responsible for creating the conditions and the institutions to coordinate the systems.

On the other side of this setting, there are private strategies. Brazilian agribusiness companies may assume two main lines: that of cost gains, associated mainly with the scale; and the strategy of adding value to their products, from the position of producers of commodities to the position of producers of differentiated products, with a brand.

Among the public policies and the private strategies, the role of the collective actions or strategies has become increasingly important in the Brazilian agribusiness, especially those of private interest associations (PIA).

Chart 1 - Foundations for the competitiveness of the agro-industrial systems

Private strategies	Collective strategies	Public policies
- Commodities: increased scale, efficient logistics, assurance of quantitative standards	- Information exchange	- Basic education
- Specialties: innovation, brand, customized design	- Inter and intra-segment association of agro-industrial systems	- Logistics infrastructure (export corridors)
	- Joint investments in marketing and technology	- Storage infrastructure (especially qualitative)
	- Pressure against the world protectionism	- Strategic funding of projects (promotion of clusters and regions)
	- Quality and sustainability certifications	- Food safety
		- Standards of food safety and sustainability

Source: Zylbersztajn and Neves (2000)

All of these organizations of collective actions have a set of objectives in common. For instance, the objective to serve as interlocutor with the government, as well as with other organizations and the society, in general. They also play a role of trying to persuade the establishment of game rules, developing the lobbying activity. In comparison with the first,

the second activity represents a longer process, since it affects the institutional apparatus of the country and the international exchange.

In addition to these traditional roles, associations have been increasingly representing an instance to nullify disputes among agents, mediating conflicts, or even playing the role of monitoring the actions of their members, in specific cases, as for the conformity with standards and guidelines. These new roles at times implicate important organizational changes in the associations, so as to handle this new complexity of functions.

At the same time, as highlighted by Neves et al. (2005), Brazilian companies are gathering forces in the attempt to increase their productivity and their power in face of competing sectors, to encourage the growth of *per capita* consumption, to reduce informational asymmetries and to gain consumers in new markets. Therefore, the number of sector organizations aimed at the horizontal and/or vertical cooperation in a productive chain has been increasing. These organizations, however, have not obtained the success they expected due to problems such as the lack of organization and the lack of resources to finance their actions.

3.1. Model of analysis

The organizational environment is thus understood as the main organizations, which influence the irrigation sector, whereas the institutional environment consists of the norms, laws, rules and other aspects restricting and/or encouraging the sector.

Considering the theoretical framework aforementioned, an analytical model was designed in this study. Figure 2 shows the model of analysis used, in which the institutional and the organizational environments influence the performance of different industries connected to the irrigation sector (a). In a contrary movement, the industries try to organize themselves in associations for lobbying the organizational environment (b), as a consequence of the institutional change (c).

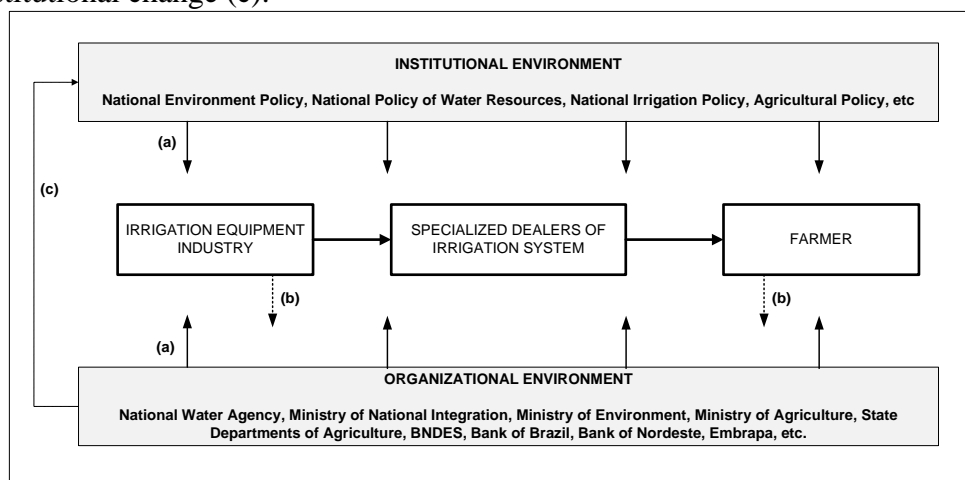


Figure 2 – Model of analysis

Source: Elaborated by the authors.

4. Discussion

Based on the data collected, a map of the institutional environment in the irrigation sector was designed, divided into the regulatory and the incentive environments (Figure 3).

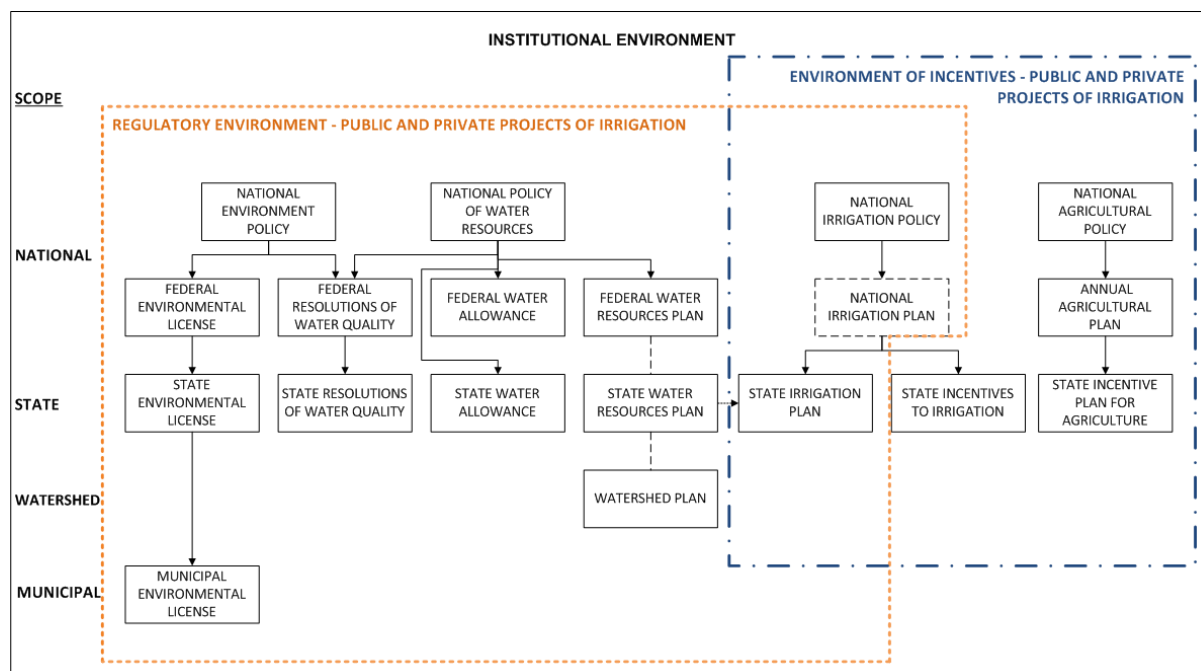


Figure 3 - Regulatory and incentive environments of the irrigation sector
Source: Elaborated by the authors.

The regulatory environment is made of the National Irrigation Policy, the National Policy of Water Resources and the National Environment Policy. These policies establish guidelines and rules that any irrigation project must inevitably follow.

The environment of incentives comprises the rules established for private agents regarding the development of the irrigated agriculture. These incentives are assured in the National Irrigation Policy, in consonance with the National Agricultural Policy, by means of the Agricultural and Livestock Plan defined for each crop.

The main considerations regarding each policy are presented as it follows.

4.1. *National Environment Policy (NEP)*

The National Environment Policy (NEP) was instituted by the law no. 6.938, on August 31, 1981. The instruments for the execution of the NEP include the evaluation of environment impacts and the licensing and examination of effective or potentially polluting activities. These instruments have a direct impact on irrigation projects, as these projects depend on the environmental licensing.

The NEP established the National Environmental Council (CONAMA as per its acronym in Portuguese), which among other competences must establish guidelines, criteria and standards regarding the control and maintenance of the quality of the environment, including the quality of the water (which impacts on the concession of grants). Hence, CONAMA has an important role in the regulation of the use of water resources and environmental licensing (the latter in association with the Brazilian Institute of Environment and Renewable Natural Resources [IBAMA as per its acronym in Portuguese]).

In order to obtain the compulsory environmental license, irrigation projects (both public and private) must comply with the regulations determined by the city (if existent), the state and those of CONAMA.

4.2. *National Policy of Water Resources (NPWR)*

The National Policy of Water Resources (NPWR) was established in 1997¹. Water Resource Plans are the main plans aimed at grounding and guiding the implementation of the policy and the management of water resources, which may be elaborated as per watershed, state and for the entire country.

The guidelines established by the plan include the priorities for granting rights on the use of water resources and restrictions regarding its use. Hence, irrigation plans must take into consideration the water availability authorized for agriculture use in each region, considering the State Water Resources Plan and the Watershed Plan, when existent.

Chart 2 allows to observe the states that stand out by having a state plan and encouraging the development of plans for their watersheds. As observed, in some regions and states there is little concern with the matter. According to experts, these areas in which plans have not been elaborated yet are specifically the areas with high water availability and still little conflict for this resource

Chart 2: Status of the water resource state plans and the existence of state watershed plans (December, 2011).

State	Status of the state plan	Existence of watershed plans
Acre	Elaborated	No
Amapá	Inexistent	No
Amazonas	Inexistent	No
Pará	Inexistent	No
Rondônia	Inexistent	No
Roraima	Contract in process	No
Tocantins	Elaborated	Yes
Goiás	Elaborated	No
Mato Grosso	Elaborated	No
Mato Grosso do Sul	Elaborated	No
Espírito Santo	Inexistent	Yes
Minas Gerais	Elaborated	Yes
Rio de Janeiro	Contract in process	Yes
São Paulo	Elaborated	Yes
Paraná	Elaborated	No
Rio Grande do Sul	Contract in process	Yes
Santa Catarina	Inexistent	Yes
Alagoas	Elaborated	Yes
Bahia	Elaborated	No
Ceará	Elaborated	Yes
Maranhão	Inexistent	No
Paraíba	Elaborated	Yes
Pernambuco	Elaborated	Yes
Piauí	Elaborated	No
Rio Grande do Norte	Elaborated	Yes
Sergipe	Elaborated	Yes

Source: ANA (2012)

An important direction given by the plans involve the priorities on the use of the watershed. Water use for human supply, followed by animal drinking water supply, has priority in any watershed, whereas other priorities are defined individually in each watershed plan.

Nevertheless, the plans do not determine the qualitative conditions for each use. In other words, there is total water availability and the determination of priority types of use, but without a limit of water availability for each type of use.

¹ BRAZIL. Law no. 9433, from January 8, 1997.



Despite that, it is possible to consider that the existence of water resource plans increases the safety of the private investment. In addition, the plans facilitate the analysis of organs that grant rights for using water resources, as they provide guidelines as for the priority uses of water in each region.

The absence of this grant makes it unfeasible to execute any irrigation project, either public or private, since the concession of grant is a pre-requisite to obtain the environmental license.

The grant is provided by the National Water Agency (ANA, as per its acronym in Portuguese) in case the watershed belongs to the government, or by the state organ that manages water resources when the watershed belong to the state. The ANA may also transfer to the states the competence over the national grants of water, whenever the state presents the necessary structure and interest in managing the watershed.

According to the interviews performed at the ANA until the beginning of 2013, the states of São Paulo, Mato Grosso, Pernambuco, Ceará and Paraná have a more stable structure to assume the granting processes. A general obstacle is the lack of technical staff in the states to meet great demands for grant.

The criteria considered for the concession of grants are defined by each competent organ, and those adopted by the ANA are often used as reference, without a mandatory character though. Regardless the criteria of water availability and flow adopted by each organ, the concession of grant follows the criterion of priority use established by law and the other priority uses of the watershed plan.

In case the watershed does not have a plan with guidelines for the use of its water resources, the concession follows the line criterion, that is, the grant is given to those who request it first (as long as they comply with the other requisites and there is water availability). Nevertheless, in these cases the use of water is not planned as for the region entitlement and the number of requestors that may appear in the future.

The grants provided by the ANA have an expiration period of five years. In general, the states follow this period, but there may be regulations to define different expirations, such as the case of Ceará, where the expiration period for the grant is four years.

A negative aspect regarding the determination of the expiration period for the irrigation grant is the dissociation with the time for return on the investment of the irrigation system made by the producer. In cases of electrical energy, for instance, the grants have longer expirations periods, due to the time for return on the investment.

The grant for the right to use water is one of the instruments of the NPWR with the greatest influence on the irrigation sector. Hence, the understanding of how each state acts in this process, the planning of concessions as for priority uses and the watershed entitlement, and the adjustment of the grant period to indicators of time for return on the investment are aspects that would influence positively the irrigation sector.

4.3. National Agricultural Policy

The current National Agricultural Policy was established on January 17 of 1991, by means of the law no. 8171. The execution of the policy requires instruments that include agricultural planning, rural credit, rural taxation and incentives and rural irrigation, drainage and electrification. These instruments interact with the irrigation sector in the form of incentives to the irrigated agriculture, which will be described as it follows.

The Agricultural and Livestock Plan, which is elaborated every crop year by the Ministry of Agriculture, Livestock and Supply (MAPA as per its acronym in Portuguese), has the objective to assure rural producers the necessary conditions to the continuous expansion



of their activities, with greater efficiency and competitiveness. The support measures include rural credit, both for funding, sales and investments.

In this sense, chart 3 synthesizes the funding lines available for the rural producer to invest in irrigation systems.

Chart 3 – Rural credit available for investment in irrigation technology

Funding lines	Description
MODERINFRA – Incentive program to irrigation and drainage	<ul style="list-style-type: none"> The producer has different funding conditions through BNDES to invest in irrigation and storage Payment deadline: 12 years; grace period: 3 years; Interest rate: 5.5% per year. Funding limited to R\$ 1.3 thousand per hectare.
PSI Rural – Investment Support Program	<ul style="list-style-type: none"> Finance the production and acquisition of new machinery and equipment of domestic manufacture, including the working capital associated to them. Payment deadline: 10 years; grace period: 2 years; Interest rate: 5.5% per year.
PRO IRRIGA – Incentive program to irrigated agriculture	<ul style="list-style-type: none"> Changes to the Moderinfra program such as extension in the time of payment, in the waiting period and reduction of the interest rate. Funding limited to R\$ 2.5 thousand per hectare, for surface irrigation or between R\$ 4 and R\$ 8 thousand per hectare for the located and aspersion modalities.

Source: MAPA (2013) and BNDES (2012).

The current model of credit concession faces a few obstacles such as the high level of warranties and insurances demanded by the plan. Hence, the resources available are poorly used. In the 2011/12 crop, for instance, 4% of the total resources available for the Moderinfra was used, from R\$ 1 billion (MAPA, 2013).

Although the PROIRRIGA program makes it more attractive for the producer to invest in irrigation, no study has yet been made on the return rate from the irrigation to support the values and deadlines presented.

Therefore, financial feasibility studies for the implementation of a culture irrigation system could contribute to effectively make the producer's access to resources feasible as well as to change the grant expiration on the use of water based on the time for return on the investments.

4.4. National Irrigation Policy

The first National Irrigation Policy was established in 1979 with the law no. 6662. In the duration of this policy, the focus of irrigation in Brazil was the development of public projects, with the construction of channels and other civil structures, establishing irrigated perimeters that were mainly managed by the São Francisco and Parnaíba Valleys Development Company (CODEVASF, as per its acronym in Portuguese) and by the National Department of Work Against Droughts (DNOCS, as per its acronym in Portuguese).

Small farmers are settled in these perimeters with the purpose to promote social development. Nevertheless, many projects were not completed, and the perimeters implemented faced several problems. Many of these problems were related to the lack of knowledge of the farmers as for agriculture and the use of technology, and to the difficulty to collect resources, since many farmers did not have any guarantee to offer.

In this model, the main concern of the governmental spheres involved the civil structure of water resources rather than the development of the irrigated agriculture as a business, that is, irrigation is seen as the end rather than the means, which results in the low number of successful irrigation perimeters.



Aimed at increasing the index of success of public irrigation projects, the federal government released, in 2012, the program Mais Irrigação (More Irrigation, in Portuguese), with two clear purposes: (i) promoting improvements in the operation and maintenance of the existing public irrigation infrastructure; and (ii) creating conditions to attract private investors to the perimeters, especially national agriculture and livestock companies, the “Agricultural Anchors”, to interact with the producers who are already settled (MAIS IRRIGAÇÃO, 2012).

Therefore, it is possible to observe an orientation towards the conclusion of public projects already initiated, the transfer of management from the perimeters to the private sector and the structuring of a new cycle of expansion for new projects.

In line with the program Mais Irrigação, in January of 2013, the law 6662 was revoked, with the institution of a new National Irrigation Policy - NIP (law no. 12787 from January 11, 2013). The law will still be subjected to regulations of the Ministry of National Integration (MI, as per its acronym in Portuguese), organ in charge of executing the NIP.

According to the National Irrigation Department (SENIR, as per its acronym in Portuguese) of the MI, the new policy has come to change the focus of irrigation in Brazil by means of the support of the private sector to the development of the irrigated agriculture. In this perspective, the state assumes the role of planning the development, adjusting incentives according to regional conditions. In order to do so, the SENIR aims to work on the instruments of execution of the policy.

4.4.1. Irrigation Plans

The Ministry of National Integration (MI) is the organ responsible for the elaboration of the National Plan, whereas the state departments appointed by the government of each state must elaborate the State Plans. The National Plan must aggregate the State Plans and other strategic elements, such as other instruments of the policy.

The state of Minas Gerais was a pioneer in the elaboration of the State Irrigation Plan, whose methodology is being used in the elaboration of plans in other states, such as Rio Grande do Sul, Mato Grosso do Sul, Bahia, Pernambuco, Ceará, Espírito Santo, Distrito Federal and Paraná.

In all the cases aforementioned, the plans are being developed in a partnership between the state and the SENIR. The definition of the priority of the states that will structure the plan with the support of the department takes place through the presence of interlocutors in the states, potentialities for the development of the irrigated agriculture and current situation of the irrigated agriculture (best developed).

State Irrigation Plans are important for the definition and approval of the public irrigation projects in these places. The law no. 12787 does not specify it is compulsory for the irrigation private projects to be in conformity with the plans. Nevertheless, the State Plan establishes strategies and action plans for the development of irrigation that influence private projects, besides strengthening the regional institutional environment, which favors the development of the irrigated agriculture.

4.4.2. Other instruments of execution of the National Irrigation Policy

In addition to the irrigation plans, other instruments of execution of the National Irrigation Policy include: the National System of Information on Irrigation; fiscal incentives, rural credit and insurance; the qualification of personnel; scientific and technological research; technical support and rural extension; special electrical energy rates for irrigation; the certification of irrigation projects; the Fund of Investment in Participations in Infrastructure (FIP-IE); and the National Irrigation Council. Each of these instruments is described in chart 4, as it follows:

Chart 4 - Instruments of execution of the National Irrigation Policy

Instrument	Description
<i>National System of Information on Irrigation</i>	<ul style="list-style-type: none"> • Intelligence system to provide subsidies to the elaboration of irrigation plans • The systematization of information is expected to allow the evaluation of public irrigation projects, to facilitate the dissemination of the best practices and to support the planning of the irrigated agriculture expansion.
<i>Fiscal incentives, rural credit and insurance</i>	<ul style="list-style-type: none"> • Rural credit and insurance as part of the agricultural policy and responsibility of the Ministry of Agriculture, Livestock and Supply (MAPA). • Rural credit and insurance aimed at the family agriculture as a responsibility of the Ministry of Agricultural Development (MDA) through the National Program of Family Agricultural Strengthening (PRONAF). • Fiscal incentives to the irrigation as a responsibility of the Ministry of National Integration (MI) through the Special Regimen of Incentives for the Development of Infrastructure (REIDI). <ul style="list-style-type: none"> ○ Exemption of some taxes (PIS and COFINS), totaling a reduction of 9.25%, for the acquisition of materials, services and equipment, both national and imported, to be applied in private projects of irrigation infrastructure.
<i>Qualification of personnel</i>	<ul style="list-style-type: none"> • The National Water Agency (ANA) offers short courses on handling irrigation and, in association with the SENAR, courses on the rural business. • The MI may offer specialization courses for the development of irrigation systems, from the construction of the dam until its handling.
<i>Scientific and technological research</i>	<ul style="list-style-type: none"> • Researching tends to be the responsibility of the MAPA, through Embrapa. • The MI must act as an articulator so that the irrigation theme is part of the researching agenda.
<i>Technical support and rural extension</i>	<ul style="list-style-type: none"> • Major producers can afford to independently hire technicians to provide support • Medium producers must be assisted by the MAPA • Small producers, as part of the Technical Support Policy aimed at the family agriculture, must be assisted by the MDA • In the case of the public perimeters of irrigation, the MI, through the DNOCS and the CODEVASF, makes the direct hiring of technical support.
<i>Special electrical energy rates for irrigation</i>	<ul style="list-style-type: none"> • Rural electrification is a responsibility of the MAPA. • The access to high-tension networks is an obstacle to the development of the irrigated agriculture. • The SENIR of the MI aims to articulate governmental subsidies for this purpose with the Ministry of Mines and Energy (MME). • The legislation of electrical energy allows the concession of incentives in energy rates for agriculture during the night. • The reduction of rates only during the night may not compensate the employment costs with night work extra rates. • Irrigation at night may not meet the agronomic needs of the plant.
<i>Certification of irrigation projects</i>	<ul style="list-style-type: none"> • The SENIR of the MI must handle the certification. • The proposal is to certify irrigation producers by means of indicators of efficient use of resources for agricultural production (water and other resources). • The creation of indicators and certification work must be developed in articulation with Embrapa and the MAPA.
<i>Fund of Investment in Participation in Infrastructure (FIP-IE)</i>	<ul style="list-style-type: none"> • The Fund of Investment in Participations in Infrastructure already exists. • Reinforcing the focus of the fund to encourage irrigation projects.
<i>National Irrigation Council</i>	<ul style="list-style-type: none"> • Creation of a council that must have a consulting and non-deliberative character. • Intense activity in the discussion of the necessary regulations for the



development of the irrigated agriculture.

Source: Elaborated by the authors.

State policies of incentive to irrigation follow the agricultural policy, using its instruments. The states of Rio Grande do Sul, Paraná, Espírito Santo and Alagoas present specific programs of incentive to the irrigated agriculture.

An analysis on the state programs aimed at the development of irrigation shows that the incentives are focused on facilitating the access to the credit for the installation of irrigation systems and on the reduction of costs and access to electrical energy.

4.5. *The role of Private Interest Associations*

The organizational environment is represented not only by public bodies, public policy makers, but also by private interest associations (PIAs), interlocutors with the government and representatives of the private sector.

Specifically for the irrigation sector, the PIAs are the Sectorial Chamber of Irrigation Equipment (CSEI, as per its acronym in Portuguese), Brazilian Association of Irrigation and Drainage (ABID, as per its acronym in Portuguese), and other regional associations of irrigators.

ABID is broader than CSEI, and joins all stakeholders interested on irrigation and drainage systems. The entity is not focused on lobbying, but more connected to education, with conferences promotion for debate of important issues. ABID supports CSEI in public policies' requests.

The Sectorial Chamber of Irrigation Equipment (CSEI) is representative only of Industry Irrigation Equipment Manufacturer. The organization emerged 25 years ago as the National Department of Agricultural Machinery, part of the Brazilian Association of Machinery and Equipment (ABIMAQ, as per its acronym in Portuguese).

This department met both manufacturers of agricultural machinery and implements as industrial irrigation equipment. However, 12 years ago, the National Department of Agricultural Machinery was separated into two separate Sectorial Chambers: Sectorial Chamber for Agricultural Machines and Implements (CSMIA, as per its acronym in Portuguese) and Sectorial Chamber of Irrigation Equipment (CSEI, as per its acronym in Portuguese).

Currently, CSEI has 35 members who, in addition to the associative fee paid to ABIMAQ (calculated as a percentage of income reported), also contribute to a CSEI's fund to participate in events such as listeners, speakers and sponsors, and also to funding of thematic studies of CSEI's interest.

In organizational terms, CSEI has a board consisting of one president and five vice-presidents, all representatives of the manufacturers of irrigation equipment. This board is supported by an Executive Secretary, who divides his time between CSEI and CSMIA, besides being the manager responsible for the Regional Office of Ribeirão Preto - SP.

The focus of CSEI is to make the government aware of the need to act, in terms of regulating the irrigation sector, and in the sense of supporting the growth of irrigated agriculture with incentives for private investment. It is a common sense that irrigated agriculture is an inducer of economic and social development of any country.

Therefore, as understanding of CSEI, there are three main obstacles or barriers to the development of irrigated agriculture in Brazil:

- Environmental licensing and granting the right to use water: complex and divergent law, with little structured bodies. ANA grants the federal rivers and each state their river basins, which results in very long term (1-2 years) to obtain the license.



- Rural electrification: lack of energy supply in terms of the availability of distribution and load capacity.

- Credit policy directed to agriculture: there are appropriate financing lines and with budget allocation (eg.: Moderinfra and PSI), but the problem is in the contracting process with the financial agent, which in addition to requiring real warranties, environmental licensing and granting the right to use water, arbitrarily prioritize the allocation of resources according to the harvest periods and eligible items. Furthermore, do not release the rural credit connected to agricultural insurance, and with the existence of irrigation equipment to minimize risks related to drought or poor water distribution.

For these bottlenecks can be overcome, CSEI understands that is necessary to work the dialogue with the government and more than that to have a focal point within the government. Therefore, the entity has stimulated the creation of the National Irrigation Department (SENIR), within the Ministry of National Integration (MI), to assume the role of public policy maker, rather than simply the realization of public works.

However, because of political pressure, SENIR focuses not only the regulation of the sector, but also the government effort to recover and finished works of irrigation infrastructure within the public irrigation perimeters, through the PPP model (Public Private Partnerships). More Irrigation Program is the result of this initiative to attract private investment to irrigation perimeters, to exploit it economically for a long period.

Regardless, SENIR's creation brought a positive externality in terms of governmental engagement with the irrigation sector, which was the more active involvement of MAPA (Ministry of Agriculture) offering instruments of credit incentive like PROIRRIGA program.

Moreover, CSEI has as strategic guideline a better communication with stakeholders, like governments, suppliers, customers, or society in general. For both its strategic agenda includes the following actions:

- Tax exemption on investment in capital goods, being REIDE Program (Special Incentive Scheme for Infrastructure Development) direct consequence of this influence of CSEI towards this institutional change.

- Demystification of environmental impact generated by irrigation regarding water use and diversion of other priority uses. Despite the strong use of water in agriculture, it is necessary to inform society in general that this use does not harm the environment, since it has the evapotranspiration of soil and plant, with only a change of state of water, and the final food contains less than 5% of water.

5. Conclusion and managerial implications

The irrigation sector is naturally multi-sector, as it involves the agricultural business, social development, the use of national resources and environmental impacts. Hence, the institutional environment is made of the interaction of several policies and different organs responsible for the execution of its instruments.

Besides the performance of the industry in the development of new products, the competitiveness of the sector is also affected by the way institutions and organizations interact to create an attractive environment. In the irrigation sector, there is a relationship of collaboration between the SENIR/MI and the ANA aimed at creating mechanisms and expediting processes to develop irrigation. The relationship of the SENIR/MI with the states has also been positive in the sense of encouraging and supporting the regional planning of irrigation.

Although irrigation is a resource for the agricultural production, the MAPA has played a supporting role in the development of the irrigated agriculture in Brazil, limited to matters of credit and research, through Embrapa. New structures are being created at the MAPA to

promote the irrigated agriculture, however, these actions do not seem to be coordinated with the actions of the SENIR - MI. Some instruments of the NIP presents more than one ministry interested in being in charge, such as in the case of electrical energy and the certification of irrigation projects.

Figure 4 presents a map of interaction between the institutional and the organizational environments of irrigation, which was designed based on the results on this study. The irrigation sector has been losing growth opportunities due to the disarticulation between the agents represented in the map. In order to gain competitiveness, the regulations of the NIP to be elaborated must be discussed in coordination with interested agents and with the society.

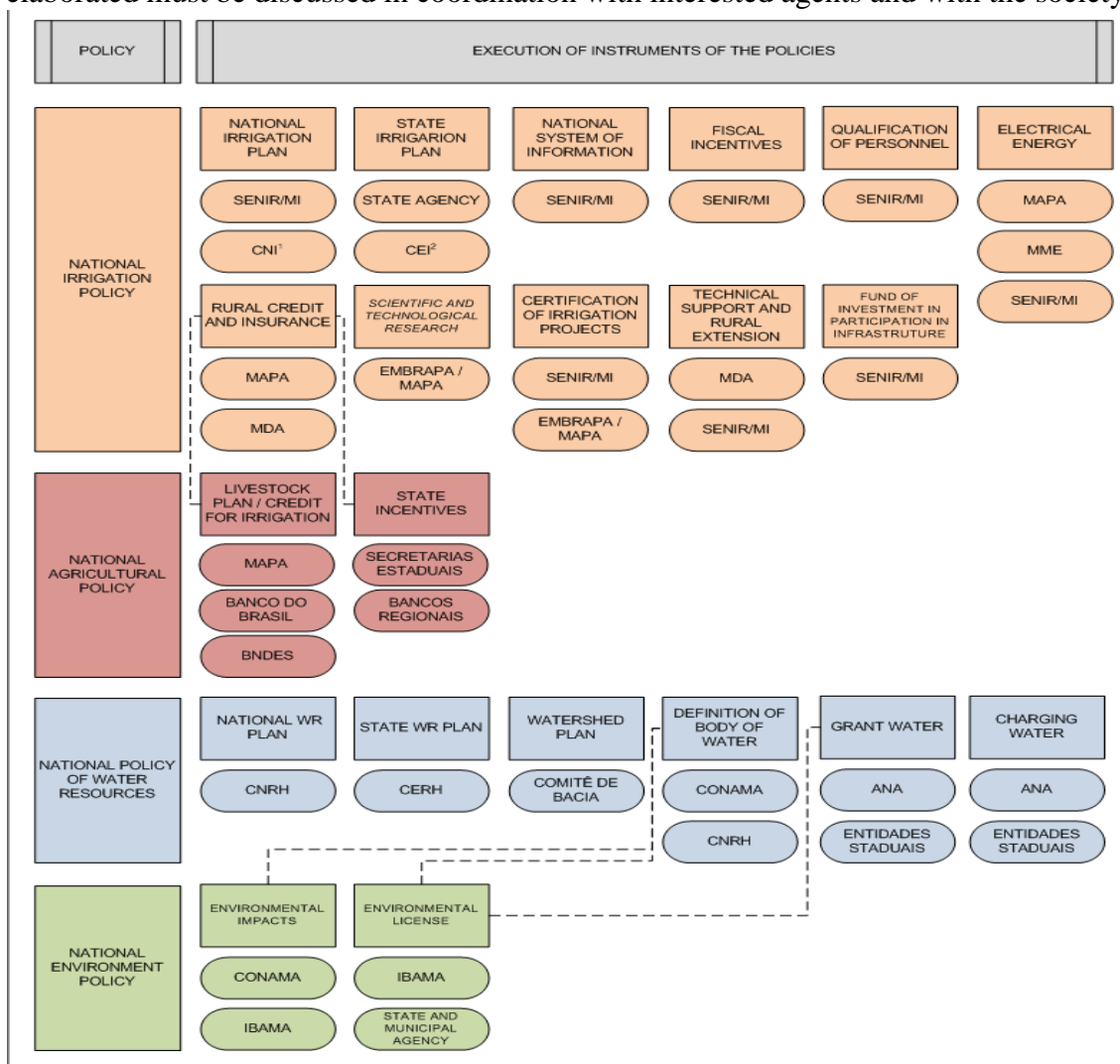


Figure 4 - Interaction between the institutional and the organizational environment of the irrigation sector. Source: Elaborated by the authors.

Concerning the NIP, the state of Minas Gerais stands out from the others by being a pioneer in the elaboration of its Irrigation Plan, which has been used as a model by other states.

From the perspective of the NPWR, the states that stand out in their planning of water resources are São Paulo, Minas Gerais and Ceará, since these states initiated the elaboration of their first plans in the 1990's and their administrative structures remain even with the changes in government.

Therefore, states that present incentive to irrigation by means of credit and access to electrification, among others, are not necessarily ahead in the development of irrigation plans.



In this perspective, the program of Rio Grande do Sul stands out in the combination of credit incentives and facilitation of the process to obtain the necessary authorizations, as well as the program of Paraná, which combines credit incentives, the reduction of electrical energy rates and the expansion of access to high-tension networks.

The incentives offered by the Agricultural and Livestock Plan must be reviewed, considering their low use, but this review must be based on studies of indicators of return on investment. The same type of study could be used to review the grant expiration period and to increase investment security.

The articulation with the Ministry of Mines and Energy (MME, as per its acronym in Portuguese) is also needed so as to promote proper incentives to electrical energy, which is one of the main components of cost in the irrigated agriculture, given that the current incentives are not in agreement with the reality of the agricultural production.

Therefore, the lack of studies and systematized information on irrigation makes it difficult for regulatory agents to act. The establishment of the National System of Information is expected to allow an evaluation of the adjustment of rules and incentives to the development of the irrigated agriculture. Nevertheless, systematized information will not lead to the development of the sector if the agents do not work in a coordinated manner, referring to the relationships of governmental organs and with representatives of the private sector so that irrigation is seen as a means of incremental production to the agribusiness.

In this sense, CSEI is aware of the barriers to the development of irrigation in Brazil. Has faced the difficulty of dialogue and communication with this variety of ministries and departments involved in the sector, electing SENIR as the focal point. Furthermore, has supported the formation of an information system through the funding of specific studies.

Even so, any private interest association suffers from a shortage of resources, and even with the lack of interest from the players of irrigation equipment to perform collective actions.

References

- ANA. Agência Nacional de Águas. Conjuntura dos recursos hídricos no Brasil: informe 2012. Ed. Especial. Brasília; ANA, 2012.
- ANA. Agência Nacional de Águas.
<http://www2.ana.gov.br/Paginas/servicos/outorgaefiscalizacao/agilize.aspx> (accessed in jan. 31, 2013).
- BNDES. Banco Nacional do Desenvolvimento. Programa de Incentivo à Irrigação e à Armazenagem - Moderinfra.
http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Programas_e_Fundos/moderinfra.html (accessed in: jan. 31, 2013).
- BRASIL. Lei nº 12.787 de 11 de janeiro de 2013. http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2013/Lei/L12787.htm (accessed in: jan. 28, 2013).
- BRASIL. Lei nº 6.938 de 31 de agosto de 1981. http://www.planalto.gov.br/ccivil_03/leis/L6938.htm (accessed in: jan. 28, 2013).
- BRASIL. Lei nº 8.171 de 17 de janeiro de 1991. http://www.planalto.gov.br/ccivil_03/leis/L8171.htm (accessed in: jan. 28, 2013).
- BRASIL. Lei nº 9.433 de 8 de janeiro de 1997. http://www.planalto.gov.br/ccivil_03/leis/L9433.htm (accessed in: jan. 28, 2013).
- CNRH. Conselho Nacional de Recursos Hídricos. Resolução nº 91/2008 de 5 de novembro de 2008. <http://pnqa.ana.gov.br/Publicacao/RESOLU%C3%87%C3%83O%20CNRH%20n%C2%BA%2091.pdf> (accessed in: jan. 29, 2013).
- COASE, R H. 1937. "The Nature of the Firm," *Economica N.S.*, 4: 386-405. Reprinted in OLIVER E. WILLIAMSON and SIDNEY WINTER, eds., 1991. *The Nature of the Firm: Origins, Evolution, Development*. New York: Oxford University Press, pp. 18-33.



- COASE, R. The problem of social cost. *Journal of Law and Economics*, vol. 3, pp 1-44, 1960.
- CONAMA. Conselho Nacional de Meio Ambiente. Resolução nº 357/2005 de 17 de março de 2005. <http://pnqa.ana.gov.br/Publicacao/RESOLU%C3%87%C3%83O%20CONAMA%20n%C2%BA%20357.pdf> (accessed in: jan. 29, 2013).
- CONAMA. Conselho Nacional de Meio Ambiente. Resolução nº 397/2008 de 03 de abril de 2008. <http://pnqa.ana.gov.br/Publicacao/Resolu%C3%A7%C3%A3o%20CONAMA%20n%C2%BA%20397%20Alterar%20o%20artigo%2034%20da%20Resol%20CONAMA%20357.pdf> (accessed in: jan. 29, 2013).
- FARINA, E.M.M.Q. Competitividade e coordenação de sistemas agroindustriais: um ensaio conceitual. *Revista Gestão da Produção*, vol.6, n.3, pp. 147-161, 1999.
- IICA. Instituto Interamericano de Cooperação para a Agricultura. Plano Diretor de Agricultura Irrigada do Estado de Minas Gerais. http://186.202.16.13/relatorio/R_6_final%20CD.pdf (accessed in: jan. 17, 2013).
- IKEDA, A.A. Reflections on qualitative research in business. *Revista de Gestão da USP*, v. 16, n.3, p. 49-64, julho-setembro de 2009.
- MAPA. Ministério da Agricultura, Pecuário e Abastecimento. Plano Agrícola e Pecuário 2012/2013. http://www.agricultura.gov.br/arq_editor/file/Pol%C3%ADtica_Agr%C3%ADcola/Plano%20Agr%C3%ADcola%202012_2013/PAP2012-2013_livroWEB%20-%20Atualizado.pdf (accessed in: jan. 21, 2013.)
- MMA. Ministério do Meio Ambiente. Plano Nacional de Recursos Hídricos. http://www.integracao.gov.br/c/document_library/get_file?uuid=c37feae3-8169-4049-900b-e8160661f541&groupId=66920 (accessed in: jan. 13, 2013).
- NASSAR, A. M. Eficiência das Associações de Interesse Privado: uma análise do agronegócio brasileiro. São Paulo: USP, 2001. 234p. Dissertação (Mestrado em Administração) Faculdade de Economia, Administração e Contabilidade.
- NEVES, M. F. ; ZYLBERSZTAJN, D. ; NEVES, E. M. *Agronegócio do Brasil*. 1. ed. São Paulo: Saraiva, 2005. 152 p.
- NORTH, D. C. *Institutions, institutional change and economic performance*. Cambridge: Cambridge University Press, 1990.
- NORTH, D.C. Economic Performance trough time. *The American Economic Review*, june 1994, pp. 359-368.
- OLSON, M. *A Lógica da Ação Coletiva: os benefícios públicos e uma teoria dos grupos sociais*. Tradutor: Fabio Fernandez. São Paulo: Edusp, 1999. 201p. Título original: *The Logic of Collective Action: Public Goods and the Theory of Groups*.
- PENSA - Agribusiness Intelligence Center. *A evolução do uso da irrigação na agricultura brasileira: potencialidades e gargalos*. CSEI/PENSA Report. São Paulo, 2010.
- SECRETARIA DA AGRICULTURA, ABASTECIMENTO, AQUICULTURA E PESCA DO ESPÍRITO SANTO. Programa Energia Mais Produtiva. <http://www.seag.es.gov.br/?p=24853> (accessed in: nov. 20, 2012).
- SECRETARIA DA AGRICULTURA, PECUÁRIA E AGRONEGÓCIO DO RIO GRANDE DO SUL. Programa Mais Água, Mais Renda. http://www.agricultura.rs.gov.br/conteudo/1032/?Mais_%C3%81gua%2C_Mais_Renda (accessed in: out. 30, 2012).
- SECRETARIA DE AGRICULTURA E ABASTECIMENTO DO PARANÁ. Programa de Irrigação Noturna. <http://www.agricultura.pr.gov.br/modules/conteudo/conteudo.php?conteudo=66> (accessed in: nov. 19, 2012).
- SECRETARIA DE ESTADO DA AGRICULTURA E DESENVOLVIMENTO AGRÁRIO DE ALAGOAS. Programa de Incentivo à Irrigação e à Armazenagem (Moderinfra). <http://www.agricultura.al.gov.br/programas/credito-rural.pdf> (accessed in: nov. 20, 2012).
- WILLIAMSON, O. E. *The Economic Institutions of Capitalism*. USA: Macmillan. 450p. 1985.
- ZYLBERSZTAJN, D.; NEVES, M.F. (Org.). *Economia e gestão dos negócios agroalimentares*. São Paulo: Pioneira, 2000.