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Regulatory Impact Analysis in Brazil: theoretical approach and applications in policies for agriculture defense

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Abstract

This study aims to discuss Regulatory Impact Analysis (RIA) in Brazil focusing on policies for agriculture and livestock defense. The main concepts and analytical tools were presented, and the Cost-Benefit Analysis (CBA) was highlighted as the most recommended by policy makers for RIA. To illustrate the application of this method in programs for agriculture defense, we discuss three case studies which were carried out in Brazil: Carambola fruit fly in Amapá State, Huanglongbing (greening) and citrus canker. The results show that the benefits surpassed the costs in these programs, particularly from the government point of view. Besides, when the analysis for citrus canker took into consideration the private costs, there were scenarios in which these costs were not offset by the economic benefits. Although the CBA allows identifying and comparing returns for different policy alternatives, the environmental and social aspects are usually poorly captured by this tool.

1. Introduction

The processes of privatization and economic liberalization started in the last two decades of the last century and led to the creation of regulatory agencies to improve regulatory efficiency. In this sense, several countries have established empirical analytical methods to support the decision-making process in economic regulation, and the most widely method used is the *Regulatory Impact Analysis – RIA* (RAUEN, 2011).

According to Miranda (2012), RIA has been adopted in several countries as part of a policy to improve regulatory quality. This tool has been used to measure benefits, costs and effects of a new (*ex-ante*) or existing (*ex-post*) policy, providing greater legitimacy to regulations and reducing conflicts between the governmental and private sectors.

For the Organization for Economic Cooperation and Development (OECD, 2012), a well-designed RIA can help promote policy coherence, displaying the advantages and disadvantages inherent in regulatory proposals, identifying the parties likely to benefit from the distributional effects of regulation and the parties that will bear the costs, as well as how risk reduction in an area can generate risks to other areas of the government policy. RIA can improve policy formulation and reduce the incidence of regulatory failure due to regulation needlessly applied, or otherwise, when it fails to regulate while there is a clear need to do it.

In other words, from the perspective of OECD (2008a), RIA also facilitates coordination between several public policies that are interrelated with regulation and regulatory institutions. RIA also improves awareness and participation of the public in general in the regulatory process through greater transparency and accountability. Therefore, RIA provides improvement of regulatory quality.

According to Albuquerque (2009), experience in OECD countries confirms that the regulatory improvement collaborates to better performance of governments and economies, since it stimulates innovation, job creation, increased productivity, price reduction, improved product quality, increased competitiveness and, consequently, economic growth.

Based on these relevant functions performed by RIA, countries are currently interested in implementing it. Data published by OECD (2009) show that, until 1980, only two or three countries adopted some measure of RIA, while in 2000, 14 of the 28 OECD countries were applying this tool. In 2005, more than two-thirds of OECD jurisdictions reported a requirement to identify costs and benefits of the new policy and about half of all OECD countries reported that the benefits of the regulations in these countries justify the costs. In 2008, all OECD jurisdictions regularly used some form of RIA in new policies before implementing them.

In general, the successful adoption of RIA in OECD countries was accomplished systematically, focusing initially on specific regulation steps and then expanding to the entire regulatory process. When performed in the early stages of the regulatory cycle, RIA contributes to improve regulatory decisions (OECD, 2008a).

In most OECD countries, RIA has been used as a tool to enhance the regulatory process, thus, some emerging and developing countries have pursued the same aim. Despite differences in the implementation of RIA among the countries, its application in developed countries is more widespread than in emerging countries. The methods, however, are usually incomplete and rarely

adopted in a systematic manner in the political areas, given that the RIA is regarded as an expensive instrument that does not generate the expected results in the short-term (OECD, 2008a).

Regarding costs, Miranda (2012) highlights worrisome points in the development process of RIA for developing countries such as financial resources constraints and skilled personnel required for the assessment of impacts, mainly regarding the quantification of economic, social and environmental effects. The implementation of RIA also requires an appropriate administrative structure of regulatory agencies to deal with the lack of databases and to provide sufficient information to estimate the impacts.

The lack of convergence in the implementation of RIA among countries, according to Radaelli (2005), can be attributed to differences in political contexts, measured in terms of types of bureaucracy, the government's ability to deal with distributive conflict, political processes and preferences of stakeholders.

Conversely, for Jacobs (2005a), problems related to administrative capacity and institutional infrastructure to develop and incorporate RIA play equal importance and include not only the ability to perform the analysis, but also the structures, management procedures and techniques necessary to ensure high quality and consistency in the implementation of RIA.

Each country adopts a form of RIA according to its specificities. Despite the diversity, 10 key elements must be followed as RIA best practices recommended by OECD (1997) and cited by Rodrigo (2005) and Alves and Peci (2011): maximize political commitment to RIA, allocate responsibility to RIA, train stakeholders, use consistent analytical and flexible method, develop and implement strategies for data collection, focus efforts to the RIA, integrate RIA with the process of conducting politics and starting as soon as possible, release the results, address the public extensively, and apply RIA to new and existing regulations.

According to Peci and Sobral (2011), Brazil has considerable organizational capabilities that can encourage the successful adoption of RIA. However, these organizational capabilities are not sufficient to prevent differences in the practices of RIA, because political variables also influence this process. In Brazil, the main variables that prevent the convergence of the process are policies associated with particularities of the context of the bureaucratic and political process, namely institutional fragmentation, inefficient ministerial supervision and resistance to political control.

According to Salgado and Borges (2010), RIA has not yet been completely practiced in the Brazilian sphere. However, it represents a relevant tool of governance for agencies to strengthen their interactions with society and their legitimacy as autonomous and technical institutions. When

used by regulatory agencies, RIA can contribute to improve the orientation of their regulatory decisions, mainly because an important part of its implementation process consists of communication with sectors of society interested in regulatory issues.

Peci and Sobral (2011) highlight that OECD (2008b) recommends the adoption of RIA, since this tool can improve the Brazilian regulatory system, although it should be seen as part of a systemic approach that encompasses other policies, institutions and instruments. In response to this recommendation of the OECD, the Brazilian federal government, through the coordination of the Presidency of Civil House (Casa Civil) in partnership with specialized ministries, directly related to the regulatory agencies, established the Program of Strengthening the Institutional Capacity for Regulatory Management (PRO-REG).

The PRO-REG was established in 2007, by Decree n^{o} 6062, and aims to contribute to the improvement of the regulatory system, the coordination between the institutions participating in the process, the mechanisms of accountability, participation and monitoring by civil society and the quality of market regulation. This program has the technical and financial support from the Inter-American Development Bank (IDB) and considers the elaboration of integrated measures aimed at enhancing the capacity of formulating and analyzing public policies, provide improved coordination and strategic alignment between sectorial policies and the regulatory process, strengthen the autonomy, providing transparency and performance of regulatory agencies and improving mechanisms for the exercise of social control (ALBUQUERQUE, 2009).

One regulatory agency chosen by the Presidency Civil House as the pilot agency for the implementation of RIA, in the Brazilian federal government, is the National Agency for Health Surveillance (ANVISA). This agency has operated since 2007 in the incorporation of RIA in its regulatory practices, which is being carried out gradually. In this process, alignment and continuous dialogue with the staff responsible for the PRO-REG have been crucial (ANVISA, 2014a).

Sanitary regulation contributes to the proper functioning of the market, supplying its failures and giving greater predictability, transparency and stability to the process and regulatory performance, with the aim to generate a safe environment for the population and favorable for social and economic development of the country (ANVISA, 2014b).

Another initiative is the one mentioned by Miranda (2012). The author states that the National Council for Scientific and Technological Development (CNPq), a Brazilian institution for research support, sponsored a major project focused particularly on the organization of a Brazilian network of topics related to agriculture defense and which encompassed also the evaluation of the

current system of sanitary defense. Miranda et al. (2010) present the first results of studies on the assessment of economic and social impact of programs for agricultural defense.

Academic studies that discuss RIA are of great importance, but they have been little explored in the Brazilian context (MIRANDA et al., 2009; LIMA, 2010; SALGADO; BORGES, 2010; PECI, 2011; PROENÇA; RODRIGO, 2012; CASTRO, 2014). Regarding health regulation policies, both for public health as well as plant and animal health, research of the Brazilian scenario is limited (LUCCHESE, 2008; SILVA, 2009, 2012; ALVES; PECI, 2011; and MIRANDA, 2012).

Thus, in order to contribute to the literature about this topic, this study aimed to discuss Regulatory Impact Analysis (RIA) in Brazil focusing on policies for agriculture and livestock defense. Specifically, it is intended: i) to describe the conceptual foundations on RIA and its analytical tools with emphasis on Cost-Benefit Analysis (CBA); ii) to examine RIA and its adoption as a tool for better regulation of health and sanitary policies; and iii) to present some studies conducted in Brazil analyzing policies of agricultural defense through the CBA approach.

2. Theoretical reference

2.1. Conceptual fundaments and analytical methods of RIA

There is no unique concept of RIA or an indisputable model to be followed. In practice, there is a diversity of analytical methods that reflect the political agenda of the government, which may be associated with the maturity of the institutions involved, as well as the cultural issues that differ among countries and resource availability (LIMA, 2010).

Lima (2010), quoting Kirkpatrick and Parker (2007), states that, *a priori*, RIA was conceived as a tool to specify regulatory costs within a business scope in order to reduce the administrative burden and improve competitiveness. Over time, the conceptual basis of RIA was expanded, encompassing measurements of impacts of regulatory proposals. In this context, RIA has been considered more as a learning process than as a closed method, promoting regulatory decisions more justified and legitimized by the participation of the society.

In empirical terms, according to Peci and Sobral (2011), RIA begins with the identification and analysis of a problem and the objectives of a particular regulatory policy, followed by an assessment of costs and benefits of possible execution processes in order to select the alternative that provides the greatest public benefit.

For the World Bank, RIA is a process to make the appropriate questions in a structured way to support a broader and transparent political debate. Furthermore, RIA refers to a systematic and

consistent process of potential impacts arising from governmental action or inaction (JACOBS, 2005b).

According to the OECD (2008a), RIA can be defined as a systematic policy tool adopted to measure the benefits, costs and likely effects of a new or existing policy. It represents an analytical report to assist decision makers. Regarding its structure, RIA must contain the following information: proposal title, purpose and effect of the desired adjustment policy, assessment of the problem that the policy aims to address, consideration of alternatives to the policy, evaluation of all distributive impacts, results of the public consultation, compliance strategies, and monitoring and evaluation processes.

According to Rodrigo (2005), in OECD countries, RIA can assume various forms, reflecting a variety of political agendas of governments. The methods used by decision-makers in OECD countries to make effective decisions can be classified as: i) *expert*, in which the decision is made by an expert of trust, a decision-maker or an expert in the field, who adopts the professional judgment to decide actions to be taken; ii) consensus, in which the decision is made by a group of players who reach a common position, balancing the interests of all involved; iii) politics, whose decision is performed by political representatives, based on the consensus of the issues relevant to the political process; iv) *benchmarking*, in which the decision refers to an external model, as an international regulation; and v) empirical, in which the decision is based on research, data collection and analysis, which will specify the parameters of operation based on the criteria established. Most regulatory decisions result from a combination of these decision methods, distinguishing according to the specific features, such as cultural, political conditions and administrative style.

For Jacobs (2006), governments that currently adopt RIA should reorient their methods based on a clearer vision of good international practices, contributions of each method to good governance, as well as the need to increase the analytical quality. The OECD (2012) recommends that the RIA methods be integrated with programs that seek to incorporate an explicit objective to improve efficiency and effectiveness of regulations, including the best design of regulatory instruments in order to lower regulation costs for citizens and businesses as part of a policy to promote economic efficiency.

The main methods indicated by the literature and currently adopted to measure RIA consist of the Cost-Benefit Analysis (CBA), Cost-Effectiveness Analysis (CEA), Threshold Analysis, Risk Evaluation and Uncertainty Analysis, Partial Analysis, and Multi-Criteria Analysis. Among these

methods, the CBA has been the most widely used by regulatory agencies. Thus, the CBA will be prioritized in this study.

2.1.1. Cost-Benefit Analysis (CBA)

The method of Cost-Benefit Analysis (CBA) consists of a technique that analyzes previously defined projects and indicates whether they are feasible to be implemented. CBA monetizes each cost and benefit resulting from a project or policy and the values are compared, in the most basic sense, to ensure that the project will be considered valid and should be executed and whether the monetary value of the benefits is greater than the value of their costs. In the case of mutually exclusive projects, CBA will identify the project that generates the greatest net benefit (ZERBE; BELLAS, 2006).

According to Adler and Posner (2006), the CBA method is based on the utilitarian aspect of economic well-being, from which the desirable project should maximize the usefulness of as many people as possible, and losses and gains of project utilities are converted into monetary values and these values are aggregated. Ever since a compensatory variation can be determined for each person affected by the project, in such a way that if the sum of the compensatory variations of gains and losses for each person is positive, then the project should be approved or, otherwise, rejected. In traditional terms, CBA considers all relevant costs and benefits associated with a project in a time horizon. As costs and benefits can occur in distinct periods, a discount rate is determined to allow the measurement in terms of present value.

According to Richardson (2001), decision-making based on CBA can follow two steps. Initially, information about the willingness to pay is collected, which is reflected in a *proxy* of individual objectives of the amount to pay to carry out the project. Next, this information is aggregated in the form of Kaldor-Hichs (KH), determining the sum of the compensatory variations. This indicates the amount of resource that individuals affected by a project would be able to quit and become indifferent about the state in which they found themselves in the absence of such a project. This represents the idea of a hypothetical improvement of Pareto, which reflects an indicator of social willingness of the project.

For Zerbe and Bellas (2006), in short, the operationalization of CBA requires the fulfillment of 10 steps, namely: (i) clarify costs and benefits to be included, ii) identify alternatives, iii) set hypotheses (assumptions may be necessary for a wide variety of factors, such as costs, market conditions, duration, or interest rates and these assumptions should be explicit and attributed to

reliable sources, whenever possible), iv) list the impacts of each alternative project (impacts should be quantified whenever possible and they should be at least mentioned when it is not possible to quantify them), v) monetize these impacts, vi) deal with the non-quantified impacts, vii) determine a discount rate to obtain the present value of all future benefits and costs, viii) identify and explain the uncertainty, ix) compare benefits and costs, and x) perform a monitoring analysis after the project completion. Not all analyses will require all these steps. A project of short duration may not require discounting future benefits and a project that is being conducted can often involve little risk or uncertainty.

According to Rodrigo (2005), the trend is that countries adopt CBA, consistent with the recommendation of the OECD report of 1997, whose regulations should "produce benefits that justify costs, considering the distribution of effects to all society". This method of assessing regulatory impacts has been preferred because it aims to produce public policy that meets the criterion of being "socially optimal". Jacobs (2006) states that CBA is the method that seeks to contemplate more suitably a wide range of social, economic and environmental impacts, and is in line with the political objectives of RIA, in which *trade-offs* are identified and the benefits are maximized. Thus, creators of RIA always prioritize CBA as the most inclusive and socially responsible for the public decision-making process.

However, quantitative CBA usually needs to be complemented with other methods. The qualitative aspects, very often, may not be plausibly expressed in monetary terms, or even quantified. In situations where such qualitative factors are recognized as relevant, RIA should be used carefully not to subordinate them to quantitative factors. Therefore, regulatory processes should have some flexibility in choosing among the available analytical methods (RODRIGO, 2005).

In this sense, according to Jacobs (2006), to minimize limitations inherent in CBA, such as the impossibility of monetization of certain costs or regulatory benefits, a form of CBA Soft has currently been used, in which quantitative and qualitative parameters are combined and presented systematically. This structure produces more stringent, transparent, and consistent information for the decision-making process of a public policy, and therefore it is increasingly used in developed countries.

2.1.2. Cost-Effectiveness Analysis (CEA)

The Cost-Effectiveness Analysis (CEA) is a technique used to compare systematically and transparently the costs of various options of a policy that generate similar benefits. This method is useful, though limited, because it does not allow determining whether the benefits justify the costs and does not choose the best level of benefits. However, specific results can be obtained at lower costs. In this sense, while CBA assists governments to decide actions to be taken, CEA helps governments decide how to implement those actions (JACOBS, 2006).

According to the OECD (2009), CEA is an alternative to CBA widely used in circumstances in which the political agents are not able to monetize the most important impact of the policy. For Salgado and Borges (2010), in addition to using this analysis when monetization of benefits is not feasible, its application is recommended when benefits are intangible and dispersed. Furthermore, CEA can also be used in cases that seek to remove moral issues that may result from quantification of benefits, such as the valuation of lives. To solve this type of issue, microeconomists assess the current value of the expected income of individuals analyzed, seeking to remove any kind of ethical problem. According to Rauen (2011), CEA should be adopted when political objectives are defined rigidly or when there are low risks of *trade-offs*.

2.1.3. Risk Assessment and Uncertainty Analysis

Risk assessment is used to assess the impacts of any particular intervention; it does not measure uncertainty, but probability. This method assumes a very relevant role in situations that deal with the likelihood to affect human health or safety.

The uncertainty analysis projects the likelihood of a range of possible results due to errors of estimation, and it is used to provide policy-makers a more accurate understanding of the risk of impacts (JACOBS, 2006).

According to Salgado and Borges (2010), if there is significant uncertainty about the impact of a regulatory alternative, it is recommended to perform sensitivity estimation of the results to changes in the most relevant variables, assigning robustness not only to RIA, but also to the final regulatory decision.

2.1.4. Threshold Analysis

The threshold analysis can be applied to regulate proposals at an early stage, aiming to verify whether there is plausible justification for intervention and how to proceed. This approach

can ensure that the problems of regulatory policy be defined accurately, increasing the likelihood that a viable range of policies be identified and subject to RIA (OECD, 2009). Due to costs linked to RIA and resource constraints, according to Salgado and Borges (2010), the implementation of RIA should be discarded or its length should be reduced when the impacts generated by the regulation are relatively small or there is no appropriate political alternative to regulation.

For Rauen (2011), this method allows to identify the limits of damage or risks from which the government should take a particular regulatory action regardless of the costs to be incurred. In other words, this analysis should be adopted when the regulation is established at any cost and is limited to few options of regulatory policies.

According to Lima (2010), quantitative thresholds may occur, which establishes a minimum regulation cost required to implement RIA. Qualitative thresholds may also occur when it generates a threshold according to regulatory requirements, or a combination of the two thresholds.

Salgado and Borges (2010) highlight that, once the threshold is established, it should be used as a criterion to apply all the analyses in order to give legitimacy to the process. Therefore, the decision for the policy should be restricted to *ex ante* definition of the thresholds, and, once established, the criterion should be used for all policies.

However, for OECD (2009), quoting OECD (2006), very few documents of RIA or risk publications of government provide clear statements about threshold between acceptable and unacceptable risks. This lack of publications containing the thresholds of "acceptable risks" leads policy-makers to opt, in most countries, for the adoption of an approach based on the cost-benefit ratio for this risk. This CBA approach uses a purely utilitarian vision of risk, requiring that the risk-reduction activity always be performed, where the expected benefit exceeds the expected cost, regardless of the level of *ex ante* risk.

2.1.5. Partial Equilibrium Analysis

The use of partial analyses can be justified when it seeks to evaluate the effects of certain types of regulatory costs for specific groups. The interest in this type of analysis can be associated with the fact that the decision-makers have overlooked such impacts. In these cases, the partial analysis can be perceived as an attempt to rebalance the inputs in good regulatory decisions. However, such partial analysis can only be understood in the context of other benefits and costs of governmental actions. Moreover, the dependence on this type of method can result in risk of

systematic errors in policy decisions, reducing the benefits of governmental actions and increasing the risk of serious policy failure (JACOBS, 2006).

Jacobs (2006) reports that the partial analysis can strengthen the RIA, likewise weaken it. This method strengthens RIA whenever it highlights relevant impacts that have been neglected, but these impacts should have been considered within an integrated analytical context. On the other hand, this analysis compromises the quality of RIA if it is not integrated with a broader analytical framework, therefore, generating an undue weight to policy-making. In this situation, this approach fragments RIA in special interests, making it useless as an instrument of general policy.

Furthermore, another problem pointed by Jacobs (2006) refers to measuring the macroeconomic impact, generated by microeconomic interventions. Due to the complexity of the interactions occurring in the economy, it is very difficult to measure this effect, generating partial results for the very short term which do not reflect the objectives of the regulatory intervention.

2.1.6. Multi-Criteria Analysis (MCA)

The multi-criteria analysis (MCA) can potentially help ensure better integration of quantitative and qualitative elements in the analytical process and, consequently, improve the capacity of RIA, providing relevant and useful guidance for policy managers in contexts where important variables have not been able to be expressed in monetary terms (OECD, 2009).

According to Rodrigo (2005), there is little consensus on the selection of the best analytical methods to be used by policy-makers and many countries use a combination of qualitative and quantitative methods. In addition, the RIA methods are not yet fully developed, and differences remain on several important points, such as the establishment of a social discount rate for CBA, monetizing intangible benefits and the treatment of risk and uncertainty. Integrating measurements and balancing risks provide new methodological challenges.

Therefore, according to Jacobs (2006), the method is important, but the analytical quality within the method chosen is also equally relevant. In countries with greater investment in RIA, there are continuous efforts to increase the quality of that tool through more quantification, more precise requirements, and higher quality data.

3. RIA as a tool to improve regulation on sanitary policies

As a consequence of the opening of the economy and reshaping of state intervention that occurred in Brazil in the 1990s, several reforms were undertaken, among them, the reform of

federal sanitary surveillance. The National Health Surveillance Secretariat (SNVS) was extinct, and the National Agency of Sanitary Surveillance (ANVISA) was created, inspired by the American Food and Drug Administration Agency (FDA), internationally renowned for its rigidity with the sanitary control of products and services. The onset of ANVISA sparked a perspective for relevant changes associated with regulatory action in the health field. The creation of ANVISA led to the formalization of the National Sanitary Surveillance System, which consolidated the existing concept of risk regulation in healthcare (LUCCHESE, 2008).

According to Lucchese (2008) and Silva (2009, 2012), the institutional purpose of ANVISA is to promote healthcare to the population through the sanitary control of production and marketing of products and services subject to health surveillance, as well as control of ports, airports and borders. Regarding the sanitary control of production and marketing of products, for Lucchese (2008), it is relevant to highlight the key role played by international regulatory processes, in particular, the regulations of the General Agreement on Tariffs and Trade – GATT, and, particularly, the Agreement on Application of Sanitary and Phytosanitary Measures (SPS).

The creation of ANVISA, in the late 1990s, aimed to increase state economic efficiency in assessing and managing health risk, with transparency of processes and clear political accountability for public expenditures, as well as greater participation of society for the control of state actions (LUCCHESE, 2008). According to Silva (2009) and Alves and Peci (2011), in April 2008, the Program for the Improvement of the Regulatory Process was established by ANVISA. This program aims to qualify the regulatory system, promote transparency, improve the mechanisms for the participation of society in the regulatory process and improve coordination among organizational units of the agency. To achieve these objectives, the following initiatives are applied: consolidation and revision of the legislation on health surveillance, regulatory agenda, standardization of regulatory process, capacitation, strengthening society participation in regulation, and gradual implementation of RIA.

For the implementation of RIA in the ANVISA sphere, according to Silva (2012), in general terms, three levels of complexity and comprehensiveness were devised to be developed and implemented throughout the regulatory improvement process in order to promote the necessary learning to incorporate this new practice:

a) RIA Level 1 consists of the completion of a standardized form by the area responsible for the proposal, containing the basic elements of RIA: problem description, objectives and measures to achieve the objectives, necessary resources, specification of the main players

interested in learning and discussing the proposal, regulatory alternatives, forecasting mechanisms to facilitate consultation and participation of interested parties, reference documents and main costs and difficulties with the new rules or revising an existing regulation.

b) RIA Level 2 seeks to evaluate the potential impacts on governance, as well as the economic, social and international operational impacts.

c) RIA Level 3 consists of a comprehensive study of impact analysis that includes the collaboration of specialists in advanced techniques of RIA. Proposals with significant impacts must be applied, such as proposals that cover large parts of the budget or the economy as a whole, or impose higher costs to a sector or region.

Despite the differences in the approaches of RIA by regulatory agencies of health surveillance, the adoption of RIA to health policy provides a more consistent and predictable regulatory environment, extending credibility to consumers and producers (ALVES; PECI, 2011). For Silva (2012), credibility is critical for regulation, both from the perspective of citizens, regarding the health safety of goods, products and services of health, as well as from the market perspective in order to boost innovation and new investment, expanding interactions of citizenship in a safe environment for the population and favorable for socioeconomic development of the country.

Under the sanitary regulation, but in the scope of the Ministry of Agriculture, Livestock and Food Supply (MAPA), therefore focused on agriculture and livestock production, there is no guidance for the implementation of RIA in an institutionalized manner yet. In the specific case of agriculture defense, there is the Pest Risk Analysis (PRA), which, according to the International Standards for Phytosanitary Measures (ISPM) No. 2, is the process of biological assessment or other scientific and economic evidence to identify if the organism is a pest, if should be regulated, and, if so, what is the intensity of phytosanitary measures to be adopted against it (ISPM, 2006a). PRA consists of an analysis of the likelihood of pests, which are not yet present in Brazil, entering the country and of their potential damage. PRA is provided by the International Plant Protection Conference (IPPC), in its International Standards for Phytosanitary Measures (ISPM) No. 11, which describes the integrated processes to be used for risk assessment, as well as the selection of options for risk management (ISPM, 2006b).

The next section focuses on initiatives for impact assessment of sanitary and phytosanitary policies within the framework of the regulatory actions of the Ministry of Agriculture, Livestock

and Supply with a focus on programs of prevention, control and eradication of pests and diseases, which have already been subjected to studies through Cost-Benefit Analysis (CBA). In case this method is applied to these sanitary and phytosanitary programs, some aspects highlighted by Miranda (2012) should be taken into account, such as: (i) a biological model, indicating the expected behavior of the pest in the country, its pattern of spread, its severity in the territory, the conditions that favor or restrict its dispersion, and the damage caused in these conditions; (ii) definition of a time horizon suitable to conduct CBA; and (iii) discount rates that should be used in CBA to obtain results that reflect the fact that the sanitary policy also has social objectives, and should not, therefore, account for only the private costs and benefits.

CBA can be an instrument associated with PRA, in the context of studies aimed at decision-making on imports of agricultural products from commercial partners, connecting aspects of economic, social and environmental evaluation to those already analyzed and related to epidemiological aspects of target pests. However, CBA applied to sanitary and phytosanitary programs can also be a tool to highlight potential impacts of the establishment and dispersal of the pest already occurring in the country and that could be the target of preventive or control programs by governments.

4. Illustration of CBA application to policies for agriculture phytosanitary defense in Brazil

According to Miranda (2013), one of the main concerns when analyzing policies for agriculture defense refers to the impact on international trade, since the entry and spread of a pest can hinder exports or trades, reduce tax collections, and affect production costs and domestic and international prices. In addition to these economic impacts, we can have social impacts, such as industrial concentration and workforce reallocation; environmental impacts, such as the need to increase pesticide use affecting biodiversity and contaminating water and soil; and institutional impacts, involving the reorganization of public services and adjustments in budget or need for emergency resources, including personnel.

In this context, impact assessments play a relevant role in order to assist the definition of a government policy to prevent the entry of a pest or to allocate resources to combat others that are already occurring and control their dispersion. To measure these effects, CBA has been used in studies on pests and diseases in fruit cultures.

The use of this technique in policies for agriculture defense, according to Miranda et al. (2015), requires the specification of tangible benefits and costs and, whenever possible, intangible

ones, direct and indirect, covered in the action assessed. In practice, scenarios are constructed concerning the geographical extent of the pest dispersion, affected crops (primary and secondary hosts), affected variables in domestic and international spheres for each scenario and the policies and actions adopted. Afterwards, the current value is determined for benefits and costs projected for the time horizon considered and for the scenarios outlined in terms of actual policies or the actions and strategies of the private sectors involved.

In Brazil, some of the pests and diseases in fruits that are causing and have the potential to generate losses of great value and, thus, have become subjects of scientific research are *Bactrocera*, whose primary hosts include carambola fruit, guava, red jambo, orange, maçaranduba, arapaju, mararaju and mango; the *Huanglongbing* (HLB) or *Greening* and the *citrus canker*, these two in citrus. Many other pests have caused significant damage to fruits production, such as black Sigatoka in banana, other fruit flies, the mite *Raoiella indica*, which already occurs in the territory and can cause huge damage to palms and many others. So, this study focused on three pests mentioned above, carambola fly, HLB and citrus canker as illustrations of cases that have been the target of governmental actions in both state and federal spheres and were examined through an economic study by applying CBA. Before presenting such cases, however, it is worth exposing the framework applied to evaluate phytosanitary policies.

4.1. General framework of the CBA applied to phytosanitary policies

We propose a flowchart (Figure 1) to describe the general model used to evaluate the case studies mentioned in the previous section. This chart was built taking into consideration the steps adopted in the report of Miranda et al. (2010) and described earlier in this paper, within the theoretical background section. Miranda et al. (2010) applied those guidelines to evaluate policies of phytosanitary defense.

Figure 1 indicates that, *a priori*, it is necessary to propose scenarios based on previous information about the pest. This information should comprise epidemiological aspects, current phytosanitary policies, market data, identification of agents and sectors potentially affected by the pest, and in what way they are affected and others required to identify relevant situations to be analyzed and compared in terms of policy-making decision. Once the reference scenario (usually the current scenario) and the alternatives scenarios are defined, it is possible to establish the costs and benefits (usually given by avoided losses) implied by choosing each scenario.

Having or not having a program to prevent, eradicate or control a pest is usually the reference scenario and the policy alternatives may be analyzed also assuming different strategies and answers in terms of stakeholders behavior. In this sense, it is necessary to underline that scenarios are designed by assuming some hypotheses, which make it feasible to measure and to valuate impacts, mainly the economic, such as establishing projections about prices and costs evolution along time based on historical data or assuming certain reactions of importing markets or the possibility of substitution of products and others (MIRANDA et al., 2010).

Thus, the next step after delimitating the relevant and measurable costs and benefits for each scenario is the simulation. For the simulation, we highlight the importance of choosing the timeline of analysis, which will depend on the pest dispersion pattern or on the time required to its control or eradication, or to how long the impacts over the production and market variables will last. If analysts have available data to conduct Monte Carlo simulations it is possible to establish statistical distributions for random variables. In other situation, analysts may count on outcomes of partial or general equilibrium models that might also supply results that will contribute to a cost-benefit analysis of the policy alternatives.

If analysts want to simulate impacts along time, it is also important to select the proper discount rate in order to run the scenarios and obtain the present values of cost and benefit flows, which can be used to calculate the net present values for the scenarios and compare their results. According to Miranda et al. (2010), this kind of analysis is sensitive to the discount rate, which should be a social more than economic variable, considering the nature of the phytosanitary issue.

In relation to this CBA framework, applied to phytosanitary policies to protect the national territory from the entry or dispersion of pests, it is important to point some of its advantages and criticisms. According to Miranda et al. (2010), this framework consists in an analytical tool of easy application and offers more transparency to the policy-making decision as well as to private decisions. On the other hand, Zerbe and Bellas (2006) states that its main caveat refers to difficulties to estimate the social and environmental impacts, given the complex of monetizing some inputs and effects and to endogeneity of certain inputs. In addition, according to Miranda (2015), in a deterministic analysis, the application of the Net Present Value and CBA does not provide confidence intervals for the benefit-cost ratios obtained. The author suggests that to address this limitation it is possible to use Monte Carlo simulations, as commented before, based on field data. However, this type of data is not always accessible.

4.2. Carambola fruit fly in Amapá State

The carambola fruit fly (*Bactrocera carambolae*) is currently limited to the state of Amapá in Brazil[1], and has occurred since 1996. It was found, in 2010, in Roraima State. However, it is not widely distributed across the country. The federal government maintains the National Program for the eradication of carambola fruit fly in partnership with the state government of Amapá.

To determine the costs and economic benefits of policies for agriculture defense to control of pests and diseases in Brazil, among which, the carambola fruit fly, the study developed by Miranda et al. (2010) applied the method of CBA. Two scenarios were constructed, one with the absence of the phytosanitary policy, that is, in the absence of National Program mentioned above, and the other with the program to prevent the pest from spreading to other Brazilian states. This analysis evaluated losses for the three main primary host fruits of the carambola fruit fly (mango, guava and orange). Two distinct management procedures were also considered, one in which fruit producers already control other fruit flies and, therefore, there is synergetic effects to carambola fruit fly control, and the alternative, with the absence of the control management procedures.

This study assumes that without the program for the eradication and control of pests, after the 4th year beginning from a base year, the carambola fruit fly would occur in all northeastern states in Brazil, which would generate impacts in terms of income, international trade and jobs, since this region has significant importance in fruit business. From the 5th year onwards, the pest would affect the entire country. This timeline of dispersion for the carambola fruit fly in the Brazilian territory considers the scenario without actions of agriculture defense, also presented in the studies conducted by Miranda (2013) and Miranda et al. (2015).

In a scenario of spread of carambola fruit fly, Miranda et al. (2010) quantify the impacts concerning productivity reduction, prohibition or restriction on exports, rural unemployment and costs of sanitary defense programs. The authors considered a 10-year projection period, taking 2008 as the base year for the projection.

When comparing costs and benefits (the losses prevented by the pest control program), Miranda et al. (2010) determined that the cost-benefit of the program for the eradication of carambola fruit fly varies from 26.4 to 35.7, respectively, for the Selic discount rates and long-term interest rate (TJLP) for scenarios with the control for other fruit flies. This means that for every R$1.00 invested by the federal government in the control and eradication of this pest through the National Program, the return ranges from R$26.40 to R$35.70, and may be even higher if

[1] The *Bactrocera carambolae* was found in Roraima state in late 2010, however by the time the economic analysis here was performed, it had been reported only in Amapá state.

environmental and other social impacts, in addition to the job losses, are monetized. Miranda et al. (2015) also disclosed these results. According to these authors, even in a deterministic model, without considering a confidence interval, the magnitude of the benefit-cost ratio is very high. Therefore, such outcomes show the economic importance of this policy for agriculture defense.

Using data from Miranda et al. (2010), Barreto et al. (2011) also attest to the relevance of this measure for the control and eradication of carambola fruit fly. The authors highlight that its economic impact goes beyond the state of Amapá in Brazil, as the main fruit-growing regions are outside of this state. However, the authors recognize that the pest spread in Amapá State can hinder the strengthening of this sector. Furthermore, they emphasize that the dissemination of this pest can potentially lead to increase in operating costs for pest control and monitoring in the field.

4.3. Huanglongbing (HLB) or Greening in São Paulo State

The Huanglongbing (HLB), also known as "greening", is one of the most critical diseases to the citrus culture. In Brazil, HLB was first recorded in 2004, in orchards of central and southern regions of São Paulo State. In 2005, HLB was detected in Minas Gerais State and, in 2007, in Paraná. According to sample surveys of HLB conducted by Fundecitrus, in August 2011, 53.4% of groves in São Paulo State had at least one symptomatic plant. HLB affects several citrus species, including sweet oranges, tangerines, pomelos, ciders and lemons, and other related species such as myrtle (*Murraya exotica*). The disease is transmitted by the psyllid *Diaphorina citri*, which hosts in citrus and ornamental plants and occurs throughout the national territory (MIRANDA et al., 2011).

To assess benefits and costs of program for the monitoring, control and eradication of HLB in São Paulo and southern region of the Triângulo Mineiro (Minas Gerais), Miranda et al. (2010) built two scenarios. The first conducted the analysis without the control and eradication program for HLB, executed by Fundecitrus, in partnership with the state government and with resources from the Ministry of Agriculture, adopting a period of 20 years in simulation, while the second scenario considered the maintenance of this program in the same way it was being conducted until 2009.

In the first scenario, impacts of the HLB were evaluated in terms of losses by reducing the productivity as symptomatic plants were kept in the orchard and losses by reducing the size of orchards due to failure of replanting plants that were eradicated. In the second scenario, besides the productivity loss, impacts were also analyzed in terms of losses caused by damage to seedlings and plants that should be replanted to maintain the original stand. Additionally, job losses associated

with decrease of production were measured, which, in turn, is also related to migration of the citrus culture to other regions or its replacement by other crops (MIRANDA et al., 2010).

The results found by Miranda et al. (2010) showed that the benefit-cost ratio calculated considering production costs for inspection, control and eradication of the HLB ranges from 5.1 to 6.1, respectively, for the Selic and the TJLP discount rates. This means that for every R$ 1.00 invested in disease control by government, Fundecitrus and producers altogether, there is a return five to six-fold greater. When considering only government expenditure in partnership with Fundecitrus, without incorporating the increase in production costs faced by citrus growers, the benefit-cost ratio ranges from 72 to 85.8, respectively, for the Selic and TJLP discount rates.

Using the same projection period assumed by Miranda et al. (2010) and the same database, however, disaggregating for São Paulo State, Miranda et al. (2012) highlighted that the cost-benefit ratio calculated by incorporating production costs of citrus is 4.6 for the TJLP. In the case of evaluating only government expenditure in partnership with Fundecitrus, without including the increase of production costs to producers, the benefit-cost ratio shows that for every R$ 1.00 invested in control and eradication of HLB, the return is R$ 57.3.

In turn, the study developed by Adami and Miranda (2014) aimed to calculate costs and benefits of the policy adopted by São Paulo State by establishing sanitary insurance for citrus orchards (during the harvest 2010-11). The insurance was used as a tool to encourage the management of citrus canker and the HLB. For that purpose, two scenarios were built, one with an *ex-post* analysis for the 2010-2011 harvest and another, with an *ex-ante* analysis to evaluate the proposal for the renewal of this insurance policy. The findings showed that, in 20 years, for each R$ 1.00 invested by producers for the HLB control, the return is R$ 4.19, resulting from the maintenance of plant productivity and orchard stand. Considering the proposal for renewal, and assuming that the eradication of diagnosed plants is under the expenses of the insurance company, this ratio increases to 4.22.

4.4. Citrus canker in the state of São Paulo

Another disease that has also been expanding and causing losses to the citrus culture in São Paulo State is citrus canker, caused by the bacterium *Xanthomonas axonopodis pv*. c*itri*. According to Adami and Miranda (2014), this disease is known worldwide and was first registered in Brazil in 1957, and recently there has been a worrying increase in contamination rates. Even with the legal obligation to eradicate symptomatic plants, according to Sanches et al. (2014), there was a drastic

increase of 607% in the rate of contaminated stands in São Paulo State between 2009 and 2011, which may be associated with changes in the State phytosanitary policy.

Sanches et al. (2014) applied the CBA approach aiming to analyze the economic benefits of maintaining the citrus canker under control in orchards in São Paulo State and to compare possible alternatives for the prevention and control of this disease in terms of the economic sustainability of citrus growers. For that purpose, five scenarios were considered, two related to prevention, one concerning the disease control and two examining the disease expansion for a 20-year timeline, with reference values for June 2012.

The results of this study indicate economic advantages in keeping citrus canker under control in São Paulo State, and the cost-benefit ratios were significantly higher for scenarios of prevention and control than in scenarios of disease expansion. Considering the accumulated projection of 20 years, Sanches et al. (2014) found that prevention of citrus canker, in regions where there is no history of canker occurrence, avoids losses at the amount of R$ 12.82 to each R$1.00 invested. Furthermore, the results show that the prevention and control of the disease have a benefit-cost ratio higher than the management of the disease in the medium and long-term. However, for some scenarios of canker expansion, particularly those in which the recommendations to control the disease were assumed not being taken properly, the benefit-cost ratio was found even negative, indicating that, under some conditions, the disease control and/or the own citrus production business is not economically feasible anymore. It is worth mentioning that findings also have shown that negative ratios could become positive along time, highlighting that the short and long term decisions might differ.

Finally, Adami and Miranda (2014) stated that the accumulated losses avoided by the phytosanitary insurance policy referring to citrus canker, in 20 years, are 52.23 times greater than the additional expense to growers by contracting this insurance. This relationship increases to R$ 55.99 in the scenario where the costs of eradication are under the expenses of the insurance company. The cost-benefit ratio of the insurance policy for the government resulting from citrus canker ranged from 32.77 to 40.58, that is, the return ranged from R$ 32.77 to R$ 40.58 for every R$ 1.00 invested by the state government to subsidize the sanitary insurance premium.

This paper has illustrated case studies where the CBA tool was applied to examine impacts of phytosanitary policies aiming to impede the dissemination of diseases and pests in Brazil. It is worth mentioning that there are other methods, such as the input-output matrices and the partial and general equilibrium models, which might be employed to evaluate physanitary programs in

agriculture. Although these methods are present in the international literature, in Brazil, there are not many studies. We can cite two of them, Fachinello and Ferreira Filho (2010) and Costa and Guilhoto (2011). The former applied a general equilibrium model to estimate the economic effects of a potential introduction of avian influenza in the poultry sector in Brazil. The second analyzed the economic impact from improving the detection and consequently the elimination of plants infected by HLB, applying the input-output approach.

The lack of studies in Brazil using more sophisticated methods of economic evaluation to address phytosanitary and sanitary issues is associated to data limitations. Regarding this topic, Miranda (2015) underlines that despite the fact that methods such as general equilibrium provide better mathematic background, they require more detailed databases and sophisticated software to run, which hinder their use on this type of problem. The frequent unavailability of data also hampers the choice of other methods, which are becoming frequent to evaluate education and health policies, such as the propensity score matching and difference in differences. However, they were not found in literature specialized in agriculture, in applications to phytosanitary polices.

5. Final Remarks

The assessment of the impact of state actions on the society has increasingly aroused the interest of governments, and RIA is one of the most used tools in several countries to assess their regulatory quality. However, although these instruments offer gains in optimizing allocation of public resources, restrictive factors to RIA implementation are hindrances in developing countries, especially with regard to constraints of technical and financial resources.

Technically, in the step of quantifying impacts there are challenges related to data availability and to methodological adjustments, particularly to incorporate also social and environmental aspects. At this point, we should highlight that due to the difficulties to valuate impacts, the decision-makers in OECD countries, very often, focus on the qualitative evaluation.

Despite these restrictions, Brazil acknowledges RIA as a relevant tool of governance for agencies to strengthen their interactions with society and their legitimacy as autonomous and technical organs. In this sense, initiatives that incorporate RIA have been encouraged, as in the case of ANVISA, INMETRO and other regulatory agencies, since RIA can contribute to improve the orientation for regulatory decisions.

One of those initiatives in the Brazilian context, addressed in this study, refers to the assessment of impacts of sanitary and phytosanitary policies related to programs for the prevention,

control and eradication of pests in agriculture. Although there is not yet an official program to incorporate the RIA in the regulatory action of the MAPA, the principle that guides the elaboration of the Pest Risk Analysis implies already some efforts to evaluate the economic impacts.

Phytosanitary issues can compromise profitability of agricultural producers in Brazil, and, consequently, generate economic, social and environmental impacts, and should therefore be part of the academic research agendas. Recently, the agricultural sector and government authorities were surprised by the discovery and damages caused by the *Helicoverpa armigera*, which caused severe damages to grains production in Bahia State and exposed the lack of preventive policies and the deficiencies in technological and institutional infrastructure (for instance, registration licenses for chemicals), which hampered the possibility to an efficient immediate reaction. Therefore, *ex-ante* studies are required to identify future sanitary crises, their potential damage and necessary measures in organization and structure to prevent, postpone and combat outbreak crises.

Despite the difficulty, or even impossibility, to measure costs and benefits of certain regulatory actions, CBA is the most recommended method for RIA. In this sense, three case studies for phytosanitary policy, which were available in literature and applied this analytical method, were discussed. They concerned the carambola fruit fly, *Huanglongbing* (HLB) and citrus canker.

Although many potential impacts have not been effectively quantified in the scenario of pest and disease spread, for example, loss of fruit quality and product depreciation on the market, losses in government tax revenue, costs to develop disinfection techniques and investments in laboratories, it is observed that all cost-benefit relationships (for governments) were more than one. Those results indicate that government expenditure in these programs generate positive returns along time. Primarily, the *ex-ante* analysis of quarantine pests, which are not present in Brazil although they might cause economic losses if they were, could contribute to ranking priorities in terms of new governmental phytosanitary programs.

This is a field of applied economic studies that deserves to be explored, seeking to enhance the application of tools of economic analysis, to obtain better organization of databases, sophistication of models and to promote interaction of economists and statisticians with experts of agronomic and biological areas regarding, mainly, crop management and epidemiology. This may enable more detailed and accurate studies for the identification and quantification of impacts and provide a relevant instrument for planning and implementing public policies for agriculture defense.

References

ADAMI, A. C. O.; MIRANDA, S. H. G., 2014. Seguro sanitário para citricultura: oportunidades e desafios. *Revista de Política Agrícola*, 23, 1, 77-90.

ADLER, M.; POSNER, E., 2006. *New Foundations of Cost-Benefit Analysis*. Cambridge, Massachusetts, and, London, England: Harvard University Press.

ALBUQUERQUE, K., 2009. A visão da Secretaria de Gestão do Ministério do Planejamento, Orçamento e Gestão. In: PROENÇA, J. D.; COSTA, P. V.; MONTAGNER, P. *Desafios da regulação no Brasil*. Brasília: ENAP.

ALVES, F. N. R.; PECI, A., 2011. Análise de Impacto Regulatório: uma nova ferramenta para a melhoria da regulação na ANVISA. *Revista de Saúde Pública*, 45, 4, 802-805.

ANVISA – AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA., 2014a. *Direito da Regulação*: Políticas públicas: O que é Avaliação de Impacto Regulatório? Publicado em: 18/06/2014. Disponível em: http://www.altosestudos.com.br/?p=52963. CEAsso em: 02/10/2014 a.

_____., 2014b. *Regulação sanitária*. Disponível em: http://portal.anvisa.gov.br/wps/portal/anvisa/anvisa/regulacaosanitaria. CEAsso em: 02/10/2014.

BARRETO, M. C.; SILVA, P. C. G.; CARVALHO, A. C. A.; ALMEIDA, C. O.; WANDER, A. E., 2011. Impactos socioeconômicos da dispersão da mosca-da-carambola (*Bactrocera carambolae*) à fruticultura nacional. In: SILVA, R. A.; LEMOS, W. P.; ZUCCHI, R. A. (Org.). *Moscas-das-frutas na Amazônia brasileira*: diversidade, hospedeiros e inimigos naturais. Macapá-AP: Embrapa Amapá.

CASTRO, C. M., 2014. Some aspects of implementing Regulatory Impact Analysis in Brazil. *Revista de Administração Pública*, 48, 2, 323-342.

COSTA, C. C.; GUILHOTO, J. J. M., 2011. Impactos econômicos do sistema de detecção e eliminação precoce de citros com Huanglongbing. *Revista de Economia e Agronegócio*, 9, 3, 347-367.

FACHINELLO, A. L.; FERREIRA FILHO, J. B. S., 2010. Gripe aviária no Brasil: uma análise econômica de equilíbrio geral. *Revista de Economia e Sociologia Rural*, 48, 3, 539-566.

INTERNATIONAL STANDARDS FOR PHYTOSANITARY MEASURES – ISPM, 2006a. *Guidelines for pest risk analysis.* ISPM, n. 2. Roma: FAO.

_____, 2006b. *Pest risk analysis for quarantine pests, including analysis of environmental risks and living modified.* ISPM, n. 11. Roma: FAO.

JACOBS, S., 2005a. The role of Regulatory Impact Assessment in democratization: selected cases from the transition States of Central and Eastern Europe. *Working Paper Series n. 101*. Centre on Regulation and Competition, University of Manchester.

_____., 2005b. *International Best Practices in Regulatory Impact Analysis*. The Consensus Building Workshop on Improving the Competitiveness of the Kyrgyz Republic Economy. World Bank Institute and Jacobs & Associates: International Consultants in Regulatory Reform. Disponível em: http://info.worldbank.org/etools/docs/library/122723/International%20Best%20Practices%20in%20Regulatory%20Impact%20Analysis_Scott%20Jacobs.pdf. CEAsso em: 30/09/2014.

_____., 2006. *Current Trends in Regulatory Impact Analysis: The Challenges of Mainstreaming RIA into Policy-making*. Jacobs & Associates: International Leaders in Regulatory Reform.

LIMA, V. A. F. A., 2010. *Avaliação de Impacto Regulatório e sua aplicação no Brasil*. Rio de Janeiro: UFRJ, 2010. 156 f. Dissertação (Mestrado em Políticas Públicas, Estratégias e Desenvolvimento) – Universidade Federal do Rio de Janeiro.

LUCCHESE, G., 2008. *Globalização e regulação sanitária:* os rumos da vigilância sanitária no Brasil. Brasília: ANVISA.

MIRANDA, S. H. G., 2012. Regulatory Impact and Cost-Benefit Analyses – Tools to Evaluate Regulatory Quality and Improve Transparency among Countries. In: CADOT, O.; MALOUCHE, *M. Non-Tariff Measures* – A Fresh Look at Trade Policy's New Frontier. The World Bank.

_____., 2013. Mosca de Carambola e *Greening*: análise de benefício-custo dos programas de erradicação. In: *Ameaças Fitossanitárias* – novas pragas colocam em risco a produção de alimentos no Brasil. SBDA.

_____., 2015. Métodos quantitativos na avaliação de risco de pragas. In: SUGAYAMA, R. L. *Defesa Vegetal* (no prelo).

MIRANDA, S. H. G.; ADAMI, A. C. O.; BASSANEZI, R. B., 2012. Economic impacts of Huanglongbing Disease in São Paulo state. In: *International Association of Agricultural Economists (IAAE) Triennial Conference*. Foz do Iguaçu, PR.

MIRANDA, S. H. G.; BASSANEZI, R. B.; ADAMI, A. C. O., 2011. CBA das ações de defesa fitossanitária para o HLB em São Paulo: lições para a citricultura do Nordeste. *Bahia Agrícola*, 9, 64-71.

MIRANDA, S. H. G.; BARTHOLOMEU, D. B.; LIMA, L. M., 2009. A Análise de Impacto Regulatório como novo instrumento de gestão pública no Brasil. In: Congresso da Sociedade Brasileira de Economia, Administração e Sociologia Rural, 47. *Anais*... Porto Alegre, RS: SOBER.

MIRANDA, S. H. G.; NASCIMENTO, A. M.; XIMENES, V. P. 2015. Potenciais impactos socioeconômicos da expansão da mosca-da-carambola. In: VILELA, E. F.; ZUCCHI, R. A. *Pragas introduzidas no Brasil*: insetos e ácaros. Piracicaba-SP: FEALQ (no prelo).

MIRANDA, S. H. G.; NASCIMENTO, A. M.; XIMENES, V. P.; BASSANEZI, R. B, 2010. Uma aplicação da Análise Benefício-Custo para Políticas de Defesa Sanitária: alguns estudos de caso para o Brasil. *Relatório de Pesquisa*.

OECD – ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, 2008a. *Building an Institutional Framework for Regulatory Impact Analysis (RIA):* Guidance for Policy Makers. Version 1.1. Regulatory Policy Division Directorate for Public Governance and Territorial Development.

_____.,

2008b. *Brasil:* Fortalecendo a Governança Regulatória. Relatório Sobre Reforma Regulatória. OCDE.

_____.,

2009. *Regulatory Impact Analysis:* a tool for policy coherence. Disponível em: http://www.planejamento.gov.br/secretarias/.../OECD_Regulatory_Impact.pdf. CEAsso em: 30/09/2014.

_____.,

2012. *Recommendation of the council on regulatory policy and governance*. Disponível em: http://www.oecd.org/governance/regulatory-policy/49990.pdf. CEAsso em: 30/09/2014.

PECI, A., 2011. Avaliação do Impacto Regulatório e sua difusão no contexto brasileiro. *Revista de Administração de Empresas*, 51, 4, 336-348.

PECI, A.; SOBRAL, F., 2011. Regulatory Impact Assessment: how political and organizational forces influence its diffusion in a developing country. *Regulation & Governance*, 5, 204-220.

PROENÇA, J. D.; RODRIGO, D., 2012. Brasil: Governança Regulatória e a Análise do Impacto Regulatório. In: PROENÇA, J. D.; PAULO, C. B. *Experiências exitosas em regulação na América Latina e Caribe*. Brasília: Presidência da República.

RADAELLI, C. M, 2005. Diffusion without convergence: how political context shapes the adoption of Regulatory Impact Assessment. *Journal of European Public Policy*, 12, 5, 924-943.

RAUEN, C. V., 2011. *Metodologias de Análise de Impacto Regulatório e a Análise Custo-Benefício*. Brasília: Secretaria de Acompanhamento Econômico (SEAE) do Ministério da Fazenda.

RICHARDSON, H., 2001. The Stupidity of the Cost-Benefit Standard. In: ADLER, M.; POSNER, E.. *Cost-Benefit Analysis:* Legal, Economic, and Philosophical Perspectives. Chicago and London: University of Chicago Press.

RODRIGO, D., 2005. *Regulatory Impact Analysis in OECD countries challenges for developing countries*. Dhaka, Bangladesh: OECD.

SALGADO, L. H.; BORGES, E. B. P., 2010. Análise de Impacto Regulatório: uma abordagem exploratória. *Texto para Discussão nº 1463*. Brasília: IPEA.

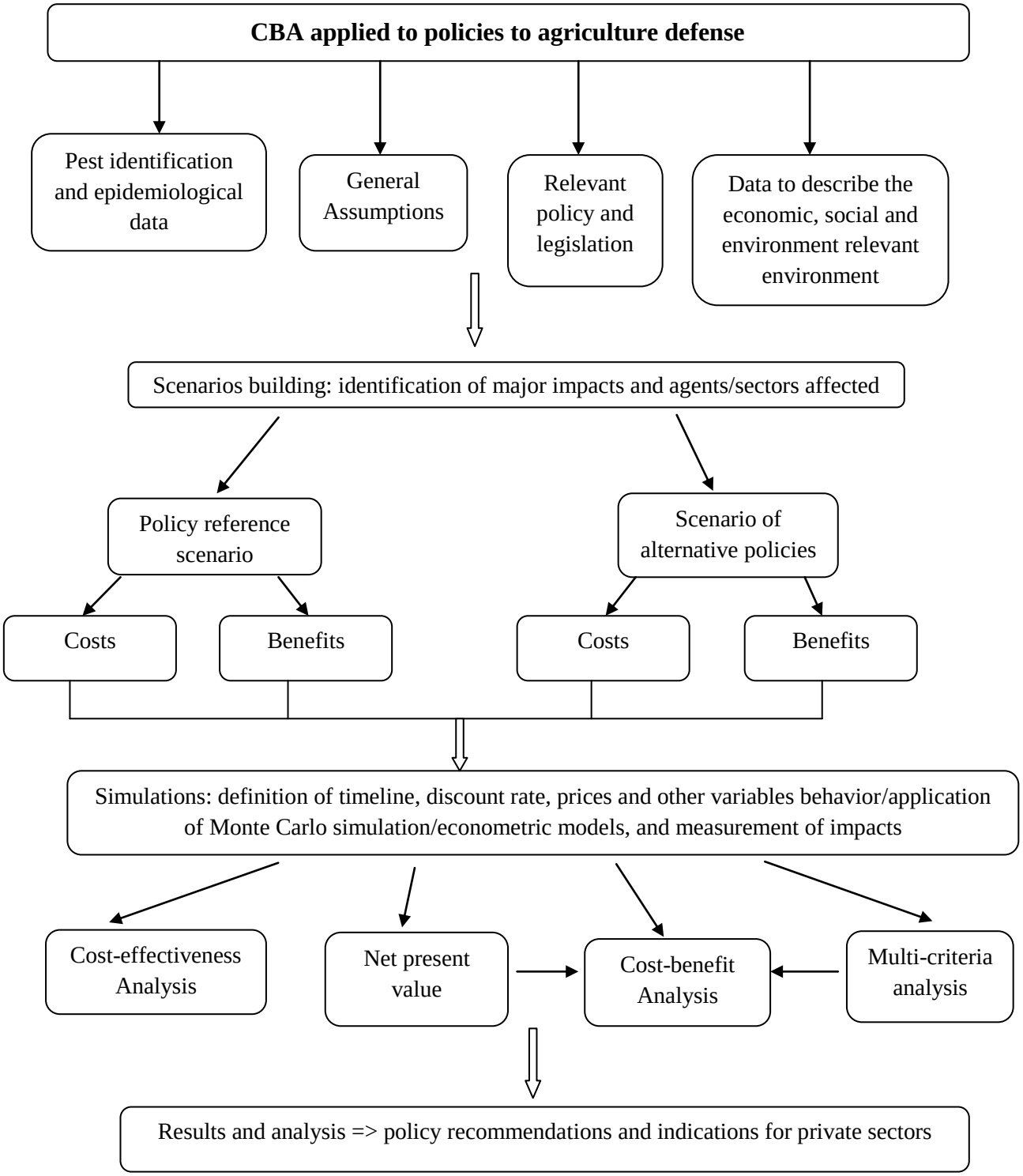
SANCHES, A. L. R.; MIRANDA, S. H. G.; BELASQUE JUNIOR, J.; BASSANEZI, R. B., 2014. Análise econômica da prevenção e controle do cancro cítrico no estado de São Paulo. *Revista de Economia e Sociologia Rural*, 52, 3, 549-566.

SILVA, G. H. T. A., 2012. Análise de Impacto Regulatório na ANVISA: uma estratégia de governança e melhoria da qualidade regulatória. In: PROENÇA, J. D.; PAULO, C. B. *Experiências exitosas em regulação na América Latina e Caribe*. Brasília: Presidência da República, 2012.

_____., 2009. Regulação sanitária no Brasil: singularidades, avanços e desafios. In: PROENÇA, J. D.; COSTA, P. V.; MONTAGNER, P. *Desafios da regulação no Brasil*. Brasília: ENAP.

ZERBE, R. O.; BELLAS, A. S., 2006. *A primer for benefit-cost analysis.* Cheltenham (United Kingdom), Northampton (Massachusetts): Edward Elgar.

Figure 1 – Flowchart illustrating general steps to apply the CBA and other quantitative and qualitative tools to evaluate impacts of policies for agriculture defense



Source: elaborated by the authors.