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Management and use of water resources and the expansion of agribusiness: water for what and for whom?

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Abstract *This article aims to conduct an analysis of the correlation between the management and use of water resources with the expansion of agribusiness and its reflections in environmental and human contamination, pointing toward challenges for SUS in the area of monitoring pesticides in water for human consumption. It is qualitative study with an adopted methodological framework of the case study, applied in an area of agribusiness expansion in the semi-arid region of the state of Ceará. The results demonstrate that there exists an unequal relationship in the management and use of water, in which agribusiness in Ceará is prioritized for access to water at the expense of the great majority of the rural population. As a result, pesticide contamination of surface and ground water brings challenges to surveillance of the control of pesticides in water for human consumption. In this sense, we present alternatives to develop health services with more effective actions in surveillance of health in general, and of Vigiagua in particular, such as: overcoming the fragmentation of vision and intervention regarding health problems; human exposure to multiple pesticides; the lack of laboratories and trained professionals; and enlarging the dissemination of information to the users of water.*

Key words *Environmental pollution, Agribusiness, Pesticides, Public health surveillance, Environmental health*

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Introduction

The political choice of the economic development model adopted by Brazil increasingly consolidates its insertion in the international market via the production of rural and mineral commodities. For example, we note the expansion of cattle raising in the Amazon region; sugarcane and fruit production for export in the Northeast; the advancement of the steel industry in the Southeast; and the monocultures of transgenic soy and corn in the Center-West and South of the country[1].

The production chains cited above present similar characteristics, spanning important concerns for the field of Collective Health. These include land concentration and the expulsion of traditional groups such as *quilombolas* (the descendants of semi-autonomous communities of escaped slaves), peasants, and river communities who organize their life and culture in harmonic relationships with these ecosystems; soil degradation and loss of biodiversity, giving way to monocultures; as well as the excessive consumption of natural resources such as water, placing the food sovereignty, water safety, and human supplies of various communities at risk[2,3].

The State, for its part, provides the necessary infrastructure for these enterprises, such as the construction of roads and highways, dams, wells, and public irrigation perimeters. The latter account for a large share of investments by the Federal Government. The Growth Acceleration Program (PAC2), for example, anticipates the allocation of R$ 6.9 billion for its expansion, representing the establishment of 200,000 hectares of irrigated areas in the semi-arid region of the Northeast[4].

However, access to water does not occur in an equitable way among the various population groups present in rural areas, and even less so in terms of its social function and destination. To cite one example, research shows that in the Irrigated Boundary of the Russas Tabuleiro, in the semi-arid zone of Ceará, close to 88% of the 622 irrigators were small farmers and 12% corresponded to agribusiness companies. Nevertheless, the former occupied only 37.7% while the latter concentrated 47.6% of irrigated lands[4,5].

In addition to land concentration, the production model rooted in agricultural modernization is dependent on a large volume of water. According to the National Plan for Water Resources, irrigated agriculture is responsible for the use of nearly 70% of all the water consumed in Brazil. The document further emphasizes that the demand needed to guarantee the production of monocultures is incompatible with regions with few available water resources, as is the case with the semiarid Northeast, and affirms that "the water consumed yearly by one hectare would be sufficient to supply more than 100 people consuming 250 liters per day, depending on the region and the irrigated crops"[6].

Agribusiness is also founded on a production model dependent on the intensive use of pesticides. According to Pignati et al.[7], in just the 2012 agricultural harvest close to 1.05 billion liters of herbicides, insecticides, and fungicides were sprayed on the country's farms. This data is worrisome from the point of view of public health, bearing in mind a growth of 67.4% in new cases of non-fatal work accidents caused by exposure to pesticides. Add to this is an increase of 126.8% in the Toxicity Coefficient, principally affecting rural workers[8].

In light of the above: "It can be supposed that the municipalities whose economy is predominantly agricultural and which use an abundance of pesticides should develop health policies that have a more specific and situational focus that incorporates the resulting health problems and their causes"[9].

In this sense, the Unified Health System (SUS) is faced with the challenge of identifying the influence of productive processes and their impact on the health of populations. In the end, the approach to the inter-relations between production/labor, environment, and health is an important reference point in understanding the differential profile of sickness and death, above all in the rural population[10].

The Health Surveillance sector, for its part, takes on a strategic role in the detection of changes both in the environmental conditions as well as the morbimortality profile of the communities, especially in municipalities with a history of expansion of agribusiness activities in their territories. It is thus implicated in a process of reorientation of practices in health services, incorporating methods and techniques capable of offering support to the definition of health problems and the involved population groups, recognizing the influence of productive processes in the social determination of the health-sickness process[11].

Within this context, the present article aims to carry out an analysis of the correlation between the management and use of water resources with the expansion of agribusiness in the semi

-arid region of Ceará, examining its reflections in environmental and human contamination. As such, it is structured into three sections: (1) an analysis of the process of concentration and privatization of water resources; (2) its contamination due to the intensive use of pesticides; and (3) the challenges for SUS in terms of monitoring pesticide levels in water for human consumption.

Methodology

The present text is in dialogue with the transdisciplinary framework between the fields of Collective Health and the Social Sciences and Humanities. To this end, it is associated with a qualitative research focus, understood as[12]: "multi-paradigmatic, wherein the people who practice it are sensitive to the value of a multi-method focus. The field of qualitative research is inherently political, working from multiple ethical and political positions".

In accordance with these precepts, we have adopted the Case Study as a methodology of investigation. However, it is necessary to make an a priori effort of epistemologically demarcating the fundamentals in which it is founded, bearing in mind the polysemy that infuses its conceptual framework.

The case study traces its origins to research in the areas of medicine and psychology, later expanding its analytical focus to other fields of knowledge, in particular that of Sociology. It constitutes an important research method for the analysis of social reality, useful for the in-depth examination of the phenomena investigated in all of their complexity[13,14].

Owing to its ontological nature, the case study is recommended when the goal is a deeper understanding of situations involving organizational, political, and social contexts[15]. Among its principal characteristics is an emphasis on the interpretation of data in a manner that is always contextual, as well as its capacity to formulate various analytical matrices around the object of study[14].

Authors such as Yin[15] frequently identify a certain conceptual imprecision in the utilization of the case study, being commonly confused with ethnography or participant observation. However, the author clarifies that: "The case study is an empirical investigation preoccupied in revealing a contemporary phenomenon in depth and in its real-life context, especially when the boundaries between the phenomenon and the context are not clearly apparent".

Esteban[12] identifies at least three distinct classifications of case study: the Instrumental, the Collective, and the Intrinsic. For this research, we have chosen the intrinsic case study, viewing it as the best alternative when the researcher: "wishes to achieve the greatest understanding of a particular case. We do not select the case because it is representative of others or because it represents one aspect or problem in particular, but because the case in itself is what interests us. We need to learn about the concrete case. We have an intrinsic interest in it"[12].

In addition, this methodology has shown great analytical potential when used in contexts that are continuously challenged by the complexity of the object of investigation, such as the expansion of agribusiness in the region of the lower Jaguaribe. Since the 1980s, this territory has seen the arrival of transnational and regional companies that are expanding their consolidated monoculture cultivation via the exploitation of great quantities of water from the surface and subterranean reservoirs[16].

The study was carried out in the municipalities of Limoeiro do Norte and Quixeré, both bordered by the Irrigated Perimeter of Jaguaribe -Apodi. In this region, the area under cultivation by the agribusiness sector has increased by four to five times in only the last five years[17].

The expansion of cultivation areas by transnational and national fruit companies for exportis accompanied by a strong need for hydrological inputs and by the increased use of pesticides. As a corollary, the municipalities cited above have recorded a growing number of deep well drillings, predominantly intended for irrigation by large corporations, which contributes to the increase of a hydrological deficit in the region.

To this is added the elevated potential for contamination of the Jandaíra aquifer, the second largest reservoir of subterranean water in Ceará. Studies show the presence of pesticides at a depth in excess of one hundred meters, putting public health and human supply at risk[17].

The research in question was developed in accordance with Resolution 196/96 of the National Health Council, in force at the time, and was also approved by the Committee on Ethics in Research of the Federal University of Ceará according to Report Nº 315/11.

Results and discussion

Management and use of water resources and the expansion of agribusiness in the semi-arid region of Ceará: water for what and for whom?

Starting in the 2000s, agribusiness in Ceará took on an important role in the commercial market. According to data from the Institute for Research and Economic Strategy of Ceará (IPECE), in the period between 2003 and 2012 the participation of Ceará in the domestic scenario of fruit cultivation for export more than doubled, growing from 5.93% to 16.22%. In financial terms, this represented a growth from US $21.56 million in 2003 to US $108.39 million in 2012. In other words, an increase of 402.67% in only a decade[18].

Among the most traded products are pineapple, banana, mango, watermelon, and melon. The latter is responsible for Ceará gaining the title of the largest exporter of this fruit in Brazil. Among the principal destinations and commercial markets are Holland (45.82%), the United Kingdom (30.17%), and Spain (12.52%)[18].

It is salient that, in tandem with melons, Ceará also exports water resources in an indirect way, bearing in mind that the fruit is comprised predominantly of water. This is occurring in the context of serious water insecurity: in the first half of 2015, 75.5% of municipalities in the state decreed a State of Emergency due to lack of water for human consumption[19].

This complex picture, which involves the appropriation, concentration and unequal division of water on the part of large corporations, even to the point of its (in)direct exportation in the form of fruit, becomes even more controversial. This is because Ceará not only maintained its position as the third major exporter of fruits in Brazil in thequinquennium of 2010-2014, but also managed to expand its real production and profit between the years 2010 and 2013, as shown in Table 1.

Even in 2014, when the export market showed a slight drop of 2.2% in the sale of fruits explained by the water shortage, Ceará maintained a level of production greater than that recorded for 2010, 2011, and 2012. Melon alone achieved an increase of more than 2 million dollars in its profitability, rising from US$ 88.7 million in 2013 to US$ 90.7 million in 2014[20].

This growth in the volume of production and commercialization of irrigated fruit farming went hand-in-hand with the need for greater water inputs. For this purpose, the facilitators of agribusiness in Ceará developed ever more sophisticated technology for the capture, damming, and channeling of water reserves.

In Quixeré this problem is made explicit. Of the 245 wells registered by the Company of Water Resource Management of Ceará (COGERH) in the municipality, 67.7% are designated for irrigation, while only 13.4% goes toward human consumption. Of the 47 registered wells in Limoeiro do Norte, 40.4% serve irrigation and industry, while 29.7% are allocated to human consumption[21].

The above numbers demonstrate that the majority of water resources of the Jandaíra aquifer are exploited by agribusiness at the expense of human supply. This concern is salient given the great volume of water extracted. According to a survey made by the Evaluation Report on Subterranean Water Resources[22], currently 80% of wells exploiting water from the aquifer are private property. The activity of irrigated agriculture alone utilizes 56% of the wells, responsible for 60% of their total discharge. At the same time, small

Table 1. Fruit Exports (US$).

State	2010 (Jan-Dec)	2011 (Jan-Dec)	2012 (Jan-Dec)	2013 (Jan-Dec)
1 Bahia	131,032,646	138,005,382	131,319,734	138.747.999
2 Pernambuco	131,850,816	148,531,297	129,333,475	122.046.151
3 Ceará	**99,162,867**	**102,390,774**	**108,289,898**	**117.037.815**
4 São Paulo	80,095,023	89,885,243	87,257,453	94.937.016
5 Rio Grande do Norte	79,515,789	85,397,794	89,079,136	91.371.633
Other states	105,388,237	86,366,494	90,406,831	112,440,638
Brazil	**627,045,378**	**650,576,984**	**636,810,206**	**676,581,252**

Source: Adapted from IPECE[20].

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farmers in the region are complaining that their wells are drying up.

In 50 wells located in Quixeré and monitored by COGERH, there has been an accentuated lowering of water levels in the period spanning the months of July to January, the time when irrigation for melon cultivation occurs at an accelerated pace on the farms. Consequently, it is estimated that the hydrological balance of the Jandaíra Aquifer has exceeded its capacity for replenishment by at least 4 million cubic meters annually[21].

The intersection of these facts about the management and use of water resources and the expansion of irrigated fruit cultivation in Ceará allows us to support the hypothesis that there exists unequal access to water, fostered by the close links between the large corporations of irrigated fruit farming and the public authorities. In this context, we note the prioritization of servicing the interests of agribusiness in Ceará at the expense of access to water by the majority of the rural population.

This assertion is more striking when we observe that 67 cities in Ceará decreed a State of Emergency due to a lack of water for human consumption in the first half of 2015. Among them were Limoeirodo Norte and Quixeré. In reality, in identifying the cause of the State of Emergency of these municipalities "as a result of drought," the document ends up obscuring all of the unequal dynamics in access to water that guarantee agribusiness the necessary conditions to continue their production, at the same time that there is a historical scarcity of water resources.

In addition, at least two other factors are responsible for exacerbating these contradictions: in analyzing the Official Gazette of the Federal Executive, we find that these same municipalities are some of the largest producers and exporters to the European market from Brazil[23], and; that this violates the National Policy on Water Resources, which states that in situations of scarcity, the primary use of water resources is for human consumption[24].

Contamination of surface and ground waters by pesticides and its impact on human health

As has been demonstrated, the expansion of agribusiness in the lower Jaguaribe, aside from promoting land and water concentration, also contributes to the degradation of the environment. Gama et al.[17] show that the region encompassing the municipalities of Limoeiro do Norte and Quixeré has the greatest variety of pesticides and active ingredients used throughout the country, even when compared with the South and Southeast.

According to data from a survey of pesticides used in the semi-arid region of Ceará, in the lower Jaguaribe alone the use of 198 active ingredients has been verified. Of these, 48% belong to Toxicological Class I and II – extremely and highly toxic, respectively. As far as environmental classification, more than 60% belong to Class I and II – products highly or very dangerous to the environment[17].

In this context, it is also worth noting the practice of aerial spraying of fungicides in toxicological classes I and II on banana crops, which are extensively cultivated in the region. Estimates indicate the release of approximately 73,750 liters of toxic mixture in each application. It is important to stress that, according to information obtained in the safety data sheets of the various manufacturers of these fungicides, clinical signs and symptoms in humans affecting the skin, mucous membranes, and Central Nervous System can be expected[2].

The above numbers prove the elevated toxic potential of active ingredients used on the plantations. This has negative repercussions in the contamination of the water table, rivers, and waterways. According to studies by COGERH, laboratory analyses have detected the presence of active ingredients in 6 out of 10 samples from the Jandaíra aquifer including insecticides, acaricides, and fungicides[21].

Among the main active ingredients identified are Propiconazole and Flutriafol, fungicides in toxicological class I and II authorized for use in the applications in melon and banana crops. Also indicated is the presence of Diazinon, a substance recently recognized by the International Agency for Research on Cancer (IARC) as a probable carcinogenic agent. Thus, research warns of their potential to unleash mutagenic and teratogenic effects, as well as problems of the endocrine system among exposed populations[25].

Environmental contamination is also present in the surface waters of the Jaguaribe-Apodi Irrigated Parameter. Research conducted in the region collected 24 samples originating from different collection points such as canals that supply communities, water tanks, and wells. In all of them, at least three active ingredients were detected. In the collection point of Tomé district alone 12 active ingredients of pesticides were identified,

including Abamectin and Chlorpyrifos, both belonging to the toxicological classification I and II and considered the most used agricultural products in the region[2,16,17].

This context of contamination excessively affects the health of the general population and of rural workers in particular. An epidemiological study conducted in Limoeiro do Norte, Russas, and Quixeré shows an annual increase in the rate of hospitalization for neoplasia 1.76 times greater compared to the other eleven control municipalities. The analyses also document that the rate of cancer mortality is 38% higher in the three municipalities cited above, demonstrating the influence of the production processes on the sickness and mortality profile of the populations[26].

In terms of concerns with health problems, research conducted during the period of 2007 to 2011 has shown that 97% of the agribusiness workers and family farmers studied were exposed to pesticides. Such exposure involved the presence of 4 to 30 distinct active ingredients, distributed between insecticides, herbicides, and fungicides. From this data set it was possible to identify the presence of 25 different chemical groups, of which 68.5% are classified as extremely toxic or very toxic[2,16].

Another study conducted in Limoeiro do Norte with rural workers on banana plantations concluded that the chronic exposure to pesticides led to an occurrence of chromosomal alterations in bone marrow cells. Of the 35 viable samples, 11 showed important chromosomal alterations, such as: deletions of chromosomes 7 and 11, monosomy of TP53, and an enlargement of TP53. The abnormalities found are similar to alterations described in clonal diseases of bone marrow such as myelodisplatic syndromes and acute myeloid leukemia[27].

The complexity of the situation presented here challenges the health sector in outlining effective strategies for the monitoring of pesticides in water for human consumption. In this sense, it provokes the development of Health Surveillance actions in all of their aspects.

Challenges for SUS involving the monitoring of pesticides in water for human consumption

Surveillance of quality of water for human consumption, including the potential contamination by pesticides, is a responsibility of Vigiagua – the National Program of Quality Control in Water for Human Consumption. One of its principal objectives is "to guarantee the population access to water in sufficient quantities, and in quality compatible with the standard of drinkability established in current legislation, for the promotion of health"[28].

Thus, the activity of this Program is organized into three major components: a) the ongoing and systematic analysis of information about water quality to confirm that the source, treatment, and distribution adhere to the objectives and regulations established in current legislation; b) systematic evaluation of different means of supplying water to the population, either collective or individual, in order to verify the degree of risk represented to public health resulting from the supply source, adequacy of treatment, and operational issues; and c) analysis of developments in the physical, chemical, and microbiological quality and its correlation to illnesses related to water quality in the entire system of water supply, in order to determine its impact[28].

Bearing in mind the serious impact of pesticides on health, and Brazil's position as the greatest consumer in the world of these products since 2008, this surveillance is of the utmost importance to public health. To this end, among other things, Decree 2.914/2011 establishes the mandatory monitoring of Maximum Permitted Amounts (VMP) of 64 chemical substances, among which are 27 active ingredients (AI) of pesticides[29]. This number has been increased from Decree 56/1977, which designated 12 AI; Decree 36/1990, which included 13 AI; and Decree 518/2004, where 22 AI are listed, reflecting the growing pollution resulting from the dominant model of agricultural production[30]. However, there are close to 430 active ingredients of pesticides registered in Brazil, which means that little more than 5% of them are subject to mandatory monitoring in accordance with legal obligations.

Aside from this, the analysis of pesticides in water for human consumption is still seldom conducted in Brazil. Of the 5,570 municipalities, only 25.1% possess data pertaining to this monitoring process. Of these, only 2.3% are collected in conjunction with the agency responsible for supply and with Surveillance[31].

Contributing to this state of affairs is the reduced number of public laboratories equipped to attend to this great demand for analyses (especially considering the variety of AI), the availability of equipment and validated methodologies, and suitably qualified human resources to produce reliable results[32,33].

It should be emphasized that Ceará, in spite of experiencing a significant expansion of agribusiness in its territory that has repercussions in environmental and human contamination, does not possess data regarding the monitoring of pesticides in water for human consumption by the Surveillance system[28]. Such a situation is exacerbated further when we bear in mind that 79.3% of the state's municipalities demonstrate unfavorable environmental and health conditions, and 20.6% of its municipalities are in a situation of environmental vulnerability[30]. In this sense, "the data reinforces the urgent necessity for a definition of public policies oriented toward regulation of the pesticide situation in the state of Ceará"[34].

According to Barcellos and Quitério[35], the Surveillance in Environmental Health program, of which Vigiagua is a part, has acquired different institutional configurations at each level of government. In the state and municipal secretariats of health, surveillance in environmental health has been organized – sometimes within epidemiology departments, or sometimes in health surveillance – without a clear definition of its goal and specifically of its actions. There remains a need for the construction of information systems capable of assisting the analysis of health scenarios and decision-making.

Another major challenge to be confronted by Vigiagua involves overcoming the fragmentation of viewpoints and interventions in health problems. This issue is present in Ceará to the degree that: "it can be clearly perceived that there exists no articulated project. The actions are isolated, precarious, and insufficient as much in their practice as in their financial procedures, hindering an effective response to the problem of pesticides in the state of Ceará"[34].

Indeed, contamination by pesticides in water for human consumption has its origin in the intensive use of these chemicals in productive processes, from which are traced routes of contamination involving air, soil, water, and foodstuffs, affecting persons who live and/or work in the surrounding area or even remotely near it, bearing in mind the environmental dynamics[36]. This raises the necessity of adopting a broad approach to the problem, inspiring new practices that include articulation between the surveillance actions currently segmented into epidemiological, sanitary, worker health, or environmental health sectors; and the understanding of the dynamic interaction between the environmental divisions, in a way that avoids actions that are isolated and detached from the real needs present in the territories.

In the case presented here, we consider that the perspective of the territorialization of surveillance of water for human consumption strengthens the efficacy of actions, similar to what we already have in the National Policy of Primary Care for the organization of labor processes in health[37], especially if it involves the participation and situated knowledge of workers and residents in the *definition of AI to be monitored,* in accordance with their use in local productive processes. This strategy may permit greater focus and specificity in the analyses. Furthermore, it strengthens the decision-making of *when to collect samples*, approximating the times when their use occurs, bearing in mind the period of degradation of the ingredients and the seasonable nature of some crops, and the decision of where to collect samples, taking into account the paths of dispersal of the contaminant.

Bearing in mind the complexity of the problems in each local or regional context, there is a need for inter-sector articulation involving public agencies responsible for the environment, agriculture, water resources, and water supply, among others, spanning the process of knowledge production to the planning of intervention around the identified problems, since a portion of these may be outside the governability of SUS.

Care must be taken with the flow of information produced by Vigiagua, in such a way that it "helps managers make decisions based on collective and alternative supplies, in the sense of demanding adequate interventions, when there is an instance of non-conformity with water quality"[38]. Of equal importance is the furnishing of data about water quality to the population and the possible risks inherent in its consumption, one of the principles of Vigiagua, aiming to guarantee the right to information of the users and consumers, favoring the social control of SUS and political action in society.

Nevertheless, research regarding the gaps between the formulation of the Vigiagua program and its implementation at the municipal level showed difficulties in the registration and surveillance of water supply installations, difficulties in the collection and analysis of data generated through surveillance, inadequacies in the georeferencing tools, and inefficient integration between departments and sectors, basically restricting them to outbreak situations. One of the challenges uncovered points to the need to surpass the basic threshold represented by the initial registration of the different forms of supply and the release of data to the information system (SI-

SAGUA), and then move on to the utilization and georeferencing of this data, helping to assess the situation as a basis for planning and decisions[39].

Among the various reasons to grasp the limits of Vigiagua's activity, which span aspects related to regulatory and surveillance dimensions, the job insecurity of SUS must also be taken into account. This is especially relevant in terms of the contingent of contracted professionals without a stable work relationship which, aside from creating challenges regarding the turnover in personnel in whose training the State has invested, creates institutional conditions that are unfavorable for the exercise of necessary autonomy. In these contexts, health workers in insecure jobs can be even more vulnerable in terms of confronting problems that involve powerful economic agents, as is the case with the chemical industry and agribusiness.

From the point of view of scientific knowledge, surveillance of pesticides in water for human consumption also has large-scale challenges, above all in terms of the evaluation of the interaction between active ingredients. That is, although the exposure to multiple AI is more frequent both for workers and for consumers of foodstuffs, the studies presented to the regulatory authorities of each country for the granting of registrations are confined to an analysis of each AI in isolation, disregarding the health effects of multiple exposures to different mixtures and their possible interactions, including synergisms, either in the environment or in living tissue. We also highlight the evaluation of risk based on toxicological studies conducted with laboratory animals or *in vitro* systems, whose results are extrapolated for their effects on human health even without a consensus in the scientific literature about the real interactions of the substances in the human organism; the disregard of the effects produced by low doses of pesticides that are not capable of triggering the protective mechanisms of detoxification, inactivation, or repair, but which can unleash toxic effects of endocrine disruption and effects on the immune system, principally in stages considered critical to development; the disregard, in the establishment of the VMP, of aggregated risk resulting from total exposure to one or more AI from different sources, such as the environment, occupation, or foodstuffs[31].

Final considerations

Although the people of the semi-arid region are long-accustomed to living with water shortages, and have developed situated knowledge for coexisting with such scarcity, it is curious that the problem of water has gained visibility in the public agenda of Brazil since the time that rationing was imposed on the capital cities of the southeast in 2015. What is being framed as a "water crisis" is not something transitory or which recently emerged, surprising those who consider themselves inhabitants of a country rich in reserves of fresh water. This is, in fact, a consequence of historical choices in the field of economics and of policy in relation to access, use, and quality of water.

The case studied here points out characteristics of the development model for the Northeast in recent decades that, similarly to the Center -West, imposes a management of water that privileges access by large agribusiness corporations, by way of the national irrigation policy and of the PAC. The modernization of agriculture, for its part, with its chemical-dependent production model, generates means of contamination that affect the water, in addition to other environmental components, resulting in serious risks to human health.

SUS relies on norms and programs designed for the surveillance of water quality, including the presence of pesticides, of great importance to public health. Such actions, however, are still limited by problems of a political, institutional, technical-scientific, and operational nature, according to what has been noted in this article.

Drawing from the case study presented, it is possible to recommend ways for perfecting surveillance of water that takes into account the specificities of territorial contexts in which contamination by pesticides occurs, incorporating the situated knowledge of local workers and residents into the monitoring actions; the need for an integrated approach from the environmental compartments and among the surveillance agencies, for example in the creation of databases, the analysis of information, and the planning of interventions; the capacity of the organization of inter-sectorial forums for the management and control of water; investment in the processes of

dissemination of the information generated to encourage the involvement of managers and the participation of users in solving the identified problems; and the creation of institutional conditions for the qualification of water surveillance.

Collaborations

MJM Ferreira, MM Viana Júnior, AGV Pontes, RM Rigotto and D Gadelha contributed equally in all stages of the development of this manuscript.

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