WATER RESOURCES MANAGEMENT AND PUBLIC POLICIES FOR IRRIGATION USE IN BRAZIL

Catariny Cabral Aleman¹ and Flávio Bastos Campos²

ABSTRACT

Water resources management in agriculture aims to optimize water use for food production and domestic use. FAO has estimated an 11% increase in water demand for irrigation over the years 2008 to 2050. Public policies for irrigation use in Brazil implement guidelines, manage conflicts over the water use and fix criteria for water resources allocation and protection. This paper presents the management and public policies on water resources use for irrigation in Brazil for optimizing agricultural production. The water crisis due to climate changes and consequent environmental impacts has caused a re-think on water resources management policies. In Brazil, the public policies for the water resources management aim to balance both of the region development and environmental impacts of water use. The Brazilian National Water Resources Council, created in 1998, mediates water use’s rules for many users, implements guidelines for the National Water Resources Policy, arbitrates water conflicts, approves projects of watershed committees and establishes criteria for water resources allocation. These practices promote the sustainable water resources use and substantiate the water as a public good, limited natural resource with economic value and multiple uses. The agricultural productivity increase studied by the Ministry of Environment is a result of no-conflict water resources use, environmental legislation and ecosystems’ diversity that supported the sustainable capacity increase of irrigated agriculture. ANA ensures that the water resources management for irrigated agriculture has favored food production’s increase and lowered prices when compared to products from non-irrigated areas. In 2013, the government established the Program for Irrigated Agriculture stimulating irrigation schemes development and the irrigated agriculture management restructuring. This program has enabled the management, operation, maintenance, revitalization, regulation and support to ensure for the irrigated areas an operational management. According to the Intergovernmental Panel on Climate Change, that evaluated temperature and precipitation projections from 2010 to 2099, it was confirmed that irrigation is an adaptive technique that adds value to the land, to the production and ensures food security. Facing the increasing world’s population and the water crisis in several world regions, the food production sustainability and the adoption of effective ways to conserve water resources, especially the development and management of irrigation should be given priority to promote water saving.

Keywords: Water saving, Agricultural production; Tax breaks.

1. INTRODUCTION

The world population has reached about 7 billion people. The forecast for 2050 is that the population reaches 9 billion (Casarin 2012). According to the predictions of UN Water (2009), up to 2050 there will be a growing demand for hydroelectric sources and other energy resources about 60%. The agricultural and livestock production of

¹ Agronomic Engineer and Irrigation Professor at Agricultural Engineering Department, Universidade Federal de Viçosa (UFV). PH Rolfs Avenue, s/n, Viçosa, Minas Gerais. Brazil. E-mail: catariny@ufv.br

² Agronomic Engineer and Master's Degree Student at Agricultural Engineering Department, Universidade Federal de Viçosa (UFV). PH Rolfs Avenue, s/n, Viçosa, Minas Gerais. Brazil. E-mail: flaviobastoscampos@gmail.com
food and energy are related to this demand. It estimated that in the next 40 years the produced food quantity would be the same produced in the last 8,000 years. There will be a need for food, fiber and fuel production, and agricultural and livestock production will need water and energy to ensure a sustainable production.

In 2008 the world had a cultivated area with 1.56 billion hectares, and from those 304 million hectares were irrigated (Congrove & Cosgrove 2012). Considering this irrigated area 40% of total agricultural production was obtained. Irrigated productivity is 2.7 times higher than dryland productivity. Irrigated agriculture enables better production management, water resources and agricultural input efficient use.

FAO (2011) estimated an 11% increase in water demand for irrigated agriculture in between 2008 and 2050. However, this estimation may be considered undervalued since in the past 10 years the total annual water volume derived from water sources to match irrigation increased by 20%, from about 2.6 billion m³, observed in 2000, to 3.1 billion m³ in 2010 (Cristofidis 2013).

In Brazil, the irrigation sector has a water withdrawal flow of about 47% of the total and a consumed flow of 69% (ANA 2009). The expansion potential for irrigated agriculture is 25.5 million. However, this expansion becomes a strategic issue, as it will mean a greater demand for water and energy resources and potential conflicts over water use (Paulino et al. 2011).

2. WATER RESOURCES MANAGEMENT IN BRAZIL

Brazil has a large water supply, about 12% the world’s surface water availability. The regional distribution of water resources is 70% for the North region, 15% in the Midwest, 12% for South and Southeast regions, which have the highest water consumption, and 3% in the Northeast. This last region, in addition to the water resources shortage had its situation aggravated by an irregular rainfall and a low permeability of the crystalline ground. With the exception of the Amazon basin, the other 19 Brazilian basins were mapped by DNAEE in the 80s. Thus, there is information about implemented irrigation projects and to about some yet to be implemented, existing and future hydropower facilities, navigable stretches, reservoirs, major releases of pollutant loads, polluted areas, low water availability areas, flood-prone areas, areas with intermittency and other important aspects for water resources management (ANA 2009; Costa & Mertens 2015).

In terms of groundwater use, Brazil’s consumption is quite modest. Yearly, about 8 thousand to 10 thousand wells are drilled, most of them to supply industries. Only in recent decades has been verified the tendency for public supply with groundwater. The State of São Paulo is Brazil’s biggest groundwater user, with about 65% of its urban centers and approximately 90% of industry being fueled partly or totally by wells (Borsoi & Torres 2015).

The water shortage in Brazil is associated with low specific availability in the Northeast region and high population densities in the Southeast and South regions. The conflicts are situated in high population density areas and intense industrial concentration - that suggests Southeast and South regions. In these last regions water resources pollution is more serious, increasing significantly the costs for water treatment. The scarcity of water resources also increases water collection costs because the sources are increasingly distant from urban centers or some alternative sources exploitation are required. In São Paulo, for example, it is estimated that by 2010 the demand for water will exceed the supply in the basins of Piracicaba, and Alto Tieté and Santos basins, the areas that concentrate most of the state's population (Branco 2006).
The water resources management by watershed has a fundamental role in environmental management because water is an indicator that can be used for modeling and simulation. It is possible to reproduce the hydraulic and environmental operation from technical basis: ownership information (use and pollution) of water and physiographic characteristics of the basin and the water body itself. The technical basis allows, on the other hand, adding to the future scenario the interests of various stakeholders in a given basin. Consequently, it can be evaluated the ones which get benefited and the ones which don't, according to the extrapolated scenarios. It is an economic and financial base that will quantify the necessary investment and the amount to be charged for their coverage. The user's willingness to pay comes mainly from the certainty that the management gives the user about the need for investment for his/her business. The better the management quality, the lower the collection imposing character (Borsoi & Torres 2015).

3. **IRRIGATION AREA IN BRAZIL**

Irrigated agriculture (Table 1) has an important highlight in both the national and international economy about employment and food access ensuring. Agricultural activities, however, suffered a severe impact with the national water crisis, which began in 2014 and is probable to remain for years to come. Besides water, the food production and sanitizing also require water. Given that the water crisis is not restricted to climatic conditions, but it is also related to management and planning problems, steps adoptions for the proper use of water, avoiding waste are fundamental. Irrigation techniques presented themselves as important tools for easing the crisis. Awareness of the natural resources scarcity is necessary, and seeking for human survival water should be treated as a limited, valuable and strategic asset for the country. (Macedo 2015).

**Table 1.** Irrigated area evolution by irrigation systems in Brazil from 2000 to 2015

<table>
<thead>
<tr>
<th>Irrigation systems</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central pivot</td>
<td>47,320</td>
<td>50,540</td>
<td>57,820</td>
<td>59,500</td>
<td>47,600</td>
<td>26,600</td>
<td>17,500</td>
<td>19,600</td>
</tr>
<tr>
<td>Reel</td>
<td>25,000</td>
<td>29,000</td>
<td>30,000</td>
<td>30,000</td>
<td>22,500</td>
<td>21,000</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Conventional</td>
<td>16,000</td>
<td>15,300</td>
<td>14,650</td>
<td>17,500</td>
<td>15,000</td>
<td>15,000</td>
<td>15,000</td>
<td>16,500</td>
</tr>
<tr>
<td>Localized</td>
<td>30,000</td>
<td>33,000</td>
<td>37,000</td>
<td>40,000</td>
<td>38,000</td>
<td>35,000</td>
<td>30,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Total (ha yr⁻¹)</td>
<td>118,520</td>
<td>127,840</td>
<td>139,470</td>
<td>147,000</td>
<td>123,100</td>
<td>97,600</td>
<td>92,500</td>
<td>106,100</td>
</tr>
<tr>
<td>Total area</td>
<td>3,068,480</td>
<td>3,196,320</td>
<td>3,335,790</td>
<td>3,482,790</td>
<td>3,605,890</td>
<td>3,703,490</td>
<td>3,795,990</td>
<td>3,902,090</td>
</tr>
</tbody>
</table>
Irrigation systems & Irrigated area (ha) per year

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Central pivot</td>
<td>49,000</td>
<td>49,500</td>
<td>52,000</td>
<td>57,750</td>
<td>84,000</td>
<td>126,000</td>
<td>102,000</td>
<td>78,000</td>
</tr>
<tr>
<td>Reel</td>
<td>30,000</td>
<td>25,000</td>
<td>30,000</td>
<td>32,500</td>
<td>32,500</td>
<td>32,500</td>
<td>10,500</td>
<td>6,000</td>
</tr>
<tr>
<td>Conventional</td>
<td>20,000</td>
<td>17,000</td>
<td>25,000</td>
<td>29,500</td>
<td>35,400</td>
<td>40,710</td>
<td>28,497</td>
<td>28,000</td>
</tr>
<tr>
<td>Localized</td>
<td>47,000</td>
<td>40,000</td>
<td>50,000</td>
<td>56,000</td>
<td>60,480</td>
<td>72,576</td>
<td>79,834</td>
<td>75,000</td>
</tr>
<tr>
<td>Total (ha yr⁻¹)</td>
<td>146,000</td>
<td>131,500</td>
<td>157,000</td>
<td>175,750</td>
<td>212,380</td>
<td>271,786</td>
<td>220,831</td>
<td>187,000</td>
</tr>
<tr>
<td>Total area</td>
<td>4,048,090</td>
<td>4,179,590</td>
<td>4,336,590</td>
<td>4,512,340</td>
<td>4,724,720</td>
<td>4,996,506</td>
<td>5,217,337</td>
<td>5,404,337</td>
</tr>
</tbody>
</table>

Source: Abimaq 2015.

4. POLICY OF WATER MANAGEMENT IN BRAZIL

The main objective of Public Policy of Water Resources in Brazil is to balance the tension between a region development and its impact on the environment, because it’s known that water is an essential resource for industries and also for the sanitation of the population, as water is responsible for over 90% of the energy production in our country (Putti et al. 2013).

The Brazilian National Water Resources Council occupies the highest level in the hierarchy of the National Water Resources Management System. It is a core that develops mediation rules between the different water users, being thus largely responsible for implementing water resources management in the country. By articulating the integration of public policies in Brazil it is recognized by society as a guide for transparent dialogue in the decisions processes in the field of hydric resource legislation. The Ministry of environment (MMA) which mission is to promote the adoption of principles and strategies for knowledge, environment protection and recovery, the sustainable use of natural resources, the environmental services valuation and the sustainable development inclusion in the formulation and implementation of public policies, in a shared way, participative and democratic at all levels of government and society. The River Basin Committees are collegiality bodies that are part of the National System of Water Resources Management and contribute to all sectors of society with interest over the basin’s water, that it has representation and a voice in its management. Its main responsibilities are to approve the Basin Water Resources Plan; to arbitrate conflicts over water use in the first administrative level; to establish mechanisms and to suggest charging fees for the use of water; among others (Matos & Dias 2013).

The Ministry of Agriculture, Livestock and Supply (MAPA) is promoting measures to increase the irrigated area; to improve irrigated agriculture, to add value to production; and to promote the sustainable irrigation development focusing some priorities into the agricultural and livestock plans. In Agricultural and Livestock Plan 2013-2014 it has been approved the financial resources amount increase and an irrigation investments interest rates reduction; reducing interest rates and increasing
the repayment term investments intended for storage; and a reduction of 3% to 1% of the additional rate for framing in Pro agro-irrigation achievements (Brasil 2013).

The Agricultural and Livestock Plan of 2013-2014 has increased the amount of resources and interest rates reduction on irrigation correlated achievements. It has maintained the low interest rate (4% per year) for irrigation systems financing; raised the financing Moderinfallimits for irrigation equipment, from R$ 1.3 million (individual) to R$ 2 million and included funding for electrical infrastructure and water reserves projects (Brasil 2014).

With the objective of promoting irrigated areas sustainability, two agreements were signed between the Ministry of Agriculture, Livestock and Supply (MAPA), the Ministry of National Integration (MI) and the Ministry of Environment. The objectives of the first agreement are to develop a political proposal of Integrated Water and Soil Conservation National Policy; to formulate and to test sets of incentive programs to the efficient water use in irrigated agriculture; to prepare integrated proposals for improvement and adaptation of the National Water Agency (ANA) regulatory activities in rural areas, with emphasis on the granting of rights to use the water for irrigation; to support, in real time, the National Irrigation System Information implementation and operation; enhance and expand the Water Producer Program; to propose and to stimulate other initiatives development and to regulate and to encourage payment for environmental services in the rural environment; and to develop and to implement joint training programs aimed at integrated and sustainable water resources management in rural areas. In the second agreement the objectives are: the National Irrigation Policy regulation; master plans and projects to encourage public and private irrigation, to define priority areas for irrigated agriculture expansion and improvement; the program and improvement actions of credit policies and targeted rural insurance for irrigated agriculture; the program and certification activities in irrigated agriculture; the program and actions development for human resources development at irrigated agriculture; the program and actions of scientific and technological research in irrigated agriculture; the program and technical assistance actions and rural extension; the program and actions towards the organization of irrigation producers; the demonstration units implementation. The ANA’s mission is to plan and coordinate the shared and integrated water resources management and regular access to water, promote its sustainable use for the benefit of present and future generations. In addition, the institution has other center irrigation strategic settings; and the program and the actions aimed at the National Irrigation Information System development and implementation (Rocha & Cristofidis 2014).

5. PUBLIC POLICY PROSPECTS IN IRRIGATED AREAS

The main results expected by 2030 if continued above proposals are: the of current irrigated area expansion from 6 million hectares to 14 million hectares; raising the irrigated production share in Brazil’s total production from the current 20% to 46%; creating conditions for irrigated products increased participation in the total agricultural production value, from the current 43% to 56%; the generation of about eight million direct jobs in irrigated agriculture and livestock; improving the irrigation water use efficiency by 25%; the agricultural losses decrease by the warranty provided by irrigated production; degraded areas recovery and the reduction of pressure from farmers and ranchers on new areas for agricultural production; and the revitalization and improvement of irrigable areas of public irrigation projects, and to extend the irrigation practice for surrounding private areas (Rocha & Cristofidis 2014).

Temperature and precipitation projections were used for the period from 2010 to 2099 under different climate scenarios, according to the 4th of the Intergovernmental Panel on Climate Change’s report. The results confirmed the irrigation effectiveness as an
adaptive measure. For all simulation periods, it is expected that the average value of small producers’ irrigated land was approximately twice the dryland value. It can be concluded that there is a need for public policy formulation strategies that seek to combat the effects of global warming in the sector, especially considering the small farming dryland vulnerability. Moreover, given the irrigation importance evidence as an adaptive measure, it must be encouraged the credit policies expansion for the implementation of this practice, especially for less capitalized producers (Cunha et al. 2013).

6. CONCLUSIONS

Facing the increasing world’s population and the water crisis in several world regions, the food production sustainability and the adoption of effective ways to conserve water resources, especially the irrigation development and management should be given priority for promoting water saving.

REFERENCES


****