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Policy Forums

Water collapse in Brazil: the danger of relying on what you neglect

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In 1996, New York City choose to invest US$ 1.5 billion in conserving and restoring the watershed in Castkill mountains to supply the city's drinking water demand rather than adopt filtration plant, thereby saving US$ 4.5–6.5 billion from engineering-based solutions (Postel and Thompson, 2005). This achievement is considered one of the benchmarks of the ongoing awakening to the importance of ecosystem services (Chichilnisky and Heal, 1998).

Now in Brazil, the country with the largest renewable freshwater resources, the two largest megacities are facing a collapse in water supply. The metropolitan regions of São Paulo (20 million inhabitants) and Rio de Janeiro (12 million inhabitants) are the capitals of the homonymous provinces that harbor about 43% of Brazilian Gross Domestic Product (GDP). These economic giants are experiencing severe drought: the Cantareira System of water reservoirs, the main source of water in the state of São Paulo, responsible for supplying 8.8 million people, was provided with facilities structures to use the void volume twice with a cost of US$ 80 million each. In February 1st 2015, it reached its lowest level, 5%, considering the two parts of void volume. However, such amount of water was not enough to avoid water shortages, and demonstrations have been done against this situation in which some neighborhoods, especially the poorer ones, run out of water for several days. The freshwater fauna was also affected, e.g., 20 tons of fish died in Piracicaba River in February 2014. In Rio de Janeiro, the main water reservoirs represented by the Paraíba System were in the lowest level in history in January, about 1% (Hanbury, 2014).

However, water supply is not the only benefit that flows from rivers, as about 80% of the Brazilian energy comes from hydroelectric power. With the droughts, the production of hydroelectric energy shrank, leading to an increase in the use of thermoelectric power plants to fulfill the national energy demand Abou-Alsamh (2013). These power plants are far more expensive and represent the main source of Brazilian carbon emissions, adding up around 1794 GgC $\times$ year^{-1} (based on data from 2002, Licks and Pires, 2010). The extra expenditures in energy production compelled energy companies to apply for a loan in Brazilian banks of about R$ 17.8 billion (US$ 5.9 billion) in 2014 (Bitencourt, 2015). These expenditures that have been accumulated in recent years will be paid partly by the Brazilian Treasure and partly by the consumers, since the energy bills are expected to increase between 30 and 40% in 2015.

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Fig. 1 – View of the Jaguari reservoir, which is part of the Cantareira system in August, 2013 (A) and August, 2014 (B). The level of lake is lower during the drought of 2014 as shown by the smaller area and by the lighter blue-green color of water. Notice the reduced forest cover in the area, including the margins of the reservoir. Images from NASA Earth Observatory.

This severe drought and its consequences – including financial expenditures and decline in well-being – is not a random climatic anomaly, but a result of the reduction of ecosystem service provided by natural forests (Postel and Thompson, 2005; Ferraz et al., 2014). Brazil is the country with the highest proportion of tropical forests in the world, but also with the highest rates of forest destruction. The Atlantic Forest, the natural biome of the Southeastern Brazil, now has only 16% of natural cover (reviewed by Ferraz et al., 2014). The mean annual deforestation in Amazon, from where part of the rainfall in Southeast comes from, had a 10-year average of 19.500 $km^2 \times year^{-1}$ through 2005 (Nepstad et al., 2014). In addition, the Brazilian Cerrado had more than 1 million km^2 destroyed – almost 50% of its former area (MMA, 2010). Such forest destruction is considered to be affecting the water cycle in South America, including the rainfall in Southeast Brazil.

The link between forest and rainfall has been enlightened recently. Initially, transpiration from trees is the main source of water in continental areas (Jasechko et al., 2013). Further, a mechanism by which forests pump water to atmosphere and guarantee the moisture necessary for its persistence was proposed recently (Makarieva and Gorshkov, 2007; Sheil and

Murdiyarso, 2009). This mechanism is based on a reduction of pressure in low-level atmosphere, which attracts clouds to areas above forest. In addition, forests release biogenic volatile organic carbon that acts as nucleus for condensation of water. Such processes produces a huge amount of water in atmosphere in forested areas, representing literally "flying rivers" (Nobre, 2014).

Therefore, processes operating in different scales may affect southeastern Brazil. Locally, areas in São Paulo state with higher proportion and less fragmentation of forest areas present more rainy days (Webb et al., 2005). The region that feed the Cantareira System presents only 21.5% of forest cover and 76.5% of the 5082 km of rivers comprising the system had their riparian forest impacted (Hirota, 2014) (Fig. 1). In a continental scale, the Brazilian portion of Amazon, had up to 47.34% of its area affected by clear-cutting and degradation, what may be affecting the flow of flying rivers that normally supply water not only for Amazon region but also for other areas in South America, including southeastern Brazil (Nobre, 2014). The Brazilian Cerrado destruction compromises the groundwater recharge on Guarani aquifer (Danielopol et al., 2003), the biggest one in the world, which provide water for several cities in the Southeast. Thus, synergetic effects of deforestation occurring in different places and different scales may be the cause of drought in southeastern Brazil.

Considering the complexity of the relationship between forest and rainfall and the regulation of climate in South America, the solution to this drought comprises an orchestrated effort to stop deforestation and restore forested areas in different regions. Only one stakeholder, the Brazilian Federal Government, could captain such an endeavor. However, it is now in a crossroad in terms of environmental policy (Loyola, 2014). On the one hand, Brazil represented an environmental leadership in the last years and obtained its largest victory by decreasing deforestation rates in Amazon since 2005 (Nepstad et al., 2014). On the other hand, the main environmental law in private lands in Brazil, the Forest Code, was weakened in 2012. Those changes can affect the forest cover, since it allows, for example, a decrease in hilltop preservation areas and reduced by 58% the areas previously under restoration requirements (Soares-Filho et al., 2014). Last January, Kátia Abreu and Aldo Rebelo, were chosen as ministers of agriculture and science, respectively (Tollefson, 2015). Both of them were involved directed in Forest Code changes: Abreu has been acting as a representative of the agribusiness sector in the National Congress while Rebelo led the project writing. Such fact may represent an empowerment of this sector of the government, which are performing against the water collapse solutions.

Although complex, the water collapse solution in Brazil is feasible. The reduction in deforestation rates suggests that, if intensified, the policies to protect Amazon may stop deforestation there. In the Atlantic forest, following the reasonability of a recent study (Banks-Leite et al., 2014), it would be necessary approximately US$ 1.6 billion to guarantee that 10% of Atlantic Forest landscapes would present at least 45% of natural vegetation cover. After three years, the annual cost would reduce to U$ 282 million. These values represent 27% and 4.8%, respectively, of what was spent to pay for extra costs of producing thermoelectric energy due to the droughts caused by the lack of forests. This could help increasing water availability in the region as well as represent an important improvement for biodiversity conservation. As New York City demonstrated twenty years ago, to invest in nature may be the most parsimonious and gainful plan of action.

Conflicts of interest

The authors declare no conflicts of interest.

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