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The paradox of irrigation efficiency

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RE: The paradox of irrigation efficiency: Brazilian Caatinga´s fish fauna threatened by crop irrigation

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Soraya Fernandes Martins, Manager- National Park of Chapada Diamantina, ICMBio- PARNA Chapada Diamantina

Adriana Kazue Takako, Professor, Universidade Federal do Tocantins

(21 November 2018)

The Chapada Diamantina, occupied by diamond mining in the past, is a mosaic landscape with a high diversity of living organisms, drained by the Rio Paraguaçu. The upper river drainage of Paraguaçu, protected by the Chapada Diamantina National Park, is essential to water production, crossing a region poor in superficial hydric resource in Caatinga (1,5).

In the Protected Area (APA) of Marimbus Iraquara, partially located in the National Park, we observe a huge wetland area formed by the confluence of rivers Santo Antonio and Utinga locally called Marimbus. This area is influenced by seasonal floods and inundations (2, 3, 5). The Remanso and Fazenda Velha Villages, both Quilombolas communities, lives off agriculture and fishery along Marimbus margin, and these waters are of great social and cultural importance for local people. The Rio Santo Antônio is the home of endangered freshwater fish species such as the Kolpotocheirodon figueiredoi and the Lepidocharax diamantina (4). Fishes are good indicators of environmental changes, because their varied habitats allow for an integrated vision of aquatic environment (2, 5). These aquatic animals take part in different aspects of local people lives, such as their art, culture, food, and religion. The Remanso Marimbus is inhabited by the Molé, Trachelyopterus galeatus, a naked catfish considered an aphrodisiac and appreciated in local people gastronomy (5). In this sense, impacting the Marimbus waters means to put an end not only to Biodiversity, but also on local oral histories and the rich culture that spring in the community nearby the river.

In spite of its importance, the Rio Santo Antônio has its integrity threatened. The concession for caption of 25 million liters of water along twenty hours a day, every day, for crop irrigation by aspersing endangers the water discharge of the main tributary of upper Rio Paraguaçu, the largest river drainage of Bahia (5, 6). The deleterious effects of inadequate use of fresh water implicates in loss of vegetation and animal life at Rio Utinga and will result in the disappearance of local important species, as the guppy, locally called Pariviva, Pamphorichthys sp.n. not yet scientifically described but already on the verge of extinction. As Rio Utinga collapsed, it is important to consider the Rio Santo Antonio as the main river sustaining the Marimbus wetland, the livelihood to traditional communities and for regional tourism. A catchment of water at this level would be fatal to the local environment. We do not question the agricultural production in the area, but the way it is being done. World production practices to feed 7.6 billion people is degrading terrestrial and aquatic ecosystems, including water resources depletion (7). About two-thirds of freshwater withdrawals are for irrigation and is frequently a driver of water stress (7, 8). Wasting water by aspersion is both a menace to the Caatinga environment and unsustainable for future agricultural production (9). A sustainable irrigated agriculture needs to be efficient and economic in water use, such as the use of techniques of microaspersion and pouring (10). Irrigation efficiency centered on water accounting and reductions in water extractions offers a pathway to improve global water security (11). Precision irrigation conserves water and maximizes water use efficiency (12). In this sense the protected areas should carefully consider the use of agricultural practices integrated with environment along its borders (1, 13).

The enchantment of Chapada Diamantina on visitors falls on its incredible landscape, people's hospitality, local culture and ultimately on its waters, of variable colors, draining rivers, waterfalls,

subterranean caves and shallow wetlands as the Marimbus. As researchers and citizens we are responsible for producing the knowledge and the means to preserve the quality and amount of fresh water in Chapada Diamantina.This is our fundamental duty as scientists.

Acknowledgments

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References

(1). Ministério do Meio Ambiente, Instituto Chico Mendes, Plano de Manejo para o Parque Nacional da Chapada Diamantina. Brasília. 2007, 1-506. [in Portuguese].

(2) U. Jaramillo-Villa, E. P. Caramaschi, Índices de Integridade Biotica usando Peixes de Agua Doce: uso nas regiões Tropical e Subtropical. Oecologia Brasiliensis 12 442-462 (2008). [in Portuguese].

(3) Diário Oficial do Estado da Bahia- DOE BA. Decreto Nº 2216 de 14 de Junho de 1993. Área de Proteção Ambiental Marimbus/Iraquara, nos Municípios de Lençóis, Iraquara, Palmeiras e Seabra. 1-2 (1993). [in Portuguese].

(4) ICMBio, Instituto Chico Mendes. List of Endangered Species. 2014. **http://www.icmbio.gov.br/portal/faunabrasileira/lista-de-especies?start=200**. Accessed on 30 Sept 2018. [in Portuguese].

(5) A.C.A. Santos, E.P. Caramaschi, Neotropical Ichthyology 9 153-160 (2011).

(6) Diário Oficial do Estado da Bahia- DOE BA. Portaria N° 16.747 de 23 de Agosto de 2018. Instituto de Meio Ambiente e Recursos Hídricos – INEMA. Autoriza direito de uso dos recursos hídricos [...] . 2018. **https://diariooficial-e.com.br/doe-ba** Accessed on 22 Oct 2018. [in Portuguese].

(7) J. Poore, T. Nemecek, Science, 360, 987–992 (2018).

(8) P. C. West et al, Science, 345 325–328 (2014).

(9) E. F. Coelho, M. A. Coelho Filho, S. L. de Oliveira, Agricultura irrigada: eficiência de irrigação e de uso de água. Bahia Agrícola 7 (2005). [in Portuguese].

(10) J. C. V. Pinheiro, N. A. Fabre, Projeto Pingo Dágua em Quixeramobim-CE: um exemplo de desenvolvimento local. Congresso da Sociedade Brasileira de Economia, Administração e Sociologia Rural 42 (2004). [in Portuguese].

(11) R.Q. Grafton et al, Science, 361 748–750 (2018).

(12) M. B. Cole et al, Nature partner Journal Science of Food, 14 1-8 (2018).

(13) C. I. Calderón et al, Agroecology-based farming provides grounds for more resilient livelihoods among smallholders in Western Guatemala. Agroecology and Sustainable Food Systems, 7 1-43. 2018. **https://infoagro.net/sites/default/files/2018-07/Guate.agroecology.pdf** Accessed on 22 Oct 2018.

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Competing Interests: None declared.

Agricultural land is globally constrained

Aaron Simmons, Technical Specialist,
NSW DPI

Other Contributors:
David Mitchell, Technical Specialist,
NSW DPI

(5 September 2018)

This paper addresses an issue critical to humanity: the allocation of freshwater, a globally constrained resource, between human needs and those of the broader environment. We have reservations regarding the analysis because one fundamental concept for sustainable agriculture, that the land available for agricultural production is a globally constrained resource, is omitted from the analysis. In doing so, it is assumed that the additional food produced by an expansion of irrigated agriculture when irrigation efficiency (IE) increases, could be produced elsewhere with the same or less impacts. This assumption is unlikely to be valid. This is because when the global demand for food, fuel or fibre increases, and additional land is required to meet this demand, deforestation will occur (1) which is associated with the emissions of CO2 which exacerbate climate change (2).
The global population is predicted to reach 9.8 billion people by 2050 and it has been estimated that increased demand for agricultural products will result in the deforestation of 289 million ha of forests, which would lead to the emission of 169 Gt CO2 (3). An alternative to this deforestation to meet additional demand would be to intensify agricultural production. Research (4) has shown that without the intensification of agricultural systems that occurred from 1961, including access to irrigation, humans would have needed to have converted up to an additional 1,761 Mha of land to agricultural product...

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Competing Interests: None declared.

Adopt the latest flood-resistant and wildfires-resistant irrigation technology

Yoshiyasu Takefuji, Professor,
Keio University

(26 August 2018)

R. Q. Grafton et al. wrote an article entitled “The paradox of irrigation efficiency” (1). We have learned two lessons from recent disaster in Japan and US. One lesson from the danger of flooding in the Mabicho district of Kurashiki, Okayama Prefecture, Japan is that the irrigation control/schedule is critical for controlling water flow in order to avoid flooding (2). Another lesson from wildfires in California is that we should use the fire-resistant technology. In its most advanced technology it might take the shape of an irrigated and shaded lawn or an intricately designed planting of carefully selected fire-resistant or low fuel-volume plants (3). We should use the latest flood-resistant and wildfires-resistant irrigation technology for avoiding disaster.

References:
1. R. Q. Grafton et al., The paradox of irrigation efficiency, Science 24 Aug 2018: Vol. 361, Issue 6404, pp. 748-750
2. **https://www.japantimes.co.jp/news/2018/07/11/national/risk-deadly-flood-...**
3. **https://www.fs.fed.us/psw/publications/documents/gtr-050/landscaping.html**
Competing Interests: None declared.

RE: Notes on the article

Ismail Kaan Tuncok, Technical Director,
Solaris Engineering and Consulting

(25 August 2018)

Dear Authors,

The paradox presented and the five-step road-map are very relevant to the root-cause of problems experienced at the farm-scale, which then find their way to the basin-, country- and global-scale issues.

As documented in the paper, IE should not pave the road to higher level of abstraction at the social, economic and environment cost of other stakeholders benefiting from the available water resources in the basin.

Therefore, an improved approach is implementation of IE with "sectoral water allocation" quotas for respective sectors. This structure will serve as the "risk-assurance" mechanism for all the stakeholders in the basin and avoid the risk of over-abstraction by one sector at the cost of other sectors.

In this context, IE in irrigation should be used strategically as the basis for optimized/lower levels of water abstraction by the agriculture sector. There is a significant benefit of this approach in terms of water "quantity" and "quality".

Please recognize that "return flows" from agriculture are typically highly polluted due to significant levels of pesticides used at the farm-level. Therefore, "optimization of water consumption" by the farmers through IE and sectoral water quotas by the local government and/or irrigation cooperatives will help minimize level of pollution and adverse impacts to downstream users.

In conclusion, use of IE with sectoral...

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Competing Interests: None declared.

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