



# Natureza & Conservação

Brazilian Journal of Nature Conservation

Supported by Boticário Group Foundation for Nature Protection

<http://www.naturezaeconservacao.com.br>



## Policy Forums

# Pulling the plug: strategies to preclude expansion of dams in Brazilian rivers with high-priority for conservation



Igor de Paiva Affonso<sup>a,\*</sup>, Robertson Fonseca Azevedo<sup>a,b</sup>,  
Natália Lacerda Carneiro dos Santos<sup>a</sup>, Rosa Maria Dias<sup>a</sup>,  
Angelo Antonio Agostinho<sup>a,c</sup>, Luiz Carlos Gomes<sup>a,c</sup>

<sup>a</sup> Post-Graduate in Aquatic Environments Ecology Continental, Universidade Estadual de Maringá, Maringá, PR, Brazil

<sup>b</sup> Ministério Público do Estado do Paraná, 3<sup>a</sup> Promotoria de Justiça de Maringá, Maringá, PR, Brazil

<sup>c</sup> Núcleo de Pesquisas em Limnologia, Ictiologia e Aqüicultura (NUPELIA), Department of Biology, Post-Graduate in Aquatic Environments Ecology Continental, Universidade Estadual de Maringá, Maringá, PR, Brazil

## ARTICLE INFO

### Article history:

Received 4 May 2015

Accepted 10 November 2015

Available online 30 November 2015

## ABSTRACT

The unrestrained ongoing construction of dams in rivers of high-priority for conservation represents a common threat to environment and surrounding societies. In Brazil, despite several known negative impacts assigned to poorly planned construction of dams, Federal and State Governments maintain the policy of expansion of the hydroelectric matrix. The outcome includes impoundments of remaining rivers that are extremely important for biodiversity conservation. Here, we suggest strategies to prevent dams in remaining rivers proven to be of high priority for conservation or with potential to social disruption. Besides, we report a successful case study in areas of two important remaining tributaries of the Paraná River (the most dammed river in the Neotropics), Brazil, where the enactment of municipal laws protecting areas of the basins, initiatives to indicate features of the rivers as heritages and the creation of protected areas are among the effective measures to prevent new dams. Distinctive features in this effort have been the exchange of information among different stakeholders and the consequent empowerment of local actors. The strategies presented here are indicated to halt projects of new dams and are applicable and encouraged to be adopted throughout Brazil, provided that some features found in Paraná State may occur elsewhere.

© 2015 Associação Brasileira de Ciência Ecológica e Conservação. Published by Elsevier Editora Ltda. All rights reserved.

\* Corresponding author.

E-mail addresses: [affonsoip@gmail.com](mailto:affonsoip@gmail.com), [igor.ecologia@gmail.com](mailto:igor.ecologia@gmail.com) (I.d.P. Affonso).

<http://dx.doi.org/10.1016/j.ncon.2015.11.008>

1679-0073/© 2015 Associação Brasileira de Ciência Ecológica e Conservação. Published by Elsevier Editora Ltda. All rights reserved.

## Introduction

The majority of large rivers worldwide are highly impacted by dams (Nilsson et al., 2005). When a dam is settled, several environmental (Agostinho et al., 2008a) and sociological (Rothman, 2008) impacts are expected. For instance, dams modify the landscape and have consequences on terrestrial and aquatic biota (Barletta et al., 2010). Furthermore, dams may displace peoples (McCully, 1996), suppress local cultures (Leite and Bahia, 2012), disable sustainable economic activities (Vainer, 2008) and destroy historic (Miranda, 2012) and archeological sites (Chmys, 2004).

Within this context, the goal of this manuscript is to make public a strategy on contesting hydroelectric projects considered to be detrimental to rivers and to local interests. Thus, we present a guide based on recent successful efforts to protect two river basins considered of high-priority for conservation. We do not provide exhaustive legal and managerial details, but we assert that the outcomes presented are legally supported and possible to be applied in any river in Brazil with high-priority for conservation and/or with relevant potential to promote social disruption due to damming. We also provide details on the outcome of such strategies applied in the Ivai and Piquiri Basins, the only two remaining dam-free tributaries of Paraná River in Paraná State.

## The strategy

First, we highlight that we do not deliberately advocate against new dams. Instead we believe that remaining rivers proven to be important for several reasons should stay free-of-dams. Thus, we present a framework (Fig. 1) based on successful actions developed to avoid dams in Paraná State. Due to the fact that Paraná State already had most of its major watersheds impounded (with significant surplus of hydropower production) and that social, environmental and economic losses have been a common consequence of the several dams

built throughout the decades, there is overspread awareness about detrimental dams in the state.

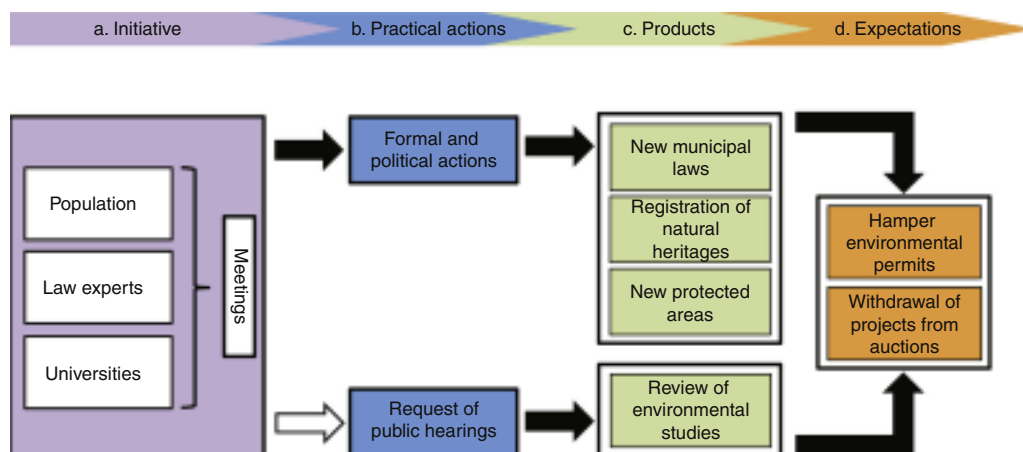
The strategies are mostly based on the union of three independent stakeholders (local communities, law experts, and universities). The experience in Paraná State has been that, as soon as development plans (projects of new dams) became public, even before permitting procedures are initiated, affected communities, law experts, and researchers from different academic fields (Natural and Social Sciences) started coordinated actions to set strategies to contain such projects. Crucial to those efforts from this net of stakeholders is the sharing of information about the potential losses caused by planned dams. This shared awareness was brought about through several meetings congregating the general public from municipalities targeted by planned impoundments and experts (Fig. 1, a).

In those meetings (143 in both basins), the exchanges of knowledge and perspectives have strengthened the shared interest for conservation, providing for the development of different strategies. Those include enactment of local statutes declaring basins, rivers or segments of rivers as of local importance for preservation; the registering of riverine features as part of the State Patrimony or natural heritages; and the establishment of new protected areas by affected municipalities.

### New municipal laws

Section 18 of the Brazilian Federal Constitution determines that the Union, the States and the Municipalities are autonomous, and Section 30, I sets the right of local governments to enact legislations on its own interests. The enactment of municipal laws declaring features of the basins as of local public interest work as a primary tool on avoiding new dams, since the National Environment Council (CONAMA 237/97, article 10 paragraph 1) states that for the issuance of an environmental permit, it is necessary to have the formal approval from the local government.

In the case of Paraná state, ten municipalities have enacted such legislation, aiming to prevent those localities from dams:



**Fig. 1** – The framework with pathways of actions to prevent dams in rivers with high-priority for conservation and/or with relevant threat of social disruption by damming is shown. The framework starts with joint initiatives (a) of three stakeholders (populations, law experts, and universities), who are able to put into practice actions (b), that may result in legally supported products (c), which are expected to turn impracticable the implementation of new dams (d). White arrow indicates that public hearings can be requested by any of the stakeholders regardless the meetings.

Barbosa Ferraz (Law 1984/2012), Fênix (Law 37/2012), Formosa do Oeste (Law 784/2014), Itambé (Law 1122/2012), Lidianópolis (Law 622/2012), Manoel Ribas (Law 021/2012), Mariluz (Law 1644/2012 and 1645/2012), Quinta do Sol (Law 09/2012), São João do Ivaí (Law 08/2012) and São Pedro do Ivaí (Law 1355/2012, see map in supplementary material).

### Registration of natural heritages

In cases when features of the rivers have scenic appeal (i.e. naturally beautiful areas that withstand local tourism) it is possible to submit a proposal for their registration as natural heritage. The registration listing process seems to be an effective strategy to provide at least provisory protection, because until the conclusion of the listing procedure, no enterprises are allowed in the area (“Provisory Registering”, Section X, Sole Paragraph, Decree-Law n° 25, from November 30, 1937).

In the Paraná State (Ivaí and Piquiri Basins) there are two initiatives to have Salto Paiquerê (a waterfall in the Goioerê River) and Recanto do Apertado (an area with rapids in the Piquiri River) registered as historical and touristic heritages. Such initiatives were proposed by the *Associação de Defesa do Meio Ambiente de Umuarama* (ADEMA) and by the *Fundação de Apoio ao Desenvolvimento Científico e Tecnológico do Vale do Piquiri* (FADCT), respectively (see map in supplementary material).

### The creation of new protected areas

The proposal for creation of protected areas follows a similar line. In Paraná State, local governments of municipalities located on the Piquiri River basin that would be affected by dams that have been subject of public hearings, were encouraged to create protected areas in rural zones surrounding Piquiri and Goioerê Rivers, with the support of researchers and professionals from local universities, the prosecutors’ office and other regional organizations (Azevedo and Miranda, *in press*).

### Review of environmental studies

The implementation of dams requires the production of environmental impact statements (EIA-RIMA). Federal regulation allows for the request of public hearings, opportunities in which the studies are subject to public review (*Resolução CONAMA, 09/87*). The environmental impact statements must follow the directives set forth by *Resolução CONAMA 01/86* and whenever they fail to do so, *Resolução Conama 237/97*, article 10, VI allows for the request of complementation of the EIA-RIMA, which can be submitted during public hearings. In some cases such requirements are able to actually postpone the issuance of environmental permits, and in the Ivaí and Piquiri rivers, it has resulted in the exclusion of projects from auctions.

### Hamper of environmental permits and withdrawal of projects of auction

So far, due to the application of the proposed strategies, three ongoing projects of dams have been halted in Paraná State. The first was Água Limpa project (Goioerê River), which did

not have the Preliminary Permit issued by *Instituto Ambiental do Paraná* (IAP) due to request of both the complementation of the EIA-RIMA and the registering Salto Paiquerê as a heritage, as well as the enactment of Law 1644/2012 in Mariluz. Similarly, due to requirements of complementation of EIA-RIMA presented on public hearings, the enactment of municipal Laws (1645/2012 in Mariluz and 784/2014 in Formosa do Oeste) and the request for registering Recanto do Apertado as State heritage, the Ercilândia and Apertados projects (Piquiri River) did not receive environmental permits on time and were, therefore, excluded from the auctions scheduled for November 2014 and April 2015 by the National Agency for Electric Energy (ANEEL–*Agência Nacional de Energia Elétrica*). Altogether, the tools presented as products (Fig. 1c) have potential to hamper the emission of environmental permits.

### The foundations of the strategy (or why should Ivaí and Piquiri Rivers stay free-of-dams)

The strategy presented in order to preclude the construction of new dams in the tributaries of the Paraná River within Paraná State was conceived due to their importance to biodiversity conservation. The Paraná River Basin in Brazil is the most impounded in the Neotropics and has about 72% of its hydraulic potential already exploited (Agostinho et al., 2007). In spite of several negative impacts associated with the construction of dams, Brazil still projects expansion of its energy system through impoundment of rivers (EPE 2007 – *Plano Nacional de Energia 2030*). Thus, the possible exploitation of dam-free rivers for hydroelectric development has generated conflicts among local communities and government entities that bear the burden associated with river impoundment.

The remaining dam-free stretch of the Paraná River inside the Brazilian territory is about 230 km long and includes the Upper Paraná River Floodplain (PRF), a very complex and biodiverse waterscape (Agostinho et al., 2000). PRF is the last riverine refuge available for fish and includes significant proportion of much of the original fauna of this basin.

The ecological integrity of the PRF is closely dependent on four large tributaries still not dammed in their main courses (see Agostinho et al., 2004a,b; Baumgartner et al., 2004). Two of those, Ivaí and Piquiri rivers (798 km and 485 km long, respectively), represent the major tributaries on the East margin of the PRF, in Paraná State, Brazil (Gubiani et al., 2006; Parolin et al., 2010, see map in supplementary material). Those rivers are highly important for the maintenance of fish diversity and stocks once they are used as spawning grounds for migratory fishes that inhabit the Paraná River (Baumgartner et al., 2004; Antonio et al., 2007; Gubiani et al., 2010). Second, they harbor several rare and endemic species of different taxonomic groups (Gubiani et al., 2006; Volkman-Ribeiro and Parolin, 2010) and present several species still not described by science (i.e. Dei Tós et al., 2014) revealing taxonomic incompleteness and spatial biases on geographic distribution of species (Linnaean and Wallacean shortfalls, Brown and Lomolino, 1998). In addition, they house endangered species (Agostinho et al., 2008b; ICMBio, 2014).

Although these rivers are free-of-dams, Piquiri’s integrity is threatened by projects of 16 impoundments on its main

channel (EPE, 2013, Plano Decenal de Expansão de Energia 2022). Other several dams are projected for the upper sections and the main channel of the Ivaí basin. The fragmentation of these rivers by successive impoundments would not only prevent access of fish to key habitats, negatively affecting their distribution, reproduction and fisheries, it would affect the landscape of the basin with serious ecosystem effects. The biota of the Upper Paraná River basin currently confined to its last dam-free stretch would likely be in peril.

Furthermore, economics linked to artisanal fisheries on the free flowing section of Paraná River and in Itaipu reservoir depend on fish species that use these tributaries as spawning and nursery areas. Thus, the deprivation of access to these rivers may result in damage to fisheries and in impacts on the livelihood of fishers (Agostinho et al., 2004a,b). Beyond that, indigenous areas (Mota, 2013), as well as archeological sites (Chmyz et al., 2008; Parellada, 2013) are common along the Ivaí and Piquiri rivers. Additionally, both rivers have several waterfalls, rapids and other waterscapes that withstand local tourism. Consequently, the construction of dams in those areas would promote multiple losses. These were all clearly described to the local society during public hearings.

In addition, new dams in Paraná state would be economically harmful. First because to build a dam, large tracts of fertile soils are flooded, dramatically affecting local economic chains, suppressing local tax revenue and invalidating local sustainable economic activities based on agriculture. As an example, the projects of Ercilândia and Apertados would affect 800 farms along the Piquiri basin.

It seems obvious that new dams have economic rewards and would benefit those in need of new sources of electric power, a product easily commercialized. Actually, hydropower plants provide about 92% of the total energy produced in Paraná State (IPARDES, 2013) and the total production of the state is about 230% higher than what is consumed internally. The surplus is distributed to other states with no compensation whatsoever, because Section 155, Paragraph 1, X, b) of the Brazilian Federal Constitution, forbids taxation of electricity exchanged among states.

If it was not for the mentioned above, the commercialization of the energy could generate local and state tax revenues by trading this surplus, which would partially compensate economic losses. In conclusion, apart from hindering traditional economic activities, dams have no potential for withstanding local economy with taxes benefits. In addition, small power plants (*Pequenas Centrais Elétricas*), which are usually the ones planned to minor tributaries, do not need to pay royalties to local municipalities, what worsen the situation.

We additionally highlight disagreements among government entities (federal and/or state levels) with regard to conservation plans, which are frequently ignored by “development” plans. This paradoxical countersense is made explicit when at federal level, *Portaria do Ministério do Meio Ambiente* (09/2007) indicates the lower Piquiri River as one of the areas of high priority for conservation and sustainable use. At state level, *Resolução Conjunta (SEMA-IAP 05, September 2009)*, proposed by the *Secretaria do Meio Ambiente e Recursos Hídricos* and by the *Instituto Ambiental do Paraná (IAP)*, establishes

the mapping of strategic areas for the conservation and restoration of Paraná State biodiversity, including the lower Piquiri River. A major paradox resides here: how can areas declared as of high-priority for conservation at federal, state and local levels be even considered for hydropower plants? This was clearly presented during public hearings.

---

## Concluding remarks

We proposed a strategy to avoid new dams in rivers of high-priority for conservation that was strongly based on successful examples of collinear actions of society, law experts (mainly public prosecutors) and scientists in Paraná State. The strategies presented here are encouraged to be adopted all-around Brazil where similar situations occur and where societies desire to conserve the rivers and prevent impacts caused by dams.

As evidenced in practice, a series of factors have contributed to successful results obtained so far: the rivers under scrutiny are remnants recognized as of environmental importance by governmental entities; they are in a State with significant surplus of energy production (for which is not rewarded); the areas threatened by impoundments are economically productive; and the institutional environment comprises several universities, prosecutors’ offices and non governmental organizations that were able to support local populations and governments on their struggle to prevent “developments” which would be detrimental to local interests (see WCD, 2000).

Finally, we emphasize that our goal falls short from entering the dispute between development and conservations strategies. Nonetheless, we highlight the lack of adequate strategies to mitigate ecological, sociological and economical impacts regarding construction of new dams.

---

## Conflicts of interest

The authors declare no conflicts of interest.

---

## Acknowledgements

We are grateful to public prosecutors and to scientists from Universidade Estadual de Maringá, Faculdade Estadual de Ciências e Letras de Campo Mourão, Universidade Federal do Paraná (Campus Palotina) and Universidade Tecnológica Federal do Paraná, who was voluntarily willing to attend the meetings and have provided excellent speeches to local people surrounding Ivaí and Piquiri rivers. We are also grateful to Nupélia team for supporting the meetings with logistic solutions and human resources. Luiz M. Bini, Rafael D. Loyola and one anonymous reviewer provided valuable comments on the manuscript. Carolina V. Minte-Vera gently suggested the title of this manuscript. This manuscript is a product of Movimento Pró Ivaí/Piquiri (visit <https://www.facebook.com/proivaipiquiri/>).

## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.ncon.2015.11.008](https://doi.org/10.1016/j.ncon.2015.11.008).

### REFERENCES

- Agostinho, A.A., Bini, L.M., Gomes, L.C., Júlio Jr., H.F., Pavanelli, C.S., Agostinho, C.A., 2004a. *Fish Assemblage*. In: Thomaz, S.M., Agostinho, A.A., Hahn, N.S. (Eds.), *The Upper Paraná River and its Floodplain: Physical Aspects, Ecology and Conservation*. Chapter 10. Backhuys Publishers, Leiden, pp. 223–246.
- Agostinho, A.A., Gomes, L.C., Pelicice, F.M., 2007. *Ecologia e Manejo de Recursos Pesqueiros em Reservatórios do Brasil*. Eduem, Maringá.
- Agostinho, A.A., Gome, L.C., Veríssimo, S., Okada, E.K., 2004b. *Flood regime, dam regulation and fish in the Upper Paraná river: effects on assemblage attributes, reproduction and recruitment*. *Rev. Fish Biol. Fisheries* 14, 11–19.
- Agostinho, A.A., Pelicice, F.M., Gomes, L.C., 2008a. *Dams and the fish fauna of the Neotropical region: impacts and management related to diversity and fisheries*. *Brazilian J. Biol.* 68, 1119–1132.
- Agostinho, A.A., Thomaz, S.M., Minte-Vera, C.V., Winemiller, K.O., 2000. *Biodiversity in the high Paraná river floodplain*. In: Gopal, B., Junk, W.J., Davis, J.A. (Eds.), *Biodiversity in Wetlands: Assessment, Function and Conservation*. Backhuys Publishers, Leiden, The Netherlands v.1, pp. 89–118.
- Agostinho, A.A., Zaniboni-Filho, E., Lima, F.C.T., 2008b. *Brycon orbignyanus* (Valenciennes, 1850). In: Machado, A.B.M., Drumond, G.M., Paglia, A.P. (Eds.), *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção*. Fundação Biodiversitas, Brasília - DF, MMA, pp. 54–56, 1.ed., volume II.
- Antonio, R.R., Agostinho, A.A., Pelicice, F.M., Bailly, D., Okada, E.K., Dias, J.H.P., 2007. *Blockage of migration routes by dam construction: can migratory fish find alternative routes?* *Neotropical Ichthyol.* 5, 177–184.
- Azevedo, R.F., Miranda, L.E. *Contesting detrimental dams: a study case from southern Brazil*. *Int. J. River Basin Manage.*, in press.
- Barletta, M., Jaureguizar, A.J., Baigun, C., Fontoura, N.F., Agostinho, A.A., Almeida-Val, V.M.F., Val, A.L., Torres, R.A., Jimenes-Segura, L.F., Giarrizzo, T., Fabré, N.N., Batista, V.S., Lasso, C., Taphorn, D.C., Costa, M.F., Chaves, P.T., Vieira, J.P., Corrêa, M.F.M., 2010. *Fish and aquatic habitat conservation in South America: a continental overview with emphasis on neotropical systems*. *J. Fish Biol.* 76, 2118–2176.
- Baumgartner, G., Nakatani, K., Gomes, L.C., Bialletzki, A., Sanches, P.V., Makrakis, M.C., 2004. *Identification of spawning sites and natural nurseries of fishes in the upper Paraná River, Brazil*. *Environ. Biol. Fishes* 71, 115–125.
- Brown, J.H., Lomolino, M.V., 1998. *Biogeography*, 2nd ed. Sinauer Press, Sunderland, MA.
- Chmys, I., 2004. *Monitoramento, uma abordagem complementar ao salvamento arqueológico*. *Arqueologia, Curitiba* 8, 61–76.
- Chmyz, I., Sganzerla, E.M., Volcov, J.E., Bora, E., Cecccon, R.S., 2008. *A arqueologia da área da LT 750kV Ivaiporã-Itaberá III, Paraná-São Paulo*. Centro de Estudos e Pesquisas Arqueológicas, Curitiba.
- Dei Tos, C., Gomes, L.C., Rodrigues, M.A., 2014. *Variation of the ichthyofauna along the Goioerê River: an important tributary of the Piquiri-Paraná Basin*. *Iheringia Sér. Zoologia* 104, 104–112.
- EPE – Empresa de Pesquisa Energética, 2007. *Plano Nacional de Energia 2030*.
- EPE – Empresa de Pesquisa Energética, 2013. *Plano Decenal de Expansão de Energia 2022*.
- Gubiani, E.A., Gomes, L.C., Agostinho, A.A., Baumgartner, G., 2010. *Variations in fish assemblages in a tributary of the upper Paraná river, Brazil: a comparison between pre and postclosure phase of dams*. *River Res. Appl.* 26, 848–865, DOI: 10.1002/rra.1298.
- Gubiani EA, Holzbach AJ, Baumgartner G, Rezende-Neto LB. & Bergmann F, 2006. *Fish, Piquiri River, Upper Paraná River Basin, Paraná State, Brazil*. *Check List* 2:9-14.
- ICMBio – Instituto Chico Mendes de Conservação da Biodiversidade, 2014. *Portaria MMA nº 445, de 17 de dezembro de 2014*.
- IPARDES, 2013. *Indicadores de desenvolvimento sustentável por bacias hidrográficas do estado do Paraná*. Instituto Paranaense de desenvolvimento Econômico e social, Curitiba, pp. 245.
- Leite, J.R.M., Bahia, C.M., 2012. *Danos extrapatrimoniais na construção de hidrelétricas*. In: Rezende, L.P., Dergam, J.A. (Eds.), *Proteção da biodiversidade e construção de barragens hidrelétricas*. Ed. Fiuza, São Paulo, pp. 125–144.
- McCully, P., 1996. *Silenced Rivers – The Ecology and Politics of Large Dams*. Zed Books, London, pp. 350.
- Miranda, M.P.S., 2012. *Análise dos impactos ao patrimônio cultural no âmbito dos estudos ambientais*. In: Rezende, L.P., Dergam, J.A. (Eds.), *Proteção da biodiversidade e construção de barragens hidrelétricas*. Ed. Fiuza, São Paulo, pp. 269–304.
- Mota, L.T., 2013. *Os Xetá no vale do rio Ivaí 1840–1920*. Eduem, Maringá-PR, pp. 158.
- Nilsson, C., Reidy, C.A., Dynesius, M., Revenga, C., 2005. *Fragmentation and flow regulation of the world's large river systems*. *Science* 308, 405, DOI: 10.1126/science.1107887.
- Parellada, C.I., 2013. *Arqueologia do vale do rio Piquiri, Paraná: paisagens, memórias e transformações*. *Revista Memore, UNISUL* 1, 24–42.
- Parolin, M., Guerreiro, R.L., Kuerten, S., Menezes, H.R., 2010. *Bacias hidrográficas paranaenses*. In: Parolin, M., Volkmer-Ribeiro, C., Leandrini, J.A. (Eds.), *Abordagem ambiental interdisciplinar em bacias hidrográficas no estado do Paraná*, Ed. FECILCAM, Campo Mourão, pp. 59–104.
- Rothman, F.D., 2008. *Vidas alagadas – conflitos sócio-ambientais, licenciamento e barragens*. Editora UFV, pp. 344.
- Vainer, C.B., 2008. *Conceito de atingido: uma revisão do debate*. In: Rothman, F.D. (Ed.), *Vidas alagadas – conflitos sócio-ambientais, licenciamento e barragens*. Editora UFV, pp. 39–63.
- Volkmer-Ribeiro, C., Parolin, M., 2010. *As esponjas*. In: Parolin, M., Volkmer-Ribeiro, C., Leandrini, J.A. (Eds.), *Abordagem ambiental interdisciplinar em bacias hidrográficas no estado do Paraná*. Ed. FECILCAM, Campo Mourão, pp. 105–130.
- World Commission on Dams, Available from: <http://www.unep.org/dams/WCD/> 2000. *United Nations Environment Programme: dams and development. A new framework for decision making* [online]. United Nations, New York.