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Saving the last wild rivers in Portugal

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Abstract

Rivers are among the natural assets subject to greater human pressure, not only because water is essential to life support and economic activity, but also because rivers are associated with other key resources like agricultural land, biological and mineral extraction, and transport routes. Rivers are hubs of civilization and cultural identity, but also sources of conflict. Cumulative water abstraction, water pollution from domestic, industrial and agricultural sources, overfishing, dam and dyke construction, siltation from deforestation, drainage of wetlands, sand extraction, land filling, urban sprawl, have led to the degradation of natural river landscapes, and jeopardized ecosystems services provided by river basins. Portuguese rivers have been a source of welfare and cultural identity; however, this often led to over-exploitation, ultimately undermining sustainable development. Some indicators of river ecosystem use and quality in Portugal: adequate monitoring exists in only 50% of water bodies under Water Framework Directive; only 52% of inland water bodies have good ecological status; water abstraction intensity has reached over 15% of natural river flow, high for the Mediterranean region; over 80% of major rivers have been heavily modified, mostly by dams, causing deep cumulative ecosystem changes and the retention of sediments, increasing coastal erosion; natural riverbank habitats in major rivers have all but disappeared due to agricultural or urban use; some migratory species, e.g. sturgeon and salmon, have gone extinct; others, such as trout, lamprey and saramugo, are threatened; commercial fisheries, e.g. sardine, who depend on estuaries for reproduction, suffer dwindling stocks. Environmental awareness and official policies (often from the EU) have begun to invert some negative trends: e.g. urban and industrial wastewater treatment rose, from close to zero 30 years ago, to present 74%. Unfortunately, the impacts of other activities are less valued or understood, and show a negative trend: a case in point is dam construction. At present Portugal has 228 large dams with 68 hydro power plants (plus about 7000 small dams), accounting for 20% of national electricity production, 50% of water abstraction, and the irrigation of thousands of km^2 of land. Current plans for five new large dams on the Tua and Tâmega rivers, if allowed to proceed, would eliminate the largest near-natural rivers in Portugal. These state-subsidized projects, which bypassed habitat protection and water management regulations, would be used for power generation, accounting for 0.5 % of national energy consumption, at a much higher cost than available alternatives. New dams are currently the main threat to Portuguese river ecosystems, and a major blow against local sustainable development plans. Cultural heritage, natural landscapes, white water sports, mountain railways, agricultural land and other unique assets are key to both maintain environmental quality and promote local jobs (and would be severely impaired by the new dams). In the past decade, several initiatives have risen to promote local development related to natural rivers and better water management, and of need to fight new dam construction. Those movements evolved to platforms that encompass local communities, environmental NGO, wine companies and ecotourism business.

Keywords: rivers, water management, local development

1. Introduction

Rivers are among the natural assets subject to greater human pressure, not only because water is essential to life support and economic activity, but also because rivers are associated with other key resources like agricultural land, fish nurseries and fishing grounds, transport and trade routes, flat land requested for construction and mineral extraction. Rivers have long been hubs of civilization and cultural identity.

Multiple uses have often made rivers a focus of conflict. Different economic and social activities compete for what has been a scarce resource since humankind became sedentary. Cumulative water abstraction, water pollution from domestic, industrial and agricultural sources, overfishing, dam and dyke construction, siltation resulting from deforestation, drainage of wetlands, sand extraction, land filling, urban sprawl, have led to the degradation of natural river landscapes, and jeopardized ecosystems services provided by river basins. Ultimately, those multiple degradation factors reduce the availability of already scarce water resources. Current trends of climate change and loss of biodiversity compound the problem.

Water management has long been a contentious issue, and has been recognised, in many international *fora*, as one of the key environment and development challenges our society faces (UN, 1992; EEA, 2009, UN 2015). In the European Union, a key step was taken with the creation of the Water Framework Directive (WFD, Directive 2000/60/EC), which provides a comprehensive framework for water management, including criteria for chemical and ecological quality and management tools.

Portugal is a case in point in water management. Like in other countries, Portuguese rivers have been a source of welfare and cultural identity; however, this often led to over-exploitation, ultimately undermining sustainable development. The country has long possessed state-of-the-art instruments to deal with water management, at least since the early 1980s, from sanitary and environmental engineering technology to data collection equipment, laboratory facilities, know-how on mathematical simulation models and management tools. However, progress has been slow and uneven. Much attention has been given to basic sanitation, especially water supply, wastewater treatment facilities and to the distribution of water resources among major users (urban supply, agriculture, industry). Much less attention has been paid to the river ecosystems, either for their intrinsic value, or for the services provided: life support, good water quality, a variety of economic activities, social amenities. There is reasonable information on the state of the environment, but often it is not used in policy-making or management decisions. Wild rivers have become a rarity in Portugal.

The goal of this paper is to study key problems threatening Portuguese rivers, focusing on dangers that have been neglected or are worsening; and discuss approaches that have been used to deal with them. Among a general trend of improving water management practice, one particular piece of policy emerges as contradictory: the national large dam plan.

2. Methods

The research reported in this paper followed three main steps:

- Brief review of major indicators regarding water management and river quality in Portugal, with an emphasis on the ecological component and ecosystem services. Most of this information is available in official reports;
- Identification of major threats, especially those worsening over time. This was obtained from official documents, expert and stakeholder consultation;
- Discussion of approaches to deal with the increasing threats against water management, particularly the disappearance of wild rivers.

3. Results and discussion

3.1. Key indicators on river status

Some indicators of river ecosystem use and quality in Portugal:

- Adequate monitoring of water bodies under the WFD is acknowledged as insufficient. Available information indicates that only 52% of water bodies have good or better status (APA, 2016);
- Water abstraction intensity has reached over 15% of natural river flow, high for the Mediterranean region;
- There are no updated data due to the decommissioning of hydrometric teams in governmental agencies in the past decades, and the lack of investment in monitoring networks, but it is estimated that between 80% and 90% of major rivers have been heavily modified, mostly by dams, causing deep ecosystem changes and the retention of sediments, increasing coastal erosion;
- Natural riverbank habitats in all major rivers have all but disappeared due to agricultural or urban use;
- Due to habitat fragmentation and water pollution, several migratory species, e.g. sturgeon and salmon, have gone extinct in historical times; others, such as trout, lamprey and saramugo, are threatened; commercial fisheries, e.g. sardine, who depend on estuaries for reproduction, suffer dwindling stocks.

Environmental awareness and official policies (often from the EU) have begun to invert some negative trends: urban and industrial wastewater treatment rose, from close to zero 30 years ago, to present 74% of population served; good quality public water supply rose to 98% of population served (APA, 2015). Agricultural runoff, although still a very significant problem, has been increasingly controlled by means of good practice codes, rising agro-chemicals prices, increasing use of biological agriculture and environmental measures in agriculture European subsidies. Unfortunately, the impacts of other activities are less valued or understood, and show a negative trend: a case in point is dam construction.

Water resources planning under the WFD, currently under way in Portugal, identifies all of the above pressures and dangers to water bodies (APA, 2016). Strangely, the National Water Plan, which serves as framework for the operational basin plans, neglects to identify the blatant conflict between almost every goal in the Plan, and the impacts created by projected new large dams.

3.2. Main impacts of large dams

Large dams have been marketed as the pinnacle of “good” electricity production, vital instruments for flood control and water storage, drivers of regional development and touristic promotion, and a solution to fighting climate change. These advantages are claimed by dam promoters, emphasized by governments and stated in hydro projects environmental impact assessments (McCully, 2001).

In Portugal it is no different. Enacted as upper public national interest, these constructions are promoted with public funding and shielded from consequent public participation, undermining worldwide scientific evidence of environmental and social impacts, negative externalities and investment, performance and risk indicators.

The impacts of dams depend on its physical and operational characteristics, as well as the region, climate, orography, hydrology, soil and habitats it is settled upon. Habitat destruction and reduction of biodiversity is the most visible impact. The shift from a flowing river into a reservoir, the barrier effect to fauna and the destruction of the river continuum are obstacles for transverse and longitudinal exchanges in fluvial ecosystems (Ward & Stanford, 1995). According to the National Report on Habitats Directive (ICNF, 2013), 35% of species and 66% of habitats under the Habitats Directive have an Unfavourable status, including most river habitats; 40% of protected species have unknown conservation status.

The main pressure threatening species conservation is the alteration of natural systems, namely river basin artificialization such as fragmentation by dam construction and river flow regime alteration.

One of the longitudinal functions of rivers affected is the nutrient and sediment transport. Together with flow regularization, sediment retention is responsible for diminishing the volume available for water storage in the medium and long-term. However, downstream impacts have a higher cost, as dams interrupt the sedimentary cycle and the coastal replenishment of sand. Several models have been used to assess this, and it is estimated that dams are responsible for an 80 % reduction of sand volume arriving at the Portuguese coast nowadays (GTL, 2014).

A large dam also results in water quality degradation, a phenomenon related to the retention time in the reservoir. The main effects are increased water temperatures and nutrient load, decreased turbidity and dissolved oxygen, and heavy metals and minerals concentration alterations. As water temperature increases, dissolved oxygen diminishes, jeopardizing the bacterial function to break down organic matter and thus increasing the likelihood of eutrophication. The current state of many Portuguese reservoirs is a case in point.

Another major environmental impact is the contribution of reservoirs to climate change. From the destruction of important carbon sinks (forests, wetlands, riverine ecosystems) to the construction of these major works, carbon dioxide emissions are increased. However, the most significant is methane emissions from reservoirs, a more powerful greenhouse gas that carbon dioxide. Although research on this topic is still limited, recent studies suggest that emissions from reservoirs could be responsible for 4 % of all anthropogenic global warming (IR, 2016). Estimates of methane emission in Portuguese reservoirs have never been modelled, due to lack of data and monitoring effort.

On the other hand, climate change can have a negative impact on hydroelectric production. According to the IPCC, hydroelectric production can be directly affected by changes in precipitation patterns (IPCC, 2007a/2014). In fact, hydropower potential is expected to decline from 20 to 50 % in the Mediterranean region by 2070 (IPCC, 2007b).

Dams are also advocated as regional development enhancers. Under the label of a “green” energy source and the lure of job opportunities, utilities companies mask the impacts by offering mitigation and compensation measures (often later found ineffective). Local governments hail the dam as a touristic asset for their regions, disregarding the opinions of local populations and economic agents. However, academia has repeatedly proven utilities and local governments wrong.

Available studies show that Portuguese dams such as Castelo do Bode, Alto Rabagão and Alto Lindoso have not contributed to socioeconomic development, with population decreases of 7 to 62 % since the dam construction (Velosa, 2009). The same study and others conclude that similar groundless promises of development are found in the Foz Tua Dam impact assessment process (Simão and Melo, 2011; Duarte, 2013). In the region where new large dams are being projected, Trás-os-Montes and Alto Douro, similar results were obtained in development indicators in municipalities with or without existing large dams (Bento at al. 2016). Construction works create temporary construction jobs, but the referred studies indicate that the effect on permanent jobs, if anything, is negative, affecting sectors like ecotourism and agriculture.

3.3. The Portuguese large dam program

At present Portugal has an inventory of 228 operational large dams (height over 15 m or reservoir volume over 1 000 000 m^3), plus an estimated number of 7 000 small dams. (CNPGB, 2016; RPAmb, 2016) They support 68 hydropower plants (accounting for 24% of national electricity production on an average year, 15% on a dry year, 30% on a rainy year), 50% of water abstraction, and the irrigation of 558 000 ha of land (DGADR, 2014).

Because new large dams show poor cost-effectiveness and cause such large impacts, very few projects have gone ahead in the recent past: in the last two decades only three new large dams were constructed in Portugal. The controversial Alqueva dam was conceived in the 1950s approved in 1995 and commissioned in 2002; its main goals are irrigation and the strategic control of the river Guadiana. Two other dams, Baixo Sabor and Ribeiradio-Ermida, were approved by 2007 and were recently commissioned, in the midst of a raging controversy, especially the Baixo Sabor, because it destroyed a Natura 2000 site and unique landscape. Litigation in the courts continues; the Baixo Sabor dam has been considered a case study in poor decision-making and conflict between biodiversity conservation and renewable energy policies (Melo et al. 2010, Jackson 2011).

In 2007 the Portuguese Government launched the "national program for dams with high hydropower potential", known as PNBEPH (INAG et al. 2007). The alleged goals of the PNBEPH were to reduce greenhouse gas emissions, to improve energy import dependency, and to improve the share of renewables, but, strangely, no targets were set for these goals. The only quantitative targets were to increase national hydropower capacity to 7 000 MW and hydro pumping capacity to 2 000 MW. No evaluation of impact on electricity cost or burden on the consumers and taxpayers was performed. No alternatives other than new dams were examined.

Seven out of the ten dams in the program were eventually approved. By 2016 only one dam was under construction (Foz Tua), two had been officially discarded (Girabolhos and Alvito), one is suspended (Fridão) and three are supposed to proceed but have not yet begun construction (the Tâmega Electroproduction System or SET).

The Portuguese Government and electric companies hailed the PNBEPH as the cornerstone of energy policy regarding climate change. To the untutored eye, the near 25% increase in installed hydropower capacity seems impressive. But, beyond major environmental impacts, when we look at the economic indicators (Table 1), the new dams show an appalling performance: cost of electricity per MWh is more than twice the average cost of the existing system; actual production amounts to only 1.7% of electricity, 0.3% of primary energy and 0.4% of energy imports, despite the fact that those were the main alleged goals of the program. The best alternative — energy efficiency — is ten times more cost-effective, regarding any of the alleged goals.

Table 1 — Performance indicators of current hydropower, new dams and energy efficiency

Indicator	Existing dams	Revised PNBEPH	Energy-saving measures equivalent to the PNBEPH
Installed power (MW)	7 003	1 655	n.a.
Pumping power (MW)	2 439	1 140	-
Average production (TWh/year)	12.8	0.9	0.9
Use of nominal power (%)	21%	6%	n.a.
Investment (M€)	n.a.	1914	170
Average production cost (€/MWh)	50	113	10
% of national electricity production	24%	1.7%	1.7%
% of national primary energy	4.3%	0.3%	0.4%
% of national energy imports	5.2%	0.4%	0.5%

Adapted from Melo, 2012, GEOTA, 2015 and RPAmb, 2016 (n.a. = not available; - = not applicable)

We can also see that current capacity (7 003 MW total hydropower and 2 439 MW pumping, reached with the recent refitting of six existing dams) already surpasses the targets defined in the PNBEPH. This is an important point: none of the new dams are needed to reach the targets defined by the program itself.

The whole program was supposed to cost about 1 200 M€ (INAG et al. 2007), but final proposals from the concession-holders indicated twice the originally defined installed power,

with almost three times the cost (Melo, 2011); this discrepancy was never officially explained. The poor performance of the new dams is related to excess capacity and low use of nominal power, 6%. The over-capacity seems to have been motivated by a promised State subsidy for "power availability". That subsidy has been reduced, by demand of the International Monetary Fund (IMF), the European Central Bank (ECB) and the European Commission (EC), due to the economic crisis and the recognition that subsidies to the electric companies are already excessive. This has prompted the electric companies to give up on several projects, despite having paid a total of 624 M€ for the concessions.

3.4. The early campaigns against dams

Of all large constructions works, few encompass as many stakeholders as large dams do. The irreversibility and high magnitude of impacts caused by dams change the lives of thousands directly, and millions indirectly. The negative nature of these impacts is often ignored in favour of the benefits gained by a few. These struggles have gained weight worldwide and in Portugal.

Opposition to large dams is an old phenomenon in Portugal, but for many years it was restricted to affected local inhabitants or environmental groups; in the XX century it rarely gained national, let alone international attention.

The first such debate to gain real public notoriety, even passion, was about the Alqueva mega-project: a large dam creating a 25 000 ha reservoir to irrigate 110 000 ha of land. The debate went on through the whole second half of the XX century. Alqueva was eventually approved despite substantial negative impacts, as it did have some benefits regarding geostrategic and development issues (Melo & Janeiro, 2005). Most critics of the project fought for impact mitigation and better practice rather than a full opposing campaign. Decisions on Alqueva were debatable, often bad, but understandable in their context.

The newer crop of dams, beginning with Foz Coa, then Cela, Baixo Sabor, Ribeiradio-Ermida and finally the PNBEPH, had very different stories, because they possessed scant or no public interest to begin with.

The campaign against the Foz Coa dam on the river Coa (Douro basin), 1992-1995, was run mostly by archaeologists protesting the destruction of unique Palaeolithic rock engravings, with large support from the international community. They capitalized on a very favourable political context, with a change in Government that promised more attention to cultural issues. The dam was stopped in 1995, after construction had already begun.

The campaign against the Cela dam on the river Minho happened in the early 2000s, involving municipalities, wine producers and environmental NGO. The project was reproved in 2005 due to the strong public opposition both in Portugal and in Galicia (Spain).

The Ribeiradio-Ermida project suffered harsh criticism but no full-blown campaign.

3.5. The "save the rivers" campaigns

The campaign against the Baixo Sabor dam began in 2004, run by the environmental coalition Plataforma Sabor Livre, focused on the ecological value of the Sabor valley Natura 2000 site. There was early success in the media and the courts, but the campaign neglected to involve local populations and economic agents. The Baixo Sabor dam was supported by heavy lobbying by EDP before the municipalities, the Portuguese Government and the European Commission. Ultimately, the pro-river campaign was defeated by the weak local opposition and the passivity of both Portuguese and European authorities (Melo et al, 2010).

The launching of the environmentally devastating large dam program in 2007, right before the Water Framework Directive came into force, prompted the Portuguese environmental movement to pay more attention to the "green energy" cause. In 2008, a group of NGO submitted a formal complaint to the European Commission against the dam program, proving

infringements of important legislations such as WFD. The complaint was closed in 2010 based on false information provided by the Portuguese Government.

Meanwhile, several NGO and many other stakeholders participated in the public consultation of these dams under the environmental impact assessment process. In cases such as Foz Tua, Fridão and the Sistema Electroprodutor do Tâmega, heavy criticism by environmental authorities and participants in the public consultation were completely dismissed and neglected in the political decisions. Upon the issuing of the licenses to construct those dams, several local movements were created to fight against each particular dam.

After the destruction of the lower course of the river Sabor by the Baixo Sabor dam, the Tua and the Tâmega are the largest Portuguese rivers close to their natural state (among the very few in Europe). All three rivers are tributaries of the Douro, the second-longest Iberian river. The cumulative impacts of six new dams (including the Baixo Sabor) in the Douro basin (water quality degradation, habitat fragmentation, sediment retention) were never studied.

The one dam of the PNBEPH currently under construction, Foz Tua, is located on the Tua river, a tributary of the right bank of the Douro River, about 1 km from the confluence. The dam is a concrete arch 108 m height and 280 m wide. It will submerge 420 ha of vineyards, olive and cork oak groves, agricultural land, plus one of the most beautiful landscapes in Portugal and a unique 140-year-old mountain railway, the last in Portugal. The new dam stands within a UNESCO World Heritage (WH) Site, the Alto Douro Wine Region (ADWR), where the worldwide famous Porto Wine is produced. The dam is being built a few meters from the WH core zone, and the whole reservoir will be within the buffer zone. According to a mission report form ICOMOS to UNESCO in 2011, "the area intervened affects fully the WH property" (ICOMOS, 2011). However, in 2012 the World Heritage Committee was misled into admitting compatibility between the dam and the ADWR, as long as a list of impact mitigation measures would be met by concessionary and the Portuguese State (WHC/ICOMOS/IUCN, 2012). The investment for the construction of the dam and power plant is estimated at 370 M€ (that will increase to at least 410 M€ with the power line and ineffective mitigation measures). The concession holder is EDP – the largest Portuguese electricity company, whose main stockholder happens to be China Three Gorges.

In the river Tâmega, already impacted by the strongly eutrophycated reservoir of the Torrão dam, and threatened with four new large dams, NGO such as ProTâmega started acting against the Fridão Dam, and submitted a legal complaint in Portuguese courts based on the risk of building a large dam 6 km upstream of a riverside city, Amarante.

Urged by the outstanding values of the Tua and Sabor valleys, GEOTA, on behalf of a coalition of NGO, presented two formal complaints to the European Commission in 2012. None has ever received a reply, nor was any action taken by the Commission to prevent further degradation while investigating both cases. The Baixo Sabor Dam was concluded in 2015, still lacking the implementation of mitigation measures.

In order to stop the Foz Tua dam, several environmental NGO and local associations, canoeing/rafting clubs and wine producers have created Platform Save the Tua (PST) in 2013. PST has repeatedly presented evidence to UNESCO, European and Portuguese authorities, that key demands have not been and almost certainly are not going to be met (PST, 2014). The promised mobility plan has been delayed and does not comply with mandatory specifications; and in October 2014, the Portuguese State approved an aerial high voltage power line connecting the hydropower plant to the national electrical grid across the ADWR property or buffer zone: two blatant infringements regarding specific conditions of the Foz Tua dam environmental impact declaration.

Several raising awareness actions have been developed under the PST campaign “Save the Tua, Protect the Douro”, reaching national and international media (PST, 2016a). Simultaneously, three legal actions were presented in the Portuguese courts between 2013 and 2015, still pending (PST, 2016b).

In 2014, the environmental organization GEOTA launched a project to preserve the last wild rivers in Portugal and halt the implementation of the Dam Program. The Rios Livres Project has adopted a methodology based on failures and victories of these past experiences: (1) Analyzing relevant documentation concerning river status and the dams EIA in order to gather data; (2) visiting the places and consulting all relevant stakeholders; (3) closely monitoring all developments (legal and *in loco*); (4) developing campaign materials that answer FAQ (5) raising awareness campaigns that embrace all stakeholders and (6) acting at a judicial and policy lobbying level.

The organization of "Caravana do Tâmega: de Chaves a Amarante" took place in November 2015 and aimed to raise awareness regarding all dams projected for the Tâmega River. The caravan spent one week following the river stream, from the highland city of Chaves to the downstream riverside city of Amarante. The caravan organized actions everyday with local associations and movements (including ProTâmega), passing through several affected villages, and ended with a kayak action and a large debate concerning the future of the valley and the region. Thousands of people were reached and the matter regained media attention in the area, relaunching a subject dormant due to years of delay in the projects (GEOTA, 2016).

More recently, PST and one of its members, the wine producer Esporão® have launched a national and international campaign, called "The Last Days of Tua", aimed at raising awareness to public in general and urge them to sign a letter pressuring UNESCO to take action. The campaign is based on the website with four small documentaries showing what four people will lose forever if the dam is concluded (PST, 2016c). So far, results demonstrate that having a good campaign product, together with a clear Call for Action, is key to target the audience. Moreover, showing the impacts on people, and not just the financial equilibrium or nature destruction, has certainly broadened the type of audience.

4. Conclusion

Our society got used to exploit resources to the point that they are no longer renewable or available. Among other important resources, water and river ecosystems have been strongly affected. We risk losing not only essential assets for our survival and comfort, but also a unique heritage in biodiversity, landscape and culture. This paper reflects on the threats and actions to save the rivers. Particular attention was paid to the campaigns against large dams, because dams were found to be the largest threat for the last wild rivers in Portugal.

The fact that the Foz Tua dam jeopardizes historical and cultural heritage, just as in the Foz Coa dam case, generated a stronger reaction from many people. Another key aspect is the increased strength of having a multi-stakeholder platform instead of divided forces, enabling to reach a wider audience. This approach was not taken in the Baixo Sabor campaign, run by environmental organizations and focused mostly on biodiversity loss.

The Rios Livres (Free Rivers) project at GEOTA has also came to the conclusion that tackling dams on a multi-disciplinary basis and embracing local movements allows much better knowledge of the issues at hand, and better effectiveness of the campaign. Simultaneously, joining geographically dispersed movements enables to widen the message, pressure local decision and opinion makers and getting a national reach in the media.

Sadly, one of the main conclusions of the struggle against dams in Portugal is the unreliability of national and European Union's institutions and legal instruments to defend objective public interest, and act before irreversible damage is made. Decision-makers often define policies and promote harmful projects in the face of contrary scientific evidence and public participation. Information available has reached the point that local inhabitants, as well as public opinion at large, when faced with the Pros and Cons of these dams, do not want them and recognize the existence of better alternatives: financially, environmentally, but mostly, socially.

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