



Restoration following a major disaster

Reflections from the Rio Doce Panel

P. May, C. Maroun, J. Renshaw, F.A.R. Barbosa, M.C.W. Brito, L.E. Sánchez, Y. Kakabadse



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The economic, environmental and social context of the Rio Doce watershed is dynamic and rapidly changing. The Rio Doce Panel has prepared this report with the best publicly available information at the time of its writing, and acknowledges that new studies and information are emerging that will shed further light on the restoration effort.

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Cover photo: The collapse of the tailings dam belonging to Samarco, owned by Vale and Anglo-Australian BHP, caused a mud flood to inundate several houses in the Bento Rodrigues district of Mariana in the central region of Minas Gerais. Initially, the mining company had claimed that two dams had broken, Fundão and Santarém. On November 16, Samarco confirmed that only the Fundão dam had ruptured.
Location: District of Bento Rodrigues, Municipality of Mariana, Minas Gerais. November 19, 2015.
Photo: Rogério Alves/TV Senado

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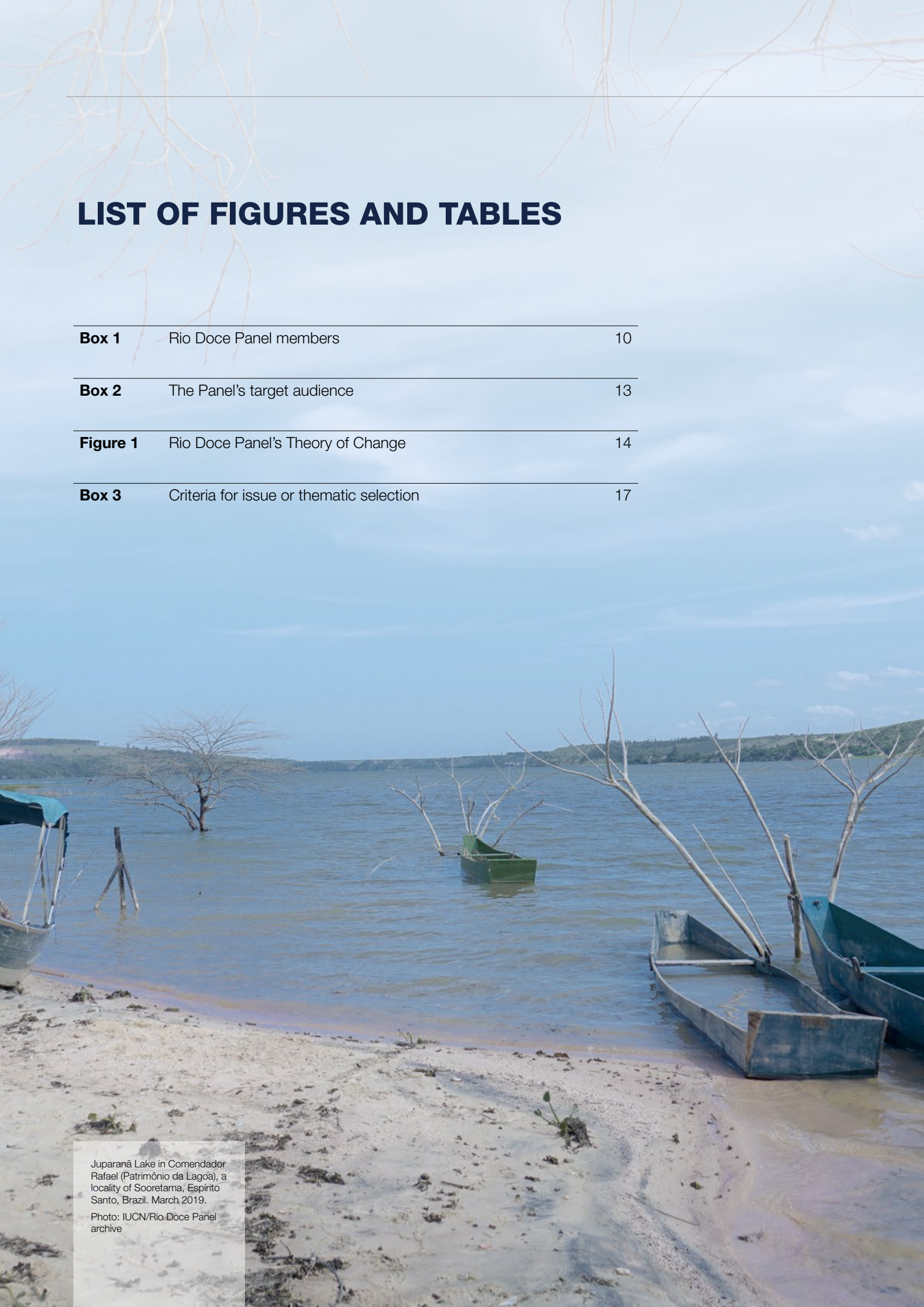
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Juparanã Lake in Comendador Rafael (Patrimônio da Lagoa), a locality of Sooretama, Espírito Santo, Brazil. March 2019.

Photo: IUCN/Rio Doce Panel archive

FOREWORD

The socio-environmental and economic tragedy caused by the Fundão dam failure in the city of Mariana (in the state of Minas Gerais) caused impacts that remain seven years later. Still, it is also important to recognise that many initiatives were – and continue to be – adopted successfully.

Dealing with the biggest mining event of its kind on the planet required organised efforts proportional to the magnitude of the damage caused by the dam failure. This led to the signing of Terms of Transaction and Conduct Adjustment (TTAC, Termo de Transação e Ajustamento de Conduta) and the adoption of a complex governance model, in which the Renova Foundation is the executing institution.

In this context, an independent panel of specialists was established, called the Rio Doce Panel and linked to IUCN, one of the oldest and most respected non-governmental entities in the world devoted to the conservation of nature and the protection of the environment, with a history of significant achievements.

The creation of the Panel, a group composed of experts from Brazil and abroad under the coordination of Yolanda Kakabadse – a former environment minister of Ecuador and internationally respected conservation leader and policy maker – was extremely relevant from an institutional perspective, as the Panel would act autonomously and independently and advise decision-makers involved in the governance system behind the reparation process.

Thematic reports prepared by the Panel outlined expertise and best international practices for the reparation of areas, which had been affected by tragedies similar to the Fundão Dam failure. The reports also enabled an ambience of reflection that would have been impossible within the Foundation's day-to-day work and immense pressure from repressed demands, court-mandated responsibilities, and dysfunctional aspects of their internal and external governance.

By enabling discussions on essential topics and producing high-level technical-scientific documents, the Panel has provided a set of inputs to assist the Renova Foundation in remedying the disaster's damage. By bringing a new and outside perspective, the Panel contributed to the Foundation and other actors in decision-making, complementing the existing work, strengthening strategic planning, and expanding the Foundation's thinking on the best available alternatives to address the region's socio-environmental and economic problems, taking into account, primarily, the assistance to those affected and the environmental recovery in the areas of water quality and biodiversity.

The Panel always conducted its interdisciplinary work in an integrated fashion and in coordination with the various stakeholders involved in restoring the Rio Doce.

In this important document, the Panel shares its reflections and lessons learned during its five years of work. Together with IUCN, the Panel leaves behind it an important legacy for current and future reparations, in view of the long-term nature of these actions.

José Carlos Carvalho
Former Minister of Environment, Brazil

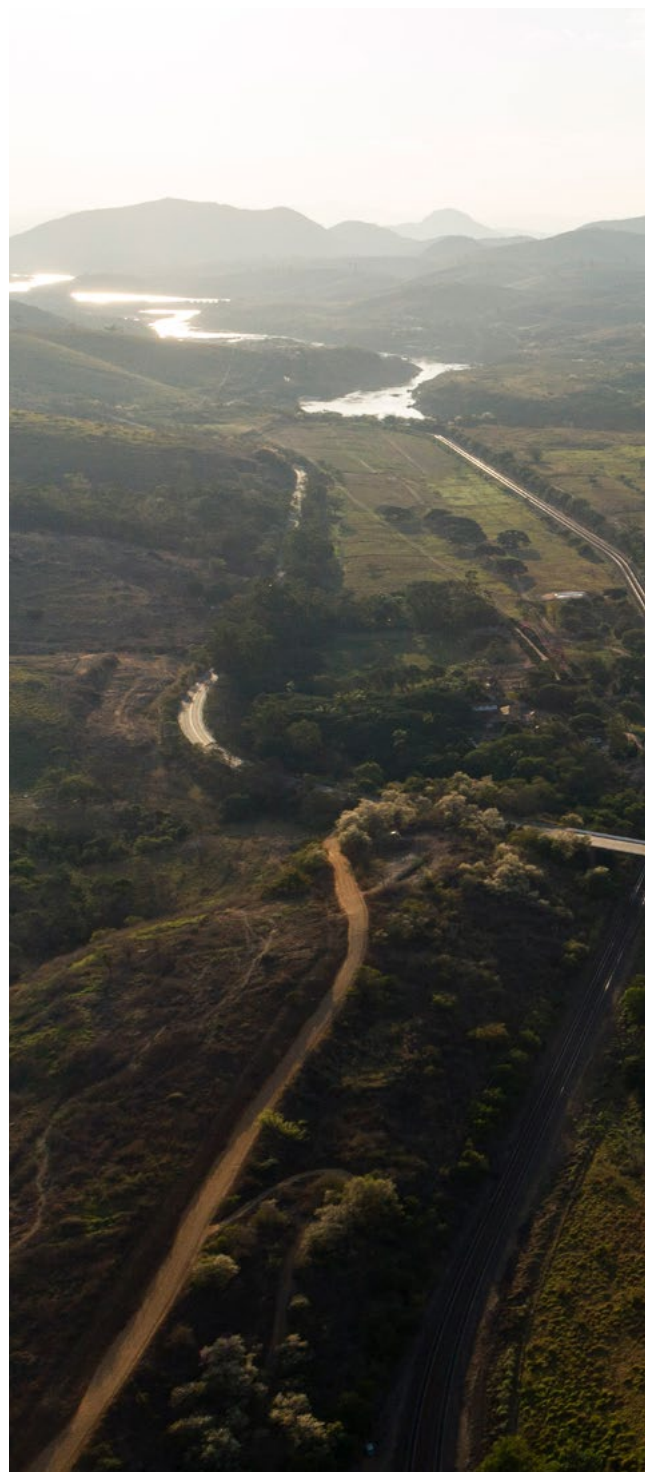
EXECUTIVE SUMMARY

Independent Scientific and Technical Advisory Panels (ISTAPs) have been established to help address a range of controversial conservation and development issues that have emerged with growing frequency and complexity at national and global levels. This report is intended to contribute to discussion of ways to improve the effectiveness of ISTAPs by outlining lessons learned by the Rio Doce Panel, an ISTAP set up in the wake of the 2015 Fundão iron tailings Dam collapse, widely considered one of Brazil's worst environmental disasters.

The multidisciplinary seven-member Panel worked from September 2017 to December 2022 following its establishment under a joint agreement between the Renova Foundation, which was created to restore socio-environmental conditions after the disaster, and the International Union for Conservation of Nature (IUCN). Working in a complex and often adversarial governance system, the Panel evolved over time from focusing on restoration to looking at the broader implications of environmental management of the basin and the wider Rio Doce catchment area, as well as engaging with a broader array of stakeholders.

The Panel's recommendations were based on three complementary perspectives: a long-term vision, a landscape approach, and the application of Nature-based Solutions (NbS). The Panel selected the specific themes that it would analyse through a combination of field visits, the experience of Panel members and discussions with stakeholders on issues relating to biodiversity, basin management, water resources, fisheries, environmental health, livelihoods and NbS, among others. These are areas where IUCN's global leadership and expertise is widely recognised.

The lessons learned in the project include *the importance of achieving a long-term, shared vision for the continual improvement of the basin and affected region; the need for effective leadership and collaboration; the identification and application of integrated, multidisciplinary solutions; the empowerment of permanent institutions; and systematic consideration of the implications of climate change.* The Panel sought to influence the long-term outcomes of the restoration through its written recommendations and direct engagement with key stakeholders. Although the uptake of the Panel's recommendations has been neither direct nor immediate, its influence in the region is likely to have a greater effect in the long-term.



Below: In the image, a bridge over the Rio Doce.
Colatina, Espírito Santo. September 15, 2022.
Photo: All rights reserved to NITRO Historias Visuais



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The Rio Doce Panel is thankful to the following institutions and their representatives, who provided meaningful information and shared their views throughout the restoration and Panel engagement, including:

- The Renova Foundation's current and former leadership, who idealised and believed in the project and supported the Panel's vision, especially Roberto Waack, André de Freitas, Guilherme Tangari and Emília Paiva.
- The Renova Foundation's focal points for their daily support and hard work, which enabled the execution of this project by providing technical information and updates necessary for the progress of the activities, especially Alan Rígolo, Alvaro Castro, Fernando Matos, Mirna Folco, Thais Herdy and Vitor Silva.
- The Renova technical teams, who provided recurrent support and extensive participation in Panel discussions, presentations and knowledge exchange, especially during the site visits, online meetings and presentations, which were essential for facilitating the Panel's work.
- The Renova Foundation communication team for supporting the activities and granting the use of images in the Reports and other communication materials.
- Representatives from the Renova Foundation's Technical Committee and Advisory Board for their continuing guidance amid the shifting priorities and concerns of different actors to the restoration;
- Representatives and specialists from the Rio Doce Watershed Committee (CBH-Doce), the Interfederative Committee (CIF) and its Technical Chambers, Pro-Rio Doce Committee, the State Public Prosecutors Offices, local and state governments, civil society, academic institutions and NGOs, and, above all, the people we met from the communities affected by the disaster for their time, patience and invaluable insights.
- Former Panel members Fernando Laureano, Hubert Roeser, Luiza Alonso, and Keith Alger for their significant contribution to the Panel's work.

Our thanks also go to the IUCN team in HQ and IUCN Sur Regional Office for providing ongoing technical support to the Panel and the management team, especially Gerard Bos, Leigh Ann Hurt, Stewart Maginnis, Chris Buss, Consuelo Espinoza, Gabriel Quijandria, Valeria Chamorro, Maria Ana Borges, Sarina van der Ploeg, and Silvia Guizzardi.

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A special thanks to the Project Manager at IUCN, Steve Edwards who accompanied the Panel since its inception, and whose guidance was always wise.

Finally, the Panel would like to express its profound appreciation for the opportunity to contribute to the recovery of socio and ecological systems after the Fundão Dam collapse and to work closely with many committed people involved in such an important mission. We were fortunate to meet and share our visions of a common future for the Rio Doce Basin.

ACRONYMS

BHP	BHP Billiton
CBH-Doce	Rio Doce Watershed Committee <i>(Comitê da Bacia Hidrográfica do Rio Doce)</i>
CIF	Inter-Federative Committee <i>(Comitê Interfederativo)</i>
CT	Technical Chamber <i>(Câmaras Técnicas)</i>
ES	Espírito Santo
FAQ	Frequently Asked Questions
IP	Issue Paper
ISTAP	Independent Scientific and Technical Advisory Panel
IUCN	International Union for Conservation of Nature
MEL	Monitoring, Evaluation, and Learning
MG	Minas Gerais
NbS	Nature-based Solutions
NGO	Non-Governmental Organisation
S2S	Source-to-Sea
TTAC	Terms of Transaction and Conduct Adjustment <i>(Termo de Transação e Ajustamento de Conduta)</i>
ToC	Theory of Change
TORs	Terms of Reference
TR	Thematic Report
UNESCO	United Nations Educational, Scientific and Cultural Organization



1. WHY WAS THE RIO DOCE PANEL CREATED?

On the afternoon of 5 November 2015, the Fundão tailings Dam collapsed. The dam contained around 52 million cubic meters (m³) of iron mining residues from the Samarco mining company's Germano Complex, jointly owned by two of the largest multinational mining corporations, Vale S.A and BHP Billiton (BHP). Reportedly, 39.2 million m³ of these tailings washed into the Santarém reservoir, immediately below the dam, creating a wave of liquid mud that poured into the Gualaxo do Norte and do Carmo rivers, both headwaters of the Rio Doce. The mass of liquified tailings tore away soil, vegetation and sediments from the upper reaches of the river, affecting around 2,000 hectares belonging to some 200 rural properties and destroying 1,469 hectares of natural vegetation.

The mud and debris demolished the villages of Bento Rodrigues and Paracatu de Baixo, damaging homes and community infrastructure further downstream in Gesteira and Barra Longa. The tailings also reached the Rio Doce estuary, 670 km below the dam, and created a plume, which spread along extensive coastal and marine areas, particularly along the shallow coastal platform. The disaster claimed 19 lives and physically displaced at least 320 families.

As a consequence of the disaster, Samarco's iron ore extraction activities were halted for five years,¹ and fishing remains banned in much of the basin, affecting employment and food security. Those displaced from the communities by the wave of mud were provided with temporary housing in Mariana and other urban areas in the basin, a situation that has lasted up to the time of this publication. Right after the disaster, local governments were forced to cut off the public supplies of water obtained from the Rio Doce and its tributaries, and to substitute them using tank trucks to deliver water to people in many of the towns and rural communities located downstream.

In an effort to mitigate the impacts and restore the areas affected by the Fundão Dam collapse, the Brazilian Federal Government, the States of Minas Gerais and Espírito Santo, Samarco, Vale and BHP signed a detailed agreement on 2 March 2016, known as the Terms of Transaction and Conduct Adjustment (TTAC).

Left: Inspection carried out by Ibama in July 2016 on the stretch affected by the collapse of the Samarco mining company's tailings dam in Mariana, Minas Gerais.

Photo: Felipe Werneck/Ibama

¹ In late 2020, Samarco received the environmental licenses required to restart its iron mining, ore concentration and transport along a 400 km slurry pipeline, and pelletising operations at a port facility which it had installed in the late 1970s near Vitória, the state capital of Espírito Santo. By mid-2022, the company had returned to 26 percent of its prior operating capacity. Samarco no longer deposits its coarse tailings behind dams but is drying and piling them for eventual use as construction materials. The fine tailings are being stored in an exhausted open pit.

The TTAC set out 42 programmes for reparation and compensation, and established an independent entity called the Renova Foundation to create, manage, and implement these programmes. Samarco's parent companies – Vale and BHP – would finance Renova, while an Inter-Federative Committee (CIF) would oversee the restoration process. The CIF included representatives from federal and state government agencies as well as municipal governments, representatives of affected populations and the civil society organisations that provide them with technical assistance. Together, Renova and the CIF were made formally responsible for the restoration, in consultation with affected communities.

The idea of installing a specialist panel to provide independent technical advice on the restoration process took shape in the two years following the disaster. The objective proposed by the leadership of Renova and Samarco's parent companies was to identify global corporate best practices and science-based perspectives on the restoration. In December 2015, BHP staff members consulted with various international organisations that were concerned about the environmental and social impacts of the Fundão Dam collapse. IUCN was among the organisations visited by the BHP staff members tasked with managing the restoration efforts. Although IUCN was unable to provide technical support to address the immediate short-term mitigation and restoration activities, the organisation had experience with the creation of ISTAPs. This initial consultation led to a dialogue between IUCN and BHP, that eventually led to the decision to create an independent panel.

On 5 December 2017, more than two years after the Fundão Dam collapsed, IUCN and the Renova Foundation's Board of Directors signed a five-year cooperation agreement to establish the Rio Doce Panel as an IUCN-supported ISTAP.



Below: The collapse of the tailings dam belonging to Samarco, owned by Vale and Anglo-Australian BHP, caused a mud flood to inundate several houses in the Bento Rodrigues district of Mariana in the central region of Minas Gerais. Initially, the mining company had claimed that two dams had broken, Fundão and Santarém. On November 16, Samarco confirmed that only the Fundão dam had ruptured.

Location: District of Bento Rodrigues, Municipality of Mariana, Minas Gerais. November 19, 2015.

Photo: Rogério Alves/TV Senado



2. THE ROLE OF INDEPENDENT SCIENTIFIC AND TECHNICAL ADVISORY PANELS

Independent scientific and/or technical advisory groups are often established to support major corporations, government agencies, or private foundations to reduce a project's impacts on nature and societies and to identify new solutions and guidance that contribute to solve controversial issues regarding conservation, while meeting economic and development goals². They can help multiple stakeholders understand situations characterised by complexity, uncertainty, and cost and can contribute to effective and efficient decision-making. Organisations which have recently created such groups include the Global Environment Facility's Scientific and Technical Advisory Panel (STAP), the World Health Organization's Scientific and Technical Advisory Committee (STAC), and the UN Framework Convention on Climate Change's Scientific and Technical Advisory Panel (STAP).

Such panels are typically convened under conditions of uncertainty. The number of unforeseen environmental disasters has been growing, for example, linked to climate change, extinctions, ozone depletion, mine-tailing dam collapses, and more. Advisory panels are also a regular feature of complex infrastructure projects. Other IUCN panels have been set up to address the impacts of major oil and gas investments in Nigeria (IUCN Niger Delta Panel) and in Russia (IUCN Western Gray Whale Advisory Panel).³

Although some IUCN Members saw partnership with mining enterprises as contrary to the reputational

interests of the organisation, there was widespread support for – and acceptance of – the effort to achieve better results from the restoration. The reputational risk became more obvious after the occurrence of a second major dam collapse at Brumadinho in January of 2019, which caused many more deaths than the Fundão disaster.⁴ IUCN followed the response to this new crisis closely: Why had the same mining enterprise (Vale) not learned enough in the three years following the Fundão Dam failure to prevent further disasters? An international inquiry sparked by Brumadinho led to the adoption of new standards for the management of tailings dams and for restoration efforts after future ruptures (Oberle 2020).⁵

The effectiveness of ISTAPs is strongly associated with their **credibility** as arbiters or scientific/technical specialists, whose **salience** or recognised prominence in the fields is perceived as relevant to the issues at hand as well as their **legitimacy** in the eyes of principal stakeholders to offer advice on these complex matters (Cash et al., 2003). Furthermore, based upon its experience with other such Panels, IUCN recognises that – to be effective – an ISTAP should operate according to four general principles: **independence, transparency, accountability, and engagement**. These principles apply to all IUCN-supported ISTAPs (IUCN, 2014). While the generic principles for advisory panels (Cash et al., 2003) address criteria similar to those adopted by IUCN, the latter put greater emphasis on the need for independence from external influences while maintaining accountability to affected groups. Later in this paper, we

2 IUCN (2014), Procedures for establishing and managing IUCN-supported Independent Scientific & Technical Advisory Panels, https://iucn.org/sites/default/files/2022-11/iucn_istap_procedures_2014.pdf

3 See: <https://www.iucn.org/western-gray-whale-advisory-panel> and <https://www.iucn.org/theme/business-and-biodiversity/our-work/business-partnerships-projects/shell/iucn-niger-delta-panel>

4 The Brumadinho disaster led to 270 deaths, mostly employees of Vale who were in the company cafeteria located immediately below the dam when it collapsed upon them.

5 Global Tailings Review (2020) – *Global Industry Standard on Tailings Management* - <https://globaltailingsreview.org/global-industry-standard/> - IUCN was part of the Tailings Review Advisory Group



Left: Rio Doce Panel during a visit to the area where the Fundão Dam collapsed. October, 2018.

Photo: IUCN/Rio Doce Panel archive

will reflect on the means employed by the Panel to ensure its effectiveness and to comply with the underlying principles that motivated its creation.

In the past two decades, IUCN has refined its ISTAP model to provide companies and other stakeholders with credible, relevant, and legitimate technical advice. According to IUCN (2021):

“ISTAPs are established with the formal designation of a group of experts, who engage in provision of scientific and/or technical advice on a specific biodiversity conservation or natural resource management issue. Typically, the recipient of the advice is one or more business entities or public authorities. While an ISTAP approach demands an objective perspective, it also links independent scientists, the private sector, governments, financial institutions, and NGOs in helping find solutions to challenging issues. The benefits of the ISTAP approach range from fostering a deeper understanding of the issues among the stakeholders to contributing toward the successful adoption of new biodiversity conservation measures and practices.”⁶

Operating from 2017 to December 2022, the IUCN Rio Doce Panel (henceforth referred to as ‘the Panel’) remained true to the legacy of previous panels, offering independent, scientifically based advice to stakeholders of the Fundão tailings Dam collapse.

⁶ The contribution of IUCN ISTAPs was discussed at the 2021 Global Conservation Congress in Marseille, France. See, for example, “*Harnessing independent scientific advice to reconcile conservation and economic development goals*”, available at: <https://www.iucn.org/news/business-and-biodiversity/202201/harnessing-independent-scientific-advice-reconcile-conservation-and-economic-development-goals>



3 THE CREATION AND OPERATION OF THE RIO DOCE PANEL

The first step in establishing the Panel was to select its chair through an international recruitment process that took place in parallel with the development of the Panel's terms of reference⁷ (TORs). This process took nearly a full year to complete and involved regular consultation with the leadership of the Renova Foundation.

Given IUCN's principal conservation mission, the Panel focused on environmental remediation and the restoration of terrestrial and aquatic ecosystems. It also considered impact assessment and monitoring, and the relation between ecosystems and livelihoods, as well as human and ecosystem health in the affected communities.

⁷ Terms of Reference for the Rio Doce Panel are available at https://www.iucn.org/sites/default/files/2022-10/rio-doce-istap-terms-of-reference_updated_2020jan.pdf



Above: Panel visits the area of Fundão, October 2018.
Photo: IUCN/Rio Doce Panel archive

These themes were compatible with the Panel's objectives, as defined by its TOR and FAQ,⁸ of making recommendations at a long-term, landscape scale and calling attention to NbS.

The Panel's specific focus was to examine the impacts of the disaster on the environment and natural resources. The Panel's remit did not cover issues that had been referred to the courts, such as indemnification payments and relocation, or the management and disposal of the tailings and other engineering issues. Detailed discussion of the generic safety of tailings dams was also excluded since this was seen as an issue for the technical specialists engaged in the international review of dam safety. Central issues included biodiversity, basin management, water resources, fisheries and NbS, since IUCN is widely recognised for its global leadership and expertise in these areas.

⁸ Frequently Asked Questions regarding the Rio Doce Panel are available at www.iucn.org/riodocepanel.

Independence is central to the Panel's operating principles, but some stakeholders had questions. To what extent could the Panel avoid manipulation and co-optation given its institutional proximity and financial dependence on Renova? Any ISTAP created in the context of disaster reparation is liable to face this question. The answer is that the Rio Doce Panel – following the lead of previous IUCN ISTAPs – has engaged in a way that is independent, transparent and accountable to all the stakeholders involved. Although its role is advisory, the Panel is not beholden to Renova or to Samarco's shareholders and parent companies. Any real or potential conflict of interest is addressed through IUCN procedures and best practice. A thorough conflict of interest verification is conducted on a regular basis, for example, to ensure that Panel members do not personally benefit from their work. These principles have been explicit during Panel consultations in the Rio Doce Basin.





Left: Ruins of Bento Rodrigues, district of the city of Mariana, Minas Gerais. September 2017.
Photo: IUCN/Rio Doce Panel archive

Below: View of the destruction of the Bento Rodrigues district, 35 km from the center of the historic city of Mariana, 13 days after the rupture of the Fundão dam, by the mining company Samarco. The district was covered by tailings from the Córrego do Feijão mine. The incident occurred on November 5, 2015. November 18, 2015.
Photo: TIAGO QUEIROZ / ESTADÃO CONTEÚDO

Above: Aerial view of the mouth of the Rio Doce, located in Regência, Espírito Santo, the path of the flood of mining tailings from the Fundão dam, which flowed down the river to reach the Atlantic Ocean. November 3, 2017.
Photo: DIDA SAMPAIO / ESTADÃO CONTEÚDO



The aim of the Panel therefore was to provide independent expert advice and guidance to Renova and other entities involved in the long-term governance of the Rio Doce Basin. The Panel took a Source-to-Sea (S2S) and landscape perspective to achieve an integrated, strategic approach. It offered long-term solutions for restoration in the region and engaged with the people and institutions affected by disaster (see the Panel's FAQs).

The Panel consisted of six technical experts with broad knowledge of the relevant social and environmental themes as well as a Chair with skills and experience in governance and engagement. It was supported by staff from IUCN's country office in Brasília and from IUCN headquarters in Gland, Switzerland.

Panel members were selected jointly by the chairperson and the IUCN project leader and endorsed by the IUCN Director General. An international search produced a shortlist of candidates, who were then interviewed and selected based on their curricula, letters of intent and published work.

The Panel was an independent and multi-disciplinary group of experts. They were leaders in their respective specialist fields and they had a wide range of relevant experience (Box 1).⁹ Their perspective was broad and holistic, and they gave high-level guidance rather than detailed, technical advice. Panel members drew on national and international experience, peer-reviewed scientific publications, and best practice. In addition, they looked for innovative, long-term NbS, which might be replicated in Brazil's other river basins or elsewhere in the world.

BOX 1 – RIO DOCE PANEL MEMBERS

The Panel included seven conservation, natural resource, and social science specialists, as follows:

- **Yolanda Kakabadse**, MSc, Chair, a former Environment Minister of Ecuador and former President of both IUCN and the World Wildlife Fund International (WWF);
- **Francisco Barbosa**, PhD, Vice-Chairperson and Professor of Ecology and Limnology at the Federal University of Minas Gerais;
- **Maria Cecilia Wey de Brito**, agronomist and MSc in environmental sciences, Director of Institutional Relations of EKOS Brazil; President of the Committee of Brazilian Member Organisations of IUCN, Former Secretary of Biodiversity and Forests of the Brazilian Ministry of Environment and Former General Secretary of WWF-Br.
- **Christianne Maroun**, DSc, consultant in climate change and sustainable development governance, and professor of environment and sustainable development at the Catholic University of Rio de Janeiro (PUC-RJ);
- **Peter H. May**, PhD, resource and ecological economist and professor of Development, Agriculture and Society at the Federal Rural University of Rio de Janeiro (UFRRJ);
- **John Renshaw**, PhD, social anthropologist, formerly Lead Social Safeguards Specialist at the Environmental Safeguards Unit of the Inter-American Development Bank (IADB); and
- **Luis Sánchez**, PhD, a mining engineer, and specialist in environmental impact assessment (Polytechnic School, University of São Paulo).

⁹ Four other specialists had previously been Panel members: Keith Alger, PhD, political scientist and specialist in ecosystem restoration and management; Luiza Alonso, EdD, former professor of sociology at PUC-Brasília, a specialist in public health and environmental justice; Fernando Laureano, DSc, a geologist, former Professor at PUC-Minas Gerais; and Hubert Roeser, PhD, Professor of water quality engineering at the Federal University of Ouro Preto (UFOP) in Minas Gerais.



Above: Rio Doce Panel and technicians from the Renova Foundation participate in the Vim Ver Program. July 2022. Photo: IUCN/Rio Doce Panel archive

Left: The Rio Doce Panel during a visit to the Hydroelectric Plant Risoleta Neves (Candonga). July 2022.

Photo: IUCN/Rio Doce Panel archive

Below: Members of the Rio Doce Panel during field visit to the areas impacted by the Fundão Dam collapse. July 2022.

Photo: IUCN/Rio Doce Panel archive



The Panel's initial focus was on understanding the extent of the disaster and its impact on people and the environment. This task, already exceptionally complex, was further complicated by the changes in government at federal, state and municipal levels, and subsequent changes to key environmental policies. These changes were reflected in the shifting sands of institutional and political negotiations on the issues of damages and reparations. Corporate and governmental responses to the disaster were also complex, and were often complicated by the competing positions of affected populations, scientific and civil society institutions, as well as the judiciary and mining companies. The Panel needed to navigate these shifts while retaining its independence.

The Panel initially assumed that it would respond primarily to Renova's needs, but this assumption was tested as policies changed and as relations shifted between Renova and other parties. Many – if not most – of the Panel's recommendations were then developed to include other governmental stakeholders such as the two state governments and the Rio Doce Watershed Committee (CBH-Doce). Over time, the Panel gradually put more effort into communicating its work and stimulating debate among the emerging primary stakeholders. This was essential, because these stakeholders would be responsible for maintenance of the socio-environmental health and revival of the basin's economy once Renova's work was finished. In a "post-Renova era", the restoration's programmes, infrastructures and institutions would be transferred to the appropriate institutions in government and civil society. Such issues had to be openly discussed among stakeholders.

Panel members found the interdisciplinary composition and diversity of their professional backgrounds to be an asset. However, for a multidisciplinary panel of this kind to function effectively, it was essential that key decisions be reached through consensus. This required Panel members to listen carefully, respect the opinions of others, follow formal protocols, and make an effort to comprehend the technical issues from the perspective of other disciplines. This was particularly important in the finalisation of the analyses and recommendations set out in the thematic reports and issues papers, which IUCN

published under the co-authorship of the Chair and all the Panel members, even though each report had its respective lead author. The need for consensus meant fewer documents were published, since publication required a time-consuming process of internal and external peer review, comment, and re-editing. However, the need for consensus also meant that arguments were more balanced, and the writing more carefully crafted.

Although changes in the composition of the Panel occurred during the five-year period of activities for varied reasons, this did not affect the methodology adopted for tripartite teamwork on each paper, though it did cause some delay in delivery timelines. However, it may have influenced the selection of topics and the focus of some of the papers without interrupting the overall programme.

The Panel made an early decision to differentiate its products into two types of reports. The first were issue papers (IP), which were relatively short, produced more rapidly, and focused on specific concerns facing the restoration. The second were thematic reports (TRs), which went into greater depth, were longer, and had a broader scope. The Panel Chair guided the process of deciding themes and asking Panel members whether they would participate in the core groups responsible for the initial drafts of technical reports and issue papers. All Panel members played an active role in discussing the relevance of possible topics, which were subsequently selected based on specific criteria such as the knowledge and experience of Panel members.

Panel members were expected to dedicate time from their already busy individual schedules to the work of the Panel. They met virtually each month, and face-to-face twice a year in the affected region. During the face-to-face gatherings, Panel members visited locations and communities affected by the disaster, as well as restoration sites, to understand the issues first hand and to follow the progress of restoration. When Panel members attended seminars, conferences and other institutional meetings related to the restoration, they did so as Panel representatives and accessed resources from the Panel budget.

The Panel was governed by its detailed ToRs, codes of conduct and its Theory of Change (ToC). At an early stage in its work, the Panel enunciated an initial version of its ToC that set up outcome indicators and a strategy to monitor the uptake of its recommendations by the primary and secondary stakeholders of the

restoration programmes under Renova’s responsibility. The primary or secondary stakeholders were defined as “Main Stakeholders, Policymakers, Influencers and Do-ers”. The categories were sometimes overlapping and may have referred to entities with multiple roles in the restoration.

BOX 2 – THE PANEL TARGET AUDIENCES

Main Stakeholders	Renova Foundation, CIF and its technical chambers
Policymakers	Federal, state and municipal governments, Basin committees, state agencies and regulatory institutions, legislature, judiciary and Public Prosecutor’s office
Influencers	Universities and research institutes, national and international corporations, advisors to the judiciary, and to the Public Prosecutor’s office
DO-ers	Affected people and its technical advisors, representative associations, private companies in the basin and NGOs working in the restoration process

According to the ToC, **Main stakeholders** include organisations which were created in response to the disaster and which are a key part of the reparation’s governance structure, such as the Renova Foundation, CIF and its Technical Chambers. **Policymakers** also deal directly with the consequences of the Fundação Dam rupture and are part of the governance structure, but they have a broader scope of action and attributions beyond the reparation. Examples include the three Brazilian levels of government (federal, state, and municipal), basin committees, regulatory institutions, and legislative,

judiciary and the public prosecutor. **Influencers** included active civil society and social movements within the region, as well as the media and higher educational institutions. Lastly, the ToC defines **Do-ers** as those which used natural resources and which were directly affected by the disaster. These include farmers, fishers and tourism operators, as well as iron and other mineral extraction companies, steel foundries and forest plantations, as well as other actors such as Independent Technical Advisors and NGOs.



October 9, 2018 Renova
Foundation | Expedition
Caminho da Reparação Aerial
view of the vicinity of the mouth
of the Rio Doce.

Photo: NITRO Histórias Visuais

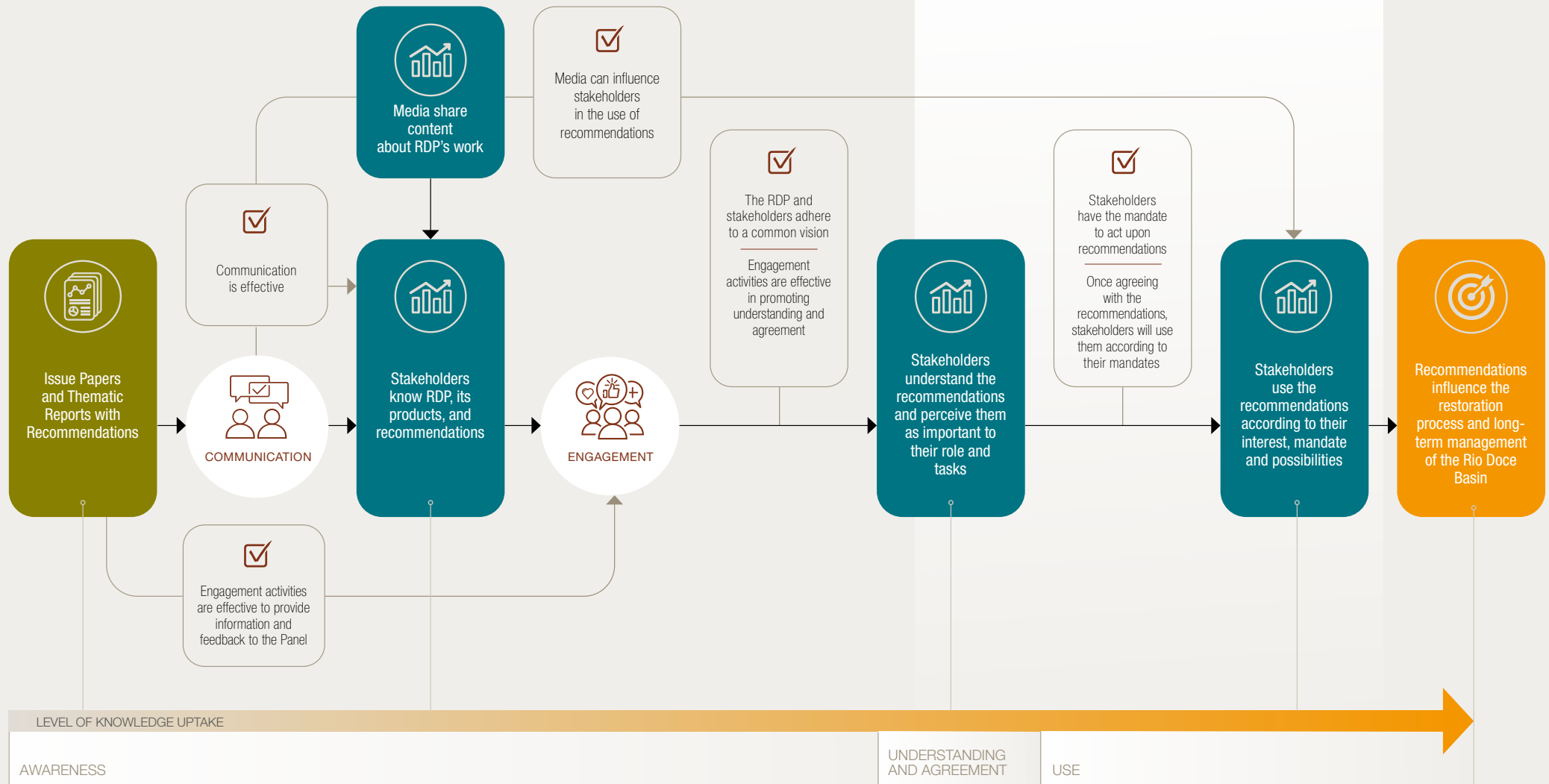
FIGURE 1 – RIO DOCE PANEL'S THEORY OF CHANGE

Source: IUCN – Rio Doce Panel (2020 revision)

THEORY OF CHANGE

RESULTS WITHIN
THE RDP ACCOUNTABILITY

RESULTS BEYOND
THE RDP ACCOUNTABILITY



MAIN STAKEHOLDERS
Renova Foundation, CIF, and its technical chambers

POLICYMAKERS
Federal, state and municipal governments, basin committees, state agencies and regulatory institutions, legislative, judiciary and Public Prosecutor's office

INFLUENCERS
Universities and research institutes, national and international corporations, advisors to the judiciary, and to the Public Prosecutor's office

DO-ERS
Affected people and its technical advisors, representative associations, private companies in the basin and NGOs working in the restoration process



Left: Stretch of the Rio Doce in rural areas undergoing restoration during a visit of the Demonstration Units of the ROAM Project. July 2022.

Photo: IUCN/Rio Doce Panel archive

After finalising the thematic reports and issue papers, the Panel and Secretariat adopted a communication strategy to publicise the recommendations and build awareness of the Panel's work. The Panel used a tailored approach to present the recommendations to main stakeholders and policymakers, promoting in-depth meetings, discussions, and joint events. Similarly, to ensure that the recommendations reached a broader audience, such as influencers, the Panel organised webinars and participated in scientific events. The Panel expected these strategies to foster engagement and bring the stakeholders to a common vision. It was hoped that these stakeholders would ultimately use and implement the Panel's recommendations according to their interest, mandate, and possibilities.

Over time, the ToC evolved to go beyond Renova, aiming to reach a broader range of primary stakeholders such as state governments and the Rio Doce Watershed Committee. The Panel began to engage more directly with these groups in 2020. At that time, it was becoming clear that Renova would be unable to act on all the Panel's recommendations, since many recommendations required broader governmental and societal engagement.

The ToC articulated the way in which the Panel would have to balance the demands of different actors while maintaining its independence. Managing such demands and the Panel's independence required constant vigilance. From the outset, the Panel's approach was to define the central issues and develop its recommendations, drawing upon contemporary peer-reviewed scientific literature and other publicly accessible sources.

The Panel developed its priority themes over multiple meetings using a common set of criteria. These began with the Panel's core principles, which were to adopt an integrative landscape approach at basin level and to seek long-term NbS. The full list of issue or thematic selection criteria is listed in Box 3, below:

BOX 3. CRITERIA FOR ISSUE OR THEMATIC SELECTION

1. Can the Panel provide a useful and well-informed scientific response to the issue / theme? Does the Panel have the requisite expertise for this issue / theme?
2. Does the issue / theme address long-term solutions and build resilience including the anticipated impacts of climate change?
3. Does the issue / theme align with the Panel TORs?
4. Is the Panel able to provide a timely response to the given issue / theme? Is the timing appropriate?
5. Does the issue / theme address basin-wide solutions?
6. Does a response to the issue / theme contribute to the construction of a new reality for the basin and its people?
7. Does the issue / theme contribute directly to improving social and environmental conditions?
8. Is the issue / theme relevant to local communities?
9. Will a response to the issue / theme help to resolve any conflict?
10. Does a response to the issue / theme help to establish the Rio Doce as a sustainable development model for other basins?
11. If the concern is identified as an issue, does a response help understanding of the Panel's priority themes?

An issue or theme would be considered ‘high’ priority only if it passed the first three criteria and at least three of the remaining eight. Prioritisation was done in-house and based on the consensus view of Panel members. Their detailed scientific knowledge of the critical problems facing the basin and its peoples helped to identify the themes that needed to be addressed. Consensus was often achieved following extensive debate among Panel members.

Once prioritised, the Chair selected an interdisciplinary core group of Panel members who were tasked to develop draft recommendations and the accompanying justification for further discussion. The leader of this core group was responsible for the paper’s structure following consultation with the other Panel members and for delegating specific responsibilities to other core group members. This draft outline was then discussed at an alignment meeting with Renova’s technical staff to determine whether the paper would meet the information requirements of the Foundation and other key stakeholders.

The core group then began the academic research through peer-reviewed and internationally recognised publications. The research might include publicly available studies by Renova or other agencies, as well as reports from the consulting companies that had been contracted by the public prosecutor’s office to review the restoration’s progress. Even when Renova did not agree with a theme, the Panel’s independence enabled it to proceed if it felt the theme was relevant to the broader restoration programme. Thematic Report number 2 (May et al., 2020) was one such example. Covering the impact of climate change on the basin’s long-term restoration, the Panel proceeded with its preparation on the grounds that it was consistent with global concern and the impacts of regional climatic events.

The Panel’s work was invariably seen as independent, technical, and scientifically grounded. This was partly because the Panel members were well-known leaders in their respective fields. Some had taught or worked with decision-makers at Renova or in government agencies while they were at university or in other roles. Just as important, the Panel relied almost exclusively on peer-reviewed and internationally recognised publications. It focused on strategic, longer-term issues relating to the reparation, rather than engaging in detailed analysis of the day-to-day issues.

The Panel initially thought they could produce a substantial volume of papers in short order, but this was simply not the case. The issues were complex. Documents required every Panel member to sign off. And



IUCN publication guidelines contained multiple steps. This slow delivery frustrated both Renova and the Panel. Future Panels may wish to make the process more agile, to avoid overpromising and under-delivering.

The multidisciplinary character of the Panel, and the part-time nature of Panel members’ involvement could also interfere with timelines. Time commitments were flexible, allowing time for revision and reflection, and deadlines were not always strict. When necessary, for example, timelines were modified so that Panel members could visit sites or meet with stakeholders. The dynamic nature of the restoration also meant that Panel members sometimes needed to incorporate new information as it emerged.

In 2021, the Panel’s *modus operandi* changed when Renova requested a new methodology for *ex post* impact assessments in the marine and coastal areas. Since a member of the Panel – Professor Luis Sánchez – is widely known as one of the most important academic specialists in this area, the Panel agreed to carry out the



Above: Rio Doce Panel and Renova Foundation technicians visit the interior of the church impacted by the mud. Paracatu de Baixo, district of Mariana, Minas Gerais. September 2017.
Photo: IUCN/Rio Doce Panel archive

study to help advance the restoration in the affected coastal areas. This led the Panel to adopt a different mode of engagement with Renova staff, although without relinquishing its independence.

The Panel's new approach enabled a constructive dialogue between the Panel and Renova's Impact Curatorship and Biodiversity teams. Professor Sánchez led successive workshops at which Panel members collaborated with Renova to further elaborate the methodology for the impact assessment. This process was the basis for producing the fifth and final Thematic Report, which presented the methodology for assessing environmental impacts on coastal and marine environments (Sánchez, et al., 2022). The positive nature of these interactions suggested that the Panel's recommendations would be adopted.

Between March 2020 and December 2021, the spread of Covid-19 in Brazil abruptly curtailed the Panel's sixth face-to-face meeting and fieldwork and prevented the realisation of the following two regular six-monthly site

visits. Many Renova offices were closed during this period. The Panel used video conferences to engage with Renova and to conduct 'virtual site-visits' involving other actors. The widespread use of videoconferencing meant that the Panel communicated more regularly with other stakeholders, including representatives from local governments and the Rio Doce Watershed Committee.

The shift to remote interactions had some positive impacts. Increased videoconferencing enhanced the engagement between actors in different cities and countries. Rather than limiting meetings to specific site visits, the videoconferencing allowed more meetings to take place. The Panel's monthly meetings were already managed through videoconferencing and their internal exchanges were largely unaffected, but they did manage to organise "virtual site visits", for which each Panel member devoted a week in September/October 2020 and March 2021. Renova staff also devised virtual field experiences ('Come See' expeditions) using interactive video so that Panel members could understand the restoration's progress.



Above: Works on the reservoir of Risoleta Neves Hydroelectric Plant (Candonga). July 2022. Photo: IUCN/Rio Doce Panel archive

4 SUPPORT FROM IUCN AND OTHER ACTORS

Well-organised support systems are essential for ISTAP efficacy. This was true for the Rio Doce Panel, which benefitted from the support of IUCN's well-organised, professional support staff at internal meetings and for regular communication with Renova and others. Based in Brasília and at the organisation's headquarters in Switzerland, the IUCN staff ensured that the Panel was able to access the most current peer-reviewed studies as well as media reports and offered insights into the perspectives of different actors and decision-makers. The support staff also managed the complex planning of site visits and meetings, both internal and external, all of which were overseen impeccably. Without the support and legitimacy of IUCN, the Panel would not have been as effective in its analysis and communications.

The monitoring, evaluation, and learning (MEL) related to Panel outputs and recommendations were an added burden for IUCN staff, but the Panel was then able to systematically track the uptake of its recommendations by different stakeholders. The inclusion of a full-time MEL officer and the elaboration of the ToC were key decisions that shaped the Panel's success. These might usefully be replicated early in the organisation of any future ISTAP.

The IUCN communication staff played a critical role in ensuring that the Panel had regular, updated access to all the relevant articles that appeared in the printed and online media, including items appearing in the local and regional, national and international press. The IUCN communications team was also responsible for communication with the press on the Panel's behalf, using different formats and media to promote public awareness of the Panel's existence as well as of its activities and recommendations, releasing all reports both in Portuguese and in English. To avoid undue duplication and mixed signals, the Panel Chair took responsibility for all direct substantive engagement with the press, while a targeted communication and outreach strategy optimised dissemination of the Panel's work to stakeholders by seeking forms for interaction that would reinforce the key messages. The editorial and layout experience of IUCN country and headquarters staff ensured the quality of the reports and their visual appeal.

IUCN Members in Brazil and other parts of Latin America were consulted at the outset and informed about the progress Panel's work. Some Members expressed concern about a partnership with major mining companies in the wake of Brazil's worst environmental disaster, fearing consequences for IUCN's institutional integrity and reputation. However, the Panel Chair had impeccable credentials and was trusted by the environmental community. No formal objection was lodged.

The Panel kept the international expert community and other stakeholders informed about their work through regular presentations at annual conferences of the International Association for Impact Assessment (IAIA), roundtables at the IUCN World Conservation Congress, and regional IUCN meetings. Panel members also participated in conferences to discuss their findings and stimulate broader awareness. Meetings in affected areas offered opportunities for representatives of the impacted communities to express their concerns. These were considered, as appropriate, in Panel recommendations.

Renova's Technical Committee was essential to track and understand the complex evolving relationships between government, Renova, and the judiciary. Committee Chair José Carlos Carvalho, a former federal Environment Minister and former State Environment and Forestry Secretary of Minas Gerais, was a key supporter of the Panel's work. His commentaries were balanced but critical, and they enabled the Panel to better understand the array of factors hindering the restoration progress. The leadership of Renova Governance played a similar role, offering critical insights into Renova's workings and its relationships with government.

Finally, the Panel's experience reinforced the critical importance for ISTAPs of listening to the people, communities, and organisations affected by the disaster, as well as analysts in research institutions, non-governmental organisation (NGOs), universities, and the media. Hearing from those who suffered the consequences of the dam collapse, as they explained their grievances, brought home the full weight of the tragedy as well as the difficulties they face in being heard by the institutions that should be responsible for their well-being.



Above: Restoration work on the church affected by mud in Paracatu de Baixo, Minas Gerais. July 2022.
Photo: IUCN/Rio Doce Panel archive



Above: An exotic species found in the Atlantic Forest, the predominant vegetation of the Rio Doce Basin. July 2022.
Photo: IUCN/Rio Doce Panel archive



Above: Bridge over the Rio Doce estuary. September 8, 2020. Renova Foundation.
Photo: All rights reserved to NITRO Historias Visuais

5 WORKING WITH RENOVA: LEARNING BY DOING

At the outset, the Renova Foundation was composed of a relatively small cadre of highly motivated, idealistic leaders, and specialists. But as the largest of the 42 programmes swung into action, and their associated funding increased, Renova grew into one of the region's largest employers. It was one of the few private organisations in the world to have been tasked with the restoration of a damaged ecosystem and economy after a major environmental and social catastrophe.

Over time, Renova evolved as it sought to build a better operational structure and increase its capacity to deliver the 42 programmes. However, this led to increasing compartmentalisation along the lines set out in the TTAC, a factor that was subsequently reinforced as many of the programmes became subject to judicial review. Renova's exponential growth in addressing the TTAC's increasingly compartmentalised programmes made the Panel's work more complex. How to engage with the large number of technically specialised departments and promote an integrated landscape approach and a long-term vision in such a highly compartmentalised framework?



Above: Yolanda Kakabadse, Chair of the Rio Doce Panel, walks through areas of the upper Rio Doce undergoing recovery. September 2018.
Photo: IUCN/Rio Doce Panel archive



Above: Instituto Terra's nursery. Aimorés, Minas Gerais. March 2019.
Photo: IUCN/Rio Doce Panel archive



Above: Application of NbS in the Gualaxo do Norte River, Minas Gerais. October 2019.
Photo: IUCN/Rio Doce Panel archive

In response to the emerging complexity and as new actors became involved, the Panel broadened its remit, offering independent technical and scientific recommendations to - and engaging with - a wider set of stakeholders. These included the CIF, some of the technical chambers that advise it, the public prosecutor's office, local governments, academic institutions, non-governmental organisations including some that were advising the affected communities, and the CBH-Doce.

Renova's high staff turnover added another layer of complexity. This might have impeded continuity in stakeholder relations and threatened the institutional knowledge base. However, the Renova staff who served as go-betweens for relationships built over five years of Panel activities, remained more stable. From the outset, the Panel was connected to the Institutional Relations and Governance teams at Renova, whose staff and consultants were relatively constant throughout much of the period. They accompanied the Panel on field visits and assisted IUCN with the logistics and programming of face-to-face meetings.

The Renova staff tasked with accompanying the Panel offered regular updates on key issues emerging during the restoration and informed the Panel on whether these issues remained relevant. While the Panel's objectives remained constant since the TTAC was signed, Renova had to adapt to new realities, and this led the Panel to modify its own strategy.

6 ISSUES AND CHALLENGES

The scale and multiple impacts of the disaster required the Panel to make recommendations across a wide range of issues and challenges, involving different disciplines. Some may be pertinent to similar situations where ISTAPs or scientific advisory bodies are convened, such as natural and man-made disasters, large-scale investment projects and the longer-term impacts of climate change. In the case of the Fundão Dam failure, the most important challenges included the scale and complexity of the disaster, the adversarial nature of the institutional and legal context, the lack of reliable data on the disaster's impacts, and the compartmentalised nature of the restoration.



Above: Aerial view of the ruins of the Bento Rodrigues district, 35 km from the center of the historic city of Mariana, two years after the collapse of the Fundão dam, by the mining company Samarco. The incident occurred on November 5, 2015. November 2, 2017. Photo: DIDA SAMPAIO / ESTADÃO CONTEÚDO

6.1 SCALE AND COMPLEXITY

The collapse of the Fundão Dam was one of the largest and most complex human-made disasters in recent history. When the 39.2 million m³ of tailings flowed downstream into the Rio Doce, they affected land and human settlements along 670 km of river as well as extensive coastal and marine areas. The disaster had multiple direct and indirect impacts on physical and chemical conditions in the river, on the biota and their maintenance processes, and on the living conditions, economy and society of people living along the river and coastal areas.

Given the complexity of the disaster, the vast amount of information generated, and controversies relating to the interpretation and understanding of the data, the Panel decided to rely exclusively on publicly available sources, with a preference for peer-reviewed journals. Many publications were devoted to the disaster, while volumes of consultancy studies were prepared for Renova, the public prosecutors' offices, and the courts. Much of this was made available online.

To ensure independence and transparency, the Panel did not cite unpublished materials including those prepared for Renova and other entities. Renova and its parent companies questioned this approach since they had invested heavily in the research. However, much of this work had not been made publicly available and the Panel opted not to cite these sources.

Nearly seven years have passed since the disaster, and there is still no comprehensive analysis of the environmental and socioeconomic impacts. Renova, the public prosecutors' office, and others have contracted a large number of studies, and peer-reviewed articles have been published in academic journals. But up to the time of this publication no overall synthesis has been published.

Similarly, no overall assessment of the reparations has been carried out. The Renova website offers a month-by-month progress report on the programmes, but these have tended to focus on inputs and outputs (amounts spent, numbers of people employed, areas reforested, and so on) rather than on the achievement of the TTAC's long-term objectives of returning socio-environmental conditions to their pre-disaster condition.

When the Panel was convened, therefore, its first priority was to prepare an overview of the situation in the Rio Doce Basin, applying the Panel members' specialist knowledge. The first thematic report (TR01 – Sánchez et al., 2018) synthesised the available information, providing an objective summary of the disaster together with background on the affected regions. Its general recommendations – which may well be applicable in other, similar situations – focused on the need for a comprehensive assessment of the impacts and the use of an adaptive management strategy. This latter should start with an evaluation of the mitigation programmes together with the potential threats – including climate change – that could undermine their expected outcomes. It also emphasised the importance of managing and disseminating knowledge gained from the disaster response.

Subsequently, some of the recommendations conveyed by the initial thematic report were further developed – with agreement from Renova – while others were put aside. Renova or other primary stakeholders did not regard them as a priority, since they were prioritising the short-term goals needed to respond to the direct obligations of the TTAC.

For example, the Panel saw adaptive management as essential to the long-term viability of the TTAC programmes, but this approach was rarely employed. The restoration effort appeared insufficiently flexible and unable to respond to the learning process required due to the uncertainties and impracticable timelines.

Information management is another important theme in a complex post-disaster situation. The Panel offered to help Renova with the development of a strategy to manage the wealth of knowledge generated by the consultancy studies it had contracted as well as the natural and social science studies published by other organisations such as universities and research institutions. Panel members insisted that an effective strategy for knowledge management would be vital to ensure the legacy of the restoration. However, Renova had already decided to contract other consultants on knowledge management and was preparing to set up regional information centres. To avoid overlap, the Panel's proposal was dropped.

6.2 THE LEGAL AND INSTITUTIONAL CONTEXT

The Panel's recommendations were initially directed at Renova, though as per the Panel's ToC, they were also intended to influence government agencies and others involved in the restoration. Subsequently the Panel adapted to the complex and changing legal and institutional context and broadened the scope of its recommendations to engage with a range of other stakeholders.

The institutional arrangements are complex, first, because the Rio Doce flows through two Brazilian states (Minas Gerais – MG and Espírito Santo – ES) and therefore its basin management comes under federal jurisdiction. This led to the involvement of federal government agencies, two state governments, the Public Prosecutors' offices in the two states and at least 40 municipal governments in the reparation. These governments and agencies will eventually have to take responsibility for the maintenance of the long-term programmes. As in other regions of Brazil, local government capacity is often severely constrained by the limited population in many municipalities. More than half the affected municipalities in MG, for instance, have less than 10,000 inhabitants. Local governments lack the resources to manage critical services, such as water supply, wastewater treatment, and the disposal of solid waste. Moreover, while everyone benefits from environmental services, they are not as visible as the community infrastructure that attracts votes, especially in small and rural municipalities.

Toward the end of its tenure, the Panel aimed its advice not just at Renova but also at government agencies and the other stakeholders represented in the CIF and Technical Chambers (CT). The relations between Renova and the CIF/CT were often more adversarial than complementary, and this complicated efforts to engage effectively with all parties critical to restoration of the Rio Doce Basin.

Further obstacles came from the fact that the TTAC was designed to facilitate a disaster response without waiting for the outcome of lengthy legal proceedings, but disagreements between Renova and the CIF/CT have regularly been referred to court. This led to uncertainty and delays in the restoration programmes.

In 2020, the Panel decided to make recommendations on governance issues, focusing on the long-term legacy of restoration in the Rio Doce Basin. Drawing on experience from the Rio Doce and other post-disaster situations, the Panel focused on the need to start with a participatory approach that would allow a broad range of stakeholders – especially the people most directly affected – to share their vision for the Rio Doce Basin. Their 'buy-in' to a long-term vision was seen as essential to achieve consensus and commitment regarding the restoration and long-term improvement of the basin, and to eventually facilitate the handover of the programmes from Renova to the agencies that will be responsible for their long-term continuity once Renova's mandate has been fulfilled.

In hindsight, it would have been better to initiate the governance review earlier, helping Renova and other key stakeholders (CIF and CT) to think about the reparation's long-term goals and the need for early engagement as part of a "polycentric governance" strategy (Ostrom, 2010). But Renova had been conceived as a temporary arrangement, offering a rapid solution to the most immediate and pressing problems of the restoration. The government and other agencies are expected eventually to take over, continue, and complement the investments and programmes that had been initiated and financed by Renova.

6.3 ENVIRONMENTAL IMPACT ANALYSIS AND BASELINE DATA

One conceptual challenge faced by the Panel was to develop a workable framework for the *ex post* analysis of the disaster's environmental impacts. The conventional frameworks for environmental impact analysis (EIA) have primarily been developed for the *ex ante* determination of the potential impacts of investments, especially in infrastructure, extractive and industrial projects, where data is collected and analysed, and mitigation measures developed, before a project is started.

In 2019, Renova's management team requested support with implementation of a recommendation from the first thematic report (Sánchez et al., 2018). In response, the Panel submitted a general framework for assessing the environmental and social impacts of disasters, which was well received. This issue paper (IP04 – Sánchez et al., 2019) encouraged Renova to establish an Impact Curatorship (*Curadoria de Impactos*).

In 2021 Renova requested the Panel's help to develop a framework for assessing the impacts of the dam's collapse on coastal and marine areas. It was agreed that the scope would be limited to environmental impacts – which in themselves are extremely complex – and would not cover the social and economic impacts. These latter impacts were controversial since key decisions were subject to judicial deliberations. Despite this necessarily restricted scope, the Panel consistently stressed the importance of a S2S approach (Granit et al., 2017), including social and economic impacts in the basin and related coastal and marine areas.

The process of developing this *ex post* framework differed from the Panel's earlier initiatives and involved more active engagement with Renova specialist staff – represented primarily by members of the Impact Assessment and Aquatic Biodiversity Conservation Teams. The proposal began by reviewing the existing

guidance on post-disaster situations, which focused largely on how to assess infrastructure damage and then to develop short-term measures which address the immediate needs. The Panel has had to look beyond these existing approaches, however, to develop a systematic, evidence-based framework for *ex post* EIA in other affected coastal and marine environments.

In the study of impacts on coastal and marine areas, the Panel and Renova faced the challenge of working outside the conventional framework for EIA. The challenge was compounded by the absence of reliable data on the pre-disaster situation – for instance, information on critical areas such as water quality (physical, chemical and biological characteristics). Moreover, it is extremely difficult to distinguish the impacts of the Fundão tailings from the cumulative, historical impacts from over 400 years of mining and industrial activity, deforestation of the basin, and contamination from agrochemicals, raw sewage and solid waste.

The Panel was able to draw on the available data and were supported by IUCN staff to identify new sources of information from academic journals and other sources to draw inferences regarding the impact of the dam break on coastal and marine habitats. Based on this broad literature review, the Panel emphasised that impact analysis should focus on the medium- to long-term risks to the biota and to human health from dispersal and re-dispersal of the Fundão tailings, rather than the immediate impacts after the dam break.

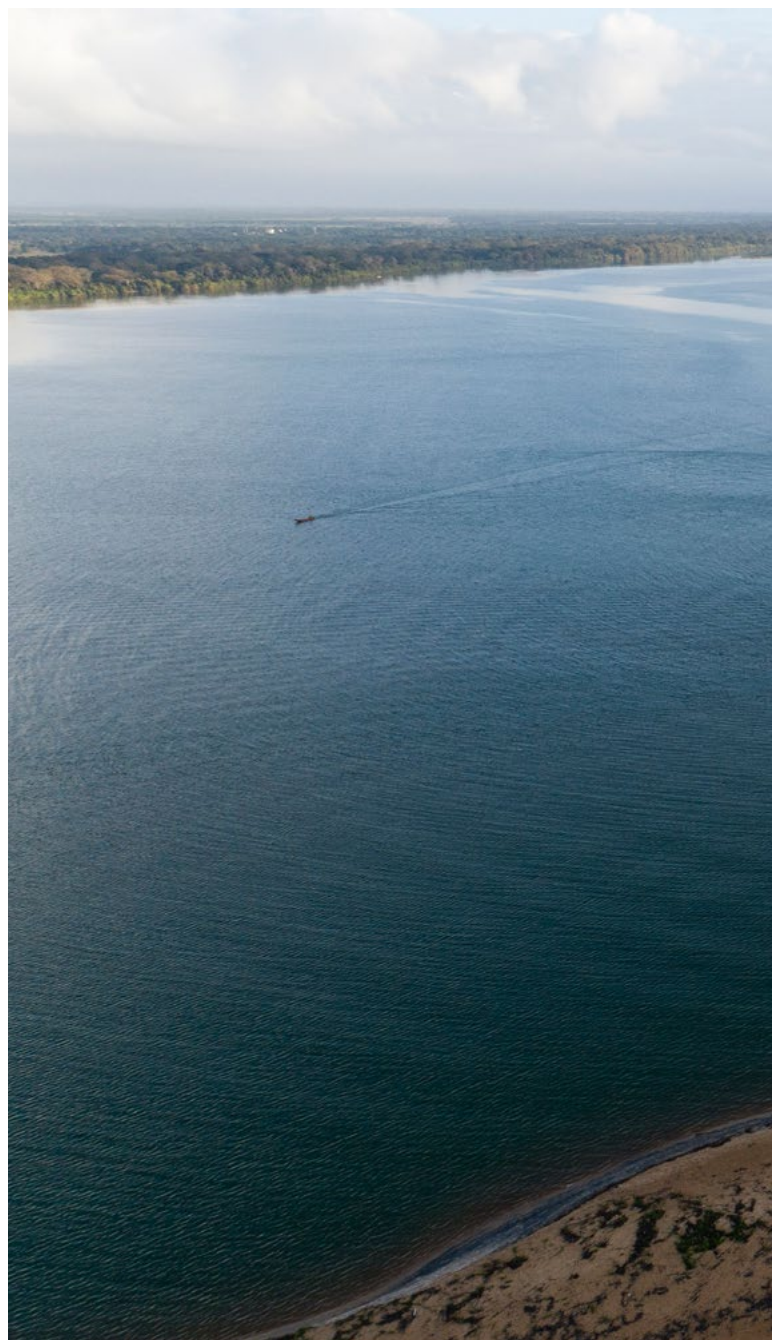
6.4 ADOPTING SOURCE-TO-SEA AND LANDSCAPE APPROACHES

The TTAC requires the restoration to return conditions to the pre-disaster state as it was in November 2015 (Clause 06.II). However, even if adequate data were available to characterise the *ex ante* environmental conditions, the Panel took the position that such a 'causal nexus' restriction would be neither feasible nor desirable. Instead, the Panel viewed the restoration as an opportunity to 'build back better', through a wide-ranging programme for the continual recovery of the Rio Doce Basin that could eventually be replicated in Brazil's other river basins and elsewhere.

Renova had been organised to implement the programmes outlined in the TTAC, and the completion of these programmes was the Foundation's number one priority. However, the TTAC's emphasis on programme-by-programme implementation led to a compartmentalised approach, which made it more difficult to achieve an overall understanding of the disaster's impacts and to develop viable long-term solutions for the most chronic and critical impacts.

From the start, however, the Panel argued for a more integrated strategy, one that would combine Landscape and S2S approaches. An S2S approach would enable a better understanding of the dynamics between the social, economic and environmental aspects. It would also focus more on the interrelationship between different environmental concerns, such as water quality, wastewater treatment, land use, biodiversity, livelihoods and human health, among others.

The integration of Landscape and S2S approaches would therefore allow stakeholders to better understand and plan for the long-term restoration of the Rio Doce Basin, including attention to the estuary, coastal, and marine areas. These approaches should be understood not solely as a theoretical approach but as an innovative set of tools that can combine with participatory stakeholder engagement for an effective restoration plan.



Below: Parts of the Rio Doce estuary,
September 7, 2020. Renova Foundation.
Photo: All rights reserved to NITRO Historias Visuais



6.5 SOCIAL AND ECONOMIC IMPACTS

The Panel had limited engagement with social and economic issues relating to the disaster, since it needed to be independent of the ongoing and potential legal disputes relating to claims for indemnity payments covering damage to life, health, property, and livelihoods.

Early on, however, the Panel did address some of the broader economic development issues in an innovative paper (IP01 – May et al., 2019), that suggested an alternative vision for the basin, based on more intensive, sustainable agriculture, rural tourism, the vertical integration of value chains, improved standards, and the development of a learning economy to be financed by permanent revolving funds. A second issue paper (IP02 – Brito et al., 2019) argued that the restoration of inland and coastal fisheries would require a unified decision-making framework to determine when and how the responsible authorities could lift the fishing bans following their imposition in the wake of the disaster. IP02 also recommended that fishing communities be more involved in the monitoring and measurement of relevant indicators.

The Panel consistently sought to promote the concepts of ‘citizen science’ or participatory monitoring at meetings to launch and disseminate its issues papers (IP02 – Brito et al., 2019; IP05 – Alonso et al., 2020) and thematic reports (TR03 – Brito et al., 2021). In principle, Renova responded positively to this idea, and put the approach into practice by involving local people to monitor water quality. Indeed, bulletins on Renova’s website represent a positive example of how information from monitoring programmes can be obtained and presented in a way that is accessible and comprehensible to the general public. However, this citizen science approach did not go much further even though some of the directly affected communities, such as Degredo, a traditional Afro-Brazilian (*quilombola*) community on the ES coast, possessed the organisation and qualified professionals needed to permit more ambitious participatory monitoring programmes. These could have included the monitoring of flora and fauna, fisheries, and the quality and availability of ground and surface water.

Below: Rio Doce Panel visiting Instituto Terra and its nursery of native plants used to restore the Rio Doce Basin. Aimorés, Minas Gerais. March 2019.

Photo: Rio Doce Panel archive



Above: Bridge over the Rio Doce estuary.

Photo: All rights reserved to NITRO Historias Visuais

Below: Group of people on a boat at the mouth of the Rio Doce. September 7, 2020. Renova Foundation.

Photo: All rights reserved to NITRO Historias Visuais



Above: Professor Luis Sánchez, a member of the Rio Doce Panel, presents the Thematic Report 1 during a meeting with researchers from UFES in Vitória, Espírito Santo. March 2019. Photo: IUCN/ Rio Doce Panel archive

6.6 HEALTH IMPACTS

One of the most frequently repeated demands to the Panel, made by the affected population, was for better information about the disaster's impacts on physical and mental health. Such impacts are typically seen as a consequence of direct exposure to the tailings, to tailings dust, and to the contamination of water supplies. But human health can also be affected by the consumption of contaminated fish and irrigated vegetables, as well as the social and psychological impact of community displacement, loss of livelihoods and dependence on monthly indemnity payments to displaced households, fishers, artisanal miners, and other affected groups.

The Panel recognised that an integrated treatment of human and ecosystem health would be beneficial for people affected by the disaster. This was thus a serious lacuna in the restoration process. Renova staff have tried to lay the groundwork for a programme of Integrated Environmental and Human Health Management (GAISMA). However, the judicial decisions have required that Renova treat these issues separately. As a result, this integration has been omitted from most remediation and restoration efforts over the seven years since the dam break.

The Panel did, however, draw attention to the continued need for an integrative perspective. For example, its final Issue Paper recommended the One Health approach (IP05 – Alonso et al., 2020). This approach shows how best to coordinate programmes, policies, legislation and research in order to unlock collaboration between the human and animal health and ecosystem conservation sectors, thereby improving public health.

IP05 addressed the wider links between human health and the environment, recommending support for public health monitoring and the exchange of information between the formal public health system (SUS, from Portuguese acronym *Sistema Único de Saúde*) and organisations in the fields of community and environmental health. These recommendations were not immediately taken up, but public health was later included as a priority theme in the TTAC's renegotiation. Additional studies would provide a more complete assessment of the disaster's impacts on human health in the areas most directly affected, but they remain stymied due to dissent in the judicial arena.

6.7 IMPORTANT THEMES NOT ADDRESSED BY THE PANEL

The Panel was unable to address critical restoration issues for reasons that varied from lack of technical expertise to situations that had been referred to courts.

One critical theme that was not tackled was how to manage the tailings deposited in the river, on the floodplain and – most of all – in the reservoir of the Risoleta Neves (Candonga) hydropower plant. Almost half of the tailings that descended the river remained in the reservoir, halting the plant's operation. They continue to represent a potential source of future contamination during periods of heavy rainfall, when the tailings are washed downstream, affecting the future of the river and estuary as well as the coastal and marine areas. The Panel consistently recognised that the continued presence of the tailings and sediment deposits was a priority issue that merited a detailed, technical analysis of the potential options and associated risks. This was particularly true in the context of the climate crisis (TR02 – May et al., 2020). In TR02, the Panel highlighted the probability that climate change will make floods more frequent and severe, an effect that the unsustainable land use practices present in much of the basin exacerbates.

Below: View of the Fundão Dam. Photo taken during the Rio Doce Panel's visit in July 2022.

Photo: IUCN/ Rio Doce Panel archive





Above: Inspection conducted by Ibama in July 2016 on the stretch affected by the rupture of the Samarco mining company's tailings dam in Mariana, Minas Gerais.
Photo: Felipe Werneck/Ibama

Left: Inspection conducted by Ibama in July 2016 on the stretch affected by the rupture of the Samarco mining company's tailings dam in Mariana, Minas Gerais.
Photo: Felipe Werneck/Ibama

When the Panel began its work, it did not prioritise the potential cumulative impacts from tailings deposition and sediment flows on the marine and freshwater biota, but it was agreed that, should the need arise, additional expertise would be sought, either through an external consultant or by adding an extra member to the Panel. As discussed above, however, Renova later sought the Panel's advice on how to better understand and manage the environmental impacts on the coastal and marine areas. Meanwhile, Renova had contracted a detailed assessment and monitoring of biota in the estuary and adjacent coastal region to a consortium of universities and scientific researchers in Espírito Santo, along with parallel studies by the Brazilian Foundation for Sustainable Development (FBDS) and consultants assigned by UNESCO. The emerging complexity and conflicting scientific findings from these overlapping studies pointed to the continued risk from deposition of the tailings. Given the lack of a common basis for describing and assessing impacts, and the need to systematise impacts into a common structure, Renova and the Panel agreed to work on the development of a systematic framework that would enable interpretation of the results generated by these and other studies.

7 LESSONS LEARNED

As previously discussed in this paper, the restoration of the Rio Doce is a complex and dynamic process, involving stakeholders who are often suspicious or unwilling to trust the recommendations of others. This suspicion has been compounded by the pressure to take decisions and implement them in a timely fashion, since the disaster deprived people of essential environmental services, such as potable water, fisheries and housing.

Here, the Panel offers some general suggestions that might be useful for future ISTAPs and Rio Doce stakeholders to help prioritise issues, achieve consensus and implement sustainable, efficient and long-term solutions.





Left: Aerial view of the Rio Doce below the city bridge. Renova Foundation | Expedicao Caminho da Reparacao. Governador Valadares, Minas Gerais. September 24, 2018.

Photo: Bruno Correa / NITRO Historias Visuais. All rights reserved to NITRO Historias Visuais

7.1 PROMOTE A LONG-TERM, SHARED VISION FOR CONTINUAL IMPROVEMENT

The effects of the Fundão Dam disaster were complex and the process of recovery has to be sustainable in the long run. To ensure such results, the process itself is as important as the outcomes. Thus, successful engagement with government and civil society is key to a sustainable and lasting restoration. The Panel focused its work on issues that contribute to the long-term sustainability of the basin and its inhabitants. To achieve long-term sustainability, these issues depend on successful intervention and engagement with local and regional institutions.

Man-made and natural disasters can have devastating impacts on the local population, their economies and social infrastructure, but they can also offer an opportunity for longer-term improvement. Recovery is not simply a return to prior conditions. The opportunities should be mapped and planned with input from diverse stakeholders – especially those that have been most directly affected – to achieve a common vision for the future.

The full benefits of a shared vision may not be felt for decades. The socioeconomic benefits of changes to economic structure, education, and sanitation may not be felt in the short term, but in the long term they are essential for the continual improvement of the environment, economy and social conditions. This is especially true for poor and degraded regions, such as the Rio Doce Basin. In the same way, the basin's environmental recovery needs to involve landowners in the restoration of degraded pastures, recovery of riparian areas and springs, alternatives to agrochemicals, management of waste generated by livestock, and so on. Fishers should play a role in the monitoring and sustainable management of native fish stocks and the spread of exotic species. Extractive industries should be engaged in alternative storage for tailings, while municipal authorities and public utilities can play roles especially in wastewater treatment and the management of solid waste.

Consultation and engagement are key to achieve a shared vision and to the development of viable programmes with an exit strategy that will ensure the restoration's continuity and sustainability. Such investments may not have immediately visible results, but they are essential for human and ecosystem health. When adapted to the specific realities of other regions and countries, this model could be applied to most post-disaster scenarios. It could also be adapted to major investments in infrastructure or extractive projects.

A participatory process may appear more complex and time-consuming, but it is the only way to guarantee a process of continual improvement that will satisfy the expectations and needs of the people affected. In the Rio Doce case, affected communities were not involved in drawing up the TTAC or in the subsequent decision-making, and this has exacerbated the mistrust and conflicts generated throughout the restoration. Some of this was inevitable, but it could have been lessened by more effective engagement with the different groups of people affected.

In the immediate aftermath of disaster, short-term solutions are required to cover people's immediate needs, reinstating access to potable water, energy supply and housing. Once this has been achieved, and people's confidence restored through short-term actions, it becomes necessary to start thinking more strategically. This requires longer-term process-oriented programmes that allow for continual improvement. Even shorter-term restoration activities should encourage participation and

Below: In the image, a person driving a boat at the mouth of the Rio Doce. Renova Foundation. September 7, 2020. Photo: All rights reserved to NITRO Historias Visuais



engagement with affected communities. By producing rapid results and ‘quick wins’, engagement can build trust between the different stakeholders.

The Panel consistently recommended the need for affected people to have the opportunity to participate in decisions about the restoration. In the case of the Fundão Dam disaster, the decision-making structure established under the TTAC led to drawn-out discussions that extended from federal and state government agencies to the public prosecutors and eventually to the judiciary. It lacked the mechanisms that would allow greater participation by those most directly affected, thus limiting their engagement and commitment to the restoration programmes. Participation is not easy – but if decision-making is done only by the existing governmental bureaucracy, then it becomes more difficult to empower society and to achieve the long-term changes needed for ‘building back better’.

In the beginning, the Panel focused on making recommendations to Renova. As time went on, however, the Panel realised the importance of engaging with other stakeholders, since different actors had to be involved to achieve lasting results through a more participatory process.

One of the lessons that may be applicable to other ISTAPs, therefore, is not to focus exclusively on one or more specific stakeholders, but to share the recommendations more widely and engage directly with all the relevant stakeholders. The Panel had been slow to work with agencies other than Renova, but during the preparation of TR02 (May et al., 2020) Renova expressed its discomfort with managing issues related to climate change. This helped the Panel appreciate the importance of engaging with a broader group of actors.

Below: Rio Doce Panel and IUCN secretariat during internal meeting during visit to the Rio Doce Basin. March 2019. Photo: IUCN/ Rio Doce Panel archive



7.2 RECOGNISE THE POWER OF LEADERSHIP AND COLLABORATION

Individuals are an important part of the restoration process, especially when difficult negotiations are required. Trust and leadership make a difference.

The capacity for collaboration among different stakeholders is critical to the establishment of responsive governance. According to Young (2013,p. 93), different types of leadership can improve the quality of collaboration: “i) cognitive leadership is the ability to come up with new ways of thinking about key issues; ii) entrepreneurial leadership [is] ... the ability to exercise skill in making deals or devising the terms of mutually acceptable agreements; and iii) structural leadership is the ability to bring the influence of powerful actors to bear in a constructive manner.”

Regardless of the leadership type, however, some stakeholders in a governance scenario must show one or more of these abilities, which are not mutually exclusive. Where collaboration between stakeholders is essential, individuals can make the difference if they have the capability and will to influence key decision makers.

Indeed, the Panel observed that different styles of leadership impacted the negotiations and implementation during the restoration. The Panel’s interviews with a range of stakeholders made it clear that the complicated relationships between Renova and government agencies meant that consensus was often difficult to achieve.

This underscores an important issue for future ISTAPs. Their need for independence prevents them from acting as an intermediary between business or government agencies and the people directly affected. However, an ISTAP should be able to recognise the concerns of affected people, give voice to their aspirations, and encourage the relevant agencies to engage with them more effectively.

Right: Yolanda Kakabadse, Chair of the Rio Doce Panel, during the launching of the 5th article of the series Issue Paper. Belo Horizonte, Minas Gerais. March 2020.
Photo: IUCN/Rio Doce Panel archive



7.3 LOOK FOR INTEGRATED, MULTIDISCIPLINARY SOLUTIONS

The desire for quick results may lead to the compartmentalisation of discussions and solutions, rather than calling for an integrated approach and acknowledging the complexity of the situation and the wide range of stakeholders.

Many restoration issues are in fact connected and the existence of parallel structures can interfere with one another. For example, if the water is contaminated, then the fish may also be contaminated, with implications for people's livelihoods, nutrition, and health. This is obvious, but when different departments or agencies are responsible for water quality, biota, public health and the economy, it becomes more difficult to attain an integrated approach. The responses of different agencies may even contradict one another as in the case of the fisheries ban discussed in IP02 (Brito et al., 2019). Technical discussions can get lost in minor details that impede the search for effective solutions when they should be considered together, taking a broader landscape perspective to address issues that affect local welfare.

The Panel consistently stressed the value of a landscape approach, rather than compartmentalised solutions. Renova did not fully internalise this view, but other stakeholders did acknowledge the need for integrated solutions to the chronic problems facing the Rio Doce Basin and associated coastal and marine areas. In this respect, the Panel played an important role, presenting the S2S approach together with landscape perspectives in a specific thematic report focused on the integration of biodiversity and water quality (TR03 – Brito et al., 2021). The S2S framework is a practical approach that has been tried and tested, not only in the Fundão case, but also in other similar situations.

The S2S principle could be applied elsewhere to restore and improve the environmental, social, and economic situation of a disaster-affected region. The impact analysis and the design of medium and long-term measures should avoid a piecemeal approach. Instead, they should adopt a broader perspective, combining landscape and S2S approaches from the start. This makes it easier to respond to the environmental, social, financial, economic, and cultural aspects of the affected region. The approach encompasses not only the spatial dimension (terrestrial and/or coastal areas), but also key flows – water, biota, sediment, pollutants, materials and ecosystem services. The S2S concept was first introduced by the Panel in its Issue Paper No. 3 (IP03 - Barbosa et al., 2019), in

which it was proposed that Renova consider installing a permanent floodgate in the Rio Pequeno to protect waters of the Juparanã lake – an important water source in the lower Rio Doce – from pollution by the Rio Doce in flooding conditions. The floodgate would have an opening and closing system to control the volume of water in rainy and dry periods to ensure connectivity between ecosystems.

The affected territory covers a vast area in two Brazilian states, with distinct social, economic, and cultural characteristics. Both states have been degraded by centuries of extractive activities, unsustainable agricultural practices and contamination with raw sewage and solid waste.

Rather than seeking a return to the pre-disaster situation as a baseline, it would be better to seek a negotiated solution that would improve conditions and kick-start a process of continual improvement in the region. This requires engagement with all the relevant parties. The Panel addressed the baseline considerations in TR04 (Maroun et al., 2021) and acknowledged the vital importance of a common vision for the region's future rather than a return to the pre-disaster conditions. This recommendation was discussed with various stakeholders, but in retrospect the Panel should have highlighted the importance of this approach from the start.

Clearly, the companies responsible for the disaster and local and state governments have a special responsibility for negotiating and defining a common vision for the future. In this context, the Panel believes that ISTAPs can play a valid role in aiding and supporting stakeholders to come together in search of a common vision.

The Panel also recommended that Renova support the establishment of a long-term fiduciary fund to finance continued efforts in the basin (IP01 – May et al., 2019) investing some of the resources originally intended for reparation. However, Renova rejected the concept on the grounds that it was not consistent with the mandate for immediate and short-term results. However, landscape analysis by Renova, UNESCO, the World Resources Institute (WRI), and other organisations have recommended that additional resources be directed toward a broader basin-level approach, including systematic analysis of the long-term development scenarios.

7.4 ENGAGE AND EMPOWER THE PERMANENT INSTITUTIONS

The process of restoration should consider the long-term governance of the affected region, noting that permanent institutions and those responsible for the restoration may have overlapping and complementary roles to play. The restoration programmes have generated studies, data, information systems, and especially capacity to execute restoration actions, but these may be lost if they are not integrated into the permanent structures of governance for the maintenance of nature's services.

In principle, there should be a balance between tasks assigned to the restoration programme's institutions and to the long-term, permanent institutions that will eventually continue the restoration's programmes and investments.

Both CIF and Renova have engaged with permanent institutions such as the Rio Doce Watershed Committee, universities, and NGOs in the area, viewing them as valuable sources of expertise. Similarly, the Panel also prioritised permanent institutions when it reached out to other groups of stakeholders.

Early on, the Panel completed a stakeholder mapping and analysis of the impacted region (see discussion of the Panel's ToC, above), allowing the Panel to understand which permanent institutions might manage selected programmes in the longer-term. During the preparation of the thematic report on governance (TR04 - Maroun et al., 2021), this analysis was updated to include a broader range of stakeholders. Key findings were also discussed with various institutions beyond Renova.

The key lesson for other ISTAPs is to initiate a process of stakeholder mapping at the outset and to update it regularly. This will provide clear understanding of the governance roles of each actor or agency in the affected region. Understanding the involvement of these actors is fundamental to the early integration of restoration efforts, guaranteeing continuity and long-term improvement.

Right: In the image, a stretch of the Rio Doce near its mouth. Renova Foundation.

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7.5 CONSIDER CLIMATE CHANGE THROUGHOUT

The climate emergency threatens ecosystems and human well-being. Emerging diseases, water rationing, droughts, and floods will become more frequent in the coming years. Fundamental changes to the economy and social values will be vital to avoid and manage these challenges. Climate change is likely to aggravate the degradation of fragile and degraded landscapes such as the Rio Doce Basin. Restoration plans and programmes should share a common climate strategy, covering both assessment and adaptation to the effects of climate change.

The Panel needed to persuade Renova that climate change issues were within its remit. Renova had been doubtful on the grounds that, first, climate change would only impact the region in the distant future, and second, that the impacts of climate change were distinct from those caused by the dam collapse. This underscores the tension between the short and long term, and between the causal impacts of the dam collapse and the need to address the underlying environmental conditions. Renova and its Board of Directors strongly contested the idea, for example, that climate change could be the cause of the extraordinary storm and rainfall events associated with the repeated deposition of tailings along the river. The Panel insisted that the theme was relevant and discussed its recommendations from TR02 (May et al., 2020) with different stakeholders.



7.6 REFLECTIONS ON THE PANEL'S *MODUS OPERANDI*

The Panel's structure and *modus operandi* may be relevant for future ISTAPs. Panel members met in person twice a year and held videoconferences at the end of every month. This helped to maintain the Panel's cohesion and the quality of interaction between its members. It also kept them up to date on the development of the thematic reports and issue papers and the reparation process itself. The Panel also held debriefing sessions following meetings and systematised the relevant information for use in subsequent analyses. Panel members met with the Chair at the end of each face-to-face meeting to evaluate each other's performance and consider future pathways.

Panel members also found it useful to divide into core groups when developing drafts of the thematic reports and issue papers. However, Panel members found it difficult to review these products if more than one paper was being prepared simultaneously. Future ISTAPs are advised to discuss and consider this balance and to review it from time to time, considering the expertise of the Panel members and the need for their participation in selected documents. ISTAPs are also advised to generate shorter, more concise products, even carefully presented intermediate products, rather than high-quality, professionally edited reports that are outdated by the time they are presented.

An important aspect to be considered in future ISTAPs is to support Panel members to participate in important regional and international events. This offers the opportunity for feedback and discussion and allows Panel members to learn from comparative perspectives and other cases, as well as permitting the Panel to share its work and insights with different stakeholders.

To what extent should the Panel be involved in the definition of solutions and moving them forward? The Panel's distinct approach recognised the urgency of the situation as well as the need to consult on the direction of the papers. It underscored the need to balance a response to specific demands for technical information with the development of broader recommendations. It was the Panel's decision to maintain its independence and not to project itself into decision-making on implementation. That said, however, the Panel's recommendations invariably suggested pathways to improve the restoration process, whose results were carefully monitored for effectiveness.

Below: In the image, stretches of the mouth of the Rio Doce. Renova Foundation. September 7, 2020.
Photo: All rights reserved to NITRO Historias Visuais




FINAL CONSIDERATIONS

In the wake of the Fundão tailings Dam collapse, the establishment of the Rio Doce Panel under the *aegis* of an institution as credible as IUCN helped to bring independent, impartial, landscape and long-term perspectives to the restoration of the affected area. The negotiations around the restoration and related processes were often extremely complex, since the multiple actors were often suspicious of each other and held distinct and often conflicting views. Moreover, the discussions tended to focus on specific, compartmentalised concerns. Despite the need for short-term solutions to respond to people's immediate needs, it is also essential to think about solutions to the long-term impacts caused by disaster.

An ISTAP can influence the process by highlighting the need for a long-term, integrated perspective, even if implementation of the recommendations is neither direct nor immediate. An ISTAP's influence may not be felt immediately by stakeholders in a disaster restoration, but it does endure.

ISTAPs can also influence important processes indirectly. One of the Panel's main legacies was the publication of impartial and independent analysis and technical advice that could be used by actors in different contexts, beyond that of the restoration of the Rio Doce watershed. By publishing thematic reports and issue papers throughout its five years of operation, the Panel contributed to discussions to change practices in the sector and to mainstream global concerns, such as climate change.



In the image, parts of the Rio Doce estuary. Renova Foundation. September 7, 2020.

Photo: All rights reserved to NITRO Historias Visuais

The Panel's recommendations were grounded in globally relevant scientific literature, and they reflected a long-term approach and landscape perspective. This can be adapted to similar disaster situations, whose frequency is increasing rapidly with climate change.

The Panel's process for developing recommendations was as important as the recommendations themselves. Knowledge of topics and methodologies that would never have been considered without participation of an ISTAP became widely disseminated in the process of consultation with stakeholders. This holds true for the S2S approach, an innovative methodology introduced by the Panel for assessment and integrated management of river basins. In the Rio Doce example, the S2S approach was presented didactically to key stakeholders in the long-term development of the region. These stakeholders included the CBH-Doce and the Pro-Rio Doce Management Committee, led by the government of Minas Gerais, both of which reacted favourably.

While preparing documents, the Panel's interactions may indirectly have enabled communication and collaboration between different Renova staff, including those who had not previously worked together in an integrated fashion. The Panel's influence directly led to the creation of the Impacts Curatorship, for example, whose mission it is to understand the disaster's broader impacts.

The lessons learned by the Panel in developing recommendations, connecting and influencing people, and communicating its products, represent a significant legacy for the Rio Doce Basin, from its source to the sea. It is hoped that other regions and future ISTAPs can benefit from the experiences and accomplishments learnt over five years by the Rio Doce Panel.



Abow: Aerial view of the Rio Doce passing through Baixo Guandu. Renova Foundation Baixo Guandu, Espírito Santo. September 9, 2020.
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