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## **Institutional Responses to Climate Change: Opportunities and Barriers for Adaptation in the Pantanal and the Upper Paraguay River Basin**

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**Abstract:** Climatic change is expected to have serious impacts on the Pantanal, a large tropical wetland located in the Upper Paraguay River Basin, in the centre of South America, where a range of institutional responses are being developed to mitigate and adapt to climate change. In order to examine the institutional achievements and challenges for managing the region, a specific typology is initially introduced, which comprises a schematic gradient of institutional responses. An empirical analysis was conducted in Brazil, Bolivia and Paraguay, the three countries that share the Pantanal, which identified the hybrid basis of the policy framework under construction, in the sense that it actually combines elements of various institutional responses included in the proposed typology. Important factors that seem to undermine the efficacy of institutional responses in addressing climate change in the region are the strong influence of the agribusiness sector and the still relatively low importance of the Pantanal for national environmental policy-making. This essay makes a claim that the principles of climate justice should guiding policies and interventions as it they constitute the most appropriate strategy to address the inequality and unfairness related to climate change.

**Keywords:** Pantanal wetland, climate change, Bolivia, Brazil, Paraguay, climate justice

### **1. Introduction**

The global interlinkages of the climate regime mean that no region in the planet is likely to be spared of the consequences of anthropogenic global warming, even areas that are located relatively distant from the main economic and industrial centers, such as the South American Pantanal, located in the Upper Paraguay River Basin (UPRB) and shared between Brazil, Bolivia and Paraguay (Ioris, 2004). The Pantanal, a genuinely unique area, as much as for its natural beauty, its diverse ecology, as for the peculiar cultural traits of its population (Girard, 2012) is considered a Brazilian national heritage since 1988 and was declared World Heritage by UNESCO in 2000. In the Pantanal region, temperature has already risen markedly during the 20th century and there are signs that the rainfall regime is undergoing changes with longer dry seasons (Marengo et al., 2010a; PBMC, 2013a).

In this article we expand a typology (first elaborated by Ioris, 2014) that helps to examine how institutions have responded to climate change in terms of mitigation and adaptation and to show that “climate justice” seems to be the most reasonable and justifiable institutional approach for dealing with climate change in peripheral areas under intensive processes of change such as the Pantanal. The essay will particularly assess the extent to which institutional responses encapsulate the legacy from the past, the controversies of regional development and the perspectives for the future. Understanding the relationships between climate change, human responses and how legal framework, law enforcement and institutions shape such responses is an increasingly urgent need.

Adaptation to existing climate variability is highly local, however, success depends on the establishment of national and regional policies frameworks that are effectively implemented at the local scale (Argrawal, 2008; Adger et al., 2007; IPCC, 2007, Lim et al., 2004).

In the next pages we will first present and discuss the typology of institutional approaches to climate change. Then we will briefly describe the Pantanal area, its recent history with a focus on development policies as well as historical climate variability as well as foreseen climate change. In the main part of the text we will examine the institutional approaches to climate change in the area using the above typology and finally discuss the relevance of “climate justice” regarding adaptation to climate change in the region.

## **2. A Schematic Typology of Institutional Responses to Climate Change**

Responses formulated by governments and civil society organizations combine a range of interpretations of the causes and future scenarios of climate change, which are influenced by the specific socio-political and ecological circumstances. Policy responses are not restricted to the economic and legal domains, but represent adjustments in a range of social institutions. It should be noted that institutions are here understood as norms, cognitive frames and meaning systems that guide human action and structure social interactions (Hall and Soskice, 1996). Institutional responses must be seen as norms that shape action, frame identities, affect the realization of problems and influence decisions and solutions. Such responses are not purely rational or technical, but include a range of actions that are culturally determined and constantly renegotiated between groups of interest (O’Riordan and Jordan, 1999).

The proposed typology is informed by the international literature and includes a gradient of five types of institutional responses, which are summarized in Table 1 and described below. The rationale behind this classification is that responses to the threats of climate change are both informed by the institutional arrangements and are also materialized through modifications in social institutions.

[TABLE 1 about here]

### **2.1. Climate skepticism**

Despite such mounting scientific evidence and concerted international efforts, there is still significant skepticism, particularly among right-wing political groups, about the actual causes of climatic change. Climate skepticism refers to a sense of climate ‘denialism’ or ‘contrarianism’ that has recently been very much in the media spotlight (Nerlich, 2010). Skeptics argue that it is not possible to demonstrate, beyond doubt, the progressive warming of the planet does not have natural causes (Poortinga et al., 2011). In practice, climate skepticism has been a convenient and prominent institutional response to the climate change demands. This argument has been particularly useful for lobbyists representing the interests of sectors that would be most affected by emission reductions. The perverse result is that climate skeptics have had a material – perhaps growing – influence on governments unwilling to spend resources and political capital on the adjustments required to cope with climate change.

## 2.2. Marketization measures

In order to achieve the stabilization of GHG concentrations, economists have recommended the allocation of appropriate emission reduction through market-based mechanisms (Jepma and Munasinghe, 1998). Such approach is based on the claims that a global optimization of GHG emissions can secure techno-economic efficiency mainly through market-like transactions (Bührs, 2010). These sort of institutional responses – that constitute a main inspiration for public policies and are indeed the main driver of the climate change diplomacy nowadays – are directly influenced by the application of the neoclassical economic theory to the study of environmental degradation (Ioris, 2010). However, it must also be observed that the reduction of wider socio-economic and environmental processes to a set of independent utility functions has become an important source of criticism levied against environmental economists. Anthoff and Tol (2010) specifically argue that the standard calculation of the costs of emissions and impacts is inadequate. These approaches restrict the responses to climate change to the narrow determination of economic costs, benefits and effects. Economic-centered measures fall short of addressing the mounting conflicts and negative impacts associated with the emission of GHGs, as well as the recognition of differential responsibilities.

## 2.3 Systematic adaptation

Another institutional response is systematic adaptation, an approach based on “experimentation”, that is, by a constant reassessment of initiatives and results (Arvai et al., 2006). The process is often initiated as a result of several factors, such as a perceived environmental threat or crisis (e.g. climate change), a new regulatory demand or the availability of financial incentives. At this point, stakeholders begin to appreciate their interdependence, the need to act together and the importance of redesigning social institutions (Gupta et al., 2010; Glaas et al., 2010).

Adaptive management, as a main institutional response nowadays, is essentially part of the broader agenda of environmental governance that permeates contemporary policy-making (Engle and Lemos, 2010; Mitchell and Breen, 2007). The argument of adaptive management (and the related endorsement of environmental governance type of solutions) has the serious weakness of diluting the accountability for the causes of climatic change and the uneven distribution of impacts (Tompkins et al., 2010).

## 2.4 Architecture of Entitlements

To overcome the limitations of environmental economics and adaptive management, the two main discourses underpinning environmental action today, Adger et al. (2001) recommend that responses to climate change should follow the lens of entitlements. The line of reasoning is that the extent to which groups and communities are entitled to use resources determines their ability to cope with and adapt to climatic stress. Consequently, the focus should shift towards the determination of entitlements and obligations among the parties involved in the use and conservation of natural resources. This fourth approach brings attention to how and by whom entitlements are defined and contested, and also the wider political and socioeconomic aspects of environmental management. (Adger and Kelly, 1999). Nonetheless, Devereux (2001) condemns the architecture of entitlements approach for its methodological individualism and its privileging of economic aspects above socio-political determinants.

## 2.5 Climate Justice

The emerging climate justice movement, the fifth approach, focuses on the politicized interactions between climate change threats and the erosion of social and economic rights. Haines and Reichman (2008) argue that fair approaches to climate change require understanding the strengths and limitations of conventional environmental policy-making. For those authors, the creation and funding of international institutions for adaptation or mitigation to climate change inescapably involve questions of justice (Harris and Symons, 2010). Because of the perceived discrimination and injustices that are maintained or aggravated by the responses to climate change, the global movement on climate justice has criticized the ineffectiveness of top-down responses, as well as the expansion of 'green capitalism', that benefits from the environmental crisis itself (Dawson, 2010).

The five main institutional responses mentioned above will be considered in relation to the mitigation and adaptation to climate change in the Upper Paraguay River Basin and the Pantanal in a following section.

### 3. The Pantanal's Climate Change Context

The Pantanal, the largest continental wetland in the world, is a seasonally flooded floodplain fed by various large rivers borne in plateaus surrounding its eastern half (Figure 1). It is located in a savannah (locally known as Cerrado) region characterized by a rich biodiversity, which face serious threats with the spread of the agricultural frontier. It is classified today as the most endangered savannah on the planet and one of the 34 global hotspots (Mittermeier et al., 2004). Since the 1970s, large areas of savannah have been replaced in their entirety by pasture and monoculture of grains, especially soybeans and corn (Pinto, 1990) as a result of public policies to promote agricultural and socioeconomic development (Alencar, 1975). The massive replacement of the natural vegetation due to a rapid shift of the agricultural frontier promoted deforestation, forest fires, indiscriminate use of chemical fertilizers and pesticides (Pignati, et al. 2007; Does and De-Lamonica-Freire, 2001; Soares and Porto, 2007; Rieder, et al, 2000). It is noteworthy that in Brazil, deforestation is the main source of GHGs (Cerri et al., 2007).

[Fig 1. About here]

The actual climate of the UPRB is characterized by a marked seasonality pattern. During the dry season, from May to October, dry spans of over a hundred days without rain are not uncommon. Most of the rain falls during January, February and March and heavy rainfalls are frequent (Collischonn et al., 2001; Girard, 2011; Piccilli, 2007). During the 20th century temperature have consistently risen within the basin and precipitation regime has become unstable as events more humid than normal as well as events dryer than normal have increased in the course of this century (Marengo et al., 2010a). The scientific community has actually identified a series of potential consequences that are going to follow climate change in South America, which includes the salinization and desertification of agriculture land, the savanization of forested areas and a reduced availability of water (IPCC, 2007, Marengo et al., 2010b; 2011). Over the next century it is likely that temperature will rise from to C. Models results for rainfall do not converge: they vary from -15 to +15 % with respect to present. Even if

precipitation does not change in the future, it is likely that the dry season will be longer and that the same amount of rain will fall in a shorter time span (Sampaio, personal communication). As well, climate instability is likely to increase in the Pantanal region as elsewhere in Brazil (Marengo et al., 2012). Under such a scenario impacts on biodiversity agriculture energy and water resources and health are to be expected (PBMC, 2013b).

#### **4. Assessing the Responses to Climate Change in the UPRB**

The typology of responses mentioned earlier should now help to understand the socio-political context and the institutional dilemmas currently affecting the management of the UPRB and the Pantanal region. The starting point of our analysis, nonetheless, is the recognition that the UPRB does not figure very high in the list of climate change priorities of Brazil, Bolivia or Paraguay. On the contrary, in those three countries scientists and policy-makers have mostly concentrated their attention to other biomes (such as the Amazon, the Andes and the Chaco, respectively). That situation represents a considerable ‘policy-making gap’ in the Pantanal that, in the end, has tended to undermine the advance of climate change policies within each country and between countries.

##### **4.1 Brazil**

In the Pantanal region there is a mix of institutional approaches to climate change. The most enduring approach to climate change in the Pantanal region is without doubt climate skepticism, which still permeate the strategies of governments and socioeconomic sectors. In the specific case of the Brazilian Pantanal, there are policies regarding the management of the environment, land, and water resources and climate change, but they do lack the necessary interlinkages to address the challenges of climate change.

The Brazilian Federal Constitution of 1988, considered the Pantanal a national heritage, stating that its use will be it in the form of law, under conditions that insure the preservation of the environment, including at this point, the use of natural resources. Despite of all this formal relevance, after more than twenty years, the Brazilian Congress has not approved a federal law to regulate the conservation of this biome. The states of Mato Grosso and Mato Grosso do Sul, in whose territories lies Pantanal, have passed state laws that had limited effects in the region.

Until the federal law regulating the biome is promulgated, the Forest Code (LAW N° 12.651, 25/05/2012) applies as a general rule to protect the environment and redeem conflicts between stakeholders. The code does not have a specific treatment for the Pantanal, and though it acknowledges for relation between forest uses and climate change, it does not provide any tools to take this relation into accounts even though it states that the policy should in the future provide these tools.

In a similar fashion the National Policy for Water Resources (LAW N° 9.433 08/01/1997) ordines the use of water resources. State policies in the Pantanal region followed the national policy. The instruments and administrative bodies of these policies did not yet integrate climate change as a reality to be dealt with. For example, a search conducted 1/0 /201 of the site of the National Water Agency (ANA) with the “climate change” ey words returned only one result: a Global Environmental Facility (GEF)

Project in the Amazon to which ANA is associated.

Finally, Brazil elaborated a National Policy for Climate Change (LAW N° 12.187), which main objective is to curb green house gases emissions, but this piece does not provide any specific strategies regarding the Pantanal, land use or water resources. Even though the law explicitly mentions adaptation, the eight sectorial plans already elaborated barely touch on the subject, except the health sectorial plan.

Apart from climate skepticism, most of the institutional responses formulated in the Brazilian section seem to gravitate around systematic adaptation and marketization measures. The systemic adaptation particularly relates to new agriculture production technologies and the expansion of hydropower energy. Probably the most relevant element of adaptive management is the improvement of agriculture practices as a strategy to reduce GHG emissions. Techniques such as no-tillage, crop rotation and perennial crops have the potential to store more carbon in the soil helping to reduce emissions. At the same time, those practices also contribute to conserve soil and water resources at the catchment level (Tollefson, 2010). In Mato Grosso do Sul, a new law passed in 2010 (No. 3,951) that introduced green certification of products as means to induce carbon capture in the soil through new agriculture practices. Also in the same year, the federal government introduced the program 'Low Carbon Agriculture' (ABC), which provides financial incentives for the adoption of techniques such as no-tillage, reforestation and cattle-crop-forest integration. Because of the scale of the agribusiness sector, both Mato Grosso and Mato Grosso do Sul are important areas for the ABC program and farmers in those states have expressed their satisfaction with the funds already made available by the national government.

Nonetheless, it is still uncertain whether these measures will curb GHG emissions, because in practice, public policies are guided primarily by an increase in the share of agriculture to the GDP with the purpose of enlarging the primary surplus. In this context, disregard for environmental standards and GHG emissions goals, which configures a practical case of climate skepticism, would not surprise as the resources available for mitigation and adaptation of climate change are applied massively in tax incentives for agriculture. According to the audit office of the State of Mato Grosso, in 2008 and 2009, the Mato Grosso agribusiness sector benefitted from a tax waiver estimated at US\$ 2.72 billion, surpassing the State budgets' for education and health (TCE-MT, 2009). In North Central Brazil, the political power is dominated by a small but powerful agrarian elite controlling environmental stewardship and consequently measures to mitigate and adapt to climate change. In a recent study (Castilho, 2012), nearly 13,000 declarations of politicians elected in 2008 and 2010 were analyzed, showing that politicians from all Brazilian regions of the country own land in the Amazon and Cerrado (including areas in the Pantanal), forging a "Rural Caucus" compromised especially with agribusiness and unwilling to spend resources and political capital on the adjustments required to cope with climate change.

In face of the economical and political importance of the agribusiness sector for the economies of the two Brazilian states, unresponsive to command and control measures, there has been, more recently and particularly in the last decade, a concerted emphasis in translating principles of environmental economics into policy-making in Brazil. As for climate change, the main goal is to assess the monetary value of its impacts and formulate financial incentives to reduce the emission of GHGs, i.e. the

‘marketization measures’, described above. The already mentioned National Policy on Climate Change instituted the national policy on climate change, which included, among many other clauses, the creation of the ‘Brazilian emission reduction market’ (under the acronym MBRE). Likewise, the National Climate Change Fund (FNMC) was also established in 2009 to raise funds to be applied in the concession of loans and in the financial support (non-reimbursable) to projects aimed at climate change mitigation and adaptation. Economic-centered measures are effectively become the new face of the policy-making related to climate change in Brazil. Initiatives related to emission trading are already encouraging the production of biofuels, such as ethanol and biodiesel, in the agriculture areas the surround the Pantanal (Walter et al., 2011).

Despite the technological advances achieved under institutional responses that reflect the rationale of systematic adaptation and marketization, it is also important to observe the narrowness of those initiatives, especially in terms of the actual beneficiaries. The above institutional responses to climate change in Brazil can be blamed for having followed the same pattern of public subsidies being channeled to the stronger and better organized economic sectors, at the expense of more inclusive and publicly accessible strategies. Consider for example the large environmental liabilities in the UPRB, mainly due to the expansion of the livestock and the growth of the ethanol industry both historically subsidized. The tangible environmental liability generated by these actors could reach R\$ 16 billion, almost 0.5% of Brazil's GDP in 2006. Such liabilities do not count the intangible losses in biodiversity and other environmental services, but only the externalities generated in agribusiness and suffered by the population (Feltran-Barbieri and Kassai, 2008). Both systematic adaptation and marketization measures are likely to reinforce the same pattern of socioeconomic inequalities and concentrated land tenure (Ioris, 2012).

#### 4.2 Bolivia and Paraguay

Bolivia and Paraguay together share around 20% of the Pantanal wetland. Similarly to the Brazilian experience in the period, the 1990s were a decade of intense institutional reform in Bolivia, which attempted to restructure the economy along neoliberal lines. With the victory of President Evo Morales, in 2005, Bolivia took a more confrontational and independent approach regarding the implementation of the Climate Change Convention. According to the above typology, the main tone of the institutional responses to climate change under Morales has been the affirmation of the architecture of the entitlements. In the last few years, the government has in effect passed a series of laws that established large reserve areas for the settlement of indigenous groups and poor peasants, which contradicts the interests of agribusiness and other dominant economic groups.

On the international scene, the Bolivian government has produced a constant tension, at least in rhetorical terms, with the main economical players. For example, at the Climate Change Summit in 2009, the Bolivian government joined a coalition of smaller state and non-state actors that push for main concessions from the central economic countries. The result is that the Bolivian government has increasingly raised a distinct voice in the international arena and galvanized the dissatisfaction of traditionally marginalized groups not only in South America, but also around the world. Morales derives legitimacy for his autonomous stance on climate change partly from his recent reelection in 2009 and partly from the input of the Bolivian Platform against Climate

Change, a network of over 180 groups. The change of discourse by the national government under Morales has had repercussions for the mobilization and intervention of civil society organizations, which have directly called for a combination of alternative technologies and the fulfillment of civil rights (e.g. CIPCA, 2009). At the same time, however, despite its confrontational policy, the Bolivian government has also welcomed initiatives more closely associated with the creation of carbon markets and other forms of payments for ecosystem services. In particular, Bolivia is one of the priority countries for the implementation of REDD, the UN program on the Reduction of Emissions from Deforestation and Degradation in developing countries.

Paraguay is somehow at an intermediate position between the approaches taken by Brazil and Bolivia in recent years. Paraguay translated the Climate Change Convention into national legislation in 1993 and in the year 2000 a regulatory system was introduced under the coordination of SEAM (Environment Secretariat). Also in 2000 a national GHG inventory was published and identified the main emission sectors (despite the limited amount of data available). Most of Paraguay economic activity depends heavily on river navigation along the Paraguay River and climate change could pose a significant threat to the operation of international waterways (what was mentioned in various interviews and seems to be one of the main areas of concern among Paraguayans). Despite those serious consequences of climate change, in practical terms, the institutional framework developed so far in Paraguay has proven very feeble and inadequate to deal with major politico-economic pressures that insist on the maintenance of conventional forms of production and natural resource exploitation. At the same time that various initiatives have been advanced in terms of alternative agriculture, forestry and energy technologies (PNUD, 2007), the agribusiness sector continues to expand due to the rising prices of agriculture commodities in global markets. Furthermore, the country has most of its electric energy generated from hydropower (i.e. the massive Itaipu dam on the border with Brazil), but the demand for oil and the high rates of deforestation remain a serious challenge in terms of GHG emission reduction.

## **5. Conclusion: The Emerging Call for Climate Justice**

At the scale of the Pantanal, systematic adaptation and marketization responses only provided for mitigation measures aimed at the most important economic actors. These approaches did not provide in any way to adaptation strategies that could help most of the population to better cope with the harsher effects of climate change. They came short of ensuring participatory processes for the democratization of the access to environmental resources are still to be formulated. Absence or failure of such policies contribute to climate injustice as it implies that it is the economically vulnerable, that will suffer the more severe consequences of climate change. However, even as climate injustice is perceptible and growing, it is possible to identify only modest signs of institutional improvement in the direction toward climate justice (Milanez and Fonseca, 2011).

The notion of climate justice mirrors that of environmental justice. Acsehrad et al. (2009) stresses that the notion of environmental justice emerged as a counterpoint to the term environmental injustice, which means the imposition of disproportionate environmental risks to the less endowed with financial, political and informational means. Environmental justice proposes a framework to overcome the environmental

dimension of this social injustice. It is a notion that has been proposed to integrate environmental and social struggles.

The Brazilian Environmental Justice Network [*Rede Brasileira de Justiça Ambiental*] (RBJA, 2013), established in 2001, consists of numerous non-governmental organizations and defines environmental justice as a set of principles and practices that:

- a - Ensure that no social group suffer a disproportionate share of the negative environmental consequences of economic operations, policy decisions and state programs, nor the environmental repercussions of the absence or failure of these policies;
- b - Ensure fair and equitable access, direct and indirect, to the environmental resources of the country;
- c - Ensure broad access to relevant information on the use of environmental resources and disposal of waste and the location of sources of environmental risks, as well as democratic and participatory processes in relevant policy, plans, programs and projects;
- d - Favor the constitution of protagonists such as, NGOs, social movements and popular organizations to construct alternative models of development ensuring a democratic access to environmental resources and their sustainable use.

Thus, the fairness element of this type of institutional response implies that climate change should be related, in a transformative way, with the problems of poverty and marginalization in the South and over-consumption and fuel dependence in the North. According to such line of argument, the lack of effective responses to the risks posed by climate change grew almost inevitably from global inequalities, which has perpetuated highly inconsistent ways of thinking and dealing with shared risks (Parks and Roberts, 2010). Consequently, it is contended that the reaction to anthropogenic global warming should target human welfare rather than provide compensation to states and should be funded through measures that impose similar emission costs on affluent people in both developed and developing countries. Also inequalities within groups of the same reinforce the importance of finding common ground between the development and climate justice agendas, as well as to reconcile the conflicting messages and objectives of civil society.

The climate justice approach also provides a framework for adaptation policy responses. Schlosberg (2012) considers that climate justice based on a capabilities approach can be used to design policies to identify and address vulnerabilities and adapt to the new environmental conditions produced by climate change. He contends that: “...that justice should not focus solely on distributive ideals, but instead on the range of capacities necessary for people to develop free and productive lives they design for themselves. The emphasis is not simply on resources but on how those resources enable us to function. Being able to function is what is ethically significant, and injustice is found in the limitation of capabilities necessary for that functioning.”

The capabilities approach includes a range of justice-related concerns such as

distributional equity, social recognition, and public participation. It can be used to map vulnerabilities caused by climate change. Mapping vulnerability would include all data already available in national and international data banks, but also those affected by climate change in the understanding and prioritizing of vulnerabilities and the development of adaptation policies in response. Such a process can be used to clarify which policy responses are most needed in particular areas, and where resources will be most aptly applied on distinct issues. The capabilities approach allows analyzing the particular needs of communities and direct adaptation policy toward preserving or rebuilding the specific capabilities under threat from climate change.

The overall conclusion is that several institutional approaches have been adopted in the Pantanal and in the Upper Paraguay River Basin at large, which reflect different rationales, from marketization to systematic adaptation. However, to a large extent those institutional responses reflect the influence of the stronger economic sectors (which are the main emitters of GHGs) and the inadequacy of public policies. Therefore, considering the politicized causes and consequences of climate change, in particular the imbalance between responsibilities and the impacts, the main approach that should start guiding policies and interventions should be based on the principles of environmental justice (or climate justice) as the most appropriate and better justified strategy for addressing old and new forms of inequality and unfairness related to anthropogenic climate change.

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### **References**

- Adger, W.N. and Kelly, P.M.: 1999, 'Social vulnerability to climate change and the architecture of entitlements', *Mitigation and Adaptation Strategies for Global Change*, 253-266.
- Adger, W.N., Benjaminsen, T.A., Brown, K., and Svarstad, H.: 2001, 'Advancing a political ecology of global environmental discourses', *Development and Change* 2, 681-715.
- Adger, W.N., Agrawala, S., Mirza, M.M.Q., Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R., Smit, B., and Takahashi, K.: 2007, Assessment of adaptation practices, options, constraints and capacity. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 717-743.
- Alencar, G.: 1975, "O POLOCENTRO no Contexto do II PND". In: *O II PND e os Programas de Desenvolvimento do Distrito Federal e do Centro-Oeste. Estudos e Debates I*. Brasília: Senado Federal, Comissão de Assuntos Regionais, May, 14, 1975.
- Anthoff, D. and Tol, R.S.J.: 2010, 'On international equity weights and national decision making on climate change', *Journal of Environmental Economics and Management* 60(1), 14-20.
- Agrawal, A.: 2008, *The Role of Local Institutions in Adaptation to Climate Change*. Paper prepared for the Social Dimensions of Climate Change, Social Development Department, The World Bank, Washington DC.

- Arvai, J., Bridge, G., Dolsak, N., Franzese, R., Koontz, T., Luginbuhl, A., Robbins, P., Richards, K., Korfmacher, K.S., Sohngen, B., Tansey, J., and Thompson, A.: 2006, 'Adaptive management of the global climate problem: Bridging the gap between climate research and climate policy', *Climatic Change* 78(1), 217-225.
- Acelrad, H., Campello, C., and Bezera, G.: 2009, *O que é Justiça Ambiental*. 1º. ed. Rio de Janeiro: Garamond, 160p.
- Bührs, T.: 2010, 'Emissions trading, equity, and sustainability: The case for allocating entitlements to "individuals-in-community"', *Local Environment* 15(9), 817-830.
- Castilho, L.A.:2012, *O partido da terra: como os políticos conquistam o território brasileiro*. São Paulo: Contexto, 238p.
- Cerri, C.E.P.; Sparovek, G.; Bernoux, M.; Easterling, W.E.; Mellilo, J.M.; Cerri C.C.: 2007, *Tropical agriculture and global warming: impacts and mitigation options*. *Scientia Agricola*, v.64, p.83-89, 2007.
- CIPCA (Centre of Investigation and Peasantry Promotion): 2009, *Propuestas de Acción y Políticas de Respuesta Frente a los Efectos del Cambio Climático*. CIPCA: La Paz.
- Collischonn, W., Tucci, C.E.M, Clarke, R.T.:2001, Further evidences of change in hydrological regime of the river Paraguay: part of a wider phenomenon of climatic change? *Journal of Hydrology*, 245: 218-238.
- Dawson, A.: 2010, 'Climate justice: The emerging movement against green capitalism', *South Atlantic Quarterly* 109(2), 313-338.
- Devereux, S.: 2001, 'Sen's entitlement approach: Critiques and counter-critiques', *Oxford Development Studies* 29(3), 245-263.
- Dores, E. F. G. C., and De-Lamonica-Freire, E. M.: 2001, *Contaminação do ambiente aquático por pesticidas. Estudo de caso: águas usadas para consumo humano em Primavera do Leste, Mato Grosso - análise preliminar*. *Quím. Nova*, vol.24, n.1 pp. 27-30.
- Engle, N.L. and Lemos, M.C.: 2010, 'Unpacking governance: Building adaptive capacity to climate change of River Basins in Brazil', *Global Environmental Change* 20, 4-13.
- Feltran-Barbieri, R., Kassai, J.R.: 2008, *Passivo ambiental das reservas legais inexistentes no cerrado*. In: IX Simpósio Nacional Cerrado, 2008, Brasília. *Desafios e estratégias para o equilíbrio entre sociedade, agronegócio e recursos naturais*. Brasília: EMBRAPA.
- Girard, P.: 2011, *Hydrology of surface and ground waters in the Pantanal floodplains*. In: *The Pantanal: Ecology, biodiversity and sustainable management of a large neotropical seasonal wetland*, Junk, W.J., Da Silva, C.J., Nunes da Cunha, C., Wantzen, K.M. (Eds) pp. 103-126.
- Girard, P. 2012. *The Pantaneiros, perceptions and conflicts about the environment in the Pantanal*. In: Antonio Augusto Rossotto Ioris. (Org.). *Tropical Wetland Management: The South-American Pantanal and International Experience*. London: Ashgate, 7-28.
- Glaas, E., Jonsson, A., Hjerpe, M., and Andersson-Söld, Y.: 2010, 'Managing climate change vulnerabilities: Formal institutions and knowledge as determinants of adaptive capacity at the local level in Sweden', *Local Environment* 15(6), 525-539.
- Gupta, J., Termeer, C., Klostermann, J., Meijerink, S., van den Brink, M., Jong, P., Nooteboom, S., and Bergsma, E.: 2010, 'The adaptive capacity wheel: A method to assess the inherent characteristics of institutions to enable the adaptive capacity of society', *Environmental Science and Policy* 1 (6), 59-471.
- Haines, F. and Reichman, N.: 2008, 'The problem that is global warming: Introduction', *Law and Policy* 30(4), 385-393.
- Hall, P. and Sosice, D.: 1996, 'Political science and the three new institutionalisms', *Political Studies* 44, 936-957.

- Harris, P.G. and Symons, J.: 2010, 'Justice in adaptation to climate change: Cosmopolitan implications for international institutions', *Environmental Politics* 19( ), 617-636.
- Ioris, A.A.R.: 200 , 'Conflicts and contradictions on the occupation of the Pantanal space', in D. Tazi , A.A.R. Ioris and S.R. Collinworth (eds.), *The Pantanal: Scientific and Institutional Challenges in Management of a Large and Complex Wetland Ecosystem*. USACE, Washington DC, pp. 26-38.
- Ioris, A.A.R.: 2010, 'The political nexus between water and economics in Brazil: A critique of recent policy reforms', *Review of Radical Political Economics* 2(2), 2 1-250.
- Ioris, A.A.R (ed): 2012, *Tropical Wetland Management: The South-American Pantanal and the International Experience*. Ashgate, Farnham, Surrey.
- Ioris, A.A.R: 201 , 'Approaches and responses to climate change: Challenges for the Pantanal and the Upper Paraguay River Basin', *Alternate Routes* 25, 119-145.
- IPCC: 2007, *Climate Change: Impacts, Adaptation and Vulnerability*. Working Group II Contribution to the IPCC Fourth Assessment Report. IPCC Secretariat, Geneva.
- Jepma, C.J. and Munasinghe, M.: 1998, *Climate Change Policy: Facts, Issues, and Analyses*. Cambridge University Press, Cambridge.
- Lim, B., Spanger-Siegfried, E. Burton, I., Malone, E.L., and Huq S.: 2004, *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*. UNDP. Cambridge University Press, Cambridge.
- Marengo, J.A., Ambrizzi, T., da Rocha, R.P., Alves, L.M., Cuadra, S.V., Valverde, M.C., Torres, R.R., Santos, D.C., and Ferraz, S.E.T.: 2010b, 'Future change of climate in South America in the late twenty-first century: Intercomparison of scenarios from three regional climate models', *Climate Dynamics* 5(6), 1089-1113.
- Marengo, J.A., Chou, S.C., Kay, G., Alves, L.M., Pesquero, J.F., Soares, W.R., Santos, D.C., Lyra, A.A., Sueiro, G., Betts, R., Chagas, D.J., Gomes, J.L., Bustamante, J.F., and Tavares, P.: 2011, 'Development of regional future climate change scenarios in South America using the Eta CPTEC/HadCM3 climate change projections: Climatology and regional analyses for the Amazon, São Francisco and the Paraná River basins', *Climate Dynamics*, Available doi: 10.1007/s00382-011-1155-5.
- Marengo, J. A.; Rusticucci, M.; Penalba, O; Renom, M.: 2010a, An intercomparison of observed and simulated extreme rainfall and temperature events during the last half of the twentieth century: part 2: historical trends. *Climatic Change* (2010) 98:509–529. DOI 10.1007/s10584-009-9743-7
- Marengo JA, Chou SC, Kay G, Alves LM, Pesquero JF, Soares WR, Santos DC, Lyra AA, Sueiro G, Betts R, Chagas DJ, Gomes JL, Bustamante JF, Tavares P.: 2012, Development of regional future climate change scenarios in South America using the Eta CPTEC/ HadCM3 climate change projections: climatology and regional analyses for the Amazon. São Francisco and the Parana River Basins. *Clim Dyn* 38(9–10):1829–1848.
- Milanez, B. and Fonseca, I. F.: 2011, 'The Climate Justice discourse in Brazil: potential and perspectives' in R. S. Motta, J. Hargrave, G. Luedemann and M. B. S. Gutierrez (eds), *Climate Change in Brazil: Economic, Social and Regulatory Aspects*. Brasília, IPEA: 221–234.
- Mitchell, S.A. and Breen, C.M.: 2007, 'The role of research in informing the governance process of the use of ecosystem resources', *Water Policy* 9(SUPPL. 2), 169-189.
- Mittermeier, R.A., Gil, P.R., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & Fonseca, G.A.B.: 2004, *Hotspots revisited: earth's biologically richest and most endangered terrestrial ecoregions*. CEMEX & Agrupacion Sierra Madre,

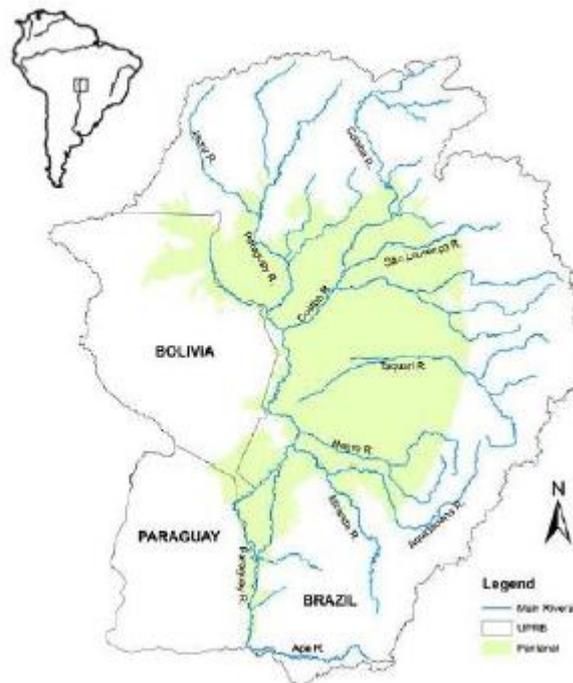
Mexico city

- Nerlich, B.: 2010, 'Climategate': Paradoxical metaphors and political paralysis', *Environmental Values* 19(4), 419-442.
- O'Riordan, T. and Jordan, A.: 1999, 'Institutions, climate change and cultural theory: Towards a common analytical framework', *Global Environmental Change* 9(2), 81-93.
- Parks, B.C. and Roberts, J.T.: 2010, 'Climate change, social theory and justice', *Theory, Culture & Society* 27(2-3), 134-166.
- Piccilli, D.G.A.: 2007, Avaliação da previsão hidroclimática no Alto Paraguai. Doctoral thesis, Federal university of Rio Grande do Sul, Hydraulic Research Institute, Porto Alegre, Brasil.
- Pignati, Wanderlei Antonio; Machado, Jorge M. H. and Cabral, James F.: 2007, Acidente rural ampliado: o caso das "chuvas" de agrotóxicos sobre a cidade de Lucas do Rio Verde - MT. *Ciênc. saúde coletiva* [online], vol.12, n.1, pp. 105-114.
- Pinto, M. N.: 1990, Cerrado: Caracterização, Ocupação e Perspectiva. Brasília: Editora Universidade de Brasília, pp. 93-390.
- PBMC, 2013a: Contribuição do Grupo de Trabalho 1 ao Primeiro Relatório de Avaliação Nacional do Painel Brasileiro de Mudanças Climáticas. Sumário Executivo GT1. PBMC, Rio de Janeiro, Brasil. 24 p.
- PBMC, 2013b: Contribuição do Grupo de Trabalho 2 ao Primeiro Relatório de Avaliação Nacional do Painel Brasileiro de Mudanças Climáticas. Sumário Executivo do GT2. PBMC, Rio de Janeiro, Brasil. 28 p.
- PNUD: 2007, Cambio Climático: Riesgos, Vulnerabilidad y Desafíos de Adaptación en Paraguay, PNUD, Asunción.
- Poortinga, W., Spence, A., Whitmarsh, L., Capstick, S., and Pidgeon, N.F.: 2011, 'Uncertain climate: An investigation into public scepticism about anthropogenic climate change', *Global Environmental Change* 21( ), 1015-1024.
- RBJA: 2013, Manifesto de Lançamento da Rede Brasileira de Justiça Ambiental. HYPERLINK [http://www.justicaambiental.org.br/\\_justicaambiental/pagina.php?id=229](http://www.justicaambiental.org.br/_justicaambiental/pagina.php?id=229). Accessed 5 April 2014
- Rieder, A.; Dores, E. F. G.C; Miguel P. L.: 2000, Alterações no teor de matéria orgânica de solos e provável efeito no poder de proteção ambiental nas bordas do pantanal diante da poluição por pesticidas. *Pesticidas*;10:87-112.
- Sampaio, G.: Personal communication from book in preparation about climate changes and impacts in the Upper Paraguay River Basin.
- Soares, W. L., and Porto, M. F.: 2007, Atividade agrícola e externalidade ambiental: uma análise a partir do uso de agrotóxicos no cerrado brasileiro. *Ciênc. saúde coletiva*, vol.12, n.1, pp. 131-143.
- Schlosberg, D.: 2012, Climate Justice and Capabilities: A Framework for Adaptation Policy. *Ethics & International Affairs*, 26: 445-461.
- Tollefson, J.: 2010, 'Intensive farming may ease climate change', *Nature* 65(7 00), 85 .
- Tompkins, E.L., Adger, W.N., Boyd, E., Nicholson-Cole, S., Weatherhead, K., and Arnell, N.: 2010, 'Observed adaptation to climate change: UK evidence of transition to a well-adapting society', *Global Environmental Change* 20( ), 627-635.
- Walter A, Dolzan P, Quilodrán O, De Oliveira JG, Da Silva C, Piacente F, Segerstedt A.: 2011, Sustainability assessment of bio-ethanol production in Brazil considering land use change, GHG emissions and socio-economic aspects. *Energy Policy*, 39(10): 5703-16.

Table 1: Typology of Institutional Responses to Climate Change

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Institutional Response	Main reasoning	Claims and approaches	Examples of responses and policy implications
Climate scepticism	Denial of the anthropogenic causes of climate change	Major scientific uncertainty remaining and the disproportionate cost of precautionary measures	No change in existing environmental and economic policies; 'wait and see'; maintain carbon intensive economic development
Marketization measures	Neoclassical economics principles; solutions through the market	Assessment of the monetary value of ecosystem services and the costs of GHG reduction	Market-based responses; carbon trading and carbon taxes; adoption of schemes such as REDD and other forms of payment for ecosystem services
Systematic adaptation	Continuous reevaluation of initiatives and technologies	Search for better environmental governance and technological improvements	Interactive responses; tentative initiatives and heuristic examination of results; constant adjustments and improvements
Architecture of entitlements	Equity between countries, groups and individuals	Acknowledgement of the social construction of resource scarcity and vulnerability	Clarification of entitlements and obligations of all parties involved in terms of access to natural resources and the distribution of impacts
Climate Justice	Criticism of unfair production and distribution patterns	Denunciation of the exploitation of society and the rest of nature	Struggle for a compensation for past and present inequalities; fulfilment of the demands of the more vulnerable social groups

Figure 1. The South American Pantanal



Adapted from Ioris (2012).