



## **Assessment criteria for the level of integration of urban water and land use management**

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**ABSTRACT:** The growth of population density in urban areas has exacerbated the negative impacts on water resources, such as pollution due to higher effluent discharge and flooding due to soil impermeabilisation. Such problems worsen when public policies and territorial management practices are not integrated. This paper recognizes the importance of integrating water resource management with land use management to provide conditions for urban sustainability. A set of criteria is defined to assess how key Brazilian legislations – the National Water Resources Policy and the City Statute – prescribe aspects of integration in urban areas, and how such integration is performed at the local level based on the corresponding plans – River Basin Management Plan and the city’s Master Plan. Extensive document and literature review were carried out to select and characterize the relevant analysis criteria, as part of a diagnostic framework. In combination with the local legislation and plans, the proposed criteria framework can be used as a data collection tool to assist in the identification of deficiencies and qualities of actions aimed at integrating the efforts of water resource and land use management. Surveys undertaken using this framework may guide the provision of resources to fill management gaps in urban spaces.

**Keywords** *Integration, Urban Planning, Water Urban Planning.*

## **1. INTRODUCTION**

Urban land use rate and density have been increasing significantly in the last few decades. According to UN (2014), 54% of the world population lived in urban areas in 2014, whereas this number was close to 30% in 1950. It is estimated that, by 2050, approximately 66% of the population will live in urban areas. North America is the most urbanised continent, with 84% of its inhabitants living in urban zones, followed by Latin America and the Caribbean, with 80% (UN, 2014). Besides population growth, urban planners also need to consider spatial scarcity and natural disaster risks, since their planning choices will impact upon spatial and environmental quality of future urban scene (Sutanta et al. 2010). Modifications arising from the spatial dynamics follow territorial restructuring, but they often occur in an uncontrolled way or as a result of non-integrated public policies, which leads to socioenvironmental problems (IBGE, 2015).

Water is indispensable for the survival of most living beings and one of the pillars of sustainable development. Services provided by water resources contribute to the reduction of poverty, economic growth and environmental sustainability (UNESCO, 2015). Tucci (2008) highlights the main urban problems associated with water infrastructure as: inadequate drainage system, which can lead to flooding; inadequate sanitation; occupation of protected spring areas; impermeabilisation and/or canalisation of urban streams and rivers; and inadequate sewage treatment systems, which affect water quality. It is thus necessary to recognise the importance of interdisciplinary work in the search for alternative solutions which, as a whole, may assist in overcoming environmental degradation and socio-spatial segregation (Pereira & Silva, 2011). The possibility of constructing analysis criteria for aspects related to urban resilience and sustainability, for integrated urban management, may assist urban planners and other stakeholders in decision making to identify priority action areas for possible improvement. Having an established set of criteria is an alternative for simplifying a complex problem, such as interdisciplinary urban management, besides making it more comprehensible to all stakeholders involved in the process (Sharifi & Yamagata, 2014). In this context, the aim of this study was to define criteria for analyses of the degree of integration of urban water and land use management, in such a way as to enable the identification of integration constraints and a better alignment of urban public management policy and actions.

## **2. THE CITY STATUTE AND NATIONAL WATER RESOURCES POLICY**

The City Statute was established by federal law 10257/2001, enhancing the application of instruments prescribed by articles 182 and 183 of the Federal Constitution, which deal with urban policy directed to the social function of cities and property. The City Statute improved the influence of municipal Master Plans as a central element of city management, in articulating other instruments (Peres & Silva, 2010). For the purpose of executing urban policy from the perspective of this law, the main elements are: I- national plan, regional and state plans of territorial arrangement and socioeconomic development, II- planning of metropolitan regions, urban agglomerations and micro-regions, III- municipal planning (Brasil, 2001). Subsequent regulatory documents are important steps

in outlining city planning and participatory management, with a view to realise the social function of urban space in all its aspects (Antonello, 2013).

The National Water Resources Policy was established by federal law 9433/1997. The fundamental aspects of this policy are its systemic approach and intersectoral and integrated management of water resources (Wolkmer & Pimmel, 2013). Its pillars are the Dublin principles of integrated river basin management (Tucci, 2004). As such, Brazil may be deemed to be ahead of most other Latin American countries in relation to its water resources management framework, for prescribing advanced concepts such as: adopting the river basin as territorial unit for policy implementation, stakeholder participation in a decentralised and democratic decision making system, which call for inter- and trans-disciplinary approaches (Rauen et al. 2015). The prescribed water management instruments are: national, state and river basin plans; water body classification according to prescribed uses and related water permits, which enable a certain level of control of both water and land use; water usage charges, which serves as an incentive for rational use and aims to reflect the economic value of this resource; and information systems (Brasil, 1997). Another key element of decentralised management is the river basin committee, which is supported by an executive agency (Tucci, 2004). One of the general directives of the national policy is the articulation of water resource and land use management, which is of direct interest in this study (Brasil, 1997).

While being the ideal territorial unit for surface water management, river basins present challenges for articulation and integration with public management in municipalities and other administrative regions (Peres & Silva, 2010). In municipalities, water resources are part of the key directives of the City Statute. However, due to the fact that this aspect is still not well instrumented, despite urban environmental concerns, alternatives are required to help resolve disputes (Peres & Silva, 2013). Thus, from the 1990s the concept of integrated water resource management (IWRM) was developed to articulate best practices adopted by organisations (Grigg, 2014). Para GWP (2000, p. 22), IWRM is “a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems”. The Brazilian water resources policy aims to contribute towards sustainable resource use, with a multisectoral approach and deployment of structural and non-structural measures (Silva & Porto, 2003). The search for fair distributive methods that take into account the characteristics of the hydrological system and its interaction with other natural resources and ecosystems characterise a holistic approach, which must encompass local resource demands and threats (GWP, 2000). It should be noted that holistic management involves not only awareness, but also coordination of different human interests and activities that demand water resources while using the land and generating waste (Jonch-Clausen & Fugl, 2001).

### **3. METHODS**

This study encompasses fundamental research aimed at assisting future development and implementation of public policy associated with urban water and land use management. It encompasses socioenvironmental analyses in a wider sense, i.e. not focusing on the characteristics of a single social, environmental, institutional or political condition.

A wide-ranging literature review and document analysis were undertaken to identify principles and analysis criteria for the level of integration of urban water and land use management. Key document repositories both in Brazil and internationally were scrutinised in the period leading up to May 2016, such as: CAPES' Portal de Periódicos, Science Direct, Scielo, public and non-governmental organisations, legislation and the internet. Keywords used as search terms included: integrated territorial management, integrated water resources management, integration of public policies, public policy and urban water management plan, river basin and land use, urban water management and watershed and land use, in addition to their counterparts in Portuguese. Key references used to identify criteria and build the framework presented herein are discussed below. For a more detailed discussion and further information, please see Justi (2016).

#### 4. RESULTS AND DISCUSSION

Table 1 summarises the conceptual division developed herein for application to the principles of water resource and land use management.

Table 1. Principles and dimensions for integration considered in this study

<b>Principles</b> Kidd & Shaw (2007), GWP (2000), Jonch-Clausen & Fugl (2001)	<b>Dimensions</b>	
	Ran & Budic (2016)	Kidd & Shaw (2007)
Natural Systems		
	Political	Sectoral
Human Systems	Territorial	Territorial
	Institutional	Organisational

Firstly, it was considered that integration must take place among the principles of natural and human systems, and encompass both temporal and spatial variability (GWP, 2000; Jonch-Clausen & Fugl, 2001; Kidd & Shaw, 2007). From this perspective and based on the literature review undertaken, it was found that water and land use management practices are more closely related to human systems. Due to being directly linked with spatial issues, human systems must determine resource use and assist in defining development priorities (GWP, 2000).

According to Ran & Budic (2016), there is a weak relationship between the planning and flood management systems, owing to poor urban water management. It can thus be improved and better coordinated if key elements are identified to fill integration gaps. Ran & Budic (2016) identified three dimensions for a systematic analysis of such integration, namely: territorial, political and institutional. In this sense, territorial integration focuses on the consistency of boundary delimitation and alignment of spatial scales, political integration refers to process implementation actions, while institutional integration involves the sharing of contexts.

Kidd & Shaw (2007) identified three major dimensions in human systems: sectoral, territorial and organisational. The sectoral dimension is associated to integrating spatial planning and water management agencies, the territorial dimension is related to spatial boundaries, and the organisational dimension deals with operational strategies to achieve integration.

The principles and dimensions identified in the literature guided the selection of criteria for integrating water resource and land use management, as summarised in Table 2 and described in the following sections.

Table 2. Dimensions and criteria for integration considered in this study

Dimensions	Criteria	Publications
	Integrated strategic agenda	1, 2, 3, 4, 5, 6
Institutional	New institutionalism as systemic planning	2, 7, 8
	Information platform of spatial data	4, 5, 9
Political	Effectiveness of local participation	1, 2, 3, 5, 6, 10, 11, 12
	Relative importance of interests and aspects	6, 8, 13, 14
	Empowerment of the organisational structure	10, 15
Territorial	Multi-scale perspective	16, 17
	Vertical and horizontal integration	1, 3, 5, 10, 15, 18

1: Kidd & Shaw (2007); 2: GWP (2000); 3: Jonch-Clausen & Fugl (2001); 4: Djalante et al. (2013);  
5: Ran & Nedovic-Budic (2016); 6: Rauen et al. (2015); 7: Brown et al. (2009); 8: Sharifi & Yamagata (2014);  
9: Sutanta et al. (2010); 10: Ashiq & Rahman (2015); 11: Neuvel & Knaap (2011); 12: Rabelo et al. (2014);  
13: Ultramari & Rezende (2008); 14: Okeola & Sule (2011); 15: UN (2015); 16: Yu (2014);  
17: WBG (2009); 18: Mitchell (2005)

#### 4.1 Integrated strategic agenda

Cross-cutting sectoral integration is key for the development of effective urban public policy (Kidd & Shaw, 2007; GWP, 2000; Jonch-Clausen & Fugl, 2001). Djalante et al. (2013) proposed the integration of agendas for strategic development as an adaptation solution to resist environmental catastrophes. Ran & Nedovic-Budic (2016), in an analysis of integration dimensions between spatial planning and flood risk management, highlighted the importance of articulating practices and wide-ranging strategies among stakeholders, such as: planning authorities, governments, private companies, non-governmental organisations and researchers. Kidd & Shaw (2007) refer to it as interagency integration. It can be seen that IWRM must be connected to different public policy domains, as decisions made by economic stakeholders in most countries have a significant impact on the demand for water and its functions (Jonch-Clausen & Fugl, 2001). A similar perspective was observed in the so-called living laboratory for participatory decentralised catchment management in the Sossego basin, in the state of Espírito Santo, Brasil (Rauen et al. 2015). This project involved integration of different approaches and academic perspectives with the participation of local society and several institutions, from the onset of the diagnostic stage to the implementation of jointly developed management solutions.

#### 4.2 New institutionalism as systemic planning

The IWRM concept is in direct contrast with the traditionally fragmented way in which decisions related to water resources use were made, which fundamentally controlled the demand and provision of water systems (GWP, 2000). In a similar manner, the new institutionalism is broader and more focused on improving the adaptation capacity of institutions, unlike the traditional model of simply adhering to meeting regulatory demands (Brown et al. 2009). Focusing solely on an institutional update would be insufficient if a more sustainable management of urban waters is to be achieved, as that

would contemplate only one of the root causes of the sustainability problem. For instance, while interventions focused solely on environmental education can lead to positive cognitive change, it does not necessarily enhance water valuation and the rules through which this should occur, since such issues are bound by normative aspects and regulation respectively (Brown et al. 2009). This much needed adaptation to urban spatial change can also be associated with urban resilience (Sharifi & Yamagata, 2014). This concept entails adaptation in the sense that a system affected by, say, a natural disaster is not necessarily required to return to a previous equilibrium state; it only requires that, with time, such system can absorb the impacts and self-organise (instead of collapsing and becoming sterile), besides enhancing its learning capacity.

#### **4.3 Information platform of spatial data**

According to Ran & Nedovic-Budic (2016), and considering that better communication is one of the integration pillars, geographical information technologies are a potential facilitator of spatial management integration. Efficient application of information technologies can promote bridge building among institutions and stakeholders (Ran & Nedovic-Budic, 2016). It thus becomes possible to improve knowledge and information to promote a broader and more systematic perspective for assessing environmental hazards, risks, vulnerabilities and impacts. This pathway requires better access to knowledge, learning and innovation to permeate the institutional system (Djalante et al. 2013). As pointed out by Sutanta et al. (2010), information related to environmental catastrophes are collected by several agencies and in multiple formats, owing to the multidisciplinary character of such events. Data standardisation efforts can then enhance information exchange and mutual collaboration among specialists, so that adequate assessments and forecasts can be made using the information thus compiled while reducing the risk of poor decision making. Thematic maps of past disasters are required to integrate influences on territorial arrangement, as well as up-to-date risk and landscape hazard maps.

#### **4.4 Effectiveness of local participation**

The effectiveness of urban planning projects can be greatly impaired by a lack of definition of the target public of specific policies. This problem tends to arise if questions such as follows remain unanswered: for whom, by whom and how decisions will be implemented. Thus, any successful strategy must highlight and involve all relevant stakeholders in the decision making process (Ashiq & Rahman, 2015). Adequate integration requires an efficient coordination of institutions and stakeholders (Ran & Nedovic-Budic, 2016). This concept is also included in the organisational dimension of Kidd & Shaw (2007), who identified the need for integration of disciplines and interested parties. Ran & Nedovic-Budic (2016) refer to a shared context in the institutional dimension, aimed at establishing and advancing common objectives and principles. This is in agreement with GWP (2000) and Jonch-Clausen & Fugl (2001) who described the importance of stakeholder integration since the planning stage of integrated water management and decision making. For Rabelo et al. (2014), such early stage participation should begin during the elaboration of the Terms of Reference for future river basin management plans, when implementation stages and activities are prescribed. Spatial measures of a given project that are in conflict with local concepts may be opposed to by local communities and stakeholders if they are not adequately discussed and adjusted beforehand (Neuvel & Knaap, 2011).

#### **4.5 Recognition of the relative importance of interests and aspects**

The effectiveness of urban interventions by the public sector depends not only on administrative competence, but also on an adequate balance of relevant influences and interests. Thus, effective integration of management aspects must involve the recognition of their relative importance. For Ultramari & Rezende (2008), physical-territorial, economic, political, socioenvironmental and management demands are being prioritised over other urban issues. However, achieving a balanced approach across all sectors and levels is one of the major challenges faced by modern municipal public administration. Similarly, recognising potentialities and appreciating the positive aspects of cities can be important elements in broader strategic planning aimed at achieving long-lasting solutions. An analogy can be made to the weighing of different aspects that influence sustainability and urban resilience as part of an indicator-based decision support system (Sharifi & Yamagata, 2014). This principle was applied in a comparative assessment of sustainable management alternatives for the urban water supply system of the city of Offa, in Nigeria. It was recognised that water supply management encompass several stakeholders and aspects, many of which are not always tangible (Okeola & Sule, 2011).

#### **4.6 Empowerment of the organisational structure**

International directives for urban and territorial planning, as prescribed by UN (2015), indicate that the mitigation of deficiencies in executing urban plans requires strong political leadership to be accompanied by adequate partnerships among all relevant stakeholders. Three key aspects must co-exist to enable the implementation of plan elements: transparency and capacity for legal execution, a robust while flexible urban planning and design, and financial feasibility with the best possible cost-benefit (UN, 2015). Institutional development requires political reform for the execution of planning stages, and “at national level to empower local authorities and improve urban governance” (UN, 2015, p.04). Such influences on the coordination of urban planning and social participation have been observed, for instance, in the city of Dhaka, Bangladesh. Ashiq & Rahman (2015) noted that political will and commitment must exist for an effective implementation of integration mechanisms. A major restriction in this case was the institutional composition to promote urban planning in line with a poor existing organisational structure, which has hierarchical gaps of top-down coordination (Ashiq & Rahman, 2015).

#### **4.7 Multi-scale perspective**

Urban development must be understood as a live and unique system, with an ecological infrastructure capable of protecting, in the long run, the integrity of natural and cultural landscapes. Spatial techniques used in urban occupation planning must indicate strategic landscape patterns applicable from the national to the local scale, which respect the fundamental ecological systems in directing the land use and growth patterns of cities. Such influences must reach decision making both in urban zones of a regional character and in projects of areas and plots at a smaller scale (Yu, 2014). This concept can be associated with design flexibility, and includes a multi-scale perspective to urban planning. A number of projects undertaken in China involved this perspective, some of which were directly related to urban water management. China has only about 7% of the world's

agricultural land and freshwater resources, but has to meet the food supply demands of about 22% of the world's population, and at least 662 cities with some level of water stress. Such figures highlight the importance of sustainable urban planning integrated with water resources management initiatives in that country, as a matter of survival (Yu, 2014). An iconic example is the *Sino-Singapore Tianjin Eco-city*, as a model sustainable city built from scratch to pursue the ideal of zero impact urban living. The multi-scale perspective as characterised by Yu (2014) is one of the pillars of this model city concept, since its principles must be applicable in different scales (WBG, 2009).

#### **4.8 Vertical and horizontal integration**

Inadequate understanding and clarity of legal territorial boundaries create obstacles to urban planning, such as wrongful decision making, competence overlapping and poor coordination of activities and plans (Ashiq & Rahman, 2015). UN (2015) highlights the need for national governments to create urban and territorial planning directives that connect and articulate plans in any physical-territorial remit, in such a way as to support decision making at every level. Many of the problems associated with water resources originate in land use patterns and activities, and the other way round. Thus, it is essential to integrate water and land use planning (Mitchell, 2005). According to Kidd & Shaw (2007), failure to do so arises from poor characterisation of the territorial dimension. Jonch-Clausen & Fugl (2001) associated it with integration of different management levels, and Ran & Nedovic-Budic (2016) associated horizontal integration with improving the consistency of physical-territorial limits, with the same competence level. Ran & Nedovic-Budic (2016) referred to vertical integration as an alignment of spatial planning scales. Thus, it is possible to draw a parallel with Mitchell (2005) in the sense that fragmented responsibilities of one government level to another (municipal to state and so forth) is regarded as vertical fragmentation, while horizontal fragmentation occurs on the same government level, such as in different agencies created for managing agriculture, forests, water resources and economic development. Hence, integration initiatives should encompass and promote information sharing among different legal competencies of surrounding regions and/or physically overlapped remit zones, as well as check the consistency and possible conflicts among the various levels of spatial policies (Ran & Nedovic-Budic, 2016).

### **5. CONCLUSION**

This paper identified key principles and criteria for integrated urban water and land use management, in terms of their potential to guide analysis of the level of integration of urban policies and practices and identify problem areas. The analysis framework proposed herein can be applied in developing and accessing city master plans and river basin management plans, so that they can be better articulated following the mitigation of integration gaps. It may be used by policy makers, technical staff and stakeholders involved in urban planning to identify pathways for more environmentally-sound decision making, with a particular emphasis on water resources. A case study is being undertaken by Justi (2016) for the city of Curitiba, Brazil, aimed at identifying integration gaps and to suggest subsidies for improving the level of integration of water and land use management.



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