STRATEGIC ENVIRONMENTAL PLANNING IN TROPICAL COUNTRIES: ELEMENTS FOR THE SUSTAINABLE MANAGEMENT OF WATER RESOURCES

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ABSTRACT
This manuscript considers elements for the formulation of strategic axes in the environmental planning of the water resource in tropical countries, differentiating the strategic, functional planning and the environmental water management. Similarly, aspects of the current problem are described using the qualitative method of quadrants, caused by the poor articulation of the instruments currently applied. Ten strategic axes are proposed to carry out the integral ordering of the water resource and for this, the determination of the magnitude, optimal decision and capacity for strategic environmental planning and the possible formulation according to the projection time. These can be financed through subsidies, taxes or fees (for use, remuneration, among others), regulation and use costs, service fees, incentives, 1% environmental investment, transfers and own resources from the operation of the responsible entities, among others, and must be integrated through a Government Water Management Agency.

Key Words: strategic environmental planning, water resources, management.

INTRODUCTION
The progressive deterioration of surface water bodies and aquifers, in terms of quality, variation in supply, use conflicts, vulnerability due to climate change, institutional weakening, difficult governance and high pressure on demand, generates progressive stress of the resource, despite the fact that there are various instruments for planning, organization, administration, handling and management, such as compliance plans, environmental management plans, management and/or resource management plans, contingency plans, decontamination, technical guides, four-year regional action plans, master plans, development programs, regional environmental management plans, 1% investment plan, follow-up and monitoring programs, compensation plans, recovery and restoration plans, sanitation plans , among others, which present little articulation, diachrony, discordance, and an evident tier normative action (Castañeda, 2019; Ruíz e. a., 2018; Santiago, 2016; Feria, 2019; Bolaño, 2016; Ruíz e. a., 2016; Miniño, 2017).

Therefore, this manuscript considers strategic environmental planning, from the formulation of strategic axes for the ordering, administration and optimal management of water management in tropical countries according to the natural behavior of the basins, with criteria of efficiency, effectiveness and quality, for in this way, considering an appropriate structure of linked, coupled, modulated instruments and for simultaneity purpose.

DEVELOPING

Strategic environmental planning.

Planning is a process that allows the comprehensive management of a system towards a desired situation or state, through the ordering of a pre-established idea, across the generation of knowledge, interrelationships with space-time conditions and the transformation of existing empirical information of each actor involved, to start a decision-making process, which must transform the planned object, in the socioeconomic, environmental, territorial and development fields. (Santiago, 2016; Miniño, 2017).

Strategic planning allows, as a tool, to make big decisions in organizations (different from operational or functional planning that is short and medium term), with criteria of efficiency, effectiveness and quality, through the formulation of priority objectives through actions and/or strategies to achieve the purpose in that desired future, in the medium or long term, through indicators and goals CEPAL, 2000; PNUD, 2009).

Conceptually planning (horizon of sense ≥ 20 years), should start with the construction of strategic axes (pillars of planning), then with the intention of formulating guidelines through public or private policies, to prepare plans (functional plan), programs, projects, activities (annual operational programming) and actions (action plan) that contribute in an articulated way in the construction of the imaginary or desired state in planning and which is an integral part of development management. (Bolaño, 2016; Ruíz e. a., 2018).

In this sense, in the order of the environmental dimension, the planning raises a qualitative and quantitative knowledge of the own composition of the ecosystem and a rationality, as well as the efficient use of resources, in terms of the potentialities, limitations and characteristics of the environment. as a basis for the functioning of the natural system (Wernes, 1995), with which decisions can be taken collectively by binding actors on the environment so that unjustifiable damage does not occur and exist a global sustainable development of the territory, in a referential framework that establishes guidelines and concrete intervention measures (Leitmann J. , 1999; Millar D. , 2005; Sheila S. , 2004; Rivas, 2002).

Strategic environmental planning is configured as a synchronous and organized process of making big decisions in a defined geographical space, which possesses and processes an specific and significant knowledge of the territory in environmental assets, which are real, dynamic and changing and that ordered and organized, they converge in a systemic direction to the integral vision of the planned object, with criteria of efficiency, effectiveness and quality, through the formulation of priority objectives across actions and/or strategies. However, the moment of planning and especially of the territorial environmental dimension, is when it is necessary to transform the information of the empirical environmental knowledge of the territory, that is, when the system is complex and changing over time, therefore, the formulation for decision-making it becomes necessary to delimit the actors (they do not make decisions because they receive and deliver information) and agents (they make decisions since it is cognitive), they set objectives and strategies, to preserve and/or adequately modify the environment (Yan, 2015; George, 2011; Hillman, 2012).

The management and the environmental planning has substantial differences between them. The first, is a set of activities leading to the comprehensive management of the environmental system; while the second should be understood as the continuous process of transformation of information into knowledge and decision-making regarding the environmental situation of a geographical space, capable of guiding development in a framework of sustainability that dynamizes an environmental policy (Sheila, 2004; Millar, 2005; Castañeda, 2019; Feria,

2019). However, both present a symbiosis and are integrated in the environmental policy, territorial development and sectoral policies context.

Some elements of the problem of water resource management in tropical countries.

In tropical countries, where there is only one season (summer) with bimodal dry and rainy season events, due to the influence of the intertropical convergence zone, where air temperatures are relatively high (≥ 20 ° C), high humidity, with periodic climatic phenomena such as El Niño or La Niña , as well as the geographic, ecological, hygienic sanitary and social overlapping conditions, which favors the changing climate conditions on a time scale of days, months and even years, is saying the fluctuating set of climate conditions leads to integrating determining and interacting factors of the climatic order in physical and geographical conditions that present a variation in time and space scales. The modifications in the interaction between the components (atmosphere, land surface, oceans, ice covered land areas, biosphere and human activity) of the climate system are due you give to the temporary variations of the climate in short periods of time (years or months) or around its average state (high dependence on the amount and distribution of rainfall), known as climatic variability (Pabón, 1998; Montealegre, 2000; Izaguirre, 2010; García, 2007; Ruíz, 2016; Ortiz, 2017; Rodríguez e. a., 2017).

According to the above, in tropical countries, the management of water resources presents external pressure drawbacks, such as: conflicts of water use, socioeconomic and environmental interests, and possible effects of adaptation to changes in climate, due to the variability and climate change. Additionally, it generates structural consequences such as actors and agents weak model; one fragmented water management model; weak design of the territory dimension and environmental attributes; does not consider externalities; little comprehensiveness and isolated actors; low coordination with environmental management tools and no correlation as environmental structure, leading to an environmental imbalance, an insufficient planning and management, with standard gradation, but not systemic and consequently, it considers not variation in the climate. The following figure illustrates some complementary aspects of the problem, using the qualitative quadrant method.

Figure 1. Qualitative quadrant method in waters resource. Source: : (Rodríguez, 2017).

Quadrant II (-, +)	*Quadrant I (+, +)*
Scarce environmental planning without construction of sustainable uses of spaces, subjects and territory. Transformation of empirical information. Complex, dynamic and changing system over time. Ecological capacity imbalance (supply and demand)	Sustainability vector = Environmental policy Intention to understand the environmental dimension of the territory. Formulation of Plans, Laws, Decrees, Resolutions and Norms to conserve the environment. Planning using GIRH
ENVIRONMENT	**TERRITORY**
Quadrant III (-, -)	*Quadrant IV (+, -)*
Little knowledge of the territory and environmental assets. Reduced knowledge of dynamic, real and changing environmental processes. Imperceptible delimitation of actors and	Functional, jurisdictional, sectoral and environmental disarticulation. Territorial and environmental regulatory asynchrony Disarticulation and low capacity to

agents in the environment. Hydrographic basin characterized as homogeneous (use, control and protection).	implement environmental policy. Lack of mechanisms and control instruments. Poor ability to mitigate long-term effects

Some strategic axes for the environmental planning of the water resource in tropical countries.

The proposal of theoretical strategic axes ($NP_{Teórico\ i,j}$) of water management for tropical countries, which can present a sustainable and balanced administration, in the planning and comprehensive ordering of settlements, cities and regions (Winter, 1995; Aguilera, 2008; Gupta, 2005; Varas, 1999; GWP, 2009; Epstein, 2003), may be:

- Strategic axis of sustainable, intelligent and resilient infrastructure to have access to drinking water and environmental sanitation.
- Strategic axis for decontamination of water resources.
- Strategic axis in environmental water health in the population.
- Strategic axis in water awareness in the population.
- Strategic axis for the management and protection of aquifers.
- Strategic axis for security and regulation water.
- Strategic axis for mitigation and adaptation to climate change and climate variability in basins.
- Strategic axis for governance in water resources.
- Strategic axis for minimizing risks from floods and droughts.
- Strategic axis for the ecological restoration of water resources.

With the above, a comprehensive management of the water resource can be carried out (at the macro, meso and micro levels), including the identification of potential uses of water, classification of water, definition of quality objectives, goals for reducing pollutants, monitoring and follow-up, whose purpose is the conservation and preservation of water, less pollution, greater investments and the correct inclusion of environmental, socio- economic and governance aspects, through the simultaneity of command, control, economic, social, financial, ecological and management instruments, for the development of the water component.

Optimal magnitude of strategic axes

The purpose of knowing the strategic axes of environmental planning applied to the management of water resources, is to minimize costs to execute the policy, consider long terms and avoid breakdowns when preparing the strategic planning guidelines. Therefore, adopting basic models of economic quantity or independent demand (Heizer, 2008; Abernathy, 2000; Fischer, 1997), it is proposed to determine the optimal size or magnitude of strategic axes:

$$NOEE = \sqrt[2]{\frac{2 * NEE_{Theoritical} * CP_{Max}}{CP_{Min}}}$$

Where NOEE = Optimal number of strategic axes; $NEE_{Theoritical}$ = number of strategic axes; CP_{Max} = Maximum cost of each strategic axis (USD $); CP_{Min} = Minimum cost of each strategic axis (USD $). The cost of each strategic axis can be estimated using the Lange method, $CP_{Min} = CP_o + \sum_{t=0}^{n-1} \frac{CP_o}{(1+i)^t}$, where CPo is the cost of each initial strategic axis (USD $), i, is the discount rate and t is the projection time of costs.

Optimal decision of strategic axes

The open decisions (of the managerial and economic process) and implicit ones (state of the system) in the elaboration of the strategic axes (Forrester, 1981; Leavitt, 1980), consider primary variables available at the decision point in the strategic environmental planning according to the information flow of the water resource; therefore, the optimal decision function can be:

$$DEE = NOEE + \left[\frac{1}{T_{EE}}\right] * \left[\frac{CP_{Max} - CP_{Min}}{CP_{Max}}\right]$$

Where, DEE is the decision rate for the strategic axes and T_{EE} is the planning time for the strategic axes (Long term between 10 to 20 years; medium term between 5 to 10 years; short term between 0 to 5 years). According to the above, the strategic environmental planning capacity (CPAE) applied to water resources through the elaboration of the strategic axes, can be as follows (Kalenatic, 2001):

$$CPAE_{RH} = \frac{\sum_{i=m}^{n} NOEE}{\sum_{i=m}^{n} NEE_{Theoritical} + \sum_{i=m}^{n} NOEE}$$

The construction of the strategic axes (can be complemented with criteria or attributes, sub- criteria, indicator and variable) of environmental planning, in the water resources in tropical countries, analyzed hierarchically with a structure of preference to the decision-maker, arises as follows shape:

STRATEGIC AXES	LOW COST STRATEGIES	MEDIUM COST STRATEGIES	HIGH COST STRATEGIES	PLANNING TIME
				LONG TERM
				MEDIUM TERM
				SHORT TERM

CONCLUSIONS

In the formulation of the transcendental axes for the strategic environmental planning of the water resource in tropical countries, where possibly the support of the policy, plans, programs and projects, may be through subsidies, taxes or fees (by use, remuneration, among others) , regulation and use costs, service fees, incentives, 1% environmental investment, transfers and own resources from the operation of the responsible entities, among others and must be integrated through a Government Water Management Agency (AGGH), which should perform the optimization of the quantity and quality of the axes raised as well as streamlining the strategic decision that must be based on effectiveness and efficiency criteria.

This Government Water Management Agency can adopt an appropriate level of decisions, according to the strategies and long-term objectives in basins, given the ecosystem system with a macro or meso or micro horizon, at the regional and national level, including tools such as geographic information systems, hydrological, hydraulic and water quality modeling software, and ecological and environmental decision support systems.

ACKNOWLEDGMENT

The authors thank the Postgraduate Studies Unit and Research (UEPI) of the Autonomous Guerrero University (Acapulco, Mexico) for their full support in the development of the Postdoctoral program in environmental planning, being this a product generated from it.

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