Strategic Prospective Methodology to Explore Sustainable Futures

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This paper shows prospective methodology as a tool to generate strategic knowledge for designing sustainable futures. The strategic prospective is a social science discipline dedicated to explore the future. Based on qualitative methods with participative experts and stakeholders, the strategic prospective allows designing different future scenarios and planning the transformation of a current situation into a desired future. To design sustainable futures, this paper proposes a four-stage methodology: understanding the context; strategy visualization; design of alternative scenarios and definition of desired future; and planning its construction. This methodology makes evident the possibility of seeking alternative scenarios for a sustainable future in different scopes, particularly, in two prospective applications: biodiversity conservation and water treatment. The outcomes of the application have allowed proposing strategies and policies for the management of environmental goods, such as environmental services and water reuse, with a long-time outlook based on a collective desired future.

Keywords: future studies, scenario methodology, strategic prospective, future scenarios, future

Introduction

The field of studies of futures is relatively young. Although mankind has always tried to anticipate the future, serious, systematic, and rigorous reflection on it dates back only to the mid-20th century. Prospective attempts to reasonably explore where the trends and the different current and future courses of action or no-action could lead us (Alonso, 2014).

A world in which poverty persists; wealth is concentrated; corruption, organized crime, debt, and economic insecurity increase; pollution and mismanagement of natural resources aggravate; the environmental viability to harbor life diminishes; and climate change continues cannot be satisfied with its present. According to the “2012 State of the Future” report of the Millennium Project, the lack of a serious focus on green growth; descent of water table; rise of food, water and energy prices; population growth; resource depletion; climate change; terrorism; and the changing patterns of disease make it likely to have catastrophic results worldwide and will force migration in the coming decades, leading a larger portion of the world to become increasingly unstable (Glenn, Gordon, & Florescu, 2012).

Since the Industrial Revolution, the conventional model of development kept an approach in which modernization simply considered development as following the standards set by an industrialized society, regardless of the conscious and efficient use of resources, assuming the deterioration thereof as an inevitable

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consequence of development. On account of these challenges, a new development model has emerged to replace the old paradigm of industrial development. Baker (2006) noted that this model of development has sought to integrate and reconcile economic activity, social progress and environmental protection within a holistic model that enables the development and promotion of human welfare without having to rely on the destruction of resources.

This new model of development has integrated the concept of sustainability, which has evolved since its first application, documented in the renewal of the mandate of the International Union for the Conservation of Nature and Natural Resources in 1969, reaching one of the most accepted definitions of sustainable development. Embodied in the “Our Common Future” by the World Commission on Environment and Development (WCED), the report establishes that sustainable development implies meeting present needs without compromising the capability of future generations to meet their own needs (WCED, 1987).

Under the light of sustainable development and strategic prospective, two case studies on the future are presented below. The first presents scenarios for the conservation of a bat species (*Tadarida brasiliensis*) living in northeastern Mexico with the problem of a declining bat colony. The second case presents scenarios for the use of treated water in the city of Monterrey, Mexico, facing the challenge of water stress in a semi-desert area.

The Futures Studies

In prospective, there are two major visions of futures studies: first, the deterministic school that prioritizes the past as the main determinant of the future and considers the phenomena that show historically verifiable behavior. As mentioned by Mojica (1999), the present is the son of the past. The other stream, voluntarism, considers building the future as a result of human action, which makes it possible that the future is designed and modified proactively (Miklos & Tello, 2006). In this sense, Mojica (1999) refers to the “proactive oxygen” when highlighting that prospective assumes the creative force of man, related to the notion of freedom, to work in one way or another. Thus, while the deterministic current mostly uses tools aimed at knowledge and explanation of the inertia factors and trends, the tools of the voluntarism current primarily consider a dynamic approach in which it is necessary to provide instruments to first identify the system’s current status and then those conditioning elements to construct and achieve the desired future. This future is shown in scenarios.

For Godet and Durance (2011, p. 26), “A scenario is a set consisting of a description of a future situation and a path of events that allow to move from the original situation to a future one”. A scenario is a story with plausible cause-and-effect links that connect a future condition with the present, illustrating decisions and key events and consequences through narrative. The scenarios can be exploratory or normative. The first ones take into account the trends and the present situation to predict the most likely future. The normative scenarios seek the collective construction of the future to achieve the most desirable situation (Glenn & The Futures Group International, 2009). Among a long list of events that could happen, some are recognized as more likely to occur than others. “The likely scenario indicates where we are going. However, where we are going is not necessarily where we want to go. The alternative scenarios point out that there are other paths and roads, whose analysis enables us to choose the best” (Mojica, 2005, p. 118).

Whether it is the discipline that frames different methodologies or it is the type or origin of the available information for the study, the methods of approach to the future can be classified on a continuum from the quantitative to the qualitative or vice versa. Thus, the left end represents the forecast, while the right, the prospective. To illustrate, we have the quantitative methods such as the analysis of time series in which the

futures are mostly conditioned by past patterns showing the series of numerical data. Conversely, on the qualitative end, the futures are mainly the result of the analysis and interpretation done by specialists or experts. In the middle, we have methodologies that incorporate information from both quantitative and qualitative nature, in which the future is determined by the cause-effect or input-output relationships among the variables that determine the object of study (Gándara, 2014).

The Prospective Process

A study of futures may be conceived and developed through a comprehensive four-step methodological process. The first stage is concerned with the global understanding of the context; the second, with a strategic view; the third with the design of futures; and the fourth with the construction of the future.

Understanding the context. It is the first approach to the object of study. It refers to the general understanding of the problem or the object of study for which the future will be visualized. It means understanding the system's dimensions. With regard to the qualitative methods, if the study requires the consultation with experts, it is at this point where it should be learned how to communicate with them. In terms of the quantitative methods, understanding the context refers to the identification of variables, observation and understanding of their past behavior, and establishing causal relationships between variables. Thus, understanding the context means having a macro-level conception from an observational point at the surface level.

Strategic visualization. Following the general understanding, it is possible to refine the observational approach to determine how the relative importance of the constituent elements under study may condition their future evolution; this is strategic visualization. In terms of the qualitative methods, it refers not only to the analysis and categorization of variables and the relationships between stakeholders, but also to determining the strategic internal and external factors and their impact in the future. The quantitative methods are concerned with the validation and quantification of the causal relationships between variables, and with the identification of patterns to analyze their internal composition and their impact in the future. Thus, strategic visualization means having an understanding at the micro level, tuning the degree of observation from an internal level.

Sketching the futures. Once the first two stages of the prospective process have been completed, there are enough elements to deepen in the futures of the object under study. The third stage, sketching the futures, allows the beginning of the design of different scenarios for the future. Whether it is through the exploratory approach or through the regulatory one, it is time to make use of the strategic information resulting in the first two stages to display the possible future states and sketch either alternative or plausible scenarios. This is the most creative stage since the stories each scenario provides are described and are given a meaningful name.

Building the future. The fourth stage, building the future, begins with the participatory definition or selection of the desired or bid scenario. It is here where the path and the pertaining courses of action should be sketched to reach the bid scenario. It is the time when prospective and strategy intertwine to form an indivisible binomial as Godet (1995) explained. Undoubtedly, this is the most complex stage in which the stakeholders' interests should be reconciled, disputes should be solved, and the environmental and internal challenges should be faced and solved. In other words, the change factors should be internalized in order to achieve the desired scenario. From the systemic point of view, it is about establishing the process that leads to reaching the evolution of the system from its current situation to the one desired in the future.

Tools for the Prospective Process

Different scientific disciplines provide methods and tools to complete each stage of the prospective process. For the understanding the context stage, there are different qualitative methodologies based on consultation with experts, such as the expert panel, focus groups, and the Delphi method, among others. There are also some tools to graphically represent the object of study such as the cause-effect or tree-problem diagrams. Here are also found the analysis of megatrends, the systems view, the Marc Giget's Tree, and the analysis of time series, which besides providing general information about the object of study also allows information for a strategic analysis.

In the strategic visualization stage, there are specific tools and methodologies to classify or ponder the relative weight of the components, factors, actors, and/or forces that influence the behavior of the object of study, such as the structural analysis (MICMAC), the stakeholders' analysis (MACTOR), and the internal and external forces analysis (SWOT).

To develop the third stage, sketching the futures, methodologies from prospective and forecast are available. Examples of the former are the methods to design scenarios, such as the Peter Schwartz's axes, the Cross Impact Systems and Matrices (SMIC), the Morphological Analysis, and the Prospective Method of Scenarios and Strategy Network (Meyep). Within the quantitative methodologies are the time series analysis, the causal models, and the dynamic modeling of systems, which allow the design of scenarios using an exploratory approach.

In the stage of building the future, it is essential to have tools and methodologies for planning, strategic intelligence, interactive management, the game theory, and negotiation and conflict resolution, in which the processes to transform the present into the desired future are set and managed.

Generating Knowledge to Move From Anticipation to Action

Anticipation, stakeholder's ownership and action are equally important to build the futures. Godet and Durance (2011) defined three inseparable areas that give meaning to strategic prospective. First, anticipation, through whose reflective prospective, will provide support and content to the second, the vision of the future. This vision, set under a collective orientation, will achieve the third, which refers to the stakeholders embracing it and thus defining its scope as their task through action.

Godet (1995, p. 47) asserted that one goal of the scenario method is to "identify key stakeholders, their strategies, the means available for their projects, mainly from the key variables". Thus, foresight provides the necessary tools to analyze the problem or object of study, recognizing its most important elements and providing a specific methodology that suits the objectives. To build sustainable futures, it is necessary the involvement of all the stakeholders. Barbieri and Medina (2000, p. 51) argued that:

Their objective includes the need to develop awareness and create skills to define and project the future in the desired direction, as ethically compatible with a human and sustainable development and humankind. Building the future implies carrying through vast and difficult educational processes and processes of culture transformation.

As previously mentioned, prospective provides tools and methodologies to know the scenarios, variables, and key stakeholders. It provides an orderly way to wander into the future and imagine what could happen, facilitating the development of specific strategies.

A proactive mindset and dedication of strengths and energies to build a desirable scenario are indispensable. Rather than being concerned about the aches and pains of what the future could bring, it is better to focus the attention on forging collective awareness to modify it. This attitude should be supported by concrete actions and strategies that lead to changing the path; it is here where prospective comes into stage, not only as a way of thinking, but also by using an effective methodology.

Bat Preservation at the Boca Cave

This case pursues the study of the *Tadarida brasiliensis* bat, known as the free-tailed bat, which inhabits at the Boca Cave. The cave permanently houses some bat species, some of which are migratory. This cave is located in the town of Santiago, Nuevo León, within the Protected Natural Area “Sierra Cerro de la Silla”, 36 kilometers from the city of Monterrey. In 2004, the cave was home to a colony of between 600,000 and 700,000 individuals of this species, but it had lost 95% of its population in the 90s (Vela, 2004). The actions to protect the area were limited, and thus, the risk of loss of the colony was latent.

This research pursues the general objective of creating possible, probable, and desirable scenarios that help solve the problems at the Boca Cave, foster the protection and preservation of its bats, and promote the sustainable development of the zone. It seeks to achieve better and greater understanding of the problems the site has and make recommendations supported on strategic prospective, leading to the preservation of the species in a 10-year time span.

Sources of the Problem

In the overall, there is a lack of environmental education and public interest; moreover, there is null respect to biodiversity, specifically related to this bat population, whose cave is subjected to constant vandalism. The human being has become the main threat to both the bats and the biodiversity in the Boca Cave. In 1991, a research study by Bat Conservation International documented an alarming loss of bats in eight of the 10 Mexican caves that have the largest populations, including the one at the Boca Cave (Walker, 1995). It is estimated that this place had a colony of over 5 million bats which easily consumed beyond 50 tons of insects a night (Moreno, 1996).

Over the years and up to the present, the cave has been visited by a recurring and varied kind of tourists, from those drawn by curiosity to know the bats, to others whose probable ignorance takes them to do vandalism, such as starting fires, doing graffiti, blasting firecrackers, or littering the place, to those who are attracted by the scenic beauty of the place. Whatever the reason might be, people have been causing a high impact (some unknowingly, others knowingly) to this fragile ecosystem. Moreover, there is an opencast mine in front of the cave, and close by is a wastewater treatment plant.

Methodological Process

Prospective is an attitude from a comprehensive and systematic vision towards the construction of a multiple and uncertain future, with evolutionary structures and dynamic relationships, by means of the actions done in the present (Godet, 2000). The understanding of the context stage entails literature review, interviews with experts, and visits to the site. The global trends in environmental matters such as sustainable development, biodiversity, and ecotourism are documented. Also, the characteristics of the species *Tadarida brasiliensis*, its ecological and economic benefits, as well as the existing legislation at the international, national, and local levels on the protection of species are researched.

The strategic visualization stage calls for a SWOT analysis to enclose the internal and external situation of the problem; a MICMAC to analyze the strategic variables for the preservation of the species; and a MACTOR to identify the role of the stakeholders related to the problem as well as their main converging and diverging issues. In the sketching of the futures stage, a SMIC is done to generate the probable, possible, and desirable scenarios for the Boca Cave. Finally, in the building the future stage, recommendations arising from the results of the research are presented.

The Proposed Future

The MICMAC results showed the following as key variables: protection of the cave, ecotourism, municipal and institutional projects, sustainable development, environmental education, public indifference, stakeholders synergy, harmful activities, ecological municipality, and public budgeting and financing. The key variables are characterized for being highly influential and dependent, ideal to activate or deactivate the system's dynamics, or in this case, essential to help and preserve the population of bats in the Boca Cave.

Twelve strategic objectives were raised in MACTOR; these objectives were evaluated by 12 actors of the public and private spheres, non-governmental organizations (NGOs), and scientific communities. The objectives were as follows: (1) to define the legal structure of protection and conservation of the cave and its area; (2) to provide the zone with the required equipment, tools, and infrastructure to protect the area and the cave; (3) to participate actively in the implementation of programs, actions, and activities to protect and preserve the area including control of erosion, reforestation of green areas, monitoring of species, and assessment of habitat; (4) to develop periodic research and studies on environmental services associated with species of bats; (5) to plan and implement comprehensive educational programs on environmental and ecological culture; (6) to have state-of-the-art technology for conservation and preservation of natural areas; (7) to organize a board with the representatives of NGOs, the Municipality of Santiago, the State of Nuevo León, citizens, the private sector, and universities to handle the administration, management, and marketing of the area; (8) to define control measures and effective care of the cave and its surrounding area; (9) to disseminate to the public the activities and programs of conservation, research, and environmental education, for the benefit of the community; (10) to set mechanisms for cooperation and active involvement among stakeholders; (11) to provide financial resources to carry out programs, projects, actions, and activities related to the sustainable development of the area; and (12) to develop low-impact ecotourism activities in the area, achieving sustainable economic growth in the region as well as financial sustainability of the project in the future.

To devise the possible and desirable scenarios with regard to the Boca Cave, six hypotheses for the future were defined; all six should help determine the success or failure of the preservation of the site. According to SMIC and taking into account the probability of occurrence of each future hypothesis, the four most likely scenarios were obtained: Scenario 1 "Bats Survive"; Scenario 2 "The Fateful"; Scenario 3 "... and now, who can help us?"; and Scenario 4 "I have everything... except money", with a probability of occurrence of 41.5%, 22.6%, 14.1%, and 4.3%, respectively.

Scenario 1, "Bats Survive", is the most likely and desirable since it is the one in which the six future hypotheses occur for the following reasons: there is an agreement of engagement among stakeholders (H1); extensive educational programs on the environment are established (H2); an ecotourism project is developed at the Boca Cave (H3); a board/trust for the management of the area is established (H4); institutional programs and projects are created in favor of the protection of bats in addition to getting financing and public interest (H5); the issues of legal land are solved, and no more harmful activities are recorded at the Boca Cave (H6).

Under this scenario, partnerships between stakeholders would be successful in that they would lead to the implementation of programs, strategies, and activities for the conservation and preservation of bats. The challenge would be met and Nuevo Leon would be among the first states with comprehensive programs of environmental education and ecological culture. Tourists, farmers, and the main divergent stakeholders in the system would become more aware of the benefits bats bring to human health.

Future Scenarios for Wastewater Reuse

Water is a finite resource and vital for the preservation of life and the development of societies; thus, its conservation is an imminent necessity. Population growth, pollution, climate changes, and inadequate management, among other factors, have contributed to the condition of water scarcity. Some countries and regions that actually face serious water stress problems have matured on the practice of wastewater reuse. Israel and the Canary and Balearic Islands in Spain illustrate this maturity.

Mexico is currently dealing with severe water scarcity; its main industrial and urban areas are located in regions where the availability of fresh water is limited due to its geographical conditions. The central and northern territories are arid and semiarid regions that concentrate two thirds of the national population and only 30% of availability of fresh water. To deal with this situation, it has been necessary to build major infrastructure to supply water. To illustrate, the dam “El Cuchillo” supplies fresh water to the metropolitan area of Monterrey (MAM), the region for which it was made.

Background

The MAM is located in the northeast of Mexico and is characterized by semiarid climate, little rain, and important population growth. Even though the metropolis treats absolutely all of its wastewater, only 10% is reused mainly in industries and golf fields. Other important potential uses, such as landscaping irrigation, agriculture, homes, businesses, and municipalities, are left aside; let alone the indirect production of drinking water through the injection of treated wastewater to the aquifers, among other options. If these uses were regarded as feasible options, all treated wastewater could be reused, diminishing the pressure on water resources and allowing water availability at the MAM for future generations. Another important point to consider in this matter is the cost of the energy required to pump water from other basins to supply cities; hence, water reuse implies a reduction of volumes pumped, and therefore, less carbon dioxide emissions.

Considering the above, the case aims to propose future scenarios for the reuse of treated wastewater in the MAM, identifying the chosen scenario in order to release a larger amount of water.

Methodological Process

Going through the first stage, understanding the context, meant reviewing the literature, interviewing experts, and visiting the sites. The major global trends in wastewater treatment and international cases known for the measures taken to increase this activity are studied. Matters such as wastewater treatment in MAM, technical aspects, policies, current situation of water availability, and water reuse were researched. In the strategic visualization stage, the most relevant variables were identified through structural analysis. In the third stage, sketching the futures, the SMIC method was implemented to describe future scenarios of water reuses in MAM. Finally, in building the future, recommendations to achieve the chosen scenario are presented.

The Proposed Future

This research helped devise a scenario for the reuse of wastewater in the MAM. By analyzing the worldwide, national, and local conditions, 24 variables involved in the studied system were identified and classified within a sub-system. These variables, used with the prospective tool structural analysis, threw a result of the following 17 strategic variables: water availability, environmental education, infrastructure, treatment model, water value, technology, reuse, scale treatment, water culture, cost of treatment, treated water competitiveness, consumers, effectiveness of collection and reuse system, human capital, industrial wastewater treatment, treated wastewater coverage, and financing.

The aforementioned variables were used to prepare six hypothetical events, and by using the SMIC method in them, the four most probable scenarios to reuse wastewater in MAM were obtained: Scenario 1 “Achievement of Water Balance”; Scenario 2 “Arrogance Has Blinded Us”; Scenario 3 “We are Left With Good Intentions”; and Scenario 4 “Trying Voluntarily”, with a probability of occurrence of 29.1%, 21.7%, 17.6%, and 14.7%, respectively.

Scenario 1, “Achievement of Water Balance”, is the most likely and desirable; it is a scenario in which all events happen: development of a culture of water reuse, environmental programs, acceptance of the use of treated water by the water company (H1); adoption of a decentralized model of treatment of small and medium scale sewage collection systems, and water distribution and treatment with an efficient infrastructure (H2); adequate treatment of industrial wastewater before discharging it to the drain (H3); incentives to encourage citizens to recycle water, investment in technology, improvements in effluent quality (H4); price and quality of treated wastewater compared to drinking water (H5); MAM focused on increasing the reuse of treated water; and ideas and strategies are routed through concrete actions covering different angles to ensure water availability (H6).

Finally, from the economic perspective, the following recommendations were made: revaluation of water through water rates; severe penalties when permissible limits of pollutants are exceeded; re-identification of industries in accordance with pollutants emitted; implementation of a dual water supply system for new buildings, including a network of grey water reuse; and decentralized treatment plants built for each housing complex or building under construction. With regard to culture and environmental education, it was recommended to have a campaign promoting water reuse and hold an agreement with public and private educational institutions; inject aquifers; and create an agreement with municipalities to use treated water.

Conclusions

This paper highlights the importance of having the knowledge to design sustainable futures by analyzing two case studies. The prospective process used at the Boca Cave and in the Water Reuse in the MAM contributed to understanding the actual situation from a number of important variables, generating knowledge about the influential relationship between them. Moreover, in the case of the Boca Cave, the analysis of key stakeholders for the preservation of bats led to knowing the alliances and conflicts among them. This analysis took into account the assessment owed to the strategic objectives, the direct and indirect influence on another, and the power each had to move the rest into action.

Likewise, the future was envisioned in terms of the solutions presented under the light of sustainability from the design of six hypotheses for the future for each case. The experts’ assessment of the probability of occurrence of these hypotheses led to obtaining the possible, probable, and desirable scenarios by means of the SMIC, identifying and describing those four that showed 80% of probability.

The study aims to be part of the limited references to the Boca Cave and those of water reuse in Monterrey, serving as the basis for future analyses. It is expected that the results from the two cases can contribute to the knowledge of possible future solutions that lead us to better coexistence with other species and to a more efficient use of the natural resources on which we base our development.

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