



Valuation of Natural Resources and Performance Indicators, Fundamental Support for Creation of a Systemic Financial Model for Watersheds

Oswaldo Daniel Martínez Camacho Cardoso¹, José R. Fábrega D.², Ph.D

¹ Doctorante en Ingeniería de Proyectos de la Universidad Tecnológica de Panamá

² Universidad Tecnológica de Panamá

ARTICLE INFO

Published Online:
10 December 2018

ABSTRACT

An overview of watershed management in the region of Central and South America indicate that they are very rich in natural resources, principally water as a primary resource. However, this wealth and others provided by nature are constantly threatened by overuse, misuse or use, degradation, land desertification among others that make sustainable management impossible.

The watersheds intervened in their home or recently established, currently still rely heavily on external funding, which means that they are not sustainable and even worse they do not have the incorporation of its inhabitants as a way of governing their habitat, consequently, the systemic financing in watersheds is the subject less developed in Latin America at the level of public policy and academically.

Conceptually, it is closely related to governance as a mean of management and watershed management through capacity building of individuals who live there, which are organized in communities and municipal institutions, responding to national policies on comprehensive Management of watersheds and the Integrated Management of Water Resources. The aim pursued by the valuation of natural resources in watersheds, is the creation of a financial systemic model of governance associated primarily responsible to their organized citizens with created capacities and long-term financing

Corresponding Author:

**Oswaldo Daniel
Martínez Camacho
Cardoso**

However it is important to create watershed performance indicators that allow us to be confident that the model, capabilities and interventions are optimal or reasonable.

It is therefore important to define indicators on governance and sustainability in watershed which are showing progress and trends on the expected horizon.

I. INTRODUCCIÓN

Watersheds demand large volumes of investment and operation, despite that, they lose their environmental, hydrological and ecological functions as a result of indiscriminate use and lack of regulation in the use of their natural resources

Many of the plans of management-master plans attribute the lack of its application to the issue of the demand of millionaire sums, therefore must resort to external financing as an alternative, leaving aside the essence in its long term sustainability "its natural resources" fundament to generate value and better living conditions among its inhabitants.

The Integral Management of Watersheds – IMW in Latin America has been financed with external funds from international cooperation, with low responsibility of the Estate and Society, which is causing the city's water

quantity and quality to be lost in an accelerated manner, likewise, territorial disputes cause conflict and ungovernability in the areas surrounding watersheds

Watershed management organizations cease to exist due to weak state institutions for water management, and to a high mortality rate or cease to exist institutionally (Dourojeanni 2004), this is due to the lack of financing and management in legalization of legal personality, consequently, these entities go through serious management problems to meet the objectives for which they were created.

One of the most important aspects in the Integral Management of Watersheds is the systemic financing related to the sustainability in watersheds product of the valuation of its own natural resources, nevertheless, some publications by The nature Conservancy in "Watershed Evaluation card"

“Valuation of Natural Resources and Performance Indicators, Fundamental Support for Creation of a Systemic Financial Model for Watersheds”

prepared by Imbach Alejandro, in his publication tangentially takes into account the subject, being also in this position the working group on finance of the initiative for water of the European Union – EUWI – FWG (Hurtado and EUWI-FWG 2012), focusing in financing through negotiated payments and considering the hydrological issue. However, the financial model can be even more robust and consistent considering all the benefits that a certain watershed provides in its biophysical elements and in the understanding that the land factor associated with the water resource provides innumerable benefits in production.

In this scenario, it is important that agreements between users and contributors are logical and accessible in order to achieve financial sustainability, less dependence on public funds (Rees, Winpenny, and Hall 2009)

The objective of this article is to explain that the systemic financing of a watershed can be realized through the inventorying and valuation of its natural resources; with the purpose of seeking governability through processes of capacity building in its inhabitants organized in watersheds organizations or under another modality, with decentralized public policies granted by the governing entities and with sustainable financing for the execution of prioritized projects.

No less important is the incorporation of indicators of governability and sustainability in watersheds based on a baseline that incorporates protocols to measure progress, achievements and expected results; A general outline of what is mentioned is presented in figure 1:

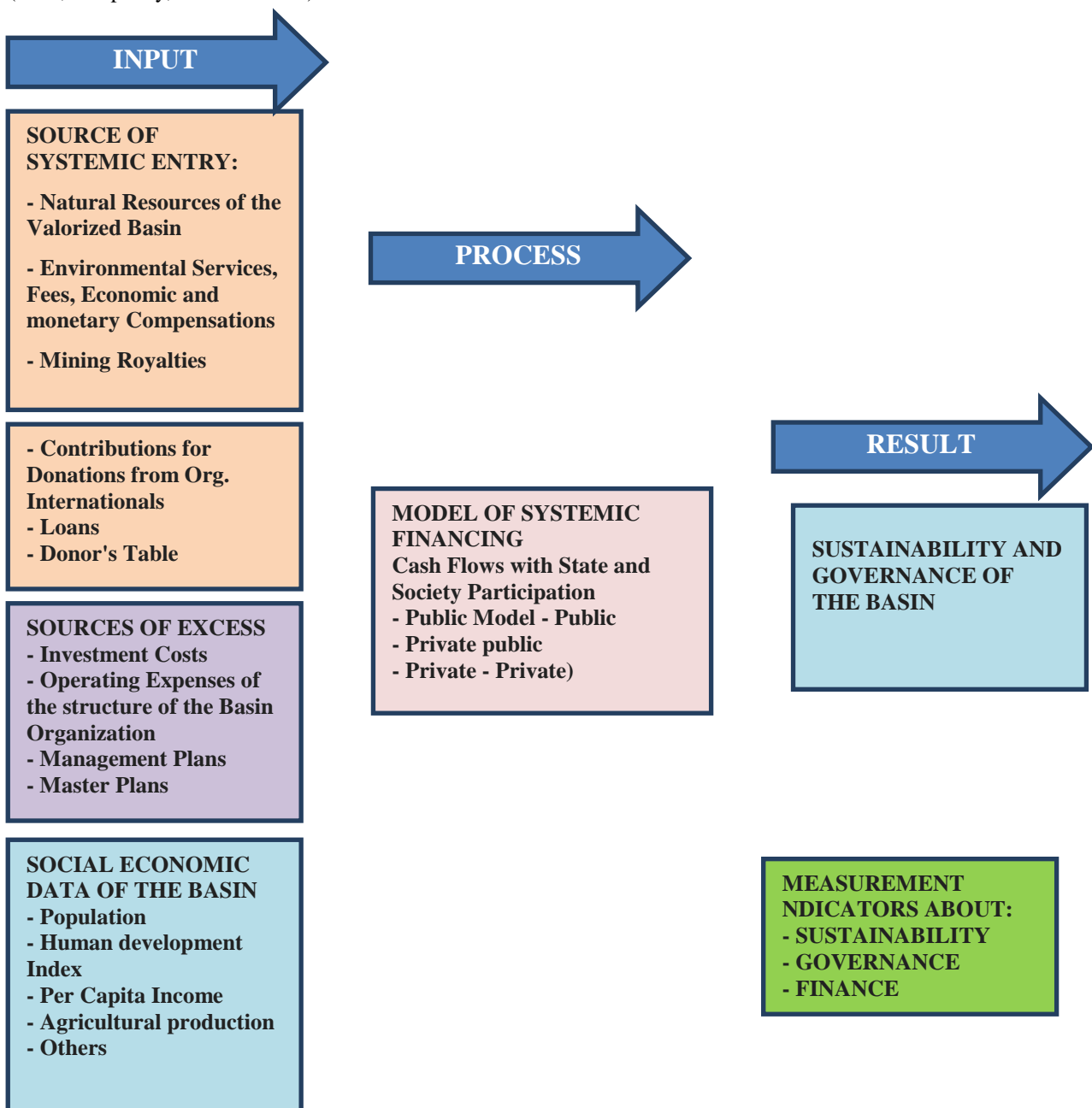


Figure 1. Systemic financing model associated with indicators of sustainability and governability in Watersheds.

Source: Own elaboration.

“Valuation of Natural Resources and Performance Indicators, Fundamental Support for Creation of a Systemic Financial Model for Watersheds”

As can be seen in figure 1, the model introduces biophysical aspects that come from master plans or watershed management that are incorporated in the diagnostic stage, as well as socio-economics aspects. The model works with inputs from the watershed itself through the valuation of natural resources, emphasizing the water resource in its different modalities of use, such as canons and negotiated payments, as well as funds from international organizations such as donations and loans. Expenses are mainly defined in two aspects: all the information related to investments exposed in Master Plans or Management plans and expenses for the operation and training of the watershed organization.

II. BODY TEXT

The value of ecosystems and their valuation has become an important mechanism in the public management of ecosystems (Villa et al., 2002), influencing through these in conservation policies (Alden, 1997). In this context, valuation techniques can be direct (focus with individual demand) or indirect (focus without demand) (Freeman, 1993; Pearce and Turner, 1995)

On the other hand, valuations techniques can be based on preferences: market prices, travel cost method, contingent valuation, discrete elections, others (Sarmiento 2003)

With the previously detailed data, systemic financing models are constructed in their different modalities according to the participation of the state and private, I have incorporated information in the horizon of financial flows such as: population growth, the variation of the price index

to the consumer and others who can expose us to different scenarios. These models must be corroborated through financial and economic indicators such as the Internal Rate of Return – IRR to evaluate the project based on the performance of the period in the flows, whose updated benefits are equal to the disbursements expressed in (Sapag and Sapag 2008); Net Present Value – NPV which is acceptable as long as its value is equal to or greater than zero, whose calculation comes from the difference between income and expenses (Sapag and Sapag 2008) and, the benefit-cost ratio generally used in the evaluation of public project, whose obtaining is through the net surplus value in a public investment.

The establishment of public policies on water as a transversal axis in productive, industrial, and agricultural processes has been considered in the strategy with a horizon of 2020, incorporating concepts on the generation of knowledge of the global network, achieving governance, and management of the water, including water (Global Water Partnership 2009), and the Integral Management of Water Resources– IMWR in central and south America has contributed significantly to the sustainability and governability of natural resources associated with watershed management; case studies have been systematized in the table below, exposing the problem, the process or actions carried out to derive optimal results that contribute to the improvement of water management.

“Valuation of Natural Resources and Performance Indicators, Fundamental Support for Creation of a Systemic Financial Model for Watersheds”

IWRM CASE STUDIES IN CENTRAL AND SOUTH AMERICA			
COUNTRY	PROBLEMATIC	ACTIVITIES/PROJECTS	RESULTS
Costa Rica-Lake Arenal Approximation of the IWRM for the achievement of a better allocation of the resource	a) Disability of the basin b) Deforestation c) Sedimentation of the reservoir	a) Construction of a dam b) Water storage capacity 2 billion M2 c) Electric power generation d) Irrigation or irrigation of 40,000 hectares of land	a) Meeting and participation of several institutions, disjointed in the past. b) Maximum use of available resources c) IWRM generates great economic benefits to society d) Planning and coordination to save resources, increase efficiency in the operation e) Organization of the representative basin, open and inclusive f) Multiple uses of water
Guatemala-Naranjo river basin Associativity for the incidence in IWRM	a) Absence of Water Law	a) Agglutination of associations in an organization CADISMA (Communities associated by water, environment, integral development and infrastructure of the basin b) Conformation Commonwealth of municipalities upper part of the basin c) Formulation of municipal water policies through consensus	a) Sensitization and training in IWRM b) Formulation of municipal water policies from the bottom up c) Establishment of the water dialogue table system d) Generation and management of information on water resources e) Social participation as guarantor of sustainability f) Implementation of water inventories to know the quantity and quality of the resource.
Guatemala - San Gerónimo Baja Verapaz River Basin Successful experiences of IWRM	a) Overexploitation of aquifer mantles b) pollution from sources near the river c) Indiscriminate forest deforestation d) Conflicts between communities e) Quantity and quality of water with problems	a) River Committee serves as a negotiating entity among the users of the basin b) Coordination with users: irrigation, aquaculture, hydroelectricity, human consumption and tourism c) Creation of a committee for coordination among actors	a) Conservation of the watershed and sustainable use of the water resource b) Increase of the socioeconomic benefits of the population c) Social responsibility of the organizations with regard to IWRM d) Establishment of coordination mechanisms between different users e) Efforts to preserve and protect the basin
Nicaragua - Indian River Municipal experiences in IWRM	a) Elimination of primary vegetation product of human activity b) Low educational level in environmental aspects c) Deconsideration of natural resources in the basin d) Livestock development that leads to conflicts over land use and forest deforestation e) Water contamination by excreta and solid waste f) Organizational weaknesses at the community level	a) Management and maintenance of forests in microwatersheds b) Conservation and protection of hydrological reserves c) Reversal of fragmentation of ecosystems d) Aquifer recharge protection e) Creation of water reserves f) Training workshops with participatory processes	a) Improvement of the quality and quantity of for human consumption b) Strengthened user network, organized, with strategic and action plan c) Model as a pilot program for other communities d) Generation of basin model led by municipal governments in coordination with organizations e) Creation of environmental and water culture through training and awareness
Panama - Panama Canal Management of the Panama Canal watershed	a) Inexperience in the integrated management of watersheds b) Absence of water culture and national water policy c) Lack of maintenance of a system and sustainable effort in education, research and negotiation between involved parties	a) Appropriate legal framework b) Improvement of water management c) Creation of a basic structure for IWRM purposes d) Consensus on legal key instruments e) Participation of key users in the IWRM process	a) Management of a basin with an international vision in a developing country that had no water culture b) Relevance in the IWRM concept and as a tool for understanding the management of the Canal c) Approach to IWRM for future sustainable development in Panama, sustainability of services and growth of world trade.
Venezuela - State of Carabobo Integrated watershed management	a) Reception of high load of domestic, industrial and agricultural effluents in Lake Tacarigua (endorheic) b) Lake pollution, which threatens the supply of drinking water to the population c) Expansion of agricultural activity, urban development resulting in deforestation, felling, inadequate disposal of solid waste d) Increased risk of erosion, desertification, loss of soil	a) Achieve the quantity and quality of water to be managed in a sustainable manner	None
FUENTE: GWP, TOOLBOX			

TableI–Systematization Of Experiences In Integral Management Of Water Resources In Central And South America

Source: Own elaboration basedon information from Global Water Partnership/Toolbook Water.

“Valuation of Natural Resources and Performance Indicators, Fundamental Support for Creation of a Systemic Financial Model for Watersheds”

The model contributes to the sustainability of the watershed in the long term and governability, carrying out the monitoring through protocols and indicators. We must emphasize that an indicator is the basis of a monitoring and evaluation system, in which the present actions are visualized, but also incorporates a future perspective to improve the interventions carried out.

Indicators of sustainability and governability. The methodology for determining these indicators is the following:

- Prepare proposals for indicators based on prioritized problems and proposed lines of action in the watershed.
- Prepare measurements protocols.
- Consider the baseline that emerges from the diagnostic information, considering indicators of sectorial documents, in this case watersheds.
- Consider the quality of the information, the availability and the lowest cost for its verification – efficiency.
- Coordination, planning, awareness and socialization with the institutions involved, taking in account:
 - Socialize the need to elaborate a baseline which expresses the starting situation, considering aspects of management and management of natural resources and integral management of watersheds.

- Provide watershed management and management principles that incorporate criteria of: complementarity, diversity, multisectoral, transversal gender, culture environment.
- Identify common indicators at the watershed level.

The Baseline for the Monitoring and Evaluation of a watershed should have a description of the qualities of a good indicator, explaining the following:

- **Relevance and pertinence.** –They must measure the most significant elements.
- **Oneness.** –Measure only one aspect.
- **Accuracy and consistency.** –Provide exact measurements and provide the same measurements applying the same procedures.
- **Objectivity.** –reflects concrete facts.
- **Ease of interpretation.** –Clear at the moment elaborated and socialized.
- **Accessible.** –Based on easily available data and at an acceptable cost.
- **Comparable.** –In space and temporality.

Some indicators of governance and sustainability for watershed management are described in Table 1, whose compilation has been taken from the Performance Evaluation Framework – PEF of the ministry of Environment and Water, the Master Plan for the Lake Poopo watershed and its own work experience in watersheds.

“Valuation of Natural Resources and Performance Indicators, Fundamental Support for Creation of a Systemic Financial Model for Watersheds”

SORT	OBJETIVE	INDICATOR
Financial sustainability	<p>a) Promote the increase of tourist activities through the inhabitants of the basin.</p> <p>b) Increase organic agricultural production related to market research</p> <p>c) Increase the number of agricultural producers in the basin through the payment of environmental services</p>	<p>a) Number of inhabitants increased in tourist activities with respect to net income received</p> <p>b) Amount of organic production in Tn by products sold with respect to income obtained related to distribution channels and amounts collected</p> <p>c) Amounts received as a result of the sale of environmental services in the basin</p>
Governance and financial sustainability	<p>a) Promote social agreements and management transparency that include shared responsibility for the Integral Management of watersheds, financing mechanisms, resource management and communication strategy, socialization and dissemination of information</p> <p>b) Support the representatives of the basin platform or organization through assembly resolutions and meetings of their organizations for the consensual use of water</p>	<p>a) Social and institutional actors regulate the uses of water in an agreed basin management.</p> <p>Number of agreements on water uses in drinking water, mining, irrigation and others</p> <p>b) Number of support resolutions for consensual uses of water by each basin organization, which implies the collection of resources</p>
Governance and financial sustainability through reallocation of mining royalties	<p>Promote the application of new public policies related to the destination of departmental mining royalties to master plans or watershed management plans, approved by the corresponding legal instances</p>	<p>Number of departmental and national laws approved, allocating resources of mining royalties to master plans or watershed management</p>
Sustainability IWRM and MIC Projects	<p>Promote implementation of projects with concurrent investment in MIC-GIRH, which generate results in the short and medium term and promote the strengthening of capacities of organizations and actors to achieve the sustainable management of resources water resources and associated natural resources at the microwatershed level</p>	<p>Sustainability Index (ISpnc) = $\Sigma (ISpr \times No. Direct Beneficiaries) / \Sigma (No. Direct Beneficiaries)$ of projects completed and evaluated.</p>
Water Governance	<p>Promote and consolidate water governance and sustainable management of natural resources through inter-institutional and inter-sectorial coordination of processes and actions</p>	<p>$IGH = \Sigma (IGce * RDce)$</p> <p>IGce = Strategic Basin Governance Index: 1) Establishment of a Technical Management Unit; 2) Degree of progress in establishment of PDC platform, 3) Degree of knowledge development of the basin, and 4) Development of operational planning and monitoring tools</p> <p>RDce = population of municipalities that are part of the strategic basin according to the census of a given year / total population of the country.</p>
Municipal Governance and institutional capacity in conducting IWRM and MIC interventions	<p>Promote the development and strengthening of inter-institutional capacities and individuals in public, private entities and social organizations, at the national, regional and local levels, for promotion, planning, facilitation and execution of IWRM-MIC processes and actions.</p>	<p>Number of operating municipalities with Capacity Index Municipal (ICM) > 0.65.</p> <p>ICM is an index with values from 0 to 1. The index is composed of three groups of coindicators: Strategic Management (GE), Operational Management (GO) and Horizontal and Inter-institutional Coordination vertical (CI).</p>

TableII–Governance And Sustainability Indicators In Watersheds

Source: Own elaboration based on information from the Vice Ministry of Water Resources and Irrigation of the Plurinational State of Bolivia

In order to arrive at the definition of the indicators in sustainability and governability related to the integral management of watersheds, a scheme has been designed, which shows the inputs of figure 1, the processes through which they pass and the results to be obtained. The indicators of governance and sustainability associated with the systemic financing model must fulfill the function of providing periodic information to verify progress, correct risks, but above all make decisions regarding the optimal management in watershed management. Therefore, the actors within the water resources management processes will manage information, will be aware of the advances and will make decisions for the benefit of the watershed as their living habitat. We must also that indicate that watershed indicators provide information to feed the integral management of watersheds at sectorial level, in such a way that it allows to make modifications, changes, additions or suppressions within public policies, in the understanding of improving the living conditions of the beneficiaries.

The conceptual framework in the definition and management of indicators, implies the desired transformation from a baseline (starting point), with definition of protocols with a tendency toward a better horizon in the integral management of natural resources, therefore, the indicators will contribute to the valuation and advances regarding knowledge, attitudes, values, income, expenditures as important elements in the transformation of inputs in models worked with cash flows.

The data collected will be parameterized through excel sheets, to then process the information regarding the indicators, from which the interpretation can be extracted according to the determined standards. The indicators will reflect the accomplishment of goals or, failing that, the correction of the planning of the watershed to achieve the described results in the short, medium and long term.

III. RESULTS Y DISCUSSION

Having indicators of sustainability and governability in watersheds involves gathering information, classifying, systematizing and applying it coherently with the purpose of comparing with an initial state, analyzing its progress, difficulties, but mainly that it serves as an instrument for decision making and to correct possible deviations or errors.

Therefore, its use will be useful for the following:

- a. Monitor the operation of the proposed model from the introduction of inputs, processed through cash flows to apply resources for the sustainability of actions in watersheds and governance in the bodies responsible for watershed management.
- b. Construction of a database to systematize and standardize the information associated with indicator

measurement protocols. From the definition of the indicators, it is necessary to build an initial baseline.

- c. Determination of progress, obstacles, problems or risks that may arise from the determination of indicators. These products allow adjustment to be made to watershed management in terms of sustainability and governability.
- d. Apply better the economic resources generated through the valuation of the natural resources of the watershed, the main input for its long-term sustainability.
- e. Continuous and permanent monitoring of the indicators in order to project trends in terms of watershed growth and implementation of prioritized and determined actions in the master plans and management.
- f. The product of the analysis and interpretation of the indicators will achieve a positive impact on the management of water resources and the integral management of watersheds, in terms of sustainability and governance, improving monitoring processes, trends and relevant adjustments in the use and application of generated resources.

IV. CONCLUSION

The objective of this article is to incorporate elements that contribute to the management of watersheds through the information generated and provided by watershed management organizations, based on the valuation of natural resources, the processing of monetary flows, the determination of indicator of management mainly in sustainability and governance; Situation that for years has not allowed to know the reality of the watersheds, which have been seen for extractive purposes and generating economic resources, forgetting the reality of its inhabitants and the preservation of the ecosystem.

Consequently, the development of any policy related to this sector, must necessarily incorporate the knowledge, customs of its inhabitants, aware of reality; who from their optics will be able to contribute significantly in the accomplishment of the goals.

The indicators based on the generation of agile, timely and reliable information will allow to reach the proposed objectives or to make the adjustments in the planning and management of the watersheds; the participation in the elaboration of public policies of the sector must incorporate all the levels of the state in an inductive/deductive process for the determination of measurement protocols, interpretation and management of improvements in watersheds.

The conformation of watersheds organizations must necessarily apply quali-quantitative indicators, in order to monitor their progress, difficulties and trends for the achievement of common welfare, care of the environment, whose previous process involves the management of

projects that make the master plans/management following dishing processes, execution of works with integral management of watersheds, monitoring and evaluation of performance through process indicators, results and impact.

From the point of view of the quantification of the benefits of the watersheds and its valuation introduced in cash flows, it will be possible to evaluate the accomplishment of goals through the generation of indicators to make the pertinent adjustments in the planning and development of the projects.

12. Freeman, M., Herriges, J., & Kling, C. (2014). *The Measurement of environmental and resource values*. USA: R F PRESS.

REFERENCIAS

1. The Nature Conservancy, Imbach, A. (2006). *Tarjeta de evaluación de cuencas hidrográficas (TECH)*. México: SEPRIM-HEUA730908-AM1.
2. Ministerio de Medio Ambiente y Agua. (2014). *Programa Plurianual de Gestión Integrada de Recursos Hídricos y Manejo Integral de Cuencas 2013-2017*. La Paz Bolivia: Viceministerio de recursos hídricos y riego.
3. Hurtado, R. & Eu Water Initiative-Finance Working Group EUWI-FWG. (2012). *La atribución del precio a los recursos hídricos para financiar su gestión sostenible*. Suecia: Rojo.
4. Programa de Gestión Sostenible de los Recursos Naturales de la Cuenca del Lago Poopó. (2015). *Línea de Base para el Monitoreo y Evaluación*. Oruro Bolivia: Latinas.
5. Buccheri, M., & Comellas, E., (2011). *Indicadores para el Monitoreo y Evaluación hacia GIRH*. Lucinda, 2, 25.
6. Global Water Partnership. (2009). *Manual para la Gestión Integrada de Recursos Hídricos en Cuencas*. Francia: Empresa Gráfica Mosca.
7. Dourojeanni, A., (2004). *Manejo Integral de Aguas Por Cuencas: Una Forma de Gobernabilidad*. 2017, de inecc.gob.mx Sitio web: <http://www.inecc.gob.mx/descargas/cuencas/manejointegralcuencas.pdf>
8. Global Water Partnership (GWP), Rees, A., Winpenny, J., & Hall, A., (2009). *Financiamiento y gobernabilidad del agua*. Francia: GWP Comité Técnico.
9. Sapag, N., & Sapag, R., (2008). *Preparación y Evaluación de Proyectos*. Colombia: Mc Graw Hill.
10. Sarmiento, M., (2003). *Desarrollo de Un Nuevo Método de Valoración Medioambiental*. Madrid: Universidad Politécnica de Madrid.
11. Villa, F.; Wilson, M.; de Groot, R.; Farber, S.; Constanza, R. and Boumans. (2002). *Designing an integrated knowledge base to support ecosystem services valuation*. USA: Ecological Economics.