USE AND MANAGEMENT OF WATER IN THE OTOMÍ-TEPEHUA ZONE: LINKING THE LEVELS OF DOWN UP AND UP DOWN.

Luis Alberto Labra Hernández
Alex Manetta
Autonomous University of the State of Hidalgo

Summary

In the Otomí-Tepehua region there are numerous water springs that help shape the hydrographic basin of the Tuxpan River, one of the most important in Mexico, so that it is a priority area of environmental interest. Based on the assumption that governments have found it difficult to establish policies that refine social demands to the need for conservation, this paper proposes to analyze the importance of linking different levels of government (national, state and municipal) in terms of Plans for the use and management of water resources in this specific area.

Introduction

Water availability is currently a major concern at the global level, so it is a priority issue of safety and as a key issue to guarantee the quality of life of the human population, maintaining biodiversity and economic activities. Water permeates all aspects of life on Earth, such as the air we breathe, it sustains human, animal and plant life, provides vital services for human health, livelihoods and well-being, and contributes to the sustainability of ecosystems. Use and management (UNESCO, 2016).

According to Toledo (2002), studies on the planet's water balances point out that only 0.007% of freshwater is actually available to all types of uses that society gives it. That is, this small portion of fresh water available, solves all the daily social activities in the

world. However, the current global water crisis is not only a quantitative problem but also a water quality.

The most recent assessments of specialists and international organizations connected with water problems suggest that by 2025 more than two-thirds of humanity will suffer some stress from the lack of this liquid (L'vovich et al. Simonovic, 1999), so by this time, a third of the population will live in situations considered highly catastrophic due to lack of water (Toledo, 2002).

The current process of water scarcity reveals the importance of the promotion of policies and programs in charge of ensuring the good use and preservation of this resource. A new way of thinking about water problems and proposing solutions is therefore urgent. Rethinking the problems of water means confronting the challenges that the future imposes on us from two new paradigms: that of complexity and that of uncertainty. The uncertainty paradigm faces two major issues: the first has its origin in the variability inherent in hydrological processes and the second has to do with the limits of our knowledge of the processes affecting the availability of water (Simonovich, 2000).

This growing shortage of water resources has prompted governments, at their various levels, to create plans and programs that promote water care, so that the issue of linking all levels of government with the objective to achieve good use and management of water resources.

Planning in the management of water resources must touch all the spaces of the planet, so that all the levels of governments can be united in the different public spheres, through a constant connection, from top to bottom and from bottom to top, with the purpose of achieving a good management of the available water resources. Planning and management decisions will have to expand their space and time scales to include inter- and intra-regional needs, over long-term horizons that span generations (Toledo, 2002).

The serious concern for the different national and international institutions has been reflected in diverse programs, conferences and congresses, directed to the good use of the water resources. Because of its importance it deserves to be highlighted in the

Millennium Declaration of the United Nations[1] (2000), the contents of which sets out an ambitious agenda to improve the living conditions of humanity. It is argued that the management and the good use of water resources can contribute to the achievement of these objectives, since the improvement in the access and supply of drinking water, as well as basic sanitation, helps to prevent diseases and to improve the quality of life of the population. It is added that water is a factor of production and its lack and inadequacy leads to problems linked to poverty (Monguilot, 2009).

In spite of these global measures and agreements, it is also worth noting that in addition to a global agenda, it is also necessary to contemplate national and local agendas focused on investigating and generating adequate measures in this area (Alfaro, 2008).

For this reason, the purpose of this article is to analyze the importance of linking levels of government in the use and management of water resources in the municipalities that make up the Otomí-Tepehua region (Hidalgo, Mexico).

Brief national (Mexico), state (Hidalgo) and regional contextualization: the Otomí-Tepehua zone

In Mexico, as in several countries around the world, it has been concerned with generating programs and public policies aimed at the conservation and adequate use of water resources, where progress has been achieved, including the creation of a legislative system Comprehensive understanding of a national water authority and a functional system of water rights, as well as a nascent resource market. However, significant challenges still remain in the country, due to issues related to sustainability, economic efficiency and equity, such as, the increasing and continuous overexploitation of water resources; the existence of distorted prices, subsidies and other interventions that encourage unsustainable practices in water use; certain laws, regulations, policies and investments that create unsustainable conditions and distortions in the use of water and which also result in an unfair allocation of fiscal resources (Guerrero, 2008).

[1] *See Millennium Declaration (2000). A / RES / 55/2.*

In Mexico irrigation agriculture is the productive activity that consumes the most surface and underground water (about 80%). Although some areas with irrigation systems are already using efficient techniques in the use of the liquid, the change has been limited (Guerrero, 2008).

In Mexico, there is a coverage of drinking water and drainage of 89.8% and 89.6%, respectively. However, there is a notable difference between the different regions that make up the country (Domínguez et al., 2013). In order to distribute the water available in the country, in order to manage and preserve water resources, its territory has been divided into thirteen Hydrological-Administrative Regions (RHA), which are formed by basin groupings, considered the basic units of management of Water resources. Its limits respect the municipal division to facilitate the integration of socio-economic information (CONAGUA, 2015).

The National Water Commission (CONAGUA), an administrative, regulatory, technical, and advisory body responsible for water management in Mexico, performs its functions through 13 basin organizations, whose scope of competence is the administrative water regions (RHA) (CONAGUA, 2015). The implementation of the RHA is based on the difference in consumption and use of water resources in different areas of the country, for the implementation of a relevant and equitable water management.

The state of Hidalgo is comprised of two hydrological regions. 95% of the area of its territory (19,883 km2) belongs to the Río Pánuco hydrological region. The remaining 5% (1,117 km2), corresponding to a small extension of the eastern portion, is part of the Tuxpan-Nautla region (PIDH, 2012), where our study region is located.

In the State of Hidalgo there are 130 storage facilities (dams, borders and lagoons) with a total storage capacity of 2,010.92 hm3. Of these stores, 122 are operated by individuals. In the entity 23 aquifers have been identified, of which 6 are interstate, that is to say their limits cover two or more states, of which the aquifers of Valle del Mezquital, Tepejí del Río and Cuautitlán-Pachuca are shared with the state of Mexico, the Apan aquifer with the state of Tlaxcala, the Acaxochitlán aquifer with the state of Puebla and the Álamo-Tuxpan aquifer with the state of Veracruz (PIDH, 2012).

Currently the state has a drinking water coverage of 85.86% of households (INEGI, 2010), which means that 377,186 inhabitants lack this service. The municipalities that present a greater lag are: Pacula, La Misión, Tepehuacan de Guerrero, Yahualica, Xochiatipan and Huehuetla (this last municipality belongs to our area of study), this because its geographical location and its type of soil in which Are abrupt and are not accessible, so it complicates the granting of the service by the city.

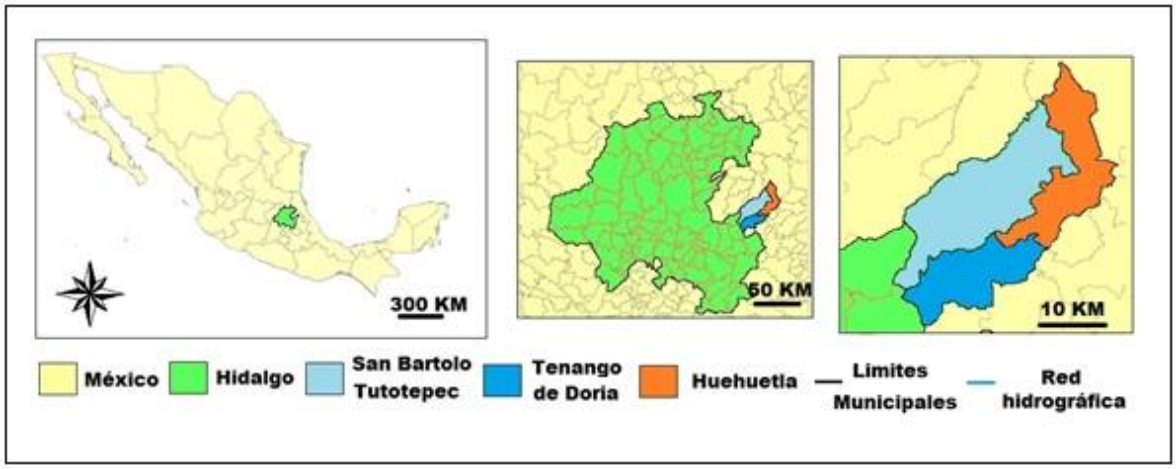
In Hidalgo, four different uses of water resources have been considered: public supply (domestic use, urban public and services); Agricultural (agricultural, livestock and related uses); Industrial (industrial and agroindustry transformation sector) and for electric power generation (PIDH, 2012).

In the Otomí-Tepehua region there is a significant biodiversity, but the reduction of large areas of original vegetation is observed, a fact that affects the loss of the habitat for the wild fauna and the destruction of significant extensions of soils, a situation that damages the dynamics (Nieto and Escandón, 2010, Alcántara Ayala and Luna Vega, 1997).

This area is considered the poorest region of the state (Ángeles, 2011). According to CONAPO data for 2010, the region has two municipalities with very high marginalization (Huehuetla and San Bartolo Tutetepec) and one with medium (Tenango de Doria). However, due to its richness in terms of water and biotic resources, it is a priority area for conservation, so the need for an adequate public management to the different social demands is emphasized, which does not exclude the use and management of the water.

The Otomí-Tepehua area is a predominantly rural region, composed of three municipalities (Huehuetla, Tenango de Doria and San Bartolo Tutotepec - Map 1), located within the Sierra Madre Oriental, where important water springs are located that originate rivers Such as the Pantepec, which, when merging with the Vinazco River, helps to form the Tuxpan River, making up one of the most important hydrographic basins in Mexico. In addition, this region is one of the least contaminated in the state, which is largely due to the predominant uses of the land (agriculture and livestock) and the existence of extensive forested areas (SIIEH, 2012-2016).

Map 1- Region under study



Source: own elaboration with the use of the Digital Map of Mexico.

In rural areas, water is used for productive activities such as growing plants, raising animals and making handicrafts, as well as reproductive activities (raising children, caring for the elderly and the elderly, preparing food, cleaning Housing and public and community use spaces) (Vázquez et al., 2014). When water scarce, the workload increases and the quality of life of the population tends to deteriorate (Carmona et al., 1998, Bonfil 1999, REGEMA, 2006).

Methodology

The issue of the use and management of water resources must be approached from an analysis of the link between different levels of government, necessarily touching on issues such as intergovernmental relations, subsidiarity and citizen participation, thus assessing the relationships of down to Up 'and' top down 'in the different governing bodies and their dependencies, highlighting what refers to public policies aimed at the use and management of water resources in the region under study.

The purpose of the methodology used is to evaluate the National Development Plan (PND), the State Development Plan (PED), the Municipal Development Plans (PMD) of the municipalities that make up the studied region and the Development Program for the

Otomí-Tepehua, thus obtaining references about the links between the different levels of government, focusing on the question of the use and management of regional water resources. So, the possibility of linking political science and public management is highlighted.

Results and discussion

With the objective of achieving water security and sustainability in Mexico, especially in those localities where water, economic, health, human and environmental conditions are less favorable, the government of the republic, through the National Development Plan (2013- 2018), created the National Water Program (2014-2018) (PNH, 2013). The HNP (2013) has six objectives: 1) to strengthen integrated and sustainable water management; 2) increase water security in drought and flood; 3) strengthen water supply and access to potable water, sewerage and sanitation services; 4) increase the technical, scientific and technological capacities of the sector; 5) to ensure water for agricultural irrigation, energy generation, industrial use, tourism and other economic activities in a sustainable manner, and 6) to consolidate Mexico's participation in the international context in the use and management of water.

In the state context, the government of the State of Hidalgo created the State Water Development Program 2011-2016 (PEDH), derived from the State Development Plan 2011-2016 (PED). This document proposes actions and strategies that, if properly implemented, will allow the good use and management of water resources in the State (PIDH, 2012). The PEDH has 6 strategic objectives: to expand the coverage and quality of potable water, sewage and sanitation services in the state; 2) to reduce the contamination of the receiving bodies of residual water; 3) to participate with government and society in the preparation of plans and construction of contingency hydraulic works in the face of meteorological phenomena; and 4) to consolidate the creation of the Water Research Center of the State of Hidalgo as the guiding axis in the management Of information on water in the entity.

After reviewing the National Development Plan 2013-2018 (PND), the State Development Plan 2011-2016 (PED) and the Municipal Development Plans 2012-2016 (PMD) of the municipalities of San Bartolo Tutotepec, Tenango de Doria And Huehuetla, we realize that everyone (some more than others) take into account the subject of water. In addition, both the PND and the PED are derived, the National Water Program 2014-2018 (PNH) and the State Water Development Program 2011-2016 (PEH), respectively. These programs are designed to respond specifically to water resources issues in the country and the state.

In the first instance, there is the alignment of the HNP with the PND and the HEP with the PED, but the HEP is not aligned with the HNP, due to the fact that the administrative periods are not simultaneous, since in the State of Hidalgo the period Administrative system was from 2011 to 2016 and the administration of the republic began in 2012 and will culminate in 2018. With this premise and reviewing the existence of possible updates in the programs (national and state) we realize that They are directly aligned, although indirectly, that is to say, in both programs are related issues by coincidence and not by strategy. Just as state development plans are updated for alignment with the NDP, the programs that derive from them should also be updated to ensure compatibility and alignment among different spheres of government in their plans and programs.

Entering the Otomí-Tepehua area, we analyzed the LDCs of the municipalities under study. The 2012-2016 PMD of Tenango de Doria, addresses the issue of water resources in the area of infrastructure and municipal services; Drinking water and wastewater treatment. It is possible to emphasize that at the moment the most important localities of the municipality count on a system of distribution of the water that operates by gravity. The municipal head has its main source of supply in the spring located in the locality called "La Viejita". The water service in Tenango de Doria is administered by the municipal presidency itself and is distributed through a network of primary and secondary lines from distribution tanks (PMD, 2012a).

The quality of the water supplied to the population is guaranteed by the installation of a booth that applies gas-chlorine in the distribution tanks. In the dry season, there is a reduction in the availability of this resource, so it is necessary to close the supply, in which extreme cases, the absence of the vital liquid in the population center (PMD 2012a).

In the municipality of Huehuetla, the issue of drinking water is taken up in its PMD (2012b). The gap between housing that has potable water service and that which does not have it has been decreasing in the municipality of Huehuetla, this problem is still not resolved and because it is a service of the highest priority, the City Council through its PMD 2012-2016 proposes five lines of action that should have been developed through the 2012-2016 administration; 1) to promote engineering studies for the construction of treatment plants, 2) to expand the infrastructure of potable water and sewerage, 3) to modernize and maintain the water and sewage infrastructure, 4) to implement a program of Chlorination of water and 5) campaigns on the use of water culture.

In San Bartolo Tutotepec, as well as the municipality of Huehuetla and Tenango de Doria, in the municipal public services section of its respective PMD, it contemplates the strategies and lines of action that the administration must follow to safeguard, manage and preserve the available drinking water in the town. At present the aquifers and the rivers have diminished their levels alarmingly. In the rivers that cross the municipality (Beltrán, Borbollón, Xuchitlán, Pantepec and Tenango) there has been a significant deterioration, both in quantity and quality, due to the irrational use, pollution, as well as a zero-conservation culture (PMD, 2012c).

After an analysis of official documents and pages of the state of Hidalgo, the Otomi-Tepehua region and the three municipalities under study, the following data on water resources were found.

The municipalities of study (San Bartotolo Tutotepec, Huehuetla and Tenango de Doria) in the Otomí Tepehua zone do not have drinking water and sanitation service operators, this management and administration is in charge of the municipal presidencies and committees created with this End (PIDH, 2012).

In San Bartotolo Tutotepec 9,662 inhabitants enjoy the coverage of the sewerage service that represents 53% of its total population, it is worth noting that this municipality is considered among the four with the lowest percentage of beneficiaries of this service in the entire state (PIDH, 2012). In Huehuetla and Tenango de Doria there are between 5000 and 7500 inhabitants who do not have the service, they represent approximately 30% of their total population (PIDH, 2012).

In San Bartotolo Tutotepec 7, 450 inhabitants lack the potable water service, which represent 41% of its total population. In Huehuetla 12, 800 inhabitants lack the potable water service, which represent 54% of its total population and in Tenango de Doria 4,200 inhabitants lack the potable water service, which represent 25% of its total population (PIDH, 2012). San Bartolo Tutotepec and Huehuetla are considered within the ten municipalities with less coverage in the potable water service (PIDH, 2012).

In the PIDH (2012) it is contemplated that in San Bartotolo Tutotepec, an average of 23 liters of waste water per second is generated. In Huehuetla an average of 29 liters of wastewater is generated per second and in Tenango de Doria an average of 20 liters of wastewater per second is generated. It should be noted that these wastewaters receive no treatment before being discharged into natural channels.

Based on the diagnosis made, the Strengths, Opportunities, Weaknesses and Threats (SWOT) of the Water Sector in the Otomí-Tepehua zone can be highlighted, in order to generate criticism, consensus and strategies to achieve water sustainability in the area.

The strengths identified are:

1. Hidalgo State has resources that preserved can sustain development;
2. There is a State Water Law that regulates the use and management of resources and a Water Information Center (CIA) that generates and disseminates up-to-date studies of state aquifers and has technical personnel committed to the subject of water, factors essential for decision-making;
3. Existence of inter - agency working between state and federal agencies, allowing a connection relatively adequate;
4. It actively participates with the Groundwater Technical Committees (COTAS) of the Tulancingo and Huichapan Valley aquifers and, in the same way, works with the specialized working groups of the basin councils.

The opportunities available to the area are:

1. The national and state policies consider water as a strategic and national security resource in their respective development plans, which makes it possible to carry out effective actions of more adequate use and management of the water resources present in the state and in the Municipalities of the Otomí-Tepehua area;
2. There are federalized programs to support the infrastructure works for drinking water, sewerage and sanitation, mainly those contemplated in Branch XXXIII, which allow the municipalities under study to meet their demands in relation to these services;
3. There is financial and technological support from foundations and NGOs tending to meet the population's water needs; and
4. At present, there is technology that allows for a substantial improvement in the efficiency of the operating agencies and water committees.

The observable weaknesses in the area are:

1. There are no watershed sanitation programs in the area, which makes it impossible to improve sanitation and manage available water;
2. There are no operators of drinking water and sewerage systems in the area and current tariff studies indicate that the payment of the service does not cover the inherent costs;
3. Significant lag in compliance with the control of wastewater discharges, which causes pollution of rivers, lakes and aquifers in the region;
4. In general, the most important aquifers that support the development of the state are being exploited irrationally, which causes their imbalance and the danger of sustainability in the long term;

5. The development plans of the municipalities in the region do not take into account the water factor as an important factor in decision making, which makes it difficult to implement programs and policies aimed at the conservation of the vital liquid;
6. The municipalities of the zone are of limited financial and technical resources which causes an incapacity of supply to the population, where besides there is no control in the use and management of the water resources;
7. Poor inter-institutional coordination for the management of comprehensive water planning between agricultural and industrial uses, which allows water reuse and less exploitation.

And finally, the threats that the area has are:

1. Poor demarcation of zones, which causes constant problems between localities, due to the use and ownership of water resources;
2. Discretionality in the permits granted for the exploitation of sources of supply, which causes disorder and hydrological imbalance;
3. Due to the payment of water rights, wastewater discharges and electric power consumption by municipal presidencies, the continuity of drinking water and sanitation services is at risk and, in turn, make it impossible to support the programs federal projects for the construction of the necessary hydraulic infrastructure;
4. Effects associated with climate change, such as: reduced aquifer recharge, increased water demand and increased extraction of groundwater that threaten the availability of water in the area and increase in meteorological phenomena such as increased of droughts in different regions and torrential rains.

CONCLUSION

It is concluded that, despite the advances made in terms of the national, state (Hidalgo) and municipal plans (of the municipalities under study), there is still much progress in public policy on good use and management of water resources, in Mexico and more specifically in the Otomí-Tepehua region. The strengths identified through the SWOT analysis, such as the existence of a State Water Law, a Water Information Center (CIA), and an inter-agency work between state and federal agencies, are considered as advances. Make it possible to carry out effective actions for the proper use and management of water resources. However, there is still a great challenge ahead, represented by the weaknesses and threats identified in results and discussions, among which the effects associated with improper and uncontrolled use of this resource and the lack of water agencies or associations in the municipalities.

Planning in the management of water resources must touch all geographical spaces on the planet, from places where there is the smallest amount of this liquid to where there is an extensive amount of it. It is necessary the intervention and union of all the governments in the different public spheres, a constant link from top to bottom and bottom up with the purpose of achieving the good use and management of water still available on our planet.

References

Alfaro M., J. (2008) *Conflict; water management and climate change: proposed adaptation to climate change and water management in Lambayeque, Piura and Cajamarca.* Lima Perú, publication of Practical Solutions-ITDG.

Angels, L. (2011) *study poverty in the state of Hidalgo. Poverty and migration: contributions to the development of the state of Hidalgo, Mexico.* Mexico, publication of Miguel Angel Porrúa and The State College of Hidalgo.

Bonfil, P. and Del Pont, R. (1999) *Indigenous women at* the *end of the millennium.* Mexico, publication of the National Commission of Women.

Carmelo, MC, Gil PD, Monguilot AI and Viera SA (2009) *Water and Sustainability: resources, risks and remedies.* 2009. Spain, publication of the Ministry of Education, Culture and Sport.

Carmona, E., Alberti, P. and Zapata, E. (1998) *Access and use of water by farmers in the household and agricultural plot irrigation.* Guanajuato Mexico, publication of notices in Socioeconomics, Statistics and Informatics.

WITH WATER. (2015) *Statistics of water in Mexico*. Mexico DF, published by the National Water Commission.

Dominguez, J., Martinez, D., Palacios, A., and Peña, A. (2013) *Social monitoring of the human right to water and sanitation, Mexico*. Mexico, published by the College de Mexico.

G. Guerrero, H. (2008) *Water in Mexico: Implications of policy intervention in the sector*. Mexico DF, publishing Fondo de Cultura Economica.

INEGI. (2000, 2005 and 2010) *Census of Population and Housing 2000 and 2010 Census of Population and Housing 2005*. Mexico, available in www.inegi.org.mx

INEGI. (2010) *System of National Accounts of Mexico. Monthly Indicator State Electricity, 2003-2012, base year 2003, to August 2012.* Mexico, available at: www.inegi.org.mx.

L'vovich, MI, GF collaboration with AV Belyaev, J. Kindler, NI Koronkevic, TR Lee and GV Voropaev. (nineteen ninety-five). *"Use and Transformation of Terrestrial. Water Systems ". In: Turner BL II (ed.). The Earth as Transformed by Human Action.* Cambridge USA, publication of Cambridge University Press.

Nazar, A. Zapata, E. and Ramirez, V. (2010) *Gender and water. Strategies to achieve sustainability with equity*. In: Jimenez, B., Torregosa, Ma L., Aboites, L. (eds.). *Water in Mexico, channels and encauses, Mexico, Mexican Academy of Sciences, National Water Commission.* pp: 383-410. Mexico, published by the Colegio de Mexico.

IHDP. (2012) *Water Development 2011-2016 State Program.* Hidalgo Mexico, published by the Ministry of Planning, Regional Development and Metropolitan Hidalgo.

PMD. (2012a) *Pan Municipal Development Tenango de Doria 2012-2016*. Mexico Hidalgo, publication of the City Tenango de Doria 2012-2016.

PMD. (2012b) *Pan Huehuetla Municipal Development 2012-2016.* Hidalgo Mexico, published by the City Council Huehuetla 2012-2016.

PMD. (2012c) *Pan Municipal Development of San Bartolo Tutotepec 2012-2016*. Hidalgo Mexico, San Bartolo publication Tutotepec City Council 2012-2016.

PNH. (2013) *National Water Program 2014-2018*. Mexico DF, published by the Secretariat of Environment and Natural Resources.

REGEMA (Red Gender and Environment). (2006) *Blue women 's agenda.* Mexico, REGEMA publication, UNDP, SEMARNAT and IMTA.

SIIEH 2012-2016. (2012) *statistical and geographical regional Notebook: Tepehua Otomi region VIII. Hidalgo, Mexico*. Mexico, publishing comprehensive information system of the State of Hidalgo.

Simonovic S., P. (2000) *Tools for Water Management One View of the Future*. USA, Water International publication

Toledo, A. (2002) *Water in Mexico and the world*. Mexico DF, published by the Ministry of Environment and Natural Resources.

Vazquez, V. Perez, Ma. A. and Muñoz C. (2014) *Development, Gender and human right to water. A comparative study in Hidalgo, Mexico*. Mexico, published by the Autonomous Metropolitan University.

WWAP (World Water Assessment Program Water Resources of the United Nations). (2016) *The United Nations World Water Development Report 2016 - Water and Jobs*. Paris, UNESCO publication.