Science for the Poor
The Mixteca Region's "Water Forever" Program[1]

Víctor M. Toledo*
Leonor Solís*

Fulvio Eccardi

Science is not neutral, no matter how hard those who defend the idea of a politically and ideologically immaculate science try to convince us otherwise. All we have to do is look around us without blinkers at the environmental and social reality of the world today to see that recent scientific contributions have been profoundly influenced by the customs, values and interests of the dominant sectors of society.

In an increasingly polarized world, dominated by market forces, scientific activity benefitting one of the two poles has given rise to a socially absurd paradox: today, the full material satisfaction of all human beings' needs is practically impossible under the current scientific and technological setup because it would lead to the destruction of the planet's ecosystem.

Since Mexico has no clear scientific policy, a good many of the country's research centers have gradually imposed a criteria of "academic science" in which the fundamental object is no longer the generation of knowledge to solve the problems of Mexican society and of the world. This has been replaced by a dehumanized practice that only makes sense to certain individuals and the academic elites. One way or another, this has meant the application of the principles of neoliberal economic policy to the country's scientific and technological research, a phenomenon that has had an impact equally on researchers, research institutions and state, regional and national policies.

This trend, which some want to make hegemonic, has been questioned by different sectors. One example is a scientific-technological experience that aimed to provide water and food to one of the most marginalized sectors in the country, showing how it is possible to develop and successfully carry out science oriented to solving the problems of rural poverty, that is, doing science for the poor.

Courtesy of Alternativas y Procesos de Participación Social, A. C.

Community participation is essential for effective science.

Using field work and popular organization, Alternatives provides basic support and training to peasant communities so they can solve the main problems themselves.

A Poor, Thirsty Region

The Mixteca region, covering parts of the states of Puebla, Oaxaca and Guerrero, is 40,000 square kilometers of irregular, mountainous terrain with low, unevenly distributed precipitation (300 to 700 millimeters a year).

Covered by typically semiarid vegetation, dominated by brambles and cacti, the area has been inhabited for about 10,000 years; it is thought that in this inhospitable terrain, plants like maize were domesticated and agriculture was born in Mesoamerica, using the available water. Today, it is inhabited by mainly indigenous peoples from at least seven different ethnic groups: the Nahuas, Mixtecs, Popolocs, Ixcatecs, Mazatecs, Cuicatecs and Chinantecs. It is one of Mexico's poorest agricultural regions, with high levels of marginalization, and, therefore, a considerable

* Researchers at the UNAM Ecology Institute, Department of Ecology of Natural Resources, Morelia campus.

Courtesy of Alternativas y Procesos de Participación Social, A. C.

Using different kinds of technology improves the chances for success.

The program considered the history of water management in the region focusing on the urgent need to create not only short-term but medium and long-term solutions.

number of its inhabitants are forced to migrate.

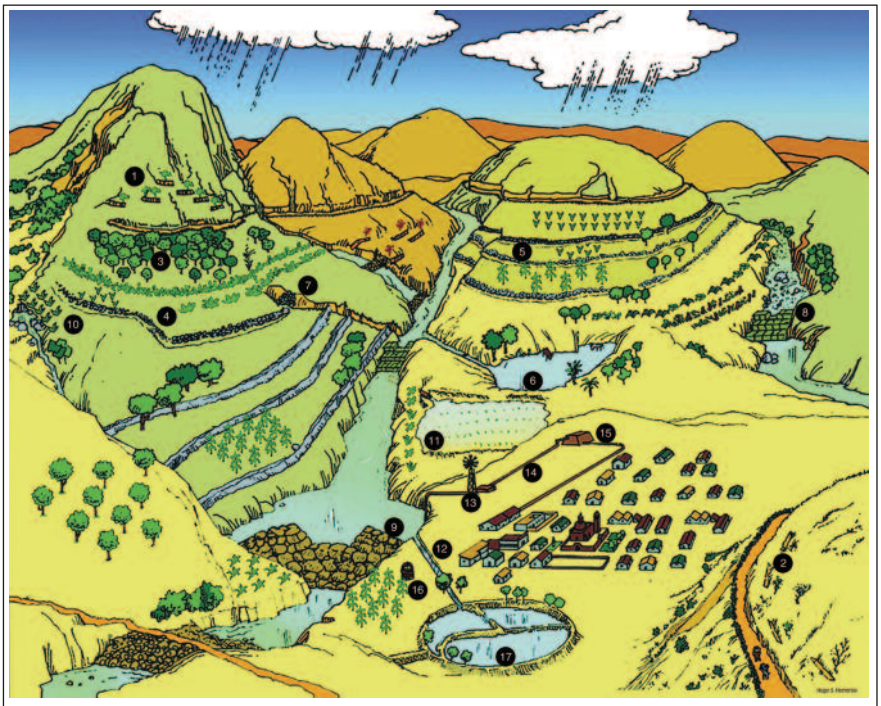
Undoubtedly, the Mixteca's most serious problem is water. The World Health Organization has established an international standard stipulating that each individual needs 150 liters of potable water a day, while the World Bank puts the figure at 50 liters a day. Average water consumption in Mexico City, for example, is 335 liters per person per day, rising to around 1,000 liters in wealthier neighborhoods and dropping to only 28 in the poorest areas. In the Mixteca, many families survive with only 7 liters a day, that is, one-fourth of the consumption of the poorest of the poor in Mexico City. This contrasts, paradoxically, with a long history of water management and use in the region: evidence of the first water management techniques date from 2,800 years ago! And today, the population still has hydro-geological and hydro-agricultural knowledge of inestimable value.

The technological option that the "modern world" offers for obtaining abundant water is drilling deep wells, which has serious geological, ecological and economic limitations given the nature of the geological substrata (for example, volcanic or metamorphic rock) in many parts of the Mixteca region with a low potential for accumulated underground moisture. On the other hand, the combined action of deforestation and over-grazing has made the layer of natural vegetation that covered the sides of hills and mountains disappear, which has in turn meant that rainwater does not filter down to the subsoil to feed underground water; rather, it runs over the surface, carrying soil with it, causing erosion. But the main limitation is economic: drilling a deep well costs between U.S.$25,000 and U.S.$40,000, a sum completely out of the reach of the Mixteca's peasant population.

Given this, a project called "Water Forever" was created by a civil group called Alternativas y Procesos de Participación Social, A.C. (Social Participation Alternatives and Processes) in 1988. Limiting its work to the northernmost area of the Mixteca, on the borders of the states of Puebla and Oaxaca and including a large part of the Tehuacán Valley, Alternatives focused its efforts on a group of about 200,000 inhabitants in approximately 100 rural communities.

The program considered the history of water management in the region essential to its activities, focusing on the urgent need to create solutions not only for the short term, but also taking into account the environmental problems implicit in the loss of underground water supplies and the soil erosion that made the regional situation increasingly critical.

This project considered that water scarcity is influenced by population increase, inappropriate use of natural resources and unequal access to available water, unjustly concentrated in the hands of a few individuals and power groups. In this way, the project recog-



Drawing by Hugo S. Herrerías

Everybody Pitch In!

To regenerate the basins, specific treatments are applied on the hills, knolls, valleys and ravines using different technologies. The work begins on the hills with retaining devices that include ditches and trenches (1), water harvesting rings (2), reforestation (3) and contour lines with vegetation (4). On rises where the slope is less than on hills, borders, terraces (5), earthen dikes (17) and watering holes (6) can be built, making it possible to water cattle and other animals or irrigate crops. If we take into account that ravines have been formed where water has most easily eroded the soil, it can be regenerated by building rock seeping dams (7) or gabion seeping dams (8). These works slow the speed and force of the initial flow with provisional water stagnation and soil retention, thus achieving control over the two natural resources involved, soil and water. The water obtained from building dams can be utilized by building shallow wells (16), seeping galleries and diversion dams (9) that channel part of the flow of water to agricultural land. In addition, the water in the high parts of the basin replenishes existing springs (10). Once water has been gathered, irrigation systems (11) are designed, as well as water storage systems that prevent its filtering and evaporating and make it available to distribute to the communities. The water can be transported to where it is used by earth-filled canals (12), unlined or lined with cement or stone. Nevertheless, the transportation of piped water (14) is the most efficient way to avoid both filtration and evaporation. Before laying the pipes, it is necessary to construct a tank (15) where the different particles in the water will settle to avoid clogging. For this work, operating costs can be cut by using alternative energy, like windmills (13) or manual pumps that will finally distribute the water to the population.

nized that the root of the problem did not lie only in obtaining water to satisfy different needs, but also in both ensuring that the extraction of water not deplete underground supplies and that access to it be fair to the different groups of society.

With this focus, the project has developed 508 hydraulic works in 98 communities in the region, benefitting between 77,000 and 134,000 inhabitants. Its activities have received significant support both from Mexican government agencies and private organizations and foundations, notably the Ford and Hilton Foundations. It has also designed, tested and perfected an applied research model that has turned out to be useful, new, original and very important.

Four Challenges for Science

For 20 years, Alternatives has worked —perhaps without knowing it— with four of the most important challenges facing contemporary science in solving rural poverty: the recognition of the ecological or biological region (bio-regionalism); participatory research; an interdisciplinary focus; and, finally, technological diversity. Both Alternatives' organizational structure and its research and technical team are a reflection of this four-sided theoretical and methodological thrust.

The Bio-regional Focus

The borders of a bio-region are not defined by political lines, but by the geographical limits of human communities and ecological systems. It contains biological communities, habitats and ecosystems that maintain ecological processes and the human settlements involved in the management, use and knowledge of its natural resources. All of this means that the way of life and interests of local communities, in addition to their surroundings, must be the starting points and the basic criteria for regional development and conservation.

Basing itself on a perspective that seeks to regenerate basins, Alternatives has managed to integrate a bio-regional focus. The main management unit are not locales, but basins, which are delimited thanks to the use of a geographic informational system generated by its personnel, with water as the crosscutting issue. Its research, social field work and development of works is based on this bio-regional unity.

Participatory Research

Alternatives' strategy has been to generate processes of self-development among the marginalized peasant families and communities that it deals with using field work and popular organization rooted in an essentially participatory methodology, giving basic support and training and organizing the peasant communities so they can solve the main problems themselves and maintain a self-organizing dynamic. This work is based on consultations, training and the transfer of technology.

To get people to perceive bio-regional unity, Alternatives fosters participatory research that leads to a micro-regional topological view and which favors collaboration among locales and families.

With this focus, the hydraulic works requested in each locale begin to be implemented. Different sectors are involved in carrying out this work, including the peasant communities themselves, nongovernmental organizations, educational institutions and certain government agencies.

Since the largest investment is in labor, carrying out the projects requires significant community participation; this means that the resources invested in construction create jobs for people in the communities and reduce migration.

With this methodology, also known as participatory natural resource management, the works proposed are based on the history of the region itself. Therefore, in addition to recuperating traditions, the work enriches them by applying new techniques and equipment to make them more efficient, with the advantage that it makes them more easily accepted. In practice, it is a process of recovering the collective memory of water management and use, something left out of the "normal" forms of doing science today, and one of its most serious limitations.

Fulvio Eccardi

Interdisciplinary Work

Since the mid-twentieth century a new focus that seeks to integrate the natural sciences with the social sciences and the humanities has grown and spread.

If the problem of water in the Mixteca were looked at as an isolated phenomenon, the final result would be reduced to simply building a few dams or drilling some deep wells, a matter restricted to geologists and engineers.

Courtesy of Alternativas y Procesos de Participación Social, A. C.

Access to water resources has made all the difference to the Mixteca region.

The focus used in these projects, however, considers the hydrological problem part of a bio-region (the basin) and takes into account the hydro-geological experience accumulated for centuries by the local cultures, thus demanding the integration of the different disciplines and the creation of multidisciplinary teams of professionals.

This convergence of knowledge around a concrete, specific problem generates, therefore, an important process of theoretical, methodological, conceptual and terminological exchanges among all the professionals and prompts the reformulation of many scientific principles and paradigms.

The efficacy of interdisciplinary practice depends on two processes: the inter-subjective communication among specialists brought together by a project and the organization of scientific and technical knowledge that each of the disciplines bring to the solution of the problem. Both these processes become a reality using the strategy adopted by Alternatives.

During the field work done in each locale and basin, the field workers or promoters act as liaison between the scientific knowledge being generated and the community, translating it and transmitting it to the local population and acting as spokespersons for the communities' proposals about the viability of the works proposed.

Technological Diversity

The final expression of the three processes described above takes on meaning in technological diversity; that is, in the implementation of a broad spectrum of designs to supply water to the communities (see box, p. 44). This leads to a redefinition of the very concept of technology, which ends up being framed in the historically determined cultural values of the communities and by the ecological conditions of the different regions (basins).

The technological system thus conceived is open to the combination of many options that stem from the ecological knowledge of the region with the aim of regenerating the basins, and the work with the community that recovers and places value on local water management knowledge. For this reason, the technological solutions adopted include pre-Hispanic, colonial and modern technologies, or a

Courtesy of Alternativas y Procesos de Participación Social, A. C.

"Academic science" could never have found such a variety of solutions to water scarcity.

mix of the three (creating hybrid technology).

Toward a Committed Science

Over the last decade, a hopeful proposal known as "sustainable development," a "sustainable society" or simply "sustainability" has taken on weight both in academic debate and in social movements.

Essentially, it is a proposal that seeks to regenerate or restore the natural and social framework so affected by the expansion of the industrial, materialist, technocratic, capitalist model of civilization that dominates today's world, a model increasingly in social and ecological crisis.

Without a doubt, the "Water Forever" project is part of this new current of sustainable development. First of all, it deals with the problems of a concrete region in an integral, holistic way, recognizing the regional situation in all its socio-ecological complexity. In the second place, it places the problem of water in the perspective that implies the restoration of the equilibrium of the regional ecosystems represented by the system of basins. That is, it makes restoration of nature a fundamental objective, the only way to maintain a constant, guaranteed flow of water. Finally, its central task is to seek social well-being for the communities involved (overcoming poverty) by encouraging local management of the water by reinforcing community and family self-organization, the revaluing of culture, their knowledge and memory and the affirmation of participatory democracy during decision making, all of which are actions that aspire to regenerating the community framework in the region.

Alternatives' experience shows that it is possible to successfully practice ecologically and socially committed science, and that more than complex theoretical discussions or big budgets, what is needed is a change of attitudes by those who practice it. All that is needed is for scientists to transcend the individualistic, neutral, mercantilist ethos that prevails today and adopt an attitude rooted in the consciousness that comes from the non-selfish identification with the world. This is what many thinkers have called an ethics of solidarity with others, of human dignity, of the survival of the planet and our species. VM

Notes

[1] This is an abbreviated version of the article by the same name published in the magazine *Ciencias* (Science) 60 (Mexico City), October-December 2001, pp. 33-39. This essay is the result of the authors' observations about the "Water Forever" project garnered during their participation in a research team coordinated by Víctor M. Toledo that evaluated it from November 2000 to January 2001.