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## The struggle of indigenous people of the lower Rio Mayo, northwestern Mexico for water resources: an overview and a critical assessment

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## The struggle of indigenous people of the lower Rio Mayo, northwestern Mexico for water resources: an overview and a critical assessment

### Cover Page Footnote

**Acknowledgments** We thank Jesús Gallardo, Diana Esquer, Enriquena Bustamante O., Ignacio Ruiz Love, and Alicia Connelly for logistic support. This research was supported by CIAD, CONACYT-ONSSSES, and the University of North Carolina at Greensboro. **Endnotes** In Mexico human-environmental studies of indigenous peoples—analyzing the diversity of peoples, places, and their interactions within the natural world—are often carried out under the rubric of “biocultural” studies (Boege 2008; RED 2015; Luque et al. 2016). The goal of these studies is to recognize the complex relationship between the linguistic, epistemological, socio-cultural, and biological aspects of many of the environmental issues facing indigenous people (Nazarea 1998; Maffi 2001; Luque et al. 2016, 25-45; Maffi and Woodley 2010). Historically, irrigation districts were centrally administered by agencies of the federal government. However, as part of the move to privatize and decentralize the government, pushed on Mexico by international financial institutions, the control of the reservoir systems was moved in 1990 from the federal government to public interest corporations or associations (Distrito de Riego del Río Mayo, 2018). These associations are, for the most part, in the hands of the larger land owners who wield power on the governing boards. Historically, irrigation districts were centrally administered by agencies of the federal government. However, as part of the move to privatize and decentralize the government, pushed on Mexico by international financial institutions, the control of the reservoir systems was moved in 1990 from the federal government to public interest corporations or associations (Distrito de Riego del Río Mayo, 2018). These associations are, for the most part, in the hands of the larger land owners who wield power on the governing boards.

## DATA NOTES

## Indigenous Perspectives on Water Management in the Lower Rio Mayo Irrigation District, Sonora, Mexico



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### ABSTRACT

*The Mayo River Valley is the ancestral land of the Mayo (Yoreme). Official plans for river water focus on high yield, high value crops, and urban water use in the sprawling cities near the river delta. Over 90 percent of those interviewed indicate the climate is hotter and drier than in the past, consistent with climatologists who report a significant increase in temperatures and a decrease in the frequency of winter frost. Community conflicts occur over water quality, household consumption, and water restrictions.*

*“Queremos seguir siendo lo que somos, pero no queremos estar como estamos”*

*“We want to continue being who we are, but not in these conditions”*

– Don Erasmo Leyva, Yoreme (Mayo) Elder and Leader (Author’s translation)

### INTRODUCTION

The World Economic Forum’s Global Risk Report identified environmental degradation as a major risk to world peace, economic stability, and human well-being. It pointed to global warming, loss of biodiversity, and conflicts over water as major threats to humanity (World Economic Forum 2016). Water scarcity is high on the agenda of most nations and international organizations such as the World Water Council (2018), the Organization of American States (2018), and the United Nations (2008). Water shortages are a

major source of conflict that threaten strategic food production systems and lead to decreased security and welfare, plus increased social turmoil—including civil unrest, migration, and even war (Kummu et al. 2016).

Much of the human-environment discourse in Mexico has centered on indigenous peoples who constitute over 15 percent of the nation’s population (CDI 2014) and whose territories contain the highest concentrations of biodiversity and serve as water catchments for rivers and aquifers; preserving biodiversity allows conservation of unique genetic resources. However, little attention has been given to the indigenous perspective on environment and climate change that supports this diversity (Boege 2008; Maffi and Woodley 2010; Toledo and Barrera-Bassols 2008). In Sonora, geographically the second largest state in Mexico (180,000 km<sup>2</sup>), indigenous peoples number around 100,000 and represent 5 percent of the popu-

lation (CDI 2014)—the largest group being the Mayo (**Yoeme**) numbering about 65,000 (Luque et al. 2016). This study focuses on how the Mayo perceive the changing climate along with related territoriality and water conflict in the Rio Mayo Irrigation District (DDR038).

## SONORA

Water and rainfall in Sonora are not evenly distributed, plus they exhibit a high degree of seasonality. In the eastern mountains of the Sierra Madre, the mean annual rainfall is about 760 mm, in the central region about 360 mm, in the coastal and southern regions 166 mm, and in the northwestern region less than 40 mm. Most of the precipitation falls during the summer and flows through nine major watersheds into the Gulf of California (Felger et al. 2001).

Along with western Chihuahua and northern Sinaloa states, Sonora is in Hydrological Administrative Region II (Region Hidrológica Administrativa—RHA II) that contains nine watersheds across 200,000 km<sup>2</sup> that drain into the Gulf of California; has a population of over 2,800,000 people; accounts for 2.86 percent of Mexico's GDP (CONAGUA 2016); and suffers a high level of hydrological stress—including water over-use and agricultural pollution (CONAGUA 2012, 2014a, 2014b). The Rio Mayo rises in western Chihuahua in the highlands of the Sierra Madre Occidental and flows through Sonora into the Gulf of California (Figure 1). Over 380 km in length, the Rio Mayo watershed covers approximately 15,000 km<sup>2</sup> and carries approximately 740 km<sup>3</sup> of water per year. Mexico's National Water Commission classifies the water quality along the river from acceptable to excellent (CONAGUA 2016)—an assertion that differs from the perception of the local populations inhabiting most of the lower basin.

FIGURE 1. Agrarian and Hydrological Territory



### *Mayo (Yoeme) Territory*

The post-revolution Mexican Constitution of 1917 recognized two types of land ownership: private and common. Common lands fall into two categories: communal holdings and **ejidos**. In the case of indigenous peoples, communal grants were recognized as restitution for ancestral lands taken from pre-Spanish communities. Ejidos, a form of communal land reform—introduced in the 1917 Mexican Constitution and accelerated during the administration of President Lázaro Cardenas (Sanderson 1984; Simpson 1937; Wolfe 2017)—granted a parcel of expropriated or federal land to a group of individuals (indigenous peoples or non-indigenous peasants) to manage and use for agricultural or fishing purposes (Yetman 2012). Each type of holding has its own governing structure and relationship to national water and property rights (Assies 2008; Cornelius and Myhre 1998; Sanderson 1984). Despite the best intentions of the land reform movement, indigenous peoples were often granted

lands of little agricultural value (Poirier and Ostergren 2002; Sjaastad and Bromley 1997; Stocks 2005).

The Mayo were granted approximately 260,000 ha of land. Mayo grants were fragmented into approximately 87 **núcleos agrarios** (parcels) of which 82 are ejidos and five are communal. Most of these land grants were outside of the irrigation district even though the irrigation district is located almost entirely on ancestral Mayo territory. As a result, when the state began to aggressively pursue irrigation and other infrastructure projects with the goal of enhancing commercial agriculture in the Rio Mayo Delta, key roads and irrigation infrastructure were located near the irrigation district and benefited lands held mostly by non-Mayo farmers (Germán et al. 1987; Luque et al. 2016; Yetman and Van Devender 2002). Most Mayo live in communities along the banks of the river, and others live in one of the three major cities in the Mayo region (Navojoa, Etchojoa, and Huatabampo). In 2010, 36 percent of those who spoke Mayo lived outside their ancestral homeland, and 25 percent had migrated to urban areas (INEGI 2010).

By 1993, there was an informal market in which much of the Mayo land with its attendant water rights was rented or sold to non-Mayo (DeWalt et al. 1994). Owing to reforms to Artículo 27 in 1992, common land was legally authorized to be titled and sold. Gradually, those Mayo with holdings transferred control of much of their land to non-Mayo to cover various types of debts (e.g., emergency medical expenses). Some took payment for future rents locking them into fixed contracts years into the future regardless of the future value of their holdings or associated water.

### *The Rio Mayo Irrigation District*

The Rio Mayo Irrigation District (DDR038) (Figure 2) created in 1956 is one of six irrigation districts in the State of Sonora. The primary source of water for

the irrigation district is the Adolfo Ruiz Cortines (Mocúzari) dam in Mayo territory, completed in 1955 and owned by Hydrological Administrative Region II (DRRMAYO 2018). The lower Mayo River irrigation district encompasses 114,000 ha of land in the **municipios** (counties) of Navojoa, Huatabampo, and Etchojoa. In 2013, nearly 90,000 ha of this land were irrigated (CONAGUA 2014a, 2017). The primary product in the region is wheat, followed by safflower, potato, maize, beans, produce (tomato, chiles, etc.), and forage (mainly alfalfa). The Rio Mayo Irrigation District was ranked 8th among the 25 districts in Mexico in total number of harvested hectares. Today, the Mayo River Irrigation District is administered by a **Sociedad de Responsabilidad Limitada** (semi-private limited liability association) formed in 1990 as part of policies generated by the North American Free Trade Agreement (NAFTA).

According to one member of the governing board, the deterioration of the irrigation system causes half the water to be lost to evaporation, filtration in poorly maintained canals, and improper management (Luque and Murphy 2019). Commonly, massive commercial holdings are given priority to this increasingly scarce resource to maintain the value and competitive status of Mexico's agroindustry. As a result, each year, a greater and greater number of Mayo smallholders find they have insufficient water for their traditional crops and must rent or sell their holdings to cover emergency medical expenses and debts (Palacios 2004).

### **METHODOLOGY**

This study was initiated by an interdisciplinary research team in the territories of seven indigenous peoples (see Luque et al. 2016; Luque and Robles 2006). To compare the Mayo with other indigenous groups of Sonora, a survey instrument covering human-environmental factors (socio/demographic issues, the use of local flora and fauna, traditional food patterns,

FIGURE 2. Mayo River Irrigation District (DDR038) - Source: Luque et al. 2016:123



relationship to government at all levels, language use and transmission, water use and governance, and views on weather patterns) was administered to a total of 1,331 indigenous interviewees between April of 2010 and May of 2011: Seri (81), Pápago (137), Cucapá (34), Pima (126), Mayo (419), Yaqui (406), and Guarijío (128) (Luque et al. 2016). Trained interviewers administered the survey (Luque et al. 2016) in the native language. In communities with 2,000 or fewer inhabitants, interviewers knocked on every door. In the larger communities (Mayo and Yaqui), interviews began at random locations and proceeded door to door until the desired number of approximately 400 interviews was met. In every case, the interview was carried out with an adult member of the household who was available at the time of contact.

A second survey was administered to a total of 170 leaders of Biocultural Production Units in the Guarijío, Mayo, Seri, and Yaqui indigenous communities. A Biocultural Production Unit is a production project that is initiated by a member of an indigenous community within his or her ancestral group; their project proposal requires approval by the community before implementation. Projects of such are linked to traditional production processes or products that are respectfully conscious of the conservation of the natural resources within their territory. Activities typically include traditional forms of agriculture and animal husbandry, craft production such as masks and clothing, traditional food restaurants and products, and eco-tourism projects (Luque et al. 2016). In addition to formal questionnaires, participant observation (with the assistance of community leaders) was used to con-

firm or suggest corrections to maps derived from the digitalization of indigenous agricultural production units. Geographic Information System analysis also was used to identify land-use/land-cover types within Mayo territory. Photography and maps were developed with the assistance of elders.

Data on water use and distribution were gathered from official state and federal agencies as well as from interviews with local producers. In 2018 and 2019, we returned to the region and carried out open-ended qualitative interviews with strategic local actors who have ties to the Rio Mayo Irrigation District.

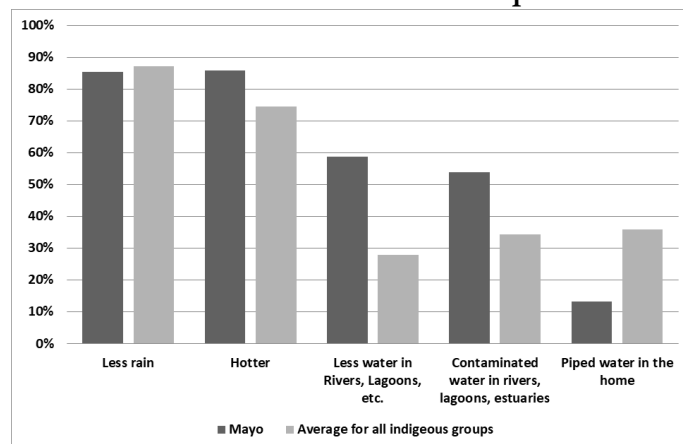
## RESULTS

### *Temperature and Water*

Most of the Mayo are in basic agreement with other indigenous groups in Sonora regarding two fundamental environmental factors associated with climate change that directly impact them, their water supply, and their crops: temperature and rainfall. Ambient temperature is rising. The Mayo recognize that their region today is warmer than it was in the past (Figure 3), making life much less comfortable for people living in the Rio Mayo basin where summer temperatures frequently exceed 38° C for extended periods. In addition, higher temperatures contributes to increased loss of water via evaporation from rivers, surface irrigation, open canals, and reservoirs.

Mayo also note a decline in the number of rainfall days compared to the past. The perceived decrease of frequency of precipitation is supported by the records for Mexico's Northern Pacific region showing that, through the years, the intensity of rainfall events has significantly increased although there are fewer rainfall events and more variability between seasons and from year-to-year (García-Páez and Cruz-Medina 2009; Méndez-González et al. 2010; Romero et al. 2014).

**FIGURE 3. Climate and Water Perceptions**



The Mayo not only perceive a decrease in rainfall, but also decreases in the amount of water available for their daily life. This is particularly problematic for the Mayo who no longer control most of the land of the Irrigation District and are therefore forbidden from using water for domestic or subsistence purposes such as watering backyard gardens and livestock from the system. Most households receive water from either a centralized community water supply network or domestic wells, but fewer than 20 percent of the homes receive enough water for their personal and domestic use (Figure 3). In many cases, water tanks, pipes, and pumps are in such state of disrepair as to be useless.

Sixty percent of Mayo households perceived a reduction in the available water (water network, river, lagoons) for domestic use, for their home gardens, and for fishing and grazing (Luque et al. 2016). Moreover, the lower flow plus pollution of water in rivers, lagoons, and estuaries limit the extent and quality of traditional subsistence fishing and gathering activities. Most respondents perceived it as the result of a combination of less rainfall, less water in streams and rivers, salinization of wells, and pollution from commercial pesticides.

*“Los ríos y los arroyos llevan muy poca agua y están muy contaminados, ya no se puede pescar.”*

*The rivers and streams carry very little water and are very contaminated, and you can no longer fish* (Luque 2011b; Luque and Murphy 2019, author’s translation).

*“Todo el estero está contaminado, ahí desemboca el dren (agrícola).”*

*The entire estuary is polluted; the (agricultural) drain empties there* (Luque 2011a, Luque and Murphy 2018, author’s translation).

**Local Resources**

The Mayo and other indigenous groups in Sonora reported that—as recently as the mid-twentieth century—over 70 percent of their food came from traditional agriculture, fishing, hunting, or gathering in their home territories (Figure 4). Thirty years later, this decreased to approximately 45 percent for the Mayo. By 2010, less than 10 percent of the foods used by the Mayo were locally produced. An analogous change can be seen in the use of local natural resources for medicinal purposes. Remarkably, the use of these resources remained high in the mid- and late-20th century but significantly declined in the early 21st century.

ry. Today, a free bus ride to Navojoa paid by a major supermarket honks along the streets of Masiaca every day at 5 AM to lure customers. To a large extent, this is the result not just of the loss of access to plant resources, but to changes in diet, resulting in a shift in morbidity of diseases associated with modern processed foods. These tend to be chronic conditions such as obesity and type II diabetes that are not considered treatable by traditional methods (Esparza-Romero, et al. 2015).

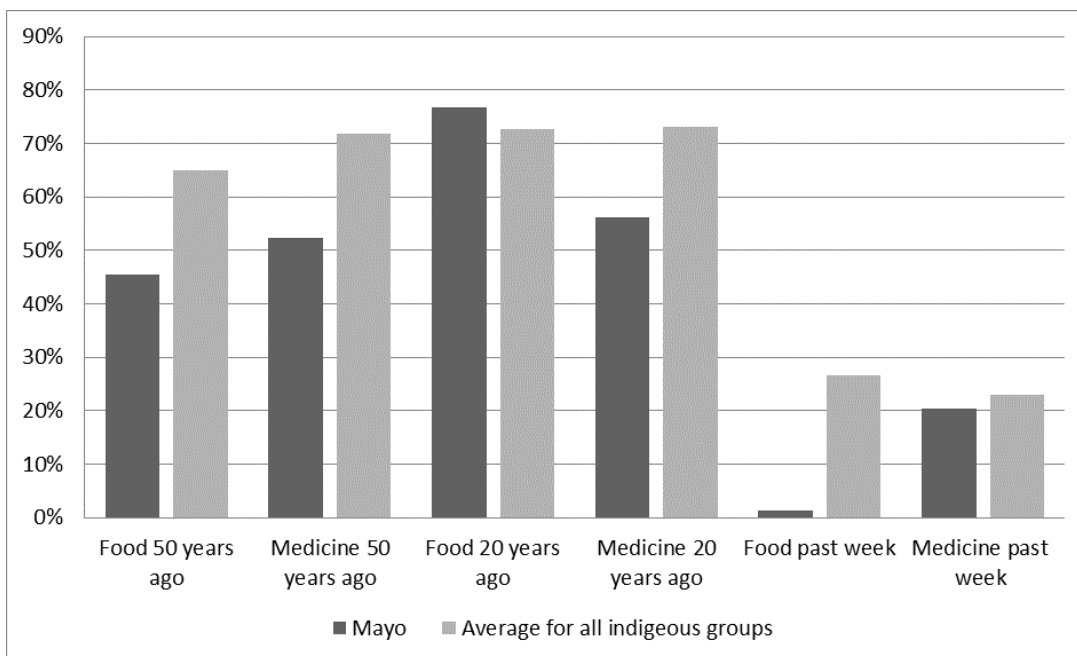
*“Antes podíamos ir al monte, por los animales y por las plantas. Ahora ya no hay nada, todo lo tenemos que comprar. Aquí hay gente que no come nada en todo el día.”*

*In the past, we could go to the fields and hills for plants and animals. Now there is nothing; we must purchase everything. There are people here who have nothing to eat.* (Luque 2011c, author’s translation).

*“Los ríos y los arroyos están muy contaminados, ya no se puede pescar.”*

*The rivers and streams are very polluted, and you can no longer fish* (Luque 2011d, author’s translation).

**FIGURE 4. Food and Medicine Produced/Gathered Locally - Source: Luque et al. 2016:226, 227, 229**





It is important not to over-romanticize the past with respect to the availability of food, medicines, and water. Older residents said the food they harvested and collected in the past was of better quality than what is currently available; however, they said there was not enough, or it was too hard to find. Most certainly, with the higher density of a growing population, they would not be able to support their families through subsistence farming, hunting, and gathering. Their struggle seems more related to a regional wage structure not providing them with sufficient funds to purchase quality food, medicines, and water.

### *Conflict*

In a semi-arid environment, water is often the source of conflict within and between groups (Miller 2001; Sheridan, 1988). This is especially true in a region where rain-fed agriculture is highly uncertain, frequently fails, and has not received any major investment in decades. For the Mayo, their greatest concerns, and sources of conflict with non-Mayo are the pollution of water sources, wells running dry, and managers (state officials pressed by agroindustry interests) of irrigation districts restricting water availability to the Mayo people. Irrigation conflicts with non-Mayo are low because most irrigated land along the valley is farmed by non-Mayo who own or lease irrigated parcels from Mayo. This practice, known as **rentismo**, is seen as favorable by most of those whom we interviewed. It provides them with a steady income from their landholdings as well as agricultural work during the periods of planting and harvest.

In contrast, pollution directly impacts Mayo subsistence farming, estuaries, marine resources, and the gathering of wild plants and animals. Forty percent of the Mayo emphasized that pollution is a source of conflict with outsiders, and they named the community water system as a major source of internal community conflict (Luque et al. 2016). The drinking water

system usually relies on a community well since tapping water from irrigation canals or the river is prohibited. The second source of internal conflict is groundwater—in particular, over-pumping. Few have private wells, and disagreements arise when a person feels that households living closer to the communal well are taking a disproportionate share and leaving less water available for those who live further away. On an individual basis, pumping below ground water is only available to the most affluent citizens as this involves buying pumps and associated equipment. It also means paying for electricity, fuel, and maintenance.

The preferred way to resolve disputes, particularly those over water, is through local authorities (Luque et al. 2016). However, issues over drinking water typically involve non-Mayo governing structures at the state or federal level, which are responsible for operating and maintaining the water supply system. Questions over individual wells are more personal and direct but may require intervention by community authorities to settle disagreements. Most indigenous people, like the Mayo, have difficulty dealing with state and federal government officials and the legal system due to hurdles and uncertainty brought on by unfamiliarity as well as by bias against indigenous peoples by those who manage the water in the DDR038 (Luque et al. 2016), and most private citizens using common underground water are usually non-indigenous people.

### CONCLUSION

Our interviews demonstrated that for the Mayo, like other indigenous people in Sonora and throughout the world (see Li 2015), water has two sources and two purposes. First subsistence; water that supports traditional activities such as gathering, hunting, fishing, harvesting in wetlands, and dry-land farming. Water for these activities is associated

with rivers, lakes, streams, wells, and rainfall. Subsistence water is directly related to **Juyia ania** (nature) and not disturbed by humans. This type of water is in opposition to the second source and purpose.

Second, water for development requires a solid infrastructure and has two purposes: domestic use and consumption through a community network, and irrigation. The sources for development water are wells, irrigation canals, and dams that constitute the core of Irrigation District DDR038. Developmental water sources, as such, make intensive commercial agriculture possible in the region and supplies the domestic water for most of the Mayo River Valley inhabitants.

Critical for the Mayo is the loss of a unique cosmology and relationship between human and physical world based on their traditional relationship to the Rio Mayo. Juyia ania depends on a healthy ecosystem and is the center of the Mayo biocultural complex. It is believed to contain spiritual entities that the Mayo approach in delicate and intricate ways. Prayers and religious festivals lead the community to nature and conservancy. The elder council is constantly reminding their youth that it is the means of cultural identity and community unity. Juyia ania is struggling to survive urbanization, industrialized agriculture, and climate change. Water for subsistence has been declining, mostly because of the irrigation district infrastructure, and now, climate change.

The Mayo have no real access to water from the irrigation district, their domestic water service is inefficient, and rain-fed agriculture is faltering with more frequency due to reduced rainfall, higher concentration of the available rainfall, and increasing temperatures; all these resulting in high levels of marginalization for most who live in the district. Lack of such resources and land will likely impact traditional food, medicine, knowledge, language, and culture practices—which are the foundation of their biocultural complex. For the **yoris** (non-Mayo), it is the loss of a biocultural knowledge system that pro-

vides insight into understanding the impact of climate change at the local level as well as developing a framework for assessing the impact of change upon hydroclimate systems derived from local epistemologies. In the face of ongoing climate change, such conjunction has the potential to provide strategies for amelioration and mitigation (Toledo 2003).

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