Water & Drought

Research Note

# Introduction

Guatemala's geographic location between North and South America makes it vulnerable to the trade winds between the two hemispheres. As temperature maximums rise in magnitude and duration, yearly dry seasons become longer. Cool shifts from hemisphere to hemisphere are delayed, and populations accustomed to produce crops with rainwater find themselves poorly prepared to withstand ever longer periods of drought.

With high rates of population growth and a national water regulation and enforcement vacuum, access to irrigation infrastructure is highly unequal. Staple crops, maize and black beans, are almost exclusively produced under no irrigation technologies by small farmers, and public budgets present constraints that limit public investment in both, within-farm irrigation systems, and larger hydraulic infrastructure projects.

Nonetheless, public responses are aiming to aggressively increase areas under irrigation and invest more in within-farm systems over the next years, while increasing jobs and improving food security. Concerns over the limited stated budgets destined for these purposes, make this topic interesting for an economy-wide assessment of policy implications.

# Problematic

Rain cycles in Guatemala are strongly influenced by the convergence between the Inter Tropical Convergence Zone (ITZC) and El Niño-Southern Oscillation (ENSO). The former is a belt of low pressure, which circles the Earth near the equator where the trade winds of the Northern and Southern Hemispheres come together. The latter is an irregularly periodical variation in winds and sea surface temperatures over the tropical eastern Pacific Ocean, affecting much of the tropics and subtropics. The presence of the warming phase of ENSO (El Niño) delays the translation of ITZC to the North, limiting rainfall and increasing the average annual temperature. Conversely, in the cooling phase of ENSO (La Niña), trade winds between Northern and Southern Hemispheres become stronger, resulting in more precipitation and a reduction of temperature (Instituto de Agricultura, Recursos Naturales y Ambiente de la Universidad Rafael Landívar [IARNA-URL], 2011).

As global average temperature increases with climate variability, ENSO's warming phase is expected to happen with more frequency liberating heat pockets and delaying ITZC with more frequency. This translates into less average precipitation and a predominance of dry years, punctuated by extreme rainfalls in rebound seasons. For Guatemala, this represents an expansion of the dry and very dry life zones (IARNA-URL, 2011).

In an analysis of very-high, high, and medium water catchment and hydrological regulation areas, Gordillo (2010) found that only 39% percent of their territory had forest cover (see Table 1). The concern is greater in the case of the very-high water catchment and hydrological regulation category, where only 25% has forest cover.

**Table 1. Forest cover in very high, high, and medium water catchment and hydrological regulation areas**

|  |  |  |  |
| --- | --- | --- | --- |
| Area category | Total area | Forest cover (Ha) | Percentage |
| Very high | 902,610.54 | 228,783.96 | 25.35 |
| High | 904,182.93 | 421,294.32 | 46.59 |
| Medium | 1,263,787.92 | 540,411.57 | 42.76 |
| Total | 3,070,581.39 | 1,190,489.85 | 38.77 |

Notes: Adapted from Gordillo (2010)

In contrast, 29% of the three categories area is already used in agricultural activities (Gordillo, 2010) placing stress in the most vulnerable areas of the country, especially dry zones.

One of the most important concerns is that staple crops, like maize and beans, are produced almost exclusively dependent on rain water by small farmers (Instituto Nacional de Estadística [INE] et al., 2013). This exposes the production of these crop to the risk of drought. After sugar cane and bananas, maize is one of the main products of the country in terms of volume, which is important, considering that the former are two large productions with important private irrigation infrastructure, carried out by bigger farms.

Beans, which also depend entirely on rain water (INE et al., 2013) account for a relevant portion of the Guatemalan diet, and it is interesting to see how the canned variety have become increasingly used by households. This form of consumption of beans is ever more present in urban kitchens, and it might represent a cultural shift that might increase the importance of industrial food processing in the food chain. An increasing industrialization of the consumption of beans will require technical investments in its production, such as irrigation.

It is important to note the share of agricultural output used by the manufacturing industries at the national level is small for these crops. For example, in the case of maize, only 20% of all used volume had a final destination in manufacturing. This is consistent with the 80% (adjusted to extract the negative stock variation) that was consumed by households. With a strong market culture present in the country, 95% beans, 88% potatoes, 97% other roots and tubers, 99% fresh culinary herbs, 91% other vegetables and 67% fruits, are consumed directly by households bypassing the food manufacturing industry. It contrasts with the 99% of the supply of unprocessed rice and wheat that were used almost exclusively by the food processing industries for the production of packaged consumer versions (INE et al., 2013).

# Impacts

In a series of climate scenario simulations (see Table 2), it was established that in a business as usual situation where the global population continues to grow in a constant manner, with low technological advance and modest, unequal, heterogenous, and unsustainable economic growth, the Guatemalan dry zones are expected to grow 1.6 times by 2020 (from the base year 2000), to double by 2050, and to reach 2.9 times their area, almost triple, by 2080 (Rosito, Pérez, Maas, Gándara & Gálvez, 2013).

In a more optimistic scenario, where there is an international consensus on environmental protection, as well as more sustainable and equal economic development, the Guatemalan dry areas are still expected to expand to 1.3 times their size by 2020 from the base year 2000, 1.4 times by 2050 and 2.7 times by 2080. In some departments from the Guatemalan Dry Corridor like Chiquimula and Jutiapa, where food security is already a concern due to low precipitation and annual agricultural yields, dry lands are expected to grow from about half of the territory to over 90% of their area in both scenarios (Rosito et al., 2013).

**Table 2. Humidity life zones evolution in Guatemala from climate change scenarios**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Scenario A2** | | | **Scenario B2** | | |
| **Humidity provinces** | **Base year (2000)** | **2020** | **2050** | **2080** | **2020** | **2050** | **2080** |
| Dry | 24.1 | 38.4 | 49 | 69.8 | 31.7 | 34.6 | 64.3 |
| Wet | 57.1 | 50 | 42.9 | 28.6 | 53.5 | 51.8 | 33.1 |
| Very wet | 18.5 | 11.5 | 8.1 | 1.6 | 14.7 | 13.5 | 2.6 |
| Rainzones | 0.3 | 0.1 | 0 | 0 | 0.1 | 0.1 | 0 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Notes: Life zones are defined with the Holdridge (196 7) methodology. Source: Rosito, Pérez, Maas, Gándara & Gálvez (2013)

Crops in dry and very dry life zones are highly vulnerable to the availability of rainwater and local food production is affected by the lack of irrigation infrastructure. Agricultural activity represented over 37% of total water use between 2007 and 2010, becoming one of the largest users in the country as an industry (IARNA-URL, 2013) for a total of 6,496.56 million m3.

The combination of highly degraded water catchment areas, and a deficient regulatory framework results in water stress and high vulnerability. The Government of Guatemala (GoG) has identified seven Departments that are vulnerable to water scarcity and low precipitation: Chiquimula, Jalapa, Jutiapa, El Progreso, Baja Verapaz, Quiché, and Zacapa (Ministerio de Agricultura, Ganadería y Alimentación [MAGA], 2016).

In a natural events risk map developed by Gálvez, Pérez, & Pineda (2009) for Guatemala, 2.6 million people, equivalent to 22.8% of the population at the time, were at risk of experiencing at least drought in a given year. Other natural events included landslides, freezing conditions, and floods, bringing the total percentage of population under threat to 75.1%. The total area at risk of drought is estimated at 29,189 km2

Gálvez and colleague's (2009) map intersections used population information from the last Census, which dates to 2002-2003. Total population at the time was 11,237,196. Recent projections place total population at 15.4 million for 2017. Population growth places greater pressures to water allocation in the face of scant regulation and enforcement.

## Possible Interventions

In the recently developed *Gran Plan Nacional de Riego* (Great National Irrigation Plan), the GoG has established a goal of 100,000 additional hectares of irrigation coverage in five years, with an annual increase of 20,000 hectares, starting in 2017. They foresee that this will result in an additional 50,240 full time jobs per year. To accomplish this task, they plan on rehabilitating 13 of 29 abandoned water irrigation stations, with a budget of Q3 million (about $400 thousand). The objective of the plan is to reduce food insecurity in urban and rural populations, eradicate chronic malnutrition, while generating jobs.Total capacity for irrigation land totals 379,353 hectares, with a total of 826,806 potential beneficiaries in 983 communities (MAGA, 2016).

Other complementary activities that have been identified by the GoG include the introduction of micro and mini-irrigation systems in subsistence small farms, as an increase to the private capital stock of the poor; the development of hydraulic regulation infrastructure, such as catchment plants, channels, pumping stations, and reservoirs (MAGA, 2013). There are no explicitly stated budgetary considerations and no detail of the source of public funding for these actions.

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