Development of Peru’s Asparagus Industry

Jessie Bullock
The Leadership Academy for Development (LAD) trains government officials and business leaders from developing countries to help the private sector be a constructive force for economic growth and development. It teaches carefully selected participants how to be effective reform leaders, promoting sound public policies in complex and contentious settings. LAD is a project of the Center on Democracy, Development and the Rule of Law, part of Stanford University’s Freeman Spogli Institute for International Studies, and is conducted in partnership with the Johns Hopkins School of Advanced International Studies. LAD gratefully acknowledges support from the Omidyar Network.
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Introduction
Dario Santiago, a major stakeholder in Agroespárragos, S.A., entered the Peruvian asparagus boom at the right time.\(^1\) In one decade, from 1990 to 2000, international demand for asparagus grew so high that Santiago and other large agro exporters more than tripled the amount of hectares cultivated for asparagus, while simultaneously doubling the price per kilogram. The coastal state of Ica in Southern Peru is the primary region for asparagus cultivation and is where Santiago’s company farms its asparagus (Figure 1). Peru, the largest global exporter of asparagus in the world; the country exported 335 thousand tons of asparagus in 2014.\(^\text{ii}\) Asparagus is Peru’s second highest grossing agricultural export at $374 million per year, and is a linchpin of Ica’s regional economy.\(^\text{iii}\)

Since the early 2000s, Ica’s water supply has been in a state of crisis. The growth of the asparagus industry (which consumes a lot of water vis-à-vis other crops), wasteful irrigation practices by some farmers, and lower than average rainfall and climactic changes in recent years have put the water supply in danger. The Ica-Villacurí aquifer, the largest in the country, is being drained at a faster rate than it is being replenished, and it requires substantial capital and/or labor for farmers to find water elsewhere. Small farmers and corporate farms alike are prepared to improve their inefficient system, but they have different opinions about who is at fault and what the best possible solutions should be.

These high stakes have attracted the attention of officials in both the central and regional governments. Fernando Cilloniz, a former asparagus and table grape agro exporter in Ica, transitioned from the private sector to the public sector in December 2014 when he was elected Ica’s regional president.\(^\text{iv}\) In that capacity, it is now his responsibility to decide which projects the regional government should involve itself, to support infrastructure projects that are critical to the region’s agricultural sector, and to work with private sector partners on water infrastructure projects. Farmers large and small have called for help from Cilloniz, the central government, and private creditors. How should he lead the Ica regional government in their decision-making about the water shortage?

An Overview: Asparagus Farming in Ica
The region of Ica is coastal, bordered to the north by the region of Lima and northeast by the region of Huancavelica, another agricultural state whose principal industries are intertwined with Ica’s (Figure 1). To the south, the regions Ayacucho and Arequipa border Ica. The Ica region refers to the valley through which the Ica River runs, from the town of San Jose de Los Molinos to Ocucaje (Figure 2). The river also flows directly above Ica’s primary source of underground water that bears the same name, the Ica Valley aquifer. The Pampas de Villacurí aquifer, adjacent to the Ica aquifer, is situated northwest of the Ica Valley aquifer, in the direction of Pozo Santo. Lastly, the capital city of Ica has access to both water from the Ica River

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*Jessie Bullock conducted interviews and prepared this case under the supervision of Francis Fukuyama of Stanford University. This case was developed solely as a basis for class discussion. It is not intended to serve as a historical record, a source of primary data, or an illustration of effective or ineffective management.*
and the Ica Valley aquifer. This region, along the path of the river and above the aquifer, is where the majority of corporate farmers grow asparagus.\(^v\)

Asparagus is not native to Peru. It was introduced in the 1950s as an export crop, first to the northern state of La Libertad, and then to Ica (Figure 1). Asparagus cultivation in Ica rapidly expanded over the 1990s and early 2000s, and both production and total planted acreage have multiplied since 1980 (Figure 3). Much of the growth in both production and acreage during the last decades occurred in Ica rather than La Libertad. The farms in Ica are the dominant producers of highly demanded fresh, green asparagus, and boast the highest yields in the world for this crop. On the other hand, most farms in La Libertad concentrate on fresh, white asparagus or canned asparagus, and neither global demand nor yield per hectare for those products has risen at the same rate. Keeping up with the growing global demand for fresh green asparagus will be crucial for Ica’s economy.

One of the reasons asparagus was brought to Ica’s fertile coastal region is because the temperate climate allows for a year-round harvest. Export competitors farther north (in Mexico and the western United States, for example) can harvest for only two or three months out of the year, meaning that Peruvian exports are the sole supplier for the remaining nine months of the year. Peruvian asparagus exports now dominate the market in the United States and Western Europe.

The large farmers in Ica can be characterized as sophisticated players in the global agriculture industry. The majority of land in the Ica Valley is farmed by large agro exporters, with more than 150 hectares per plot of land each and whose crops are primarily destined for export markets. They use sophisticated irrigation technologies and are at the forefront of agricultural innovation in Peru.

With the rapid expansion of the asparagus industry from the 1990s to present, farmers in Ica began consuming much more water. The joint Ica Valley-Pampas de Villacurí aquifer, together, the largest underground aquifer in the country, is experiencing a water deficit – growers are pumping water from the aquifer at a much faster rate than it is flowing back underground (Table 1). If no changes are made either the current level of water usage or the current level of asparagus production will be unsustainable in the long term,. There are three possible future scenarios:

1. Farmers in Ica do not reduce their production and continue drawing down the aquifer faster than it is being replenished until there is no more groundwater left.
2. Farmers in Ica reduce the amount of water pumped out of the aquifer to the estimated equilibrium level of water recharge. This implies a reduction in production of asparagus and a hit to the local economy.
3. The local government, farmers, and private sector firms work together to create a hybrid solution. This includes redirecting water from nearby above ground sources to help the aquifer recharge, implementing tighter regulations on well drilling and pumping, and experimenting with more sustainable policies.

Nearly all stakeholders would prefer the third option. The first two would lead to economic and environmental ruin in a short number of years. The problem is how to implement the third option. Deciding which water sources to improve or reroute, how to restructure water usage rates, and how to allocate access to the wells will be Cilloniz’s greatest challenges.
Current Water Landscape

The current water users can be split in two groups: above ground users and groundwater users. All water used for household and municipal consumption is aboveground water, and comprises less than five percent of total aboveground usage. For agricultural users, this division usually corresponds to size of the farm. Above ground users tend to have farms smaller than 10 hectares who water their crops with simple flood irrigation (Figure 4). Groundwater users tend to be larger agro exporters that own and operate wells, and water their crops using more sophisticated methods like drip irrigation or pump irrigation (Figure 5). They are either large farmers with more than 150 hectares of land or medium-size farmers with 10 to 150 hectares of land, who usually lease their land to the large farmers in exchange for access to their superior technology. Each type of water source has benefits and drawbacks for its users and different implications regarding future shortages. The distribution of water usage is shown in Table 2.

Sources Of Aboveground Water

The Ica River is the valley’s primary source of aboveground water. The river runs from December to April during the rainy season, and is dry for the rest of the year. Its origin is at the intersection with the Tambo and Santiago rivers in the Huancavelica region, northeast of Ica (Figure 6). Huancavelica is situated on higher ground than Ica, and as the water passes through Huancavelica towards Ica and finally to the ocean, the water level steadily decreases as more farmers use it to water their crops. Most of these small farmers are upstream (closer to Huancavelica or in Huancavelica) from the large agro exporters. It is common for small farmers to build ad-hoc, small canals redirecting some of the flow of the river towards their farms and watering their fields using flood irrigation.

The second major source of aboveground water in Ica is also derived from Huancavelica. The Choclococha lake in Huancavelica, an enormous lake with a capacity of 140 million cubic meters, is seasonally diverted towards Ica and intended to replace Inca River water when that river runs dry. Diversion typically starts at the end of the dry season, from September to November, before the rain arrives. Thus, from May to September when the Ica River is dry and before water starts flowing from Choclococha, above ground water is scarce.

A critical component of the above ground water system is the La Achirana canal. It runs parallel to the Ica River for 52 kilometers, diverting water from the Ica River during the rainy season and from Choclococha when water is flowing from the lake. The 52-kilometer stretch begins in San Jose de los Molinos on the Ica-Huancavelica border, and ends in Santiago, south of the city of Ica. The purpose of the canal is to give farmers and residents better access to aboveground water during the rainy season in this densely populated area.

Sources Of Underground Water

The region’s two adjacent aquifers, the Ica Valley aquifer and the Villacuri aquifer, together form the largest source of groundwater in Peru and provide the cleanest, freshest water to the region (Figure 7). The water is available year round, assuming that one has access to a well to extract it. Since the water is available for controlled extraction, users are able to employ more precise irrigation technologies, limiting the amount of water they pump to the amount their crops actually need. Despite this, both aquifers are currently dropping at alarming rates. In 2013, the autonomous government agency National Water Authority (ANA) estimated that 190 million
and 63 million cubic meters could be pumped annually out of the Ica Valley and Villacurí aquifers, respectively, while retaining current groundwater levels. However, in 2013, 335 million and 228 million cubic meters were pumped out of each aquifer, indicating a water “deficit” of 145 million cubic meters in the Ica Valley aquifer and 165 million cubic meters in the Villacurí aquifer (Table 3).

Sources Of Conflict

Groundwater users are extremely concerned about the depletion of the aquifers and how this will affect their future business. They argue that the region is losing too much surface water to the sea, and that better systems should be installed to divert water towards replenishing the aquifers. This is especially pertinent for the Ica Valley aquifer, which sits directly below the Ica River (Figure 7B). Because large agro exporters are concentrated at the lower flow of the Ica River in the downstream area, little water seeps underground to help replenish the aquifer.

On the other hand, above ground users argue that the agro exporters are harming the environment by overusing the groundwater and leaving them (the small farmers) with no choice but to rely exclusively on the river and lake supply. Underground water is simply not accessible to them or too expensive. The ANA issued a moratorium on digging new wells in 2008 to slow the consumption of groundwater and it increased regulatory fees for current well usage. However, this policy seemed to have only further concentrated well usage in the hands of the large agro exporters. Some small farmers could no longer afford the fees on their wells or their share of a well owned by many small farmers. Some sold their wells to large corporations, while others turned to covert drilling to try to obtain water illicitly (Table 4). The majority of small farmers, though, they simply had to rely more heavily on aboveground water.

The National Water Authority (ANA)

An important stakeholder in Ica water policy is the ANA, a government agency housed within the central government’s Ministry of Agriculture and Irrigation. The ANA is the country’s highest authority on water policy; all policy decisions regarding water have to be approved by the central ANA office or one of the satellite regional offices, called AAAs (Administrative Water Authorities). These are then further subdivided into local branches in the region, called ALAs (Local Water Authorities). Government in Peru has been highly decentralized since ANA’s creation in 2008; Figure 8 shows ANA’s organizational structure. ANA (and its subdivisions) is also responsible for collecting and analyzing data such as water levels, river flow, and the number of wells and registered users. Any of Cilloniz’s potential infrastructure plans must first be approved by the ANA.

The ANA subdivisions do not follow political boundaries between regions. Modeled after the Tennessee Valley Authority in the United States, the ANA is divided into 14 AAAs that correspond to geographic boundaries and sources of water rather than administrative boundary lines. For example, the northernmost part of the Ica region is in a different AAA than the rest of the Ica region because its terrain is more similar to Lima’s terrain. The rest of Ica, including the Ica Valley and Ica River, are in the Chaparra-Chincha AAA, which is further subdivided into six ALAs (Figure 9).

It is important to note that a different AAA, the Pampas-Apurimac AAA, governs the Choclococha Lake. This means that policies regarding transferring water from the lake to the Ica River will have to be approved by both the Pampas-Apurimac AAA and the Chaparra-Chincha AAA.
**The Decision: How Can Cilloniz Bring Water to Ica?**

The high-grossing agriculture industry and its potential for growth have caught the attention of private firms and the central government alike. ProInversión, an independent agency in the central government responsible for soliciting private sector investment in Peru (often for large infrastructure projects like highways, port improvements, and dams), began studying the Ica water situation in 2008. ProInversión is currently working with potential investors and the ANA to determine the feasibility of some large-scale projects. Two private firms have proposed projects and indicated that they are willing to co-finance these large-scale investments in a public-private partnership, along with the central government. Both projects involve bringing water from east to west by diverting more surface water from the Huancavelica region to the Ica region. One of the proposed projects is an expansion of the Choclococha canal to divert more water from the Choclococha lake, and the other is a diversion of rainwater and Andean runoff from Carhuancho, which is further away than Choclococha and at a higher altitude. If the ANA approves the projects, ProInversión will release the details to the public and issue a separate call for investors to either sign up as co-financers or to submit a modification of the plan, in case it could be improved upon.

Cilloniz’s regional government would be responsible for managing these projects down the road. Though not involved in the decision-making about which projects get funded or their financing, his government will be responsible for the project implementation. Thus, in the current preparatory stage, he has to have answers to questions that potential investors care about, such as “How will you charge users for water?” or “Can you impose regulatory limits on the amount of water users can extract?” How can Cilloniz address the distribution of water between the current above ground users and the groundwater users? Is there a policy he can propose that is both equitable and will appeal to these potential investors?

**Potential Solutions**

With any policy, there will be winners and losers. Cilloniz’s goal is to minimize total loss for all of his constituents while solving the water shortage problem in Ica. The following are some considerations he must take into account:

- **Incorporation of illegal wells and/or subsidies for small farmers.** One of the unsustainable parts of the current water situation is the number of illegal wells and the high cost of ground water extraction for small farmers. The current well fees and maintenance costs make it nearly impossible for small farmers to access groundwater (Table 5). However, the high number of illegal wells (Table 4) could reduce investor confidence and make them fear that their investment might not be utilized properly. In order to secure investment and potentially get further funding from the private sector or other international actors, how should Cilloniz structure future groundwater policy?

- **Compensating the neighbors.** Some of the proposed projects that ProInversión is considering involve moving water from Huancavelica (and subsequently, neighboring regions) to Ica. This would be a huge benefit for the industries in Ica, but citizens of Huancavelica would see little benefit. What would be the incentive for their AAA to approve such plans? Is there a way to compensate them for their water loss?

- **Regulating above ground water usage.** Cilloniz and his policymakers understand and agree with large farmers that drip irrigation is more efficient, but the technology is so expensive that few can afford it (Table 5). Is there a way to help small farmers who
cannot afford drip irrigation to transition from flood to drip irrigation so that aboveground water is not scarce eliminated for personal use and usage in the city of Ica?

Taking all of this into account, how should Cilloniz lead the way forward with Ica’s water policy?
Endnotes

i Fictional name and company used per request of the interviewee. All other details are factual.

ii SISCEX database, 2014 net weight for fresh, canned, and frozen asparagus.

iii SISCEX database, 2014 FOB value for fresh, canned, and frozen asparagus. The top grossing agricultural export in 2014 was coffee.

iv A regional president in Peru is analogous to a governor in the United States.

v For the purpose of clarity, “Ica” refers to the region of Ica, and the Ica Valley, Ica River, or capital city of Ica will explicitly be specified as such.

vi In a 2010 survey by the National Water Authority (ANA) on the Ica-Villacurí region, there were 1,324 wells. Of these, only 388 (29%) were legally registered with the ANA.
The state of Ica is on the Western coast of Peru, just South of the state and capital city of Lima.
Source: http://goperu.about.com/od/citiesandregions/ss/Regions-Of-Peru.htm
The Ica Valley is the region through which the Ica River runs and where the belowground Ica Valley aquifer is located. The aquifer stretches from San Jose de Los Molinos in the north to Ocucaje in the south, stretching roughly 75 kilometers. To the northwest of the Ica Valley aquifer is the belowground Pampas de Villacurí aquifer, from San Juan Bautista to Pozo Santo.

This shows total production and acreage growth in the entire country, not just Ica. However, much of this growth can be attributed to the growth in Ica, which grew at a faster pace than all other regions.

*Source: USDA, 2010*

### Table 1: Overconsumption of both Ica Valley and Villacurí aquifers

<table>
<thead>
<tr>
<th>Year</th>
<th>Ratio (consumption: recharge)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>0.232</td>
</tr>
<tr>
<td>1990</td>
<td>0.161</td>
</tr>
<tr>
<td>1995</td>
<td>0.353</td>
</tr>
<tr>
<td>2000</td>
<td>0.300</td>
</tr>
<tr>
<td>2004</td>
<td>0.466</td>
</tr>
<tr>
<td>2007</td>
<td>0.437</td>
</tr>
<tr>
<td>2010</td>
<td>0.762</td>
</tr>
</tbody>
</table>

This table shows the total ratio of consumption to aquifer recharge. A ratio of zero means that the citizens are using exactly the right amount where the amount of water they are drawing each year out equals the amount of annual recharge. The recent high values show that consumption has exceeded recharge by an alarming amount in the last decade.

*Source: Autoridad Nacional de Agua*
Figure 4: Example of an asparagus field irrigated using flood irrigation

These are young asparagus plants in the rows of this field. Between each row, there is a “valley” or “path.” Field workers dig the fields as such in order to distribute the water as evenly as possible among the crops. As named, they “flood” the field with a large amount of water, which reaches all crops by flowing through these low paths.

Source: Author’s own.
Drip irrigation is a mechanized process. When each new crop of asparagus is planted, the water lines are laid beside each row, the black tubes in the above photo. Each tube dispenses a specific amount of water at regulated intervals to reduce water waste and provide the plant with a steady stream of water. The white plastic sheeting in the photo above is to protect the crops from frost during the winter season.

*Source: Author’s own.*

### Table 2: Distribution of water usage in Ica in 2014

<table>
<thead>
<tr>
<th>Source of Water</th>
<th>Percent of Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboveground, seasonal water</td>
<td>24%</td>
</tr>
<tr>
<td>Aboveground, transferred water</td>
<td>10%</td>
</tr>
<tr>
<td>Underground water</td>
<td>66%</td>
</tr>
</tbody>
</table>

Aboveground, seasonal water refers to water that flows naturally through the Ica River when the river is flowing. Aboveground, transferred water is water that flows through the bed of the Ica River but that is diverted from Choclococha lake when the Ica River is dry. Underground water refers to water either from the Ica Valley or Pampas de Villacurí aquifer.

*Source: ProInversión, 2015*
Figure 6: Map of the flow of water in the Ica Valley

Regional borders are denoted by dotted tan lines. The border between Ica and Huancavelica stretches from the top to bottom of this map. The J-shaped arrow on the right follows the flow of the Ica River, from its mouth at the intersection of the Tambo and Santiago rivers. The circled red lake marked “1” is Choclococha lake, in the state of Huancavelica. Following the flow to arrow number 2 is how water is diverted from Choclococha lake until it meets the Ica River. The La Achirana canal, 52 kilometers long, runs parallel to the Ica River from point 3 to point 4 and is intended to increase the water supply for residents of the city of Ica.

Figure 7A: Map of the area covered by the Ica and Villacurí aquifers

The shaded area shows the underground area covered by the Ica Valley aquifer and, to the northwest, the Pampas de Villacuri aquifer. The dots show registered well locations.

*Source: World Bank, 2010*
Figure 7B: Cross section of the depth of the Ica and Villacuri Aquifers

This cross-section shows the depth of both the Ica Valley and Pampas de Villacuri aquifers, from the A to A¹ position on Figure 7A. The Ica Valley aquifer benefits from additional recharge because the Ica River flows on top of it.

Table 3: Water balance: 2013, in millions of m³

<table>
<thead>
<tr>
<th>Location</th>
<th>Estimated usable reserves</th>
<th>Annual use</th>
<th>Water deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ica Valley Aquifer</td>
<td>190</td>
<td>335</td>
<td>-145</td>
</tr>
<tr>
<td>Pampas de Villacuri Aquifer</td>
<td>63</td>
<td>228</td>
<td>-165</td>
</tr>
<tr>
<td>Total</td>
<td>253</td>
<td>563</td>
<td>-310</td>
</tr>
</tbody>
</table>

*Source: ALA Ica, 2013 data*

Table 4: Well drilling, both legal and illegal

<table>
<thead>
<tr>
<th>Location</th>
<th>Total wells</th>
<th>Legal wells</th>
<th>Illegal wells</th>
<th>% legal wells</th>
<th>% illegal wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ica Valley Aquifer</td>
<td>864</td>
<td>249</td>
<td>615</td>
<td>29%</td>
<td>71%</td>
</tr>
<tr>
<td>Pampas de Villacuri Aquifer</td>
<td>460</td>
<td>139</td>
<td>321</td>
<td>30%</td>
<td>70%</td>
</tr>
<tr>
<td>Total</td>
<td>1,324</td>
<td>388</td>
<td>936</td>
<td>29%</td>
<td>71%</td>
</tr>
</tbody>
</table>

*Source: ALA Ica, 2009 data*
Figure 8: Organizational structure of the National Water Authority

Source: Author’s own.
Figure 9: Administrative boundaries of AAAs

The Ica Valley and capital city of Ica are in the AAA Chaparra-Chincha (22), which covers parts of the states of Ica and Huancavelica (olive green in color). Lake Choclococha is in AAA Pampas-Apurimac (145), which stretches from Huancavelica to neighboring states of Ayacucho and Apurimac.

Source: Autoridad Nacional de Agua

Table 5A: Estimated costs of well creation and maintenance

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digging a 50 meter (average size) well</td>
<td>$15,000 USD</td>
</tr>
</tbody>
</table>

Table 5B: Estimated costs of Drip Irrigation to bring water from the well to the fields

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation of irrigation system</td>
<td>$10,000/hectare</td>
</tr>
<tr>
<td>Water fees, if in a prime area above aquifer</td>
<td>$16,000 - $20,000/hectare</td>
</tr>
<tr>
<td>Water fees, if further from aquifer</td>
<td>$10,000 - $14,000/hectare</td>
</tr>
</tbody>
</table>

Source: ALA Ica
Case writer Jessie Bullock standing in the middle of the Ica River, which is completely dry during the winter (summer in North America, this photo was taken in July 2015).

Meeting with the engineer Alfredo Prado (left) and his team that promotes investment in water-related infrastructure for ProInversión in their headquarters in Lima, Peru. Case study writer Jessie Bullock is second from the left.
Jose Asunciòn Herrera, an engineer and the administrator in charge of the Administrative Authority on Water (AAA) in Ica, with case study writer Jessie Bullock.

Meeting with Engineer Luicio Estrada (right), director of irrigation projects for the National Water Association (ANA), and colleague (left) in the agency’s headquarters in Lima, Peru. Case study writer Jessie Bullock is in the center.