Report on the Jalisco Section of the Santiago River Basin. Using the Institutional Compass

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Abstract

We report on aspects of a joint project between the University of Guadalajara and George Washington University to better understand and assess how to solve problems in the state of Jalisco. We recount the experience students had through the work they did to assess the situation using an institutional compass.

1. Introduction, Context

In March of 2023, a group of 28 students from both George Washington University and The University of Guadalajara CUCEA collected economic, social and environmental data from several sites, including: a berry farm in Jocotepec, an agave farm for the tequila industry and an abandoned waste site at the industrial corridor of El

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Salto. These locations are all in the province of Jalisco, and are part of the Santiago River basin. We used the data from the sites to create institutional compasses. Based on the compass readings, we made some recommendations to restore the river basin to make it more sustainable. The students were led by Salvador Peniche Camps and Michèle Friend.

In general, we found that none of the sites is sustainable.

In this report, we explain the concept of the institutional compass [Friend, 2022], the experience of the students, how we define sustainability, the recommendations and conclusions.

The institutional compass gives a reading in terms of a quality and intensity of that quality. The qualities range through: harmony, discipline and excitement. Harmony means that everything is going well and smoothly, discipline is when there are rules conflicts, real difficulties and hardships, excitement indicates that things are in flux, a lot is unknown, there is passion.

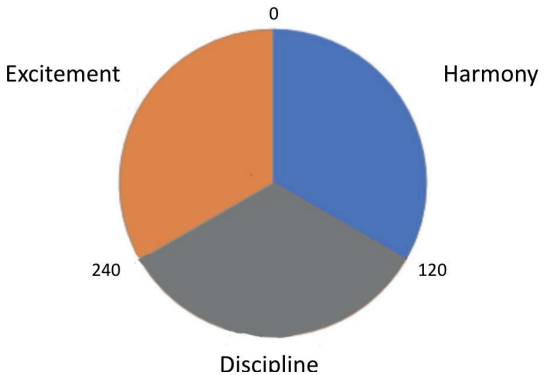
We give and introduction to the institutional compass and how it works, we describe the methodology we used for the report, and we give the report on each aspect of the Santiago River Basin, followed by a general conclusion.

1. Concept of the Institutional Compass and the Definition of Sustainability

The word "institution" comes from institutional economics. An institution is any organization or system with rules, constraints and has a clear boundary. The rules and constraints are those experienced by the people who lectured to us. The boundary of the "institution" is the experience of the people the students encountered that day. This might seem to be a very subjective and biased experience, but we shall see that it is more robust and objective than it appears at first sight.

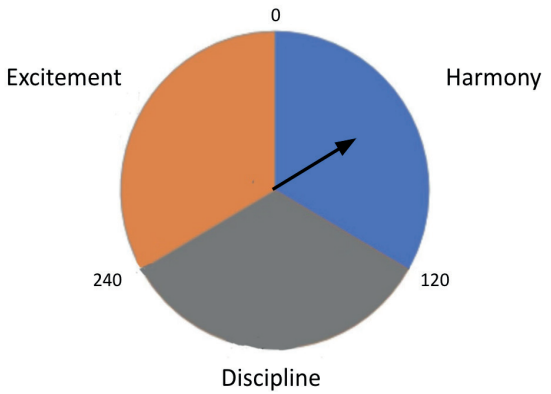
A table of social, environmental, and economic data is used for constructing an institutional compass. A length and a degree are assigned to each datum to give it meaning and a measurement. The length demonstrates importance. The degree is on a circle. The degrees progress clockwise, with zero at the top. The degree denotes a quality. The length and quality can be visualized as a vector on a circle with the tail at the center. The vector arrow represents an amplitude and a quality direction. There are 3 main directions: harmony, excitement, and discipline. See Figure 1.

Figure 1
An Institutional Compass



Harmony means sustainability. We define sustainability as an arrow strongly pointing in harmony. See figure 2. For an economic state, it means stability (no loss, no growth, fixed fees, predictability). For society, it means balance (good health, security, safety, tradition). For the environment, it means a healthy ecosystem (good vitality, biodiversity and resilience to pressure and stress). If we want sustainability, we also want harmony *between* the economy and society, between society and the environment and between the economy and the environment. The economy supports society and the ecosystem, society supports the economy and the ecosystem. The ecosystem sustains the society and the economy.

Figure 2
Sustainability according to the institutional compass



Discipline indicates loss, hardship, rules, struggle. Economically, discipline is reflected by: bankruptcy, wasted, lost or stolen money. For society it means: illness, depression, early deaths, crime, violence, low education, traditions are lost. For the environment it means ecosystem collapse.

Excitement is: flashy, passionate, regal, unpredictable or unstable. Economically means investment and fluctuating prices. Socially, it means new technologies regarding medicine, a high level of education, new measures for protection, competition, festivities and glamour. Environmentally, it means man changing and taming nature to improve or enhance it.

2. Methodology

Students from the University of Guadalajara organized an outing and lecture each day for the students from George Washington University.

Each day, 7 students were assigned the role of "data scientists". They recorded data from the day's outing, including asking many questions. In the evening they, and other students, would gather with Professor Friend to do data analysis: assign a length and a degree to each data point. Normally, the length is assigned with reference to a larger region, a comparative that sets a baseline. Then how much the particular institution deviates from this gives a measure on a scale of 0 – 10 where 5 is the baseline. We did not have a baseline comparative. We assumed, however, that the lecturer did. So, we looked for semiotic cues to tell us how important the data point was for the lecturer. We also used common sense, and when possible, asked the local students to help us. The degree assignment is easier, especially in the case of economic and environmental data. For social data it can be more difficult, and again, we relied on semiotic cues from the lecturer or asked the local students if the data was harmonious, a real hardship or exciting. The discussion for one data point could be quite long, since interpreting data (in terms of length and quality) raises social questions about expectations and what is reasonable. But consensus would be reached.[3]

After the data table was compiled, with each datum assigned a length and degree, Friend would use her mathematical formula to make a compass reading of the table of data [Friend 2022].

3. Compass Results by Day

We present a narrative of the day's experience, the compass reading, a selection of two or three data points that stood out and some recommendations. See the appendix for the complete data tables.

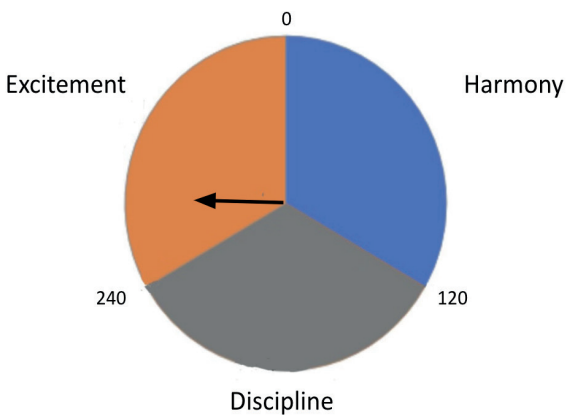
3 There are methods for dealing with situations when there is no consensus over the length and quality interpretation of a datum – the easiest is to split the datum in two, including a note about the disagreement in the name of the datum and then decreasing the length, since there are fewer people in agreement.

3.1 Day 1: Lecture by Dr. Béatrice Graciela González and Enrique Enciso.

3.1.1 Experience

On the first day, we had an orientation lecture by a sociologist Dr. Béatrice Graciela Gonzalez and a well-informed local, Enrique Enciso, who has experienced the environmental and social factors in the area firsthand. They provided an overview of what we would be seeing: tequila farms, raspberry fields, a waste dump, lake Chapala and the industrial corridor of El Salto that borders the Santiago River. They showed aerial photographs of the tequila farms and raspberry fields to emphasize just how far these industries spanned in the state of Jalisco and the sheer number of resources required to maintain them. We were also shown an old picture of Santiago River from before it became severely polluted. It was full of life; people were fishing, swimming and playing in the water. This was to emphasize the negative effects of the contamination since there is now no activity on the riverbank and the buildings are abandoned.

Figure 3
Compass representation of data gathered in the first lecture



The compass reading is in figure 3. The reading is in excitement, but close to discipline. This means that according to the data the situation is far from sustainable since it pointing almost directly away from harmony. The situation is in flux and change. It is somewhat chaotic and disorganized. Moreover, the arrow is strongly in excitement (the length of the arrow indicates strength). Because it is close to discipline, this suggests, not the fun and stimulating parts of excitement, but rather instability, danger and chaos.

3.1.2 Data

The following three data points fell in the sector of discipline. The first point is that the life expectancy in Jalisco is 74, compared to 54 in El Salto. The low life expectancy and the disparity in life expectancy raises concerns. This shows social unsustainability, if not social collapse. The second data point is that half the children born in El Salto are born with kidney failure. The third and final point is that there are 170 people living close to a waste dump, causing a drastic change in lifestyle within one generation due to the ecological collapse because of all of the water, air, and soil pollution. These are the data points that most influence the final arrow directly away from sustainability.

3.1.3 Recommendation

The population, especially in El Salto, needs better healthcare. This does not only mean more healthcare facilities, since the health of the population is affected by pollution. This is the underlying cause. So, pollution needs to be better controlled. End of pipe dumping of industrial waste should be stopped. Waste sites should be properly closed.

3.2 Day 2: Visit to government ministry.

3.2.1 Experience

On the second day in Jalisco, we visited officials from Aipromades, an intermunicipal environmental government organization for lake Chapala. Aipromades focuses on eight components of restoration: solid urban waste management, integrated management of aquatic weeds, climate change, ecosystem conservation, fire management, institutional strengthening, territorial management and fundraising. Each of these is necessary to work towards a cleaner lake, and if one component is missing, their work is made much more difficult.

While these all carry the same importance, our group mostly discussed the integrated management of aquatic weeds. We learned that the weeds grow so aggressively that they cover the entire top of the water, making it look like a field. This then suffocates anything living in the water, severely harming the ecosystem and biodiversity within the lake ecosystem.

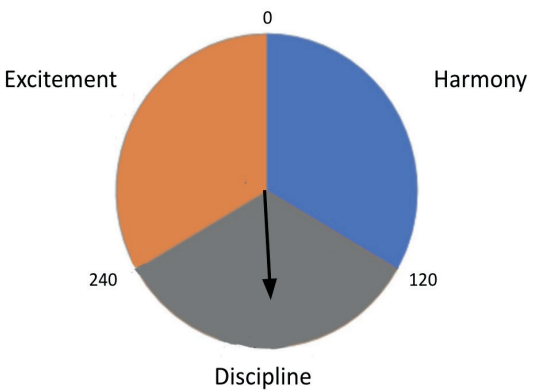
Aipromades introduced the use of machines that drive through the water, effectively removing the invasive plant from the water. The intention is to allow sunshine and oxygen to be reintroduced in the aquatic ecosystem. However, this solution creates another problem. The machines are powered by diesel fuel which is just as harmful to the environment as the original weeds. So, while the intention is good, the solution is not effective. This is just one example of how complex the environmental issues are in the area and how difficult it is to solve just one problem, let alone the long list of problems.

Finally, we discussed how important transparency is for groups like Aipromades and the government, since they have a history of lying or embellishing what they are

actually doing in order to make themselves look better and to put the public at ease. The government's efforts are very weak, but they portray them as highly effective and helping the community. One example of this is the water treatment plant we saw later on the trip. The water treatment plant was a major investment, was publicized by the government as the solution to restoring the state of the water, but it is ineffectual. This emphasized the importance of transparency in environmental efforts, which can be addressed through things like reports of the work that has been done and effective accountability.

The institutional compass representation for the data is in figure 4.

Figure 4:
The institutional compass representation for the data from the Aipromades ministry



The reading is in the middle of discipline. This shows us that the challenges to the ministry are very real and worth addressing. In particular, we have social failure and environmental collapse.

3.2.2 Data

Four data points stood out. In Airpromades, one of the most important data points is the sheer number of municipalities that the organization oversees. With 13 municipalities, it is difficult for the organization to have unity and coordination of efforts. Municipalities in this part of Mexico compete against each other for funding from the government at higher levels, for power and for resources, such as water. Second, there are a great number of ecological problems in the river basin. Third, wildfires are frequent, and firefighting efforts are often lacking. Fourth, to supply the city of Guadalajara, more water is pumped from the lake than is naturally replenished from rivers. The water level of the lake is decreasing.

3.2.3 Recommendations

To be effective, Airpromades needs to have real power over the municipalities to create a better sense of common cause. The compass can be of help here, since changes in the compass reading can be watched in "real" time, as the data changes. If the municipalities see their common cause as working to shift the *compass reading* to harmony, they can choose how they will each do this effectively. If they had the power and could control rewards and punishments to the municipalities, they could do this according to each municipality's efforts to change the compass reading.

They also need more visibility and communication with local populations, who can contribute to the compass by offering data (public data collecting) and making changes that count. To address the ecological problems that affect social and economic health, data collection by the public should focus on pollution, wildfires and (excessive) water use by people living in Guadalajara and near lake Chapala. This would give the lake a chance to replenish. By setting up and managing public data collection, we have several knock-on effects: raised public awareness, which creates public pressure at the lower level of the ministries (to work together towards the common compass goal), more dialogue between the ministry and the public (and therefore more transparency and trust). Again, the compass reading can be updated in real time, and the reading be made public. This can only add to transparency and trust by the public.

At the municipal level, the immediate contributions would be to fire management, pollution control and measures to decrease water consumption. If these recommendations are followed, the compass reading will shift towards harmony.

3.3 Day 3: Agave Farming

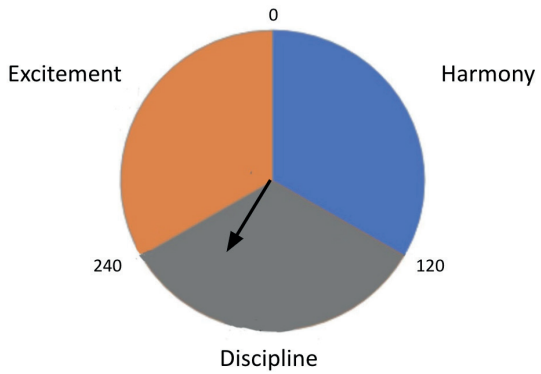
3.3.1 Experience

On this day, we were guided through an area of an agave and corn fields and saw waterways that flowed into the Santiago River that were seemingly healthy. However, the industries dump their waste into the river in the late afternoon, and it runs through agricultural fields and residential areas. The discharge from the industries is officially regulated and tested, but there is only one inspector in the entire state who conducts the inspections. He warns the industries of his visit, giving them time to flush the discharge pipes of any chemicals. This is just one example of how the government is ineffective and too weak to solve the complex environmental problems.

The farmers told us that once the sun goes down, the smell that the water exudes is so potent that they cannot bear to be near it. The noxious gasses from the tributary cause headaches and nausea. The agave farmers explained to us how harmful the production of tequila is to the river because the solid waste that sits on top of the water suffocates aquatic life and the liquid waste makes the river water toxic and some of it seeps into the ground. We also spoke to wealthy residents of the area who were building a weekend home. They said they did not experience any health problems from the

water, since they had potable well water at their disposal, something only the wealthy in Jalisco have, emphasizing the wealth disparity in the area.

Figure 5
Agave farming



The arrow is in discipline and close to excitement.[4] This is almost diametrically opposed to the direction for sustainability. This tells us that agave farming and the tequila industry is close to collapsing. This is so for economic, social and environmental reasons.

3.3.2 Data

At the agave farms, there were three data points that concerned us. The first is a social data point. Children are being born with cerebral palsy, Down syndrome, brain paralysis, and other conditions due to pollution from the fields or the excess vinasse that is dumped into the river during tequila production. The direct chemical cause for the health problems is unknown, and this lack of "one cause" has served as an excuse to do nothing about the problem.

The second data point is that pesticides and herbicides are used in some agave fields. They destroy all of the life in the soil except agave for 3-5 years, leading to monoculture and soil nutrient collapse.

4 Note that Emily Philbrook, one of the students, wrote a more extended report (not yet published), specifically on the tequila industry, consulting research papers and Salvador Velazquez, who wrote a Ph.D. on the tequila industry. The interesting outcome was that the compass reading is very close to the one seen here. This shows us that the methodology is robust, and the reading is accurate. This same finding (of not much change in the final reading) has occurred with other compasses. This tells us that for the purposes of the final compass reading there is a threshold of data, when it stabilizes. No more data is needed.

The third data point that was extensively discussed by the data analysts was that organic solid waste – bagasse - produced by tequila production is used to feed cattle and make compost (the compost mixture is not well-studied). What we know is that for every 1 L tequila, 1.4 kg solid waste is produced. This is a major piece of data because the waste from the agave plants is causing dangerous methane byproducts to be released.

3.3.3 Recommendations

The data points are related.

While visiting the tequila industry farms, the most important data point was that the agave farms are all located in close proximity to running water and the fields are connected by these water systems. This is key because it emphasizes that the byproducts that are poisoning the water are becoming ingrained in the soil of the region and the environment by water movement, irrigation and cattle manure. The feeding of cattle and the compost production have to be better controlled.

The tequila industry is a major pollutant in the Santiago River basin. Over cultivation of agave has caused not only major pollution in the area, but a significant decrease in the quality of agave plants that are grown.

The tequila industry is owned by foreign companies. While foreign investment seems good on paper, here we witnessed the negative effects. The foreign industrialists do not suffer the negative effects directly. They want to increase profit at the expense of the local Mexican population. Tequila is an important export product for Mexico, for reasons of national pride amongst others. Only liquor made from Agave grown in this geographical region can qualify as Tequila. Re-nationalizing the industry might go some way towards correcting the problems. But to gain better assurance of stopping the endemic problem is to control the industry – to ensure only small, high-quality "artisan" production. This would mean a re-distribution of the wealth earned from the Tequila industry to the people in Jalisco, and preventing monopoly – reducing the income gap, and making for a healthier economy and society. It would also mean that the people in the industry would be concerned about the pollution problems since it is the locals who are directly affected. This means altering the tequila market, by decreasing the net production of tequila working towards a higher-quality product. It is important then to watch for foreign investment in other, competing (such as Mescal) or less prestigious products that replace the lower-end market for high alcohol beverages (a sort-of unofficial tequila), since the same problems will re-occur.

3.4 Day 4: Raspberry farming

3.4.1 Experience

The fifth day,[5] we visited a raspberry farm that supplied Driscoll. We spoke to two of the managers of the site. We were told 100% of the berries harvested are exported to

5 The students were given the 4th day off. So this is the fourth day of research, but the fifth day of the trip.

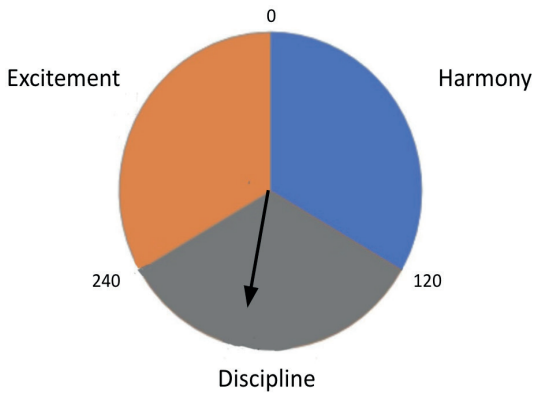
the United States and none remained in the local area. The berries that are deemed to be too damaged to sell are made into jam and exported, but if damaged or infected berries reach the border, they are then disposed of and become waste. If even one carton is bad, the whole truck load is thrown out. These berries are transported to the border by trucks every day. The trucks leave within a short time from the start of loading to preserve freshness. They leave regardless of how full or empty the truck is. This is wasteful of energy (fuel to drive the truck).

Previously, the berries had been GMO and there had to be significant methods of containing the GMO seed. The berries we saw were not treated with pesticides and were non-GMO. The farmers use large tents and nets to protect the berries from birds and insects. However, we were told that in neighboring farms, pesticides are used. The berries that are treated with pesticides, which is harmful to both the environment and the consumer, are more profitable for Driscoll.

Regarding the social implications of the raspberry farms, the farmers work eight-hour days starting at 7:30 am and only receive $1.50 MXN per bucket, which is equal to $0.083 USD. The bucket is small, but it still takes about 20 minutes to fill. This means a daily salary of around $36 MXN = $2 USD per day. This is very low, and the data might not be accurate. But even if it is only approximately correct, it is supported by the social fact that adults and even children without their parents, travel from El Salvador and Honduras, to do seasonal work in the berry plantations. One of the managers told us that there is child labor. Unfortunately, it is very common for children to migrate on their own due to the recent economic crises in Latin America and it is said to be related to the refugee crisis in North Africa, although how exactly, was not clear. Migrant workers come to earn money to provide for their families back home because it is one of the only places that will hire them.

The compass reading for raspberry farming is in figure 6.

Figure 6
Raspberry farming



3.4.2 Data

The berry farm gave an insight into how another form of agriculture is affecting the economy, society and natural environment, and the data points reflected the difference. The two compass readings were deep in the discipline section. Both types of farming might be profitable in the short term, but they are not sustainable: socially or environmentally.

The first data point that stood out was that water from the lake is used by the berry farms. This practice contaminates the public water drinking supply, forcing the public to drink polluted lake water which is causing health problems, decrease in fish and the chocking of the lake ecology.

The second point is that the seeds used for Driscoll farms are not local and are not from the existing plants. They all come from Driscoll and are hybrids developed at the University of San Diego.

The third important data point is that the use of methyl bromide by some of the industrial farms is causing kidney failure in people who live in the region. A large portion of children suffer from kidney failure.

At the Driscoll berry farms, we noted that 100 percent of the farms in that region work directly with export companies. This is an issue, because it drains the soil, contributes to the lack of protections for workers and locals, and foreign American companies are not accountable for the health and ecological damage they are causing.

3.4.3 Recommendations

The data calls for a variety of solutions, starting with increasing soil biodiversity, implementing rainwater capture systems, supporting unions and increasing access to education in the area.

More government oversight is needed to accurately track water use by berry farms, and workers need to be protected. They need to be given rights and be educated about them.

Like the Tequila industry, the berry farms produce a cash crop. The contracts are with foreign companies whose stakeholders are unaffected by the damage of the farming practices. The recommendation is the same: to re-gain local control over the production and marketing of the berries. Hybrids could be developed locally, by the university of Guadalajara – in consultation with the farmers. The transportation system has to be re-thought. More berries should be consumed locally. Diversify the cultures. Could mushrooms be grown alongside the berry plants? Could some berry plants be grown for wild birds and insects – to restore biodiversity in the surrounding area?

3.5 Day 5: Disused Solid Waste Site

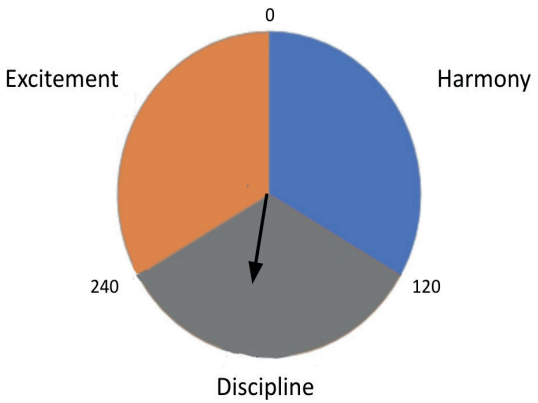
3.5.1 Experience

On the sixth day, we were originally going to visit the government run Huaxtla waste site, but the government did not allow it, making us question the conditions of the site and/or what they did not want us to see. The refusal might have been for safety

reasons, for reasons of secrecy or both. So, instead, we visited an abandoned waste site, which was in operation only for six years from 1988 to 1994. Despite being out of commission for nearly three decades, its environmental impacts are still detrimental to the ecosystem. The water in the area contains many chemicals including cadmium, mercury, and arsenic. These chemicals alone are dangerous to the environment, but it is unknown how these chemicals combine in the water and how those combinations impact the environment. This is another complication of the environmental crisis in Jalisco, making it impossible to pinpoint the largest contributor to contamination and the harm it causes to its surroundings, since the waste site is abandoned. Cows and cattle that escape from their farms and wander into the abandoned dump site, drink the water that is full of leakage from the old garbage. They don't make it back because the chemicals in the water kill them rapidly. We saw bones of young bovine littering the area. The original waste managers tried to prevent water contamination by making a containment pool for the water, but the infrastructure was too weak, resulting in water leaking into the ground, and flowing into a tributary that feeds into the Santiago River. This means it continues to contaminate the soil and surrounding water, harming organisms near it. Only one species of tree can withstand the pollution in the soil and water, so the dump is covered with them and where these trees grow used to be piles of trash that are now covered by sandy soil.

The compass reading for the disused waste site is in figure 7.

Figure 7
Compass for waste site



3.5.2 Data

At the abandoned Huaxtla waste site, we learned that the ecosystem collapsed in the 1980s due to polluted water systems and the lack of biodiversity. This is important to note because it shows the extent to which the chemical waste from the pre-existing dump has contributed to the environmental destruction and is the basis of the activists' fight there. Another data point we collected was that the abandoned waste site

is leaking cyanide, arsenic, mercury, lead, cadmium, and other hazardous chemicals. These pollutants are highly toxic and threaten not only the health of humans and livestock that live there, but the ability of any species to survive in proximity to such dangerous chemicals.

At the abandoned waste site, disheartening effects of the improper closing of a waste site are seen to this day.

3.5.3 Recommendations

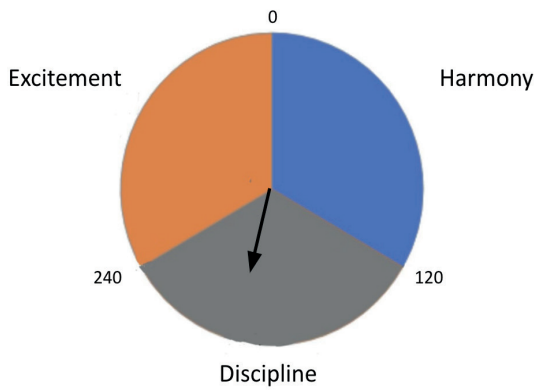
Currently, the abandoned Huaxtla waste site, along with others like it, are not secured and they are easily accessible to the general public. In order to prevent further health issues in both people and animals, there needs to be more security for these sites. This could include fences or walls blocking it off, surveillance of the area, or physical guards, depending on how toxic the site is. This is a short-term solution. In the long term, collection of the liquid waste needs to be more effective – getting all of it and containing it. For the future, an effective protocol should be developed for containing waste and closing waste sites. This could include strengthening infrastructure that holds toxic materials or removal of these materials to other sites. The current procedure to cover in sand and grow trees over the waste is not enough.

3.6 Day 6: El Salto

3.6.1 Experience

The last day of the trip involved a tour of El Salto. This day was filled with many concerning observations and alarming data points. The compass reading for El Salto is in figure 8.

Figure 8:
The compass for El Salto



3.6.2 Data

At the Santiago River, we documented that 94 percent of the companies in the industrial area near the river are not following the guidelines for disposing of their waste. This shows a direct correlation between the pollution in the river and the lack of responsibility from industry. This is directly related to the fact that there is only 1 inspector for investigating water pollution per 600 companies. This demonstrates the government's priority of simply box ticking and lack of accountability rather than protecting the local population. The combination of these data points is representative of how the situation has escalated due to the joint negligence of industry and government. The water treatment system is ineffectual. It removes only two substances: nitrogen and phosphorus.

The problem is not restricted to the river. The wells are also affected. This means drinking water for the poor in the population is not safe. In 7 wells in the area, there are 8 different toxic chemicals. This has led to 98% of children having at least 8 heavy metals in their blood. This encapsulates the humanitarian crisis that is currently taking place in El Salto. The activists call this an "extermination policy". Through neglect, the government is exterminating the poor in the local population. Since El Salto is an industrial corridor. The overwhelming majority of the residents and workers are poor, and often recent migrants who do not know the history, and put up with poor conditions because fleeing worse ones.

The other most imperative data point from the visit to El Salto was that there are 26 illegal metal factories in the corridor in an area called Los Minerales. This illustrates how the government has turned a blind eye to illegal industry practices that are having direct consequences for the community. The illegal metal factories pollute the air the water and the soil. The pollution affects the health of the children and the adults in the area. Young workers who migrate to the area for work are also affected. There were no old people in El Salto.

Since 2015, 52,000 workers commute daily into the industrial zone instead of employing locals who have lived in the area for generations. These locals are often blacklisted by industry and not employed. They commute out to work. This is highly inefficient in terms of transport resources, but more important, it leads to social fragmentation, and prevents communication and worker solidarity. A related data point is that many protesters died in 2005 when protesting over the stealing of water to create Castillo de Belmonte, a private housing project for workers.

3.6.3 Recommendations

At first glance the situation seems hopeless, but there are a few solutions that can be implemented to improve the situation, not only for the people but for the local ecosystem. The water treatment systems need to be overhauled and controlled by local people together with effective enforcement of regulations concerning industrial waste. Other substances need to be removed apart from nitrogen and phosphorus, especially the

very toxic ones that affect the health of local children. To encourage the government through shame, an increase in coverage in local and foreign media will be of great benefit. The industrial culture needs to change, and this is not done by talking to the heads of industry. Rather, it will come from the bottom up, or through enforced regulation.

A lack of access to education is a systemic issue in El Salto, which plays into the ability of industry to take advantage of the people in the area. Thus, it's vital that a high school is added to the city in addition to increasing access to non-trade schooling. By increasing access – by efficient transportation and financial assistance, the population will be better equipped with the knowledge and skills necessary to fight back and work towards protecting their water quality.

Conclusions

From what we witnessed, and supported by the compass readings, we conclude that the present situation is unsustainable. The ecosystems and social systems are collapsing. We predict that, if nothing is done, this will lead to economic collapse. Foreign industrialists will not care. They will just move their factories to somewhere else where there is a good water supply (for industrial use and waste removal), where they can pollute with impunity and where there is a cheap labor force.

The problems are real, complex and alarming.

If the ecosystem is healthy, the society can be healthy. If the society is healthy, the economy can be steady.

The general recommendations are in the short terms to address the pollution problems immediately, provide better health treatment to the local population and to legislate against foreign control over industrial practices. In the longer term, it is worthwhile to invest in education for locals and migrant workers.

Give more power to Airpromades or higher regulatory bodies to re-nationalize and keep small-scale the production of Tequila, lessen the grip of foreign companies on the berry industry, control the abandoned waste sites and ensure that solid waste is properly treated by incineration or containment, re-invest in an effective water treatment plant while effectively enforcing pollution regulation from industry.

If the problems of the Santiago River basin can be partly solved, then the effort will serve as a model for other parts of Mexico and for many other regions in the world where people are facing similar complex and alarming situations. The compass data can be used for negotiation and accountability in the region.[6]

Reference

Friend, Michèle. (2022). *The Institutional Compass; Method, Use and Scope. Methods series*. Springer Nature.

6 An article by Ayon, Friend and Gerritson is in preparation on exactly this topic.

Appendix: Data Tables

Lecture by Graciela González, Enrique Enciso

#	Name	source	length	Corrected length	degree
1.	Social Change course of river 1800km into 593km	Henrique	9	1.5	300
2.	Social life expectancy in Jalisco 74, El Salto 54	Graciella	7	.7	180
3.	Social, 1/2 children have kidney failure	Graciella	8	.8	180
4.	Fish 507 tons of contaminants dumped into the river every day from industry	"	10	1	180
5.	Socially for industry 94 % of companies are not following norms for pollution		10	1.5	340
6.	Economically for industry 94 % of companies are not following norms for pollution		4	1	330
7.	Economics GDP in the area highest in Mexico		8	1.5	320
8.	Soil and Water pollution from Tequila industry 10 litres of pesticide is used to make 1 litre of Tequila		6	.5	180
9.	Socially: Soil and Water pollution from Tequila industry 10 litres of pesticide is used to make 1 litre of Tequila		2	.2	180
10.	Socially Tequilla industry owned by foreign company's people working for foreigners, Reputation high, cutting corners, so reputation will go down.		5	1	260
11.	Economic Tequilla exported, brings in money		5	1	330
12	170 people living close to waste dump. Change in lifestyle within one generation, environment dies because of pollution to water soil and air.		2	.2	180
13	Environment Management of the waste dump		7	.7	180
14	Socially: Only 1 inspector for pollution for 600 companies – becomes exercise in box ticking, shows social priorities		6	.6	130
15	Environment, river: landfill: University waste 26,000 students,		3	.3	180
16	Socially should set standard, to the wider community, and for the education of students: University waste 26,000 students,		6	.6	150
17	Environment: berries production: soil poisoned 30 cm down by Methyl Bromide		7	.7	180

Government Ministry

#	Name	Source	Degree	Length	Corrected Length	Type
1	50% of protected land is privatized and 50% is HILOS Community	Association Intermunicipal	90	7	1.5	Social
2	Lake Chapala has shrunk 226 square kilometers since 1973	Association Intermunicipal	290	8	1	Environmental
3	20% of land area around the lake is protected	Association Intermunicipal	300	2.5	.3	Social
4	20% of land area around the lake is protected	Association Intermunicipal	150	2.5	1	Environmental
5	Mexico's three largest states for economic industry are located on River Lerma	Association Intermunicipal	180	8.5	3	Environmental
6	The 6 pillars of management that are being work towards receive different funding year to year	Association Intermunicipal	290	6	1	Social
7	Municipal government changes every three years which makes municipal governance unstable	Association Intermunicipal	310	8	1	Social
8	Fire management	Association Intermunicipal	30	2		Environmental
9	Fire management, protecting human property	Association Intermunicipal	90	2		Social
10	Install solar panels on 80 houses for 300 people	Association Intermunicipal	310	1	.7	Social
11	5 states are contributing to lake pollution	Association Intermunicipal	210	2.5	1	Social
12	Working with 16 municipalities within Jalisco to manage pollution	Association Intermunicipal	110	8		Social

13	Harvest are being delayed 2-3 months	Association Intermunicipal				
14	Increase in agricultural demand	Association Intermunicipal	260	3	.4	Environmental
15	Increase in agricultural demand for workers	Association Intermunicipal	115	2.5		Social
16	Increase in agricultural demand for Mexico's reputation	Association Intermunicipal	350	7	1	Social

Tequlia Farming

#	Name	Gen type	Degree	Length	Norm. length for 14/03/23
1,	Children born with cerebral palsy, down syndrome, brain paralysis, etc. caused by pollution either in the fields or in the molasses (not sure if it's field or molasses)	Social	220	7	2
2,	Pesticides and herbicides for some agave fields destroy all life in soil, except for agave, for 3-5 years	Environmental	180	5	1
3,	Fluctuation in price of agave plant	Economic	300	8	2
4,	Decrease in quality and homogenization of the product (tequila)	Economic	345	3	1
5,	Entropy produced and energy used via tequila production (for every 1 L tequila, 10 L of vinasses are produced)	Environmental	130	6	6
6,	Organic solid waste produced by tequila production used to feed cattle and make compost (compost mixture not well-studied; for every 1 L tequila, 1.4 kg solid waste produced)	Environmental	320	2	1
7,	Agave farms all close to running water, which means that runoff from fields enters water system	Environmental	180	9	2
8,	Asymmetry between technology, production practices, and subsidies in corn production between US and Mexico	Social	250	9	2
9,	Asymmetry between technology, production practices, and subsidies in corn production between US and Mexico	Economic	210	4	1

Berry farming

	Name	Type	Degree	Len.	Cor. Len.
1.	20 years ago, agricultural practices changed to berries. Previously pumpkins, chiles, tomatoes, beans	Environmental	330	5	.5
2.	Workers in the agricultural sector paid $1.5 per basket of berries	Social	115	8	2
3.	60-70% of people in Jocotepec work in berry fields (don't need to travel to work)	Social	30	8	2
4.	Aquifer going down, digging more wells	Environmental	185	8	2
5.	Increased methyl-bromide usage, kidney failure	Social	170	7	2
6.	100% of the farms work directly with export companies (fluctuating because it's dependent on other countries, out of the control of locals)	Social	250	10	1
7.	20% of berries used to make jam	Social	30	2	.5
8.	Saving on fertilizer by using plant parts	Environmental	355	3	.1
9.	All of the picking and sorting is from manual labor	environmental	355	6	.5
10.	Water goes toward berry farms, not toward public drinking water. Public has to use polluted lake water, causes health issues.	Social	220	9	2
11.	Trucks leave for the border every 2-3 hours regardless of whether they are full (inefficient fuel use, excessive fuel use for refrigeration)	Environmental	180	7	2
12.	Waste from quality control-> ensures high rate of compliance with international standards (cooperation from coercion) [Social and legal]	Social	80	8	2
13.	They have their own bees	Environmental	345	4	.5
14.	Starter seeds all come from Driscolls (seeds that are hybridized come from the US [University of San Diego])	Environmental	270	8	1
15.	Starter seeds all come from Driscolls (seeds that are hybridized come from the US [University of San Diego])	Social	225	4	1
16.	Starter seeds all come from Driscolls (seeds that are hybridized come from the US [University of San Diego])	Economic	270	5	.5
17.	2 varieties, monoculture—1 variety per tent	Environmental	250	8	1

Waste Site

#	Name	Gen. typ.	Degree.	Leng.
1.	Ecosystem collapsed in the 1980s and they (political activists) are trying to restore the water system and stop the loss of biodiversity and ecosystem collapse	Social	220	5
2.	Ecosystem collapsed in the 1980s and they (political activists) are trying to restore the water system and stop the loss of biodiversity and ecosystem collapse	environmental	180	8
3.	Important extension of solid waste dump site from 30 hectares to 42 hectares	Social	340	4
4.	Important extension of solid waste dump site from 30 hectares to 42 hectares	Environmental	180	6
5.	Abandoned waste site is leaking cyanide, arsenic, mercury, lead, and cadmium.	Environmental	180	8
6.	Longevity of waste (only open for 6 years, but still seeing effects 28 years later)	Environmental	170	8
7.	Huizache (tree species resistant to most contaminants) growing over trash piles, which means soil retention so soil will build up again, and produces nitrogen, so nitrogen returns to soil	Environmental	330	5
8.	Local activists started organizing in 2006-2007 when they noticed that the water, they used in their households was dirty.	Social	300	4
9.	Old landfill site, Copalita, is still being used informally by industrialists.	Social	150	5
10.	Old landfill site, Copalita, is still being used informally by private people.	Social	130	2
11.	Old landfill site, Copalita, is still being used informally because it isn't being regulated.	Environmental	180	2
12.	Last wholistic/complete water test was in 2008	Social	180	3

El Salto

#	Name	Gen. type	degree	Len.
1.	Santiago river passes through 5 different states	Social	210	8
2.	7 wells in the area have 8 different toxic chemicals	Environmental	180	8
3.	7 wells in the area have 8 different toxic chemicals—affects children. 98% of children had at least 8 metals in their blood	Social	180	10
4.	Guadalajara metro extracts 198,000 L3 of water total. Lake Chapala only has a capacity of 181,000 L3, so GDL has to supplement from other reservoirs.	Environmental	180	7

5.	Guadalajara metro extracts 198,000 L3 of water total. Lake Chapala only has a capacity of 181,000 L3, so GDL has to supplement from other reservoirs	Social	260	5
6.	People in the industrial corridor only learn trades	Social	100	8
7.	Workers living in the communities are trapped (single-family housing is misleading)	Social	190	7
8.	Since 2015, 52,000 workers commute daily in industrial zone. Not locals, commuting from other metros. Forced commute. Societal fragmentation, lack of unified communication/worker solidarity.	Social	220	8
9.	People work 12 hours/day, little to no leisure time	Social	160	9
10.	26 illegal metal factories in the corridor (create water, air, soil pollution). Streets named after bronze, nickel, silver, and other metals, and the neighborhood is called Los Minerales.	Environmental	180	7
11.	26 illegal metal factories in the corridor's residential areas. Proximity to children.	Social	150	6
12.	For Honda to make 1 car it requires 400,000 L of water--the amount of water that would supply a family of 6 for a year. They make 325 cars per day. The water is being stolen from locals. (Honda one of several)	Social	180	7
13.	Honda is the one doing it. Internationally recognized, has ESG goals. Getting awards for being sustainable (via hard to verify means) (local perspective). Symbolic of other companies.	Social	200	6
14.	96% of kids had 400% more benzene in their system than factory workers	Social	180	10
15.	600,000 pesos to buy a house in Castillo de Belmonte (30,000 USD) [worker housing]	Economic	250	3
16.	Protests started after 2008 —8-year-old boy named Miguel Angel. Convulsing by dinnertime.	Social	260	4
17.	Government introduced tilapia to replace fish dying, but they started dying too	Environmental	180	9
18.	Working people have to wait 2-3 months to get drinking water in their houses	Social	180	4
19.	Unequal distribution of water in amount and quality. Political tensions	Social	270	8
20.	¾ of the meat consumed in GDL comes from El Salto	Social	180	6
21.	Mass flooding from deforestation of the hill (historically indigenous land) in order to build urban worker housing.	Environmental	180	8
22.	Flooding (see above)	Social	250	4
23.	4,000 companies in the area	Economic	290	8
24.	10-17.5% of these companies are transnational	Social	250	7

25.	Miscarriages and forced abortions from contact with metal	Social	180	9
26.	Labor unions are legal but often don't represent workers—"white syndicate"	Social	260	6
27.	Water treatment plant only treats 2,250 L/s of the 78,000 L/s. (2.8 %)	Environmental	350	1
28.	Water treatment plant only treats 2,250 L/s of the 78,000 L/s. (2.8 %). Greenwashing	Social	190	8
29.	Treatment plant only treats 3 of the 1,090 contaminates (nitrates and phosphates).	Environmental	350	1
30.	Governor of Jalisco reported in DC (and currently in NY) that the Santiago River is 71% clean. Using data to justify 8 megaprojects.	Social	190	9
31.	Government said nothing was wrong for 10 years despite constant pressure	Social	190	8
32.	Contract with international body was to improve public health, but it only covers 3 of the 68 towns affected by contamination	Social	40	1
33.	7 million pesos spent on a pipe that doesn't work	Economic	200	3
34.	Mexico spending 78 billion pesos on the issue	Economic	330	4
35.	Mexico has to pay damages via international contract, meaning organizations 999 pocket that money.	Social	190	6
36.	25,000 new houses constructed in 2021. Loss of cultural identity for El Salto locals.	Social	200	8
37.	Tensions due to proximity to Narcos and high security prison	Social	140	5
38.	Narcos reselling Pemex oil at a lower price	Economic	205	3
39.	296 inspections over the last 10 years out of 4,000 companies	Social	130	1
40.	In 2005 people died protesting the stealing of water to create Castillo de Belmonte	Social	230	3
41.	Companies get prime choice of land; middle school is last	Social	200	3
42.	Houses are very small, don't fit furniture. Uniform walled area.	Social	100	7
43.	Industrial region exposed to high-risk areas necessary for trade (trains carrying chlorine that could kill the entire population in 15 minutes). No emergency signage	Social	260	8