

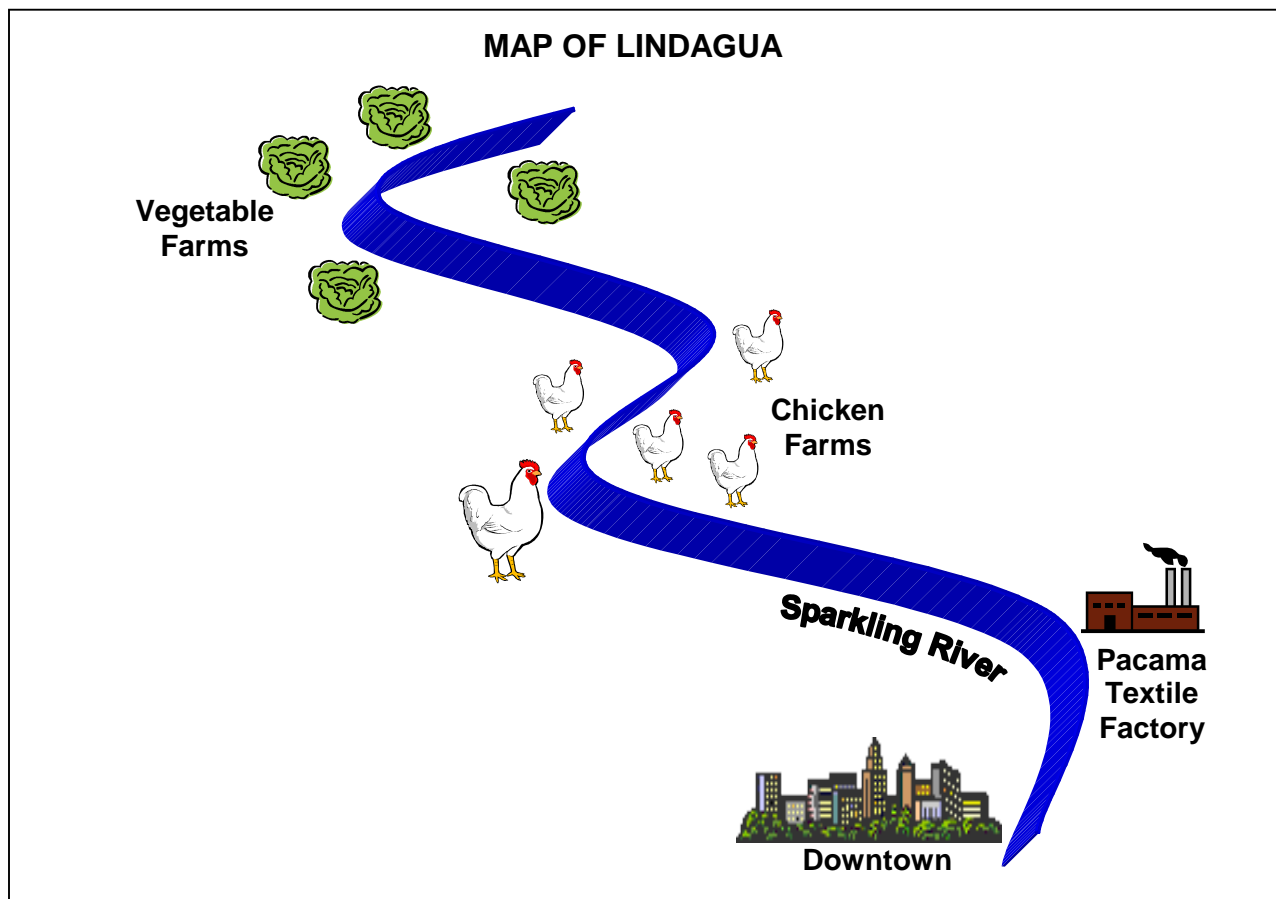
Lindagua Case Study

Sparkling River flows through the municipality of Lindagua, in the country of Costa Verde (see Map of Lindagua *below*). For thousands of years, Sparkling River has supported the residents of Lindagua, providing fresh water for drinking, cooking, irrigation, fishing, and swimming. Sparkling River is nearly pristine when it enters Lindagua, but over the past decade, the quality of the water in Sparkling River has declined due to pressures created by the growing population of Lindagua, intensification of farming practices, and the growth of industry along the River.

According to the Constitution of Costa Verde, all citizens have the right to a clean and healthy environment. The Constitution also vests some responsibility in the municipalities of Costa Verde to protect the public health and natural resources of their residents.

Within the boundaries of Lindagua are the following users of Sparkling River:

- Four large vegetable farms – the most upstream user of Sparkling River in Lindagua, the farms produce the staple foods eaten by most Lindaguans
- Five chicken farms
- The Pacama Textile Factory – the largest single employer in Lindagua
- The downtown area of Lindagua – home to 500,000 people (and growing)



Exercise 1: Writing an Enforceable Requirement

Pacama Textile Factory:

The Pacama Textile Factory discharges cadmium into Sparkling River. It also draws in water for cooling and then discharges it back into the river at 25°C.

The government of Costa Verde has set a nationwide permitted ambient concentration level for cadmium at 0.2 parts per million (ppm) in all lakes and rivers in the country. The current level of cadmium in Sparkling River is 0.15 ppm.

Normal seasonal temperature trends of Sparkling River are: winter: 5-18°C; summer: 17-30°C. Large and sudden variations in water temperature will have significant negative consequences on biodiversity in the river.

Exercise 2: Setting Priorities for an Effective Environmental Compliance and Enforcement Program

Along with the Pacama Textile Factory discussed in Exercise 1, a number of other users contribute pollutant streams to the watershed. These other polluters are:

Vegetable Farms:

The four vegetable farms treat their fields with fertilizers. Much of this runs off the land into Sparkling River, causing increased levels of phosphates and nitrates. The increased nutrient load also increases biological oxygen demand (BOD), meaning that bacteria are using more of the dissolved oxygen in the water, leaving less for the fish and other organisms that rely on oxygen, thereby eventually leading to reduced diversity of life in the river.

Lindagua requirements applicable to grain/vegetable farms:

- Setback / buffer requirement: “Tilled farms cannot be closer than 15 meters to waterways.”
- “Fertilizer must be loaded into the dispensing equipment only in locations where spilled fertilizer cannot enter a water body or other non-target area. Tanks, buckets, and other dispensing equipment also must not be washed in or near streams, rivers, or lakes.”
- “If a soil test indicates that a field has concentrations of phosphorus greater than 30 ppm, then soil management practices such as windbreaks (trees), grass strips, and reduced tilling must be put in place to reduce soil erosion.”

Chicken Farms:

The chicken farms, four of which have roughly 100 chickens and one of which has 500 chickens, use water from Sparkling River to clean out the chicken coops and to dilute large manure lagoons.

When lagoons overflow or leak, they contribute large volumes of biological waste into the river, increasing levels of phosphates and nitrates, as well as BOD. The manure also contains numerous microorganisms that can pose risks to human health – gastrointestinal illness, skin irritation, reduced oxygen-carrying capacity of blood, and potentially death.

Lindagua requirements applicable to chicken farms:

- Setback / buffer requirement: “Concentrated animal feeding operations with more than 50 animals must keep all livestock and manure lagoons further than 15 meters from waterways.”
- “Manure lagoons must have an impervious lining that prevents seepage into groundwater, as well as storage sheds to prevent rain from washing manure into waterways.”

Downtown:

Downtown homes and businesses are connected to the sanitary sewer system and have piped potable water, but oil and trash from the downtown still pose threats to Sparkling River.

The downtown has one street with a high concentration of auto repair shops, which have traditionally disposed of used motor oil by dumping it into a pit behind the shops that is adjacent to Sparkling River.

Trash on downtown streets gets caught up in stormwater runoff that ends up in the river. This trash consists of household waste improperly disposed of by downtown residents; the most ubiquitous items by far are the plastic bags distributed by food merchants for carrying groceries.

The oil and trash go downstream through the popular fishing and swimming areas used by Lindaguans, posing hazards to aquatic life and diminishing the value of the river for recreational purposes.

Lindagua requirements relevant to downtown:

- “All household or consumer waste must be disposed of in a municipal landfill or in a municipal trash receptacle.”
- “Plastic bags shall no longer be used in Lindagua starting 1 year after enactment of this regulation.”
- “All garage workshops and other auto repair facilities must store used oil in oil disposal barrels.”

Setting Priorities

Design an environmental compliance and enforcement program to protect human health and the environment of Lindagua. The annual program budget is **850 gjaconas**.

Review the enforcement and compliance promotion tools below, and select an appropriate balance of tools to adequately respond to the activities of the four main polluters of the watershed (the textile factory, the chicken farms, the vegetable farms, and the downtown area).

Be prepared to explain to the other groups your reasons for choosing your assortment of tools.

Compliance Tool	Cost
Train 2 inspectors to monitor and test Pacama Textile Factory effluent for cadmium content and temperature	100 gjaconas
Conduct water quality testing in Sparkling River at various points along the river, and at the least, just downstream of each source of pollution	50 gjaconas
Work with Pacama Textile Factory to design a self-monitoring & reporting program	30 gjaconas
Implement and collect a 10-gjacona fee for each kilo of dye with a cadmium content of over 50 milligrams per kilo	200 gjaconas
Train 2 inspectors to verify vegetable farms' compliance with setback and equipment cleaning requirements, to test soil for phosphorous concentrations, and to verify implementation of soil management practices	150 gjaconas
Develop compliance promotion subsidy to provide financial support to vegetable farmers to implement best practices for soil conservation	250 gjaconas
Develop education campaign (e.g., distribution of flyers) and conduct trainings for vegetable farmers on the Lindaguan requirements, including appropriate methods for cleaning fertilizer equipment and preventing soil erosion.	175 gjaconas
Train 1 inspector to do quick, spot inspections of all 5 chicken farms to verify compliance with setback and lagoon requirements	80 gjaconas
Train 1 inspector to do thorough inspections of the biggest chicken farm and more sporadic spot checks of the other farms, and widely publicize the enforcement actions against the biggest farm so as to deter the smaller farms	150 gjaconas
Conduct overflights to do aerial monitoring of compliance with setback and lagoon requirements	300 gjaconas
Develop education campaign (e.g., distribution of flyers) and conduct trainings for chicken farmers on the Lindaguan setback and lagoon requirements	175 gjaconas
Develop education campaign for auto repair shops about oil disposal requirements	75 gjaconas
Create recognition award for complying auto repair shops	40 gjaconas
Train 1 inspector to collect evidence of illegal oil dumping to enable prosecution	80 gjaconas
Train 5 officers to monitor citizens' waste disposal and fine violators	250 gjaconas
Conduct public education campaign about proper waste disposal	150 gjaconas
Implement and collect a 1-gjacona fee on food merchants for every 1000 plastic bags distributed	200 gjaconas
Implement public education program to train public on how to recognize and report environmental violations, including establishing a hotline to receive anonymous complaints	150 gjaconas

Exercise 3: Calculating an Appropriate Penalty

Despite repeated warnings from the Lindaguan government, Pacama Textile Factory has continued to discharge effluent at 25°C into the river year-round for the past 2 years. Lindagua has a regulation, which has been incorporated into Pacama's discharge permit, that states that "No facility shall discharge effluent into the Lindagua River that falls outside the range of the river's normal seasonal temperature trends, which are: winter: 5-18°C; summer: 17-30°C."

Pacama Textile Factory would have to spend 300 giaconas to develop a system of cooling ponds to decrease the effluent temperature in winter, as well as 50 giaconas a month to maintain the system. Pacama admits that it has violated the requirement, but it has complied with all other requirements. Pacama argues that it has fallen on hard economic times and cannot afford to implement the cooling system.

The Lindaguan environmental ministry wants to develop a protected fish habitat area. Pacama has indicated an interest in helping with the program, which would incur costs to Pacama of 90 giaconas a year.

Using the penalty form on the next page, calculate an appropriate penalty for the violation by the Pacama Textile Factory.

PENALTY CALCULATION WORKSHEET

Facility: _____

1. Money the Facility Saved by not Complying (“Recovery of Economic Benefit”)

$$\frac{\text{_____}}{\text{cost avoided}} + \frac{\text{_____}}{\text{cost postponed}} = \frac{\text{_____}}{\text{subtotal 1}}$$

2. Seriousness of the Violation (“Gravity Component”)

Potential for Harm	Amount of deviation from the requirement(s)		
		High	Low
High	100-300 gjaconas	25-100 gjaconas	
Low	25-100 gjaconas	5-25 gjaconas	

$$\frac{\text{_____}}{\text{penalty per day (from matrix)}} \times \frac{\text{_____}}{\text{days of noncompliance}} = \frac{\text{_____}}{\text{subtotal 2}}$$

3. Total Unadjusted Penalty (1)+(2) _____

4. Adjustment Factors

Degree of Cooperation	_____	_____
	Reduction	Increase
History of Compliance	_____	_____
	Reduction	Increase
Ability to Pay	_____	_____
	Reduction	Increase
Supplemental Environmental Program	_____	_____
	Reduction	Increase
Voluntary Audits	_____	_____
	Reduction	Increase

5. Total Adjusted Penalty (3) +/- (Adjustments in 4) _____

Exercise 4: Designing Environmental Compliance and Enforcement Indicators

Now that Lindagua has an environmental compliance and enforcement program, the next step is to develop a program to measure how effective the program’s activities are and to determine where to focus resources for future compliance and enforcement activities.

Design a set of environmental compliance and enforcement indicators using the logic model below that would enable the Lindaguan environment ministry to assess the effectiveness of the environmental compliance and enforcement program you designed in Exercise 2.

Applying the Logic Model

Inputs <i>resources</i>	Outputs <i>Activities</i>	Intermediate Outcome <i>behavior change</i>	Final Outcome <i>environmental impact</i>