See the System, Not the Dog

🟩 Abstract

For decades, local governments have invested millions in campaigns to reduce stray dog populations through neutering or euthanasia. Yet the problem persists. This article presents a systemic hypothesis: these well-intentioned policies target visible symptoms instead of the deeper structural causes. We explore how variables like citizen habits, food waste management, urban dog migration, and the lack of preventive models create a system that perpetuates the issue. More than just analyzing the stray dog crisis, this article invites readers —especially in business and policy-making— to rethink how we often focus on surface-level problems while ignoring the latent structures that sustain them.

Oasis Incubator Online	**Autores:** **Pedro Dagoberto Almaguer Prado** pedro@oasis-io.com **+52(81)17588310** **Ramiro Luis Almaguer Navarro** ramiro@oasis-io.com **+52(81)43966945** https://oasis-io.com

Mayo 30, 2025

Keywords

simulation model, systems thinking, stray dogs, public policy, food waste, urban migration, latent structure, symptomatic policies, public health, habit change, policy innovation, social complexity.

Table of contents:

Table of figures:

📚 Introduction

We’ve all seen stray dogs wandering through parks, markets, and streets. Governments come and go, implementing neutering campaigns or euthanasia policies, even passing laws —yet the problem persists. What are we missing? This article invites a shift in focus: to stop seeing the dog as the problem, and instead see the system that keeps producing it.

Our hypothesis is clear: **stray dogs are not the cause; they are the effect of a neglected system** —a complex structure where cultural habits (such as throwing food in public spaces), poor waste management, lack of metropolitan coordination, animal migration, and policies focused on symptoms rather than causes all converge.

This same pattern is present in business: organizations face recurring problems and apply quick fixes, but fail to change the system behind the symptoms. Just like the dogs keep reappearing, business challenges resurface —again and again. This model is not just about the stray dog issue; it’s a call to transform our mindset: **to see the latent structure, not just the visible effects**.

Welcome to the challenge of thinking differently.

🟠 Problem Description

Despite decades of institutional efforts, stray dogs remain a common sight in cities across the globe. The most commonly adopted policies —neutering and euthanasia— have proven to be short-term solutions that fail to address the root causes. These approaches tend to focus on visible variables (effects), such as the number of dogs on the streets, without intervening in the structure that generates the phenomenon.

The real causes lie within a neglected systemic network: the widespread habit of discarding food waste in public spaces, inefficient garbage collection systems, the absence of metropolitan coordination (which allows canine migration between urban areas), and institutional cultures that react to public pressure instead of implementing preventive solutions. The result is a repeating cycle: dogs reappear, resources are spent, and the problem persists.

This issue, which is both a public health and urban image concern, also serves as a powerful metaphor for how businesses and organizations often apply symptomatic fixes without addressing the invisible structures that create recurring problems.

🔧 Model registration

This section records the model's key metadata: title, short description, and tags. This information allows the model to be classified, searched, and shared within the online simulator, supporting its educational use, community dissemination, and integration into collaborative exercises for analyzing complex problems.

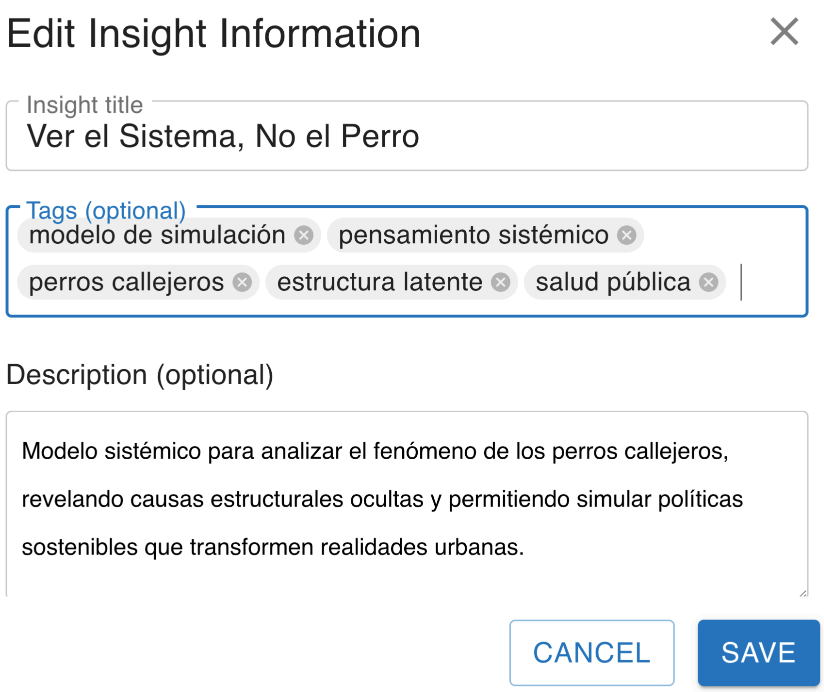

Figure 1: Model registration with key metadata for use and sharing.

✅ Title

See the System, Not the Dog

✅ Tags sugeridos *(en ambos idiomas)*:

simulation model, systems thinking, stray dogs, public policy, food waste, urban migration, latent structure, symptomatic policies, public health, habit change, policy innovation, social complexity.

📝 Model short description

A systemic model to analyze the stray dog phenomenon, uncovering hidden structural causes and enabling simulation of sustainable policies to transform urban realities.

Model settings

This section defines the simulation parameters that govern the model's dynamics. It sets the start time, total duration, time units, integration step, and algorithm type, enabling precise control over the model's behavior across different scenarios.

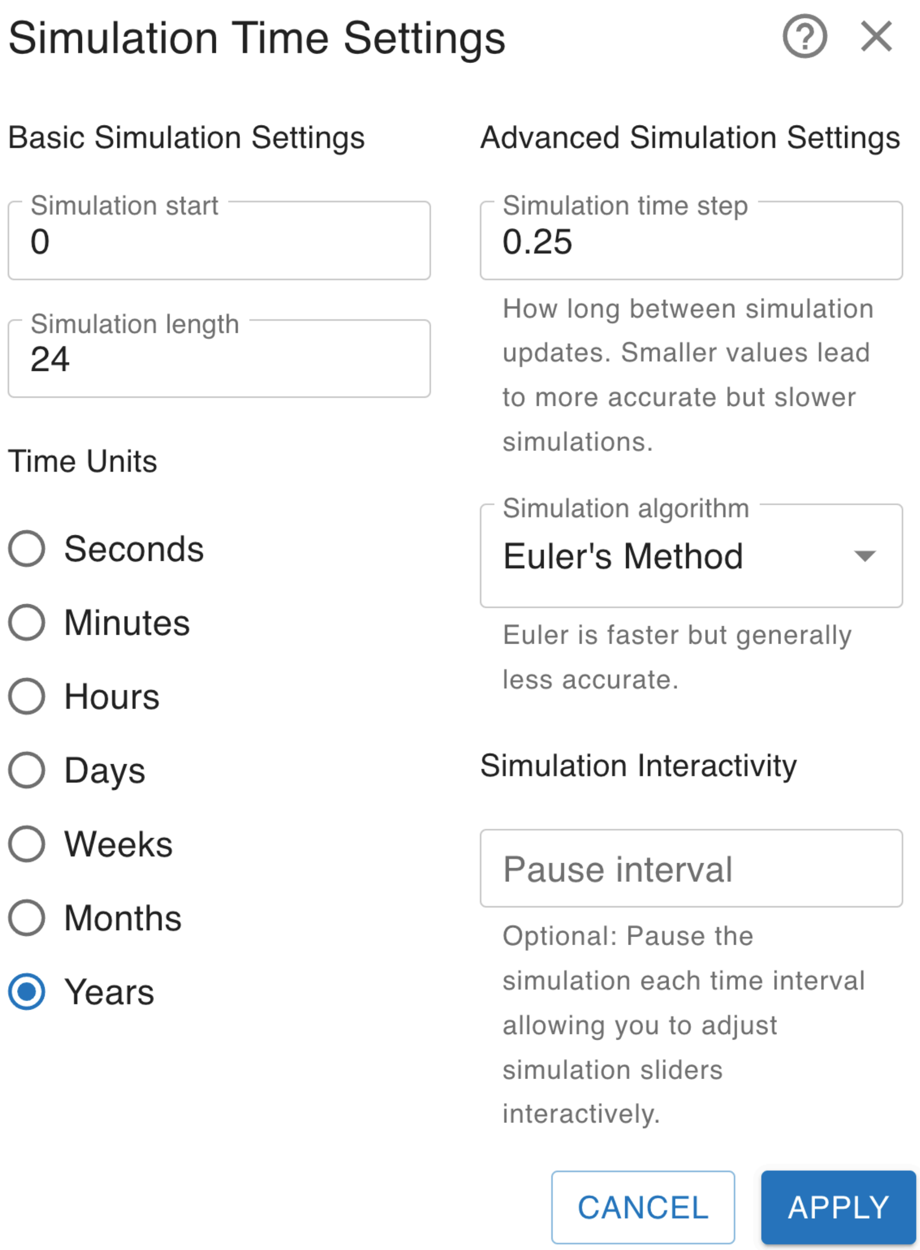

Figure 2: Model's time and computation settings.

The Story Behind the Model

Narrative behind the model, based on the global stray dog phenomenon. Invites us to look beyond symptoms and explore structural causes.

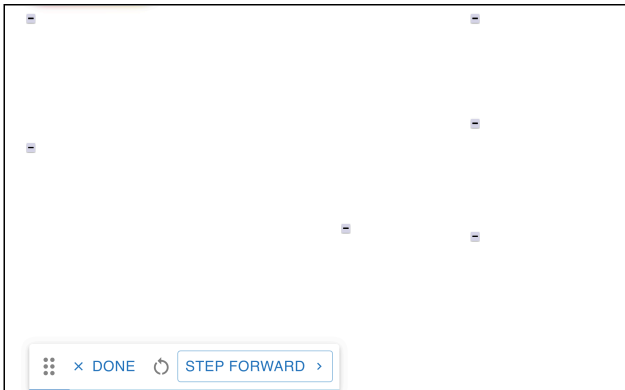

Figure 3: Step 1: Blank

Base model with no elements yet.

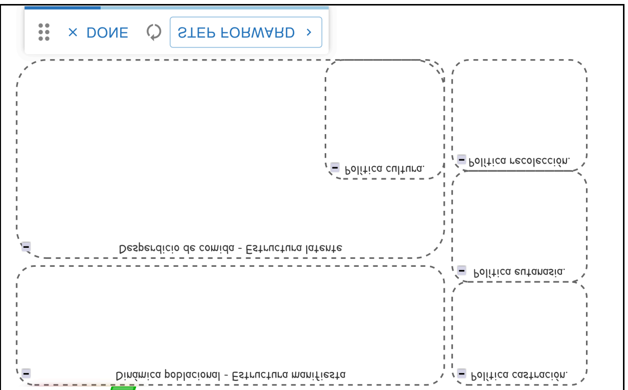

Figure 4: Step 2: Model Sectors

System split into key areas.

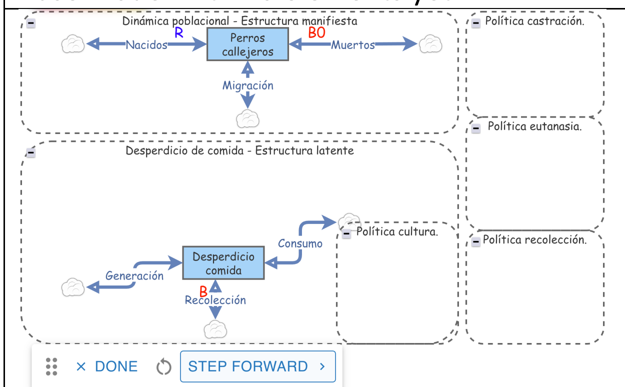

Figure 5: Step 3: Stocks and Flows

Core system structure.

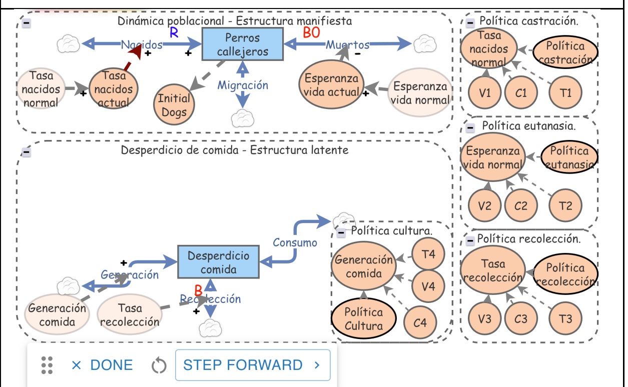

Figure 6: Step 4: Policies

Proposed interventions.

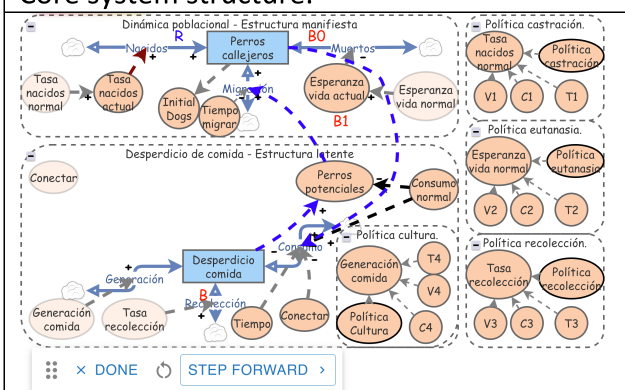

Figure 7: Step 5: Loop (B1) Migration

Balancing through displacement.

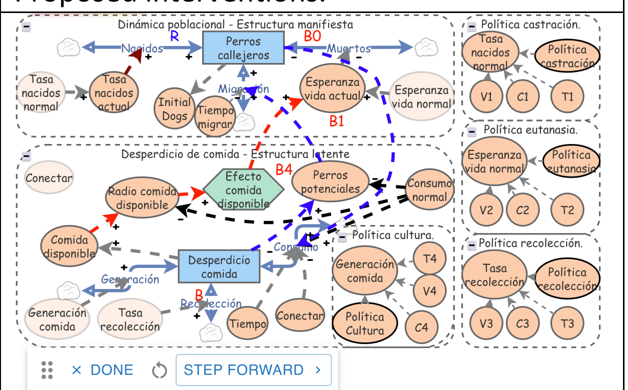

Figure 8: Step 6: Loop (R1) Food Effect

More food, more dogs.

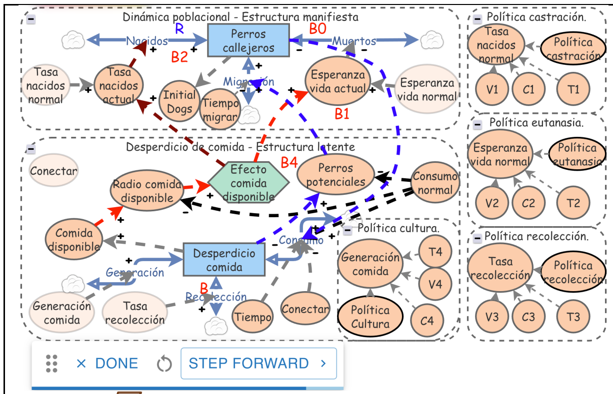

Figure 9: Step 7: Loop (B2) – Habits limit food.

Less food, fewer dogs.

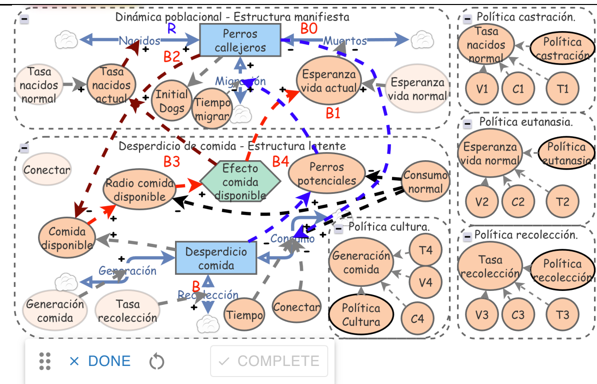

*Figure 10: **Step 8: Loop (B3) Available Food***

Less food, fewer dogs.

Full Model: System Structure

This diagram integrates all sectors, cycles, and policies of the model to visualize how the root causes of the stray dog phenomenon interact.

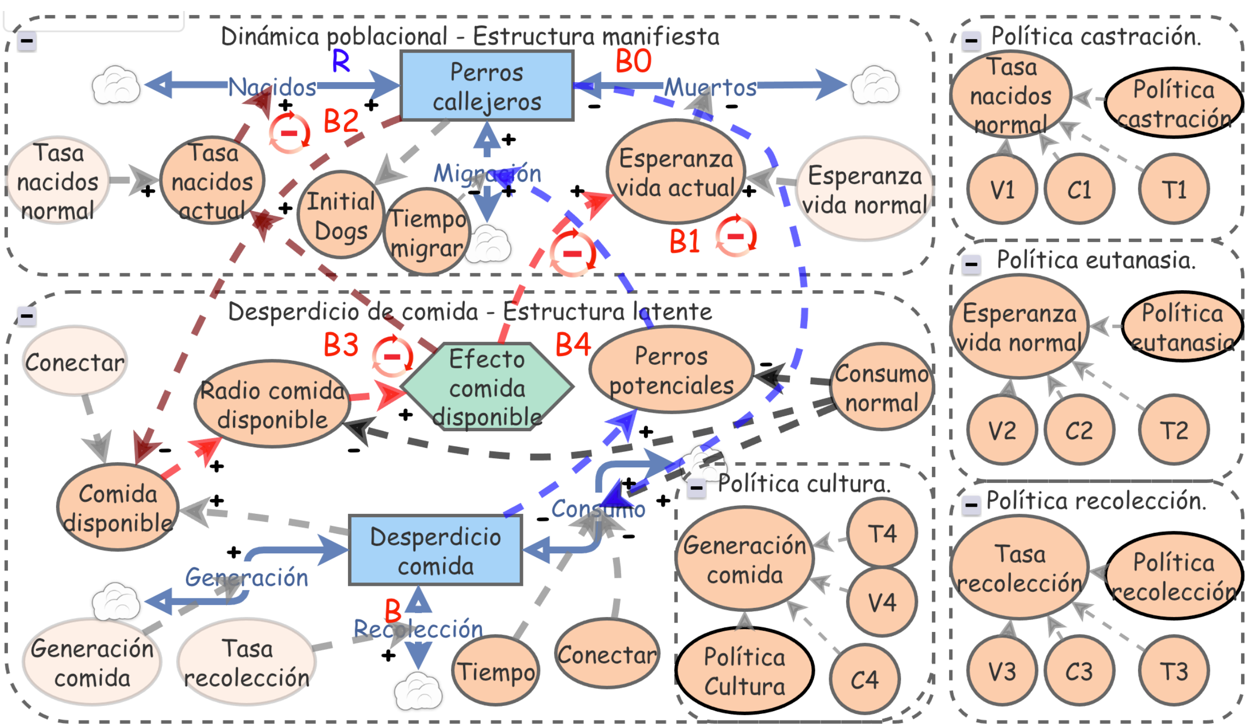

Figure 11: (Full model) The full system at a glance..

🧱 Macro sección: Primitivos del modelo

En esta sección se documentan todos los elementos fundamentales del modelo, conocidos como *primitivos*: stocks, flujos, variables auxiliares, constantes y conectores. Cada uno se describe con su nombre, propósito, unidad, fórmula (si aplica) y rol dentro de la dinámica del sistema. Esta documentación es esencial para comprender, construir, replicar y mejorar el modelo de forma colaborativa y educativa.

🇺🇸 📜 Model Policy Documentation

This section presents the policies implemented in the model to intervene in the system's dynamics. Each policy is described by its purpose, mechanism of action, involved variables, and expected effects. This analysis enables the evaluation of alternatives, comparison of results, and reflection on more effective and sustainable strategies.

📌 Variable: Tasa nacidos normal

Unit: 1/Year
Sector: *Política castración*
📝 **Description:**
The variable **Tasa nacidos normal** represents the base birth rate of stray dogs. This can be modified through a policy that allows increasing or decreasing its value from a specific point in the simulation.
Formula:
[V1] * (1 - ifthenelse([Política castración], 1, 0) * STEP([T1], [C1]))

- **V1:** Base birth rate of stray dogs. Value: 0.1 (1/Months)
- **Política castración:** Boolean variable (State type) (true/false) that activates the castration policy. Value: false
- **T1:** Time when the policy takes effect. Value: 5 Year
- **C1:** Percentage of change applied to the birth rate. Value: 0.8 (unitless)
- **STEP([T1], [C1]):** Step function that introduces the change after time T1

When the policy is activated (*Política castración* = true), starting in month 5, the birth rate of stray dogs decreases by 80%, from 0.1 to 0.02 (1/Year). This change simulates ecological policies aimed at controlling the stray dog population and has significant effects on the balance of the modeled ecosystem.

📌 Variable: Esperanza vida normal

Unit: Year
Sector: *Política eutanasia*
📝 **Description:**
The variable **Esperanza vida normal** represents the base life expectancy of stray dogs. It can be modified through a euthanasia policy that changes its value from a specific time in the simulation.
Formula:
[V2] * (1 - ifthenelse([Política eutanasia], 1, 0) * STEP([T2], [C2]))

- **V2:** Normal life expectancy of stray dogs. Value: 10 (Year)
- **Política eutanasia:** Boolean variable (State type) (true/false) that activates the euthanasia policy. Value: false
- **T2:** Time when the policy takes effect. Value: 5 Year
- **C2:** Percentage of change applied to life expectancy. Value: 0.8 (unitless)
- **STEP([T2], [C2]):** Step function that introduces the change after time T2

When the policy is activated (*Política eutanasia* = true), from month 5 onward, the life expectancy of stray dogs decreases by 80%, from 10 to 2 years. This change simulates ecological policies aimed at eliminating stray dogs and significantly affects the balance of the modeled ecosystem.

📌 Variable: Tasa recolección

Unit: 1/Year
Sector: *Política recolección*
📝 **Description:**
The variable **Tasa recolección** represents the base rate of food waste collection. It can be modified through a garbage collection policy that increases its value after a specific point in the simulation.
Formula:
[V3] + ifthenelse([Política recolección], 1, 0) * STEP([T3], [C3])

- **V3:** Normal rate of food waste collection. Value: 0 (Unitless)
- **Política recolección:** Boolean variable (State type) (true/false) that activates the policy to collect thrown food waste. Value: false
- **T3:** Time when the policy takes effect. Value: 5 Year
- **C3:** Percentage change applied to the collection rate. Value: 0.6 (unitless)
- **STEP([T3], [C3]):** Step function that introduces the change after time T3

When the policy is activated (*Política recolección* = true), from month 5, the collection rate increases by 60%, going from 0 to 0.60 (1/Year). This change simulates ecological food waste collection policies and has a significant impact on the balance of the modeled ecosystem.

📌 Variable: Generación comida

Unit: Food/Year
Sector: *Política cultura*
📝 **Description:**
The variable **Generación comida** represents the amount of food waste generated (Food/Year). It can be modified through a cultural change policy aimed at reducing food waste from a certain point in the simulation.
Formula:
[V4] * (1 - ifthenelse([Política Cultura], 1, 0) * STEP([T4], [C4]))

- **V4:** Normal generation rate of food waste. Value: 100 (Food/Year)
- **Política Cultura:** Boolean variable (State type) (true/false) that activates the policy to reduce food waste. Value: false
- **T4:** Time when the policy takes effect. Value: 5 Year
- **C4:** Percentage of change applied to the generation of food waste. Value: 0.6 (unitless)
- **STEP([T4], [C4]):** Step function that introduces the change after time T4

When the policy is activated (*Política Cultura* = true), from month 5, food waste generation is reduced by 60%, dropping from 100 to 40 Food/Year. This change simulates cultural policies aimed at reducing food waste and significantly impacts the equilibrium of the modeled ecosystem.

🧩 Policy Summary Table: Stray Dog System Dynamics Model

Policy Name	Variable Affected	Change Applied	Trigger Time	Effect on System
🐾 **Spaying Policy**	Tasa nacidos normal	Decrease by 80% (×0.2)	Month 5	Reduces dog birth rate → fewer stray dogs
💉 **Euthanasia Policy**	Esperanza vida normal	Decrease by 80% (×0.2)	Month 5	Shortens dog lifespan → accelerates population decline
🚛 **Garbage Collection Policy**	Tasa recolección	Increase by 60% (+0.6)	Month 5	Reduces food availability → limits stray dog survival
🍽️ **Cultural Change Policy**	Generación comida	Decrease by 60% (×0.4)	Month 5	Reduces waste generation → lowers food supply for stray dogs

These policies are activated through a boolean variable (true or false). The effects are applied immediately using a STEP function at month 5 of the simulation, triggering changes in the system's behavior.

📁 Sector: Stray Dog Population (Visible Structure)

This section documents the **visible structure** of the system: the stocks and flows that describe the evolution of the stray dog population. It details births, deaths, and migrations, as well as the variables that directly influence them. This structure is key to understanding how the system behaves under different policies and conditions.

In the context of **businesses and organizations**, this visible structure is analogous to the **observable outcomes**—such as financial results, customer complaints, employee turnover, or supply chain imbalances. Just like stray dog population changes are visible effects of deeper causes, many challenges in organizations are symptoms of **underlying systemic issues**. Focusing only on these visible indicators without addressing the hidden structures behind them often leads to temporary fixes rather than sustainable change.

By simulating and analyzing the visible structure, decision-makers can anticipate unintended consequences and design more effective strategies that align short-term actions with long-term goals.

📦 Variable (Stock): Stray Dogs

Initial Value: 100
Units: Dogs (Perro)
Sector: Stray Dog Population Dynamics
📝 **Description (English):**
Represents the number of stray dogs in the system at any given time. It changes based on births, deaths, and migration.

📌 Variable: Tiempo migrar (*Migration Time*)

Value: 4
Units: Year
Sector: Stray Dog Population Dynamics
📝 **Description (English):**
Represents the average time it takes for a stray dog to migrate from one city to another.

📌 Variable: Initial Dogs

Units: Dog
Equation: Fix([Perros callejeros])
Sector: Stray Dog Population Dynamics
📝 **Description (English):**
Represents the number of stray dogs at the start of the simulation. It is calculated using Fix([Perros callejeros]), where the Fix function captures the initial stock value. This variable

serves as a visual reference line in graphs to evaluate whether applied policies improve or worsen the situation.

📌 Variable: Tasa nacidos normal (Normal Birth Rate) *(Ghost)*

Units: 1/Year
Sector: Stray Dog Population Dynamics / Castration Policy
📝 **Description:**
This variable is a *ghost*, meaning it mirrors its original definition from the castration policy. It represents the base birth rate of stray dogs and can be modified by that policy.

Variable: Tasa nacidos actual (Current Birth Rate)

Units: 1/Year
It is calculated as: [Tasa nacidos normal] * [Efecto comida disponible]
Sector: Stray Dog Population Dynamics
📝 **Description:**
This variable updates the *Normal Birth Rate* based on the effect of food availability or other factors.

Flow: Nacidos (Births)

Units: Dog/Year
Formula: **[Perros callejeros]*[Tasa nacidos actual]**
📝 **Description:**
This flow represents the number of stray dogs born each year.

📌 Variable: Esperanza vida normal (Normal Life Expectancy) *(Ghost)*

Units: Year
📝 **Description:**
This variable reflects the baseline life expectancy of stray dogs. It is a *Ghost*, meaning it mirrors the values and properties of its source variable, defined in the euthanasia policy. It cannot be edited directly.

📌 Variable: Esperanza vida actual (Current Life Expectancy)

Units: Year
Formula: [Available Food Effect] * [Normal Life Expectancy]
📝 **Description:**
A strategically defined variable that updates the **Normal Life Expectancy** (defined in the euthanasia policy) by the **Available Food Effect** or other future influences. It supports model scalability for future development.

📌 Flow: Muertos (Deaths)

Units: Dog/Year
Formula: [Stray Dogs] / [Current Life Expectancy]
📝 **Description:**
This flow represents the number of stray dogs dying per year. It is calculated by dividing the current stray dog population by their current life expectancy.

Flow: Migración (Migration)

Units: Dog/Year
📝 **Description:**
This flow represents the net migration of stray dogs between cities. It is calculated as:
-([Potential Dogs] - [Stray Dogs]) / [Time to Migrate]
A negative value means immigration (dogs arrive), and a positive value indicates emigration (dogs leave), depending on where food is more accessible

🧠 Sector: Food Waste (Latent Structure)

This section documents the **latent structure** of the system — the underlying, often invisible processes that drive the observed behavior of the stray dog population. In this case, the food waste generated by households, restaurants, and businesses creates favorable conditions for the survival and reproduction of stray dogs. It is an unintended but consistent food source that significantly influences system dynamics.

In the world of **business and organizations**, this latent structure is analogous to **informal practices, poorly designed incentives, or invisible policies** that generate unintended consequences. Examples include sales strategies that encourage overproduction, logistical processes that create excessive inventory, or organizational cultures that tolerate high employee turnover. These underlying causes are not always reflected in metrics or dashboards, but they determine long-term systemic behavior.

Ignoring the latent structure is like trying to reduce the stray dog population without considering why they survive — it's addressing symptoms, not causes. Similarly, in business, tackling only visible issues without redesigning the underlying structures perpetuates problems. That's why **diagnosing and redesigning latent structures** is essential for achieving sustainable change and solving root problems effectively.

Stock: Desperdicio comida (Food Waste)

Initial value: 100
Unit of measure: Food
Description:
The Food Waste stock represents the accumulated amount of leftover or surplus food available in the environment. This waste serves as a resource for stray dogs and is a key component of the system's latent structure.

Its initial value is 100 Food, and it is influenced by the flows of Generation and Collection. This stock models the connection between human practices—such as food consumption, waste, and collection—and their indirect impacts on the urban ecosystem, including the stray dog population.

Analyzing this stock helps reveal how resource availability dynamics shape other system behaviors, and it uncovers the hidden role organizational decisions play in driving social and environmental challenges.

Variable: Generación comida (Food Generation) (Ghost)

Type: Ghost
Description:
This variable is a *Ghost*, meaning it mirrors the values and properties of its source variable and cannot be directly edited in this section of the model. Its role is to facilitate connections with other parts of the system—such as the stray dog population sector—without duplicating logic or compromising the structural integrity of the model.

As a variable related to food waste, its value indirectly affects the survival and reproduction of stray dogs. It acts as a bridge between the latent structure (available food due to waste) and the manifest structure (population dynamics of stray dogs).

Unit of measure: Food/Year (depending on the definition of the original variable)

Flow: Generación (Generation)

Formula: [Food Generation]
Unit of Measure: Food/Year
Description:
This flow represents the annual generation of food waste, measured in kilograms per year. It directly mirrors the value of the variable **Food Generation** (a *Ghost*) and determines how much food waste enters the system over time. This input is essential for understanding how food availability influences other sectors—particularly the population dynamics of stray dogs.

By tracking this flow, we can observe how changes in behavior, culture, or food policies impact the ecosystem and provide valuable insight for designing sustainable interventions.

📎 Variable: : Tasa recolección (Collection Rate)

Type: Ghost (mirror of another primitive)
Unit of measurement: 1/Year
Description:
The **Collection Rate** variable is a *Ghost*, meaning it mirrors another primitive variable from a different sector or module of the model. It cannot be modified directly, as its value and properties depend on its original source.

This variable represents the fraction of food waste that is collected per unit of time. It plays a key role in determining the **Collection** flow, and its value directly influences the amount of waste that remains available in the environment.

Through this rate, organizational practices or municipal policies related to waste collection efficiency can be evaluated, highlighting how operational decisions impact urban ecosystems and sustainability.

🔄 Flow: Collection

Formula: [Collection Rate] * [Food Waste]
Unit of measure: Food/Year
Description:
The **Collection** flow represents the removal of food waste from the environment, typically by municipal services or private sanitation efforts. It is calculated as the product of the **Collection Rate** and the current level of **Food Waste**.

This flow plays a crucial role in shaping the availability of food for stray animals. A high collection rate reduces food supply for dogs, potentially influencing their survival, reproduction, and migration patterns.

In a business or policy context, this variable reflects how operational decisions in waste management can have unintended consequences on urban ecosystems, emphasizing the importance of aligning environmental and public health goals.

📎 Variable: Time

Value: 1
Unit of measurement: Year
Description:
The **Time** variable has a fixed value of 1 year and is used as a scaling factor to calculate the **Consumption** flow in units of Food/Year. It serves as a temporal reference in the model, helping

to standardize and structure rates over a yearly time frame. This is particularly useful when translating ratios or unitless effects into measurable yearly flows within the system.

📎 Variable: Conectar

Type: Boolean (True/False)
Initial value: True
Unit of measure: (Dimensionless)
Description:
The **Conectar** variable is a Boolean switch used to **enable or disable the connection between sectors of the model**. Its initial value is True, meaning that the sectors are connected at the start of the simulation. Setting it to False interrupts the interaction between modules, allowing for **testing or separate analysis** of specific parts of the system.
This variable is particularly useful during model development, debugging, or sensitivity analysis, as it facilitates **controlled experimentation** without modifying the underlying structure.

📎 Variable: Consumo normal

Type: Variable
Initial Value: 1
Unit of Measurement: Food/Perro
📌 **Description:**
The **Consumo normal** variable represents the average amount of food consumed by a stray dog per year. Its initial value is set to **1 kilogram per dog**, which serves as a baseline to calculate the total food consumption within the system.

This variable plays a **critical role** in estimating the **demand for food resources** and, consequently, in understanding how the availability of food waste directly affects the **survival and reproduction** of stray dogs.

By incorporating this variable into the model, we can assess the **systemic impact of food scarcity or abundance**, evaluate intervention strategies, and examine how fluctuations in available food influence population dynamics.

📎 Flow: Consumption

Type: Flow
Formula:

```
if ([Connect]) then
  ([Normal Consumption] * [Stray Dogs]) / [Time]
else
  ([Normal Consumption] * Fix([Stray Dogs])) / [Time]
end if
```

- **Unit of Measurement:** Food/Year

📌 **Description:**

The **Consumption** flow calculates the annual amount of food waste consumed by stray dogs. It uses a conditional formula that depends on the value of the **Connect** boolean variable:

- If **Connect = True**, the model uses the current value of the **Stray Dogs** stock, meaning the system is **fully dynamic**.
- If **Connect = False**, the model uses the **initial fixed value** of the stray dog population, allowing for controlled testing or isolation of model components.

This approach allows for **experimental flexibility**, such as evaluating sector-specific behavior without interference from other parts of the system. The variable **Normal Consumption** provides the average food consumed per dog, while **Time** is used to scale the result into an annual flow.

This flow helps simulate **resource demand pressure** exerted by stray dogs on available food waste and supports analyses of how food availability affects survival and sustainability of the population.

📎 Variable: Potential Dogs

Type: Auxiliary variable
Formula:

[Food Waste] / [Normal Consumption]

- **Unit of Measure:** Dog

📌 **Description:**

The **Potential Dogs** variable estimates the **maximum number of stray dogs** that the ecosystem can support based on the **available food waste** and the **average consumption per dog**. In other words, it reflects the **carrying capacity** of the urban environment in terms of food availability for the stray dog population.

This variable plays a critical role in calculating the **Migration** flow, as it allows for a comparison between the actual number of **Stray Dogs** and the **Potential Dogs** the system can sustain. When the number of stray dogs exceeds this capacity, the model triggers **emigration** toward other cities, representing a **self-regulating mechanism** within the system.

Understanding this variable helps link **human decisions**—such as food waste policies or waste collection efficiency—to the **population dynamics** of stray animals. It shows how these decisions can indirectly influence growth, stability, or migration in stray dog populations.

📎 Variable: Conectar (Ghost)

Type: Ghost (mirror of another primitive)
Unit of Measure: None (Boolean: True/False)

📌 **Description:**

The **Conectar** variable is a *Ghost*, meaning it mirrors a Boolean variable defined in another part of the model. It cannot be edited directly, as its value depends on its original source.

This variable serves to **enable or disable connections between model sectors**, supporting experimental testing or comparative simulations. Setting it to False allows analysts to observe the behavior of a sector in isolation, which is helpful for sensitivity testing, policy experiments, or model validation.

📎 Variable: Comida disponible (Available Food)

- **Type:** Auxiliary variable
- **Unit of measure:** Food/Dog

📌 **Description:**
The **Available Food** variable estimates the average amount of food accessible per stray dog, serving as a key indicator of ecological pressure on the dog population.
It is calculated with the formula:

```
If ([Conectar]) Then
  [Food Waste]/[Stray Dogs]
Else
  [Food Waste]/Fix([Stray Dogs])
End If
```

The conditional logic enables comparative simulations:

- If Conectar = True, the ratio updates dynamically as the system evolves.
- If Conectar = False, it uses the initial number of stray dogs, allowing controlled experiments to assess the impact of external changes.

This variable directly influences others such as **Birth Rate Adjusted by Strategy** and **Current Life Expectancy**, making it essential for understanding how resource availability shapes system behavior.

📎 Variable: Radio comida disponible (Food Availability Ratio)

- **Type:** Auxiliary variable
- **Unit of measure:** Dimensionless (no units)

📌 **Description:**

The **Food Availability Ratio** expresses how many times the available food per dog exceeds (or falls short of) its normal consumption.
It is calculated with the formula:

[Available Food] / [Normal Consumption]

Since both variables are in Food/Dog, the units cancel out, making this ratio **dimensionless**.
This indicator is useful for assessing abundance or scarcity conditions in the system:

- If the value is **greater than 1**, there's more food than required per dog.
- If it's **equal to 1**, food just meets demand.
- If it's **less than 1**, there's a deficit—potentially triggering responses like higher mortality or migration.

This ratio can also be used to model nonlinear effects on health, reproduction, or stray dog behavior.

📎 Variable: Efecto comida disponible (Food Availability Effect)

- **Type:** Converter (nonlinear function)
- **Unit of measure:** Dimensionless (no units)

📌 **Description:**

The **Food Availability Effect** is a *converter*-type variable—a nonlinear function that transforms the **Food Availability Ratio** into a quantifiable impact on other system components.

This effect is used to dynamically adjust:

- The **Normal Birth Rate**, influencing stray dog reproduction.
- The **Normal Life Expectancy**, modifying longevity based on food availability.

The relationship is defined via a lookup graph (table of coordinate pairs), and **linear interpolation** is applied to estimate in-between values, allowing smooth behavioral transitions in the simulation.

This converter represents how, in both living systems and business environments, resource availability directly affects growth and survival rates. It serves as a critical lever for policy testing and systemic insight.

Figure 12: Nonlinear relationship between food availability ratio and its effect on birth rate and life expectancy.

Radio comida disponible (Unitless)	Efecto comida disponible (Unitless)
0	0.135048231511
0.2	0.167202572347
0.4	0.250803858521
0.6	0.430868167203
0.8	0.604501607717
1	1
1.2	1.47909967846
1.4	1.69131832797
1.6	1.80707395498
1.8	1.90996784566
2	1.97427652733

Visual Guide for Chart Setup

This section outlines the key parameters (axes, ranges, and variables) needed to build and visually analyze the model's charts in simulation tools.

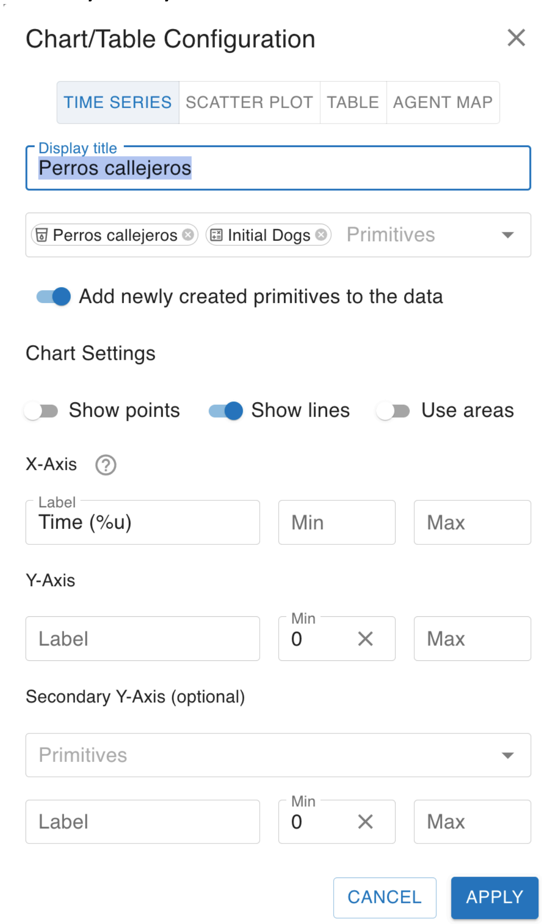

Figure 13: Technical details to replicate the model's charts.

📊 Simulation Results: Evaluating Policies to Control the Stray Dog Population

🎯 Objective

To explore the impact of different policy combinations on the population dynamics of stray dogs and the urban food waste system, distinguishing between **operational (manifest)** and **structural (latent)** interventions. The goal is to identify effective and sustainable long-term strategies.

🧩 Simulated Policies

1. **Neutering** – Reduces the birth rate. *(manifest structure)*
2. **Euthanasia** – Reduces life expectancy. *(manifest structure)*
3. **Waste Collection** – Increases the efficiency of food waste collection. *(latent structure)*
4. **Generation** – Addresses cultural habits to reduce food waste generation. *(latent structure)*

📉 Policy Scenarios

🔵 Scenario 1: No Policies Activated – Baseline Equilibrium

- ✅ **Purpose**: To verify that the model behaves correctly under natural conditions without any interventions.
- 📈 **Expected Outcome**: Stability in both dog population and available food. Serves as the reference point for all future comparisons.

Figure 14: Scenario 1: Baseline equilibrium without intervention.

The system stabilizes without any policy, allowing validation of its natural behavior and mathematical consistency.

🟡 Scenario 2: Neutering and Euthanasia (separately and combined)

- ✅ **Purpose**: To test the short-term impact of visible (manifest) interventions.
- 📈 **Expected Outcomes**:
  - Neutering lowers the birth rate.
  - Euthanasia shortens life expectancy.
  - Combined: Rapid decrease in stray population.
- ⚠️ **Limitation**: Without addressing root causes, the system may rebound or become unstable over time.

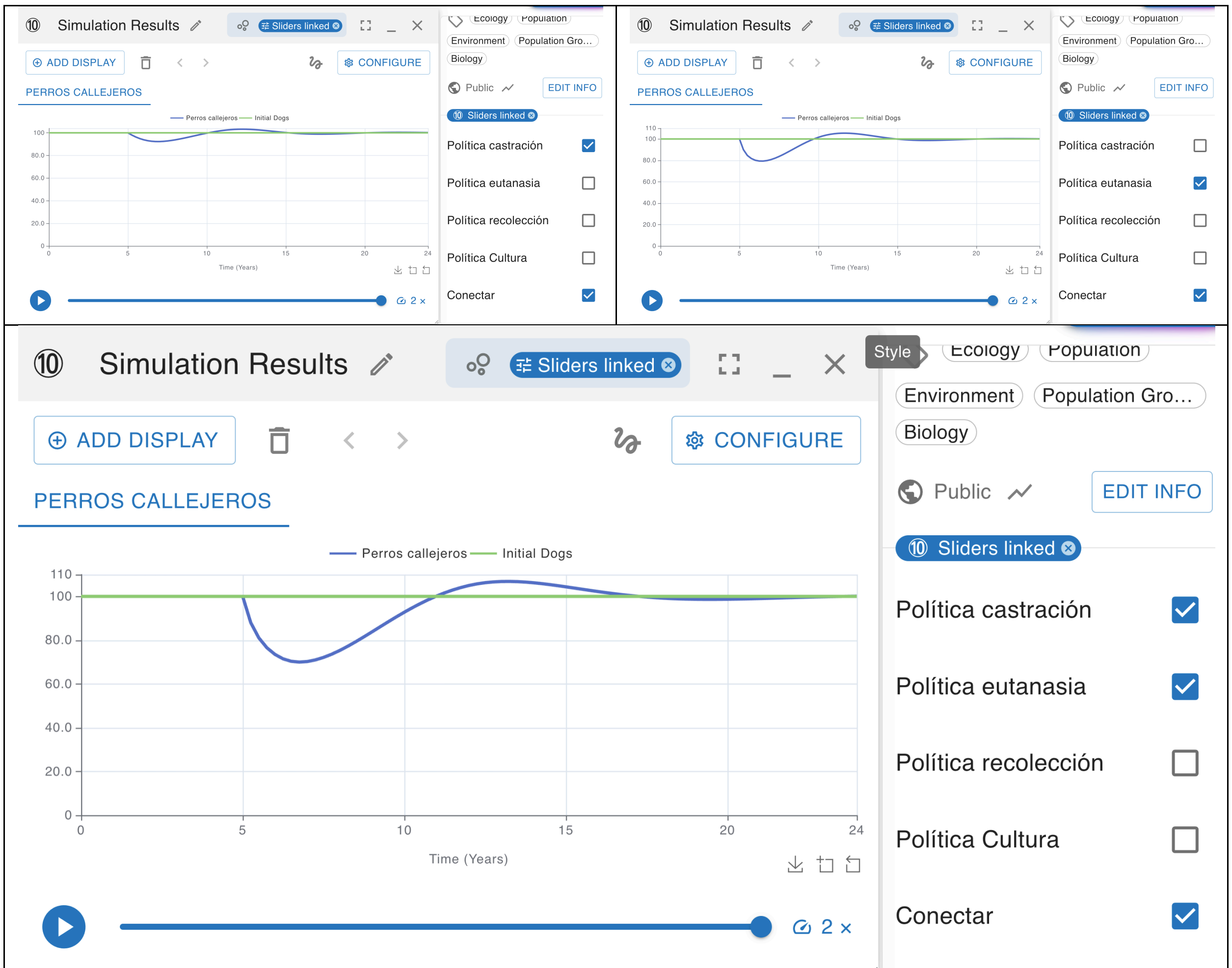

Figure 15: Scenario 2 – Immediate effects, no sustainability.

Spaying/neutering and euthanasia temporarily reduce the population, but the system reverts if root causes aren't addressed.

🟢 Scenario 3: Structural Policies – Waste Collection and Generation Reduction

- ✅ **Purpose**: To evaluate the effects of addressing latent, systemic causes.
- 🔁 **Sub-Scenarios**:
  - Waste Collection Only → Moderate improvement.
  - Generation Reduction Only → Deeper, gradual impact.
  - Both Together → Strongest, most sustainable results.
- 📈 **Expected Outcome**: Long-term reduction of the stray population by limiting food availability and restoring system balance.

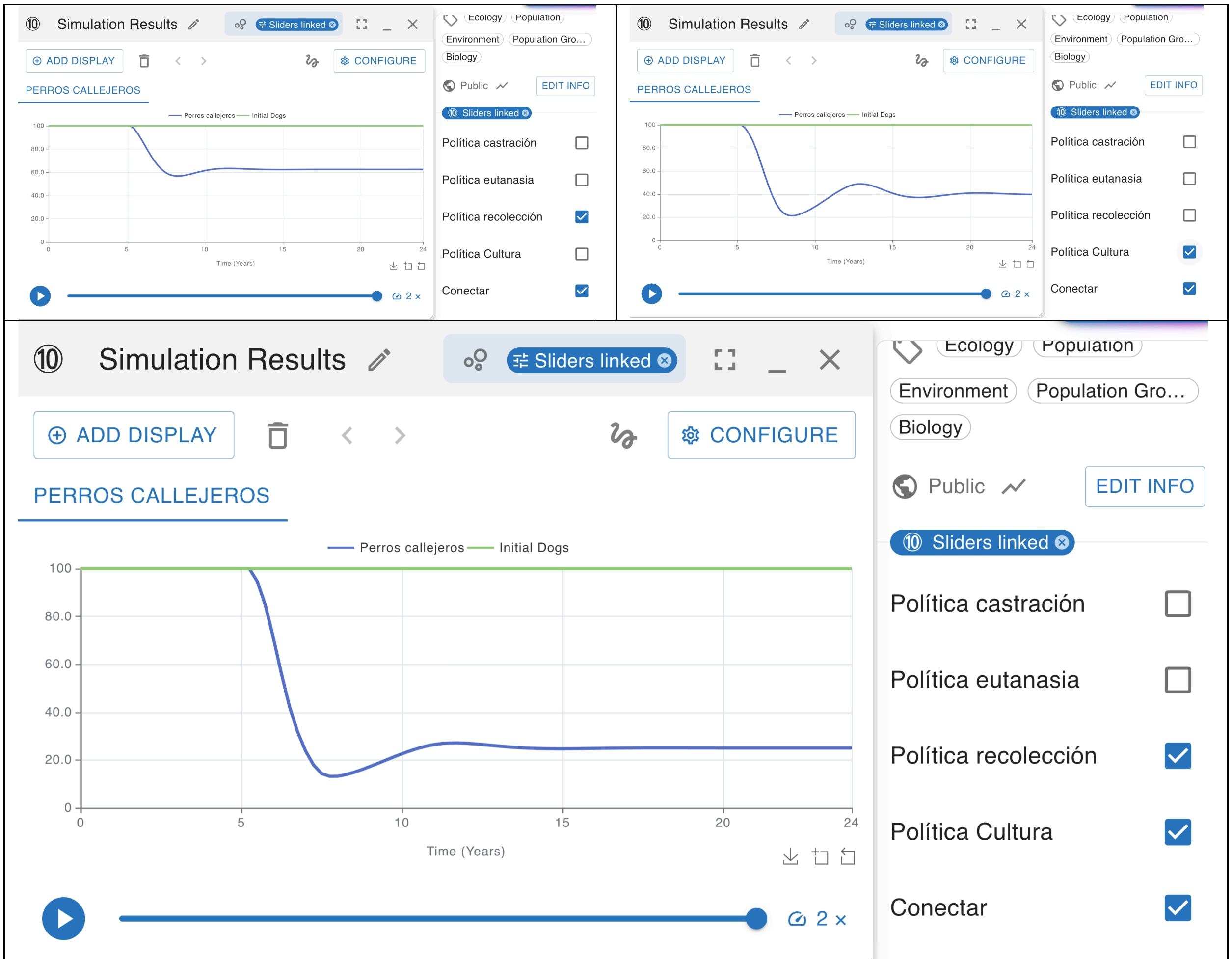

Figure 16: Scenario 3 – Root-level transformation.

Policies targeting the latent structure (waste collection and reduced food waste generation) deliver sustainable results by addressing underlying causes.

🔴 Scenario 4: All Policies Combined

- ✅ **Purpose**: To assess whether structural (latent) policies alone are sufficient, or whether short-term manifest interventions are also required—as often seen in real-world practices.
- ❓ **Guiding Question**: Is it enough to act on the root causes alone, or must we also manage symptoms in parallel for real-world effectiveness?

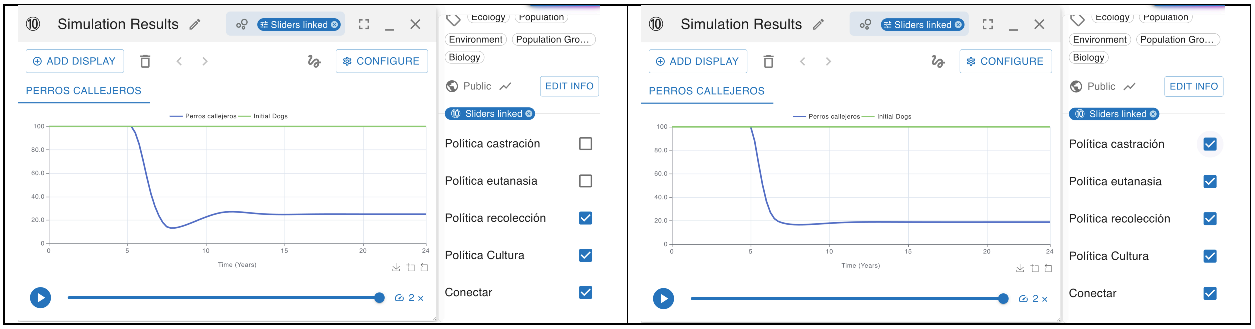

Figure 17: Scenario 4 – Full intervention.

The combination of all policies shows that only those targeting the latent structure ensure sustainability. Neutering and euthanasia may enhance short-term results, but cannot replace deep structural change.

📌 Expected Conclusion

1. **Visible structures create pressure, but not solutions.**
   Acting solely on visible symptoms—like the current population of stray dogs—might provide temporary relief, but it doesn't change the deeper root causes of the problem.
2. **The latent structure holds the true leverage point.**
   Managing food waste—through cultural change and improved waste collection logistics—offers long-term, scalable, and sustainable solutions.
3. **System dynamics models reveal what intuition often ignores.**
   Only by simulating the system's invisible interactions can we anticipate the real impact of policies and avoid the common trap of treating symptoms instead of causes.
4. **Implementing any of the four policies involves significant investments.**
   It makes little sense to allocate large budgets to sterilization or euthanasia if the structural causes of the problem remain untouched. Latent-structure solutions cost the same or less and deliver better long-term returns.
5. **This model isn't just about dogs.**
   It's a living metaphor for how systems behave in businesses, cities, and culture. Ignoring the invisible is funding failure. Transforming the structure is how we build a resilient future.

Conclusion

This model of stray dog population dynamics is not just about urban animals—it is a **systemic archetype** that mirrors challenges across businesses, governments, and cultures. Divided into **manifest structures** (like neutering and euthanasia) and **latent structures** (like food waste habits and collection efficiency), it reveals a key insight: **sustainable solutions rarely lie in what is visible.**

In the world of business, this plays out in organizations that try to manage symptoms—layoffs, cost-cutting, motivational campaigns—without addressing the deeper, often invisible structures: outdated mental models, toxic cultures, misaligned incentives, or broken feedback systems.

The model raises essential strategic questions:

- Where are we intervening?
- Are we solving root causes or masking effects?
- Are we building sustainable systems or merely buying time?

When companies focus solely on visible structures, they may achieve short-term improvements. But those willing to shift culture, decision logic, and the invisible flows of power, information, and motivation are the ones who generate **lasting transformation**.

This model serves as an educational tool—but more importantly, it's a **mirror**. A mirror reflecting not just how a canine population behaves, but how **our organizations, our cities, and our systems function**—and how they could change.

References

Stray dogs, street gangs and terrorists: manifestations of a latent capacity support system. (revised April 13, 2009) by Khalid Saeed