

**2025 ICM**  
**Problem E: Making Room for Agriculture**



**Situation:**

A forest filled with towering trees and diverse wildlife was cleared to make way for agriculture. The once-thriving ecosystem, home to birds, insects, and animals, vanished and in its place, rows of crops were planted. The land began to change – soil that once held the richness of nature became depleted, and pests began to invade the crops. To combat this, the farmers turned to chemicals, but the balance of the land was disrupted. With this shift, the intricate web of life that had flourished in the forest was broken, and a new, human-driven cycle of agriculture took its place creating a new food web based on an agricultural ecosystem. In an established agricultural system, there are bats, birds and other species but to get there, the ecosystem must mature.

**Model and Analyze:**

In places throughout the world, scenarios like this one occur. As a member of the Consideration of Mature Agricultural Practices (COMAP) group, you have been asked to construct a model to track habitat change from forest-to-farm. Your supervisor has given your team the lead in determining how a **converted forest area** can change over time as the ecosystem evolves along with accompanying agricultural choices. Your supervisor wants the analysis to include both *natural processes* as well as *human decisions*. Therefore, you should start your model of a newly cleared converted forest area ecosystem and track the model through stages of change due to the changes in species in addition to the many impacts of farming practices. You can make assumptions to build a situation of forest-to-farm, or you can use data and information from stages in a real historic sample of this kind of evolution. You may want to consider the following in your analysis:

**- Natural Processes**

- **Model the current ecosystem.** Build a basic **food web** model for this new **agricultural ecosystem** which recently took the place of a heavily forested region. Include the producers and the consumers as well as the impact of the **agriculture cycle** and its seasonality which changes the system dynamics over time. Consider the impact of herbicides and pesticides by including the effects of chemical use on plant health, insect populations, **bat** and bird populations as well as the ecosystem stability.

- **Incorporate the reemergence of species.** Over time, the **edge habitats** begin to mature which brings back the species native to the area. As species return, the agricultural ecosystem changes due to the interactions of these species with the current environment. Incorporate two different species into the model to determine the impacts.

- **Human Decisions**

- **Removal of herbicide.** As the ecosystem matures, farmers may attempt to remove some of the chemical dependence.
  - If the herbicide was removed, report on the stability of the ecosystem in terms of the producers and consumers.
  - Bring the ecosystem back into balance by incorporating bats into the food web model. Model bats as insectivores that control pest populations and as pollinators that support plant reproduction. Consider how bats' interactions with insects, plants, and predators influence the overall stability of the ecosystem. Identify another species that can provide benefits to bring the ecosystem back into balance and compare the impacts.
- **Go green?** Analyze the implications of a farmer considering organic farming methods. Consideration should be given to different scenarios with varying components of organic farming. Demonstrate the impact on the ecosystem as a whole and to the individual components. Discuss aspects such as pest control, crop health, plant reproduction, biodiversity, long-term sustainability and cost effectiveness.

**Share Your Insights**

- Include a one-page letter to a farmer who is exploring organic farming practices.
- Advise the farmer on what methods should be employed including discussions on economic trade-offs as well as sustainability. Help the farmer determine strategies that could be implemented to balance costs and sustainability and how advocating for certain policies could incentivize this type of conservation in agriculture.

Your PDF solution of no more than 25 total pages should include:

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- One-page letter.
- References list.
- [AI Use Report](#) (If used does not count toward the 25-page limit.)

**Note:** There is no specific required minimum page length for a complete ICM submission. You may use up to 25 total pages for all your solution work and any additional information you want to include (for example: drawings, diagrams, calculations, tables). Partial solutions are accepted. We permit the careful use of AI such as ChatGPT, although it is not necessary to create a solution

to this problem. If you choose to utilize a generative AI, you must follow the [COMAP AI use policy](#). This will result in an additional AI use report that you must add to the end of your PDF solution file and does not count toward the 25 total page limit for your solution.

### [NEW MCM/ICM: Online Submission Process](#)

The purpose of this article is to assist and guide students and advisors participating in MCM/ICM. In the article, COMAP, provides information about the new online submission process using the new online submission page <https://forms.comap.org/241335097294056>. You will need your team's control number, advisor id number and your problem choice to complete your submission.

### Glossary

**Converted Forest Area:** An area where a forest was cleared so the land could be used for agriculture.

**Food Web:** A food web is a complex network of feeding relationships between organisms in an ecosystem. It depicts how energy and nutrients flow and interact through different levels of the ecosystem from producers (plants) to many levels of consumers (herbivores, carnivores, and omnivores) and then decomposers (fungi, bacteria). It is critical to understanding how ecosystems function and maintain balance.

- *Primary producers:* Plants and crops.
- *Primary consumers:* Herbivores that feed on plants.
- *Secondary consumers:* Insectivores and other predators that consume herbivores.
- *Tertiary consumers:* Larger predators that feed on secondary consumers.
- *Decomposers:* Fungi, bacteria and earthworms that break down the dead and bring nutrients back into the ecosystem.

**Agricultural Ecosystem:** Agricultural ecosystems are complex, with various species interacting in food webs that support both ecological balance and crop production. Human interventions such as the use of herbicides, pesticides, and fertilizers are commonly employed to increase crop yields, but these can have negative ecological and economic consequences. Bats provide valuable ecosystem services, such as pest control and pollination, which contribute to agricultural sustainability.

**Agriculture Cycle:** The agriculture cycle refers to the stages of agricultural production from planting and growing crops to harvesting and preparing them for consumption or sale. Key stages are:

- *Preparation of Soil:* Farmers prepare the land by tilling, removing weeds, and adding fertilizers. The soil is critical as it serves as the medium in which crops grow and supports the food web.
- *Planting/Seeding:* Farmers plant seeds or seedlings at the appropriate time for the crops to grow. This is dependent on weather, temperature and soil conditions.

- *Growth Phase:* Crops grow through photosynthesis as they take in carbon dioxide from the air, water from the soil, and energy from the sun. This is part of the energy flow in the food web as the plants are the producers and the herbivores may interact with them.
- *Fertilization and Pest Control:* Fertilizers can be applied to ensure crops have enough nutrients to grow. Pesticides or organic methods may be used to control pests that can damage crops. These methods may impact the natural food webs by affecting certain species, which can have cascading effects on the ecosystem.
- *Harvesting:* When the crops reach maturity, they are harvested which removes the plants from within the food web temporarily.
- *Post-Harvest Processing:* Crops can be processed into food products, packaged and transported to markets which connects the agricultural cycle with the broader economy.
- *Consumption:* Finally, the crops are consumed by humans and animals or converted into other products.
- *Decomposition:* Any organic waste may decompose, returning nutrients to the soil.

**Bats:** As an example of a species beneficial to agricultural food webs, we introduce the importance of bats. They play a critical role in maintaining healthy ecosystems, which in turn provides significant economic benefits. This includes pest control, pollination and seed dispersal, ecosystem balance, guano as fertilizer, ecotourism, as well as reduced health care cost.

**Edge Habitats:** The habitats in the area around a field used for agriculture that serves as a buffer between the field and the surrounding ecosystem(s).