# Context Document: Agriculture Best Management Practices Ecosystem Service Logic Model

Project: GEMS
http://bit.ly/NI-GEMS

Ecosystem Service Logic Models (ESLMs) are conceptual models that summarize the effects of an intervention, such as a habitat restoration project, on the ecological and social systems. Each model links changes in biophysical systems caused by an intervention to measurable socioeconomic, human well-being, and ecological outcomes. ESLMs assume that the restoration is successful and include all potentially significant outcomes for the intervention; not all outcomes will be relevant to each individual project, depending on location and environmental conditions.

The direction of an outcome (whether the restoration will have a positive or negative influence) often depends on the specific situation or is unclear due to multiple links (arrows) leading into an outcome that may have opposite effects. Thus, language like "increased" or "decreased" is not included in the models. These models are often used to consider management with or without an intervention or to compare different interventions.

This context document includes additional information about the restoration approach and details about some of the relationships in the agriculture best management practices (BMPs) ESLM. It also includes a list of the references used to develop the ESLM and names of experts with whom we spoke to refine the model.

## Agriculture Best Management Practices Description and Use in the Gulf of Mexico

Best management practices for agriculture include a suite of management techniques intended to reduce nutrients and other pollution types from agricultural lands reaching waterways: cover crops, conservation tillage, riparian buffers, livestock exclusion from streams, and improved fertilizer management. Many of these approaches are mentioned in the RESTORE planning framework and have been implemented through RESTORE-funded projects along the Gulf Coast. Often, these projects aim to promote a set of water-quality focused BMPs on all agricultural land within a focal area (e.g., Apalachicola Watershed Agriculture Water Quality Improvement, Weeks Bay Nutrient Reduction).

Constructed wetlands can remove pollutants from agricultural runoff and aquaculture runoff. The effects of constructed wetlands in agricultural systems would be similar to those shown in the Wastewater Treatment or Constructed Wetlands ESLM. There may be some differences due to the types and amounts of pollutants in the runoff water and the location of the treatment wetland. Only a few examples of these types of projects in the Gulf of Mexico coastal region were found (Millhollon et al. 2009, Tilley et al. 2002).

## External Factors That Influence Restoration Success

Adoption of BMPs by managers of agricultural land can be challenging and prevent projects from achieving their goals. Some of this hesitation may be due to comfort levels with current practices and perceived costs of implementing new practices. While many BMPs do have an up-front cost, this can often be offset by increased yield or quality of crop or livestock production, as shown in the ESLM.

## Model Notes and Clarifications

**Cover crops and yields:** The relationship between cover crops and crop production is driven by the influence of cover crops on soil nutrients and pest populations. Legume cover crops in particular enhance soil nitrogen, which can increase main crop yields, but this effect varies by the type of main crop grown. Cover crops also reduce weed populations directly through competition and can reduce insect pest populations as well, depending on cover crop species and management. Cover crops can also contribute to decreased main crop growth due to increased seedling disease, but this effect can be avoided through management practices.

**Conservation tillage and yields:** Compared to conventional tillage, no-till systems increase soil water and organic matter content and reduce nitrogen loss, benefiting crops. Some studies also show that crops grown in no-till systems are more resilient to drought and high temperatures than conventionally tilled crops, leading to higher yields.

**Riparian buffers and yields:** Because riparian buffers require removing land from production, they are likely to reduce total yield. In a survey of farmers' views of riparian buffers, some producers also reported that adding buffers to small, irregularly shaped fields can leave an area too small for viable production, and would therefore decrease yields even more if implemented in these areas.

**Livestock exclusion and health:** Preventing livestock from accessing streams has been shown to correlate with increased weight gain or milk production (in beef and dairy operations, respectively) and decreased rates of disease in livestock.

**Fertilizer management:** The improved fertilizer management section of the ESLM was adapted from a model of nutrient management practices on Canadian croplands. An evidence library for that model includes additional details and literature sources for the links related to fertilizer management.

**Rotational grazing (excluded):** This practice is encouraged in some parts of the Gulf Coast and is sometimes described as improving infiltration and providing better nutrition for cattle. However, several large review papers have concluded that there is no consistent difference between rotational and conventional grazing in terms of forage quality, cattle production, or environmental effects (Briske et al. 2008, Briske et al. 2011). The debate about the effects of rotational grazing is likely driven by differences in management effectiveness rather than the actual grazing system.

## Experts Consulted

Brian Koch, Texas State Soil and Water Conservation Board

Sonny Vela, USDA-NRCS

Additional experts consulted for the nutrient management practices model, listed in its evidence library.

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