A QUALITATIVE ASSESSMENT MODEL FOR EVALUATING ECOSYSTEM SERVICES IN AGRICULTURE

CDFA ENVIRONMENTAL FARMING ACT SCIENCE ADVISORY PANEL

INTRODUCTION

California agriculture provides many social and financial benefits both nationally and internationally. Growers and ranchers use many innovative methods to balance food and fiber production with environmental stewardship. One example is the transition from flood irrigation of fields for crop production to micro-sprinkler or drip irrigation methods which has led to better plant nutrient management, and in many cases, water conservation. A qualitative assessment model is useful to illustrate the net environmental benefits from management practices, implemented by growers and ranchers, to enhance the environment.

For many years, growers and ranchers in California have voluntarily implemented management practices on their fields that enhance the environment. However, little has been done formally by CDFA, to promote, recognize and incentivize growers for their environmental stewardship efforts. The Environmental Farming Act Science Advisory Panel (EFA SAP), formed in August 2011 by the Secretary of CDFA, was established to document, study, recognize, and incentivize environmental stewardship efforts on farms and ranches.[1] The scientific panel established three specific objectives to meet this goal. They are:

1. Establish a definition for management practices that contributes to improving the net environmental quality of farms and ranchers
2. Create a qualitative and educational assessment model to effectively show and communicate the benefits of using management practices to enhance the environment on agricultural fields
3. Identify specific incentives to support pilot projects which will support, and potentially lead to the establishment of larger projects on farms and ranches

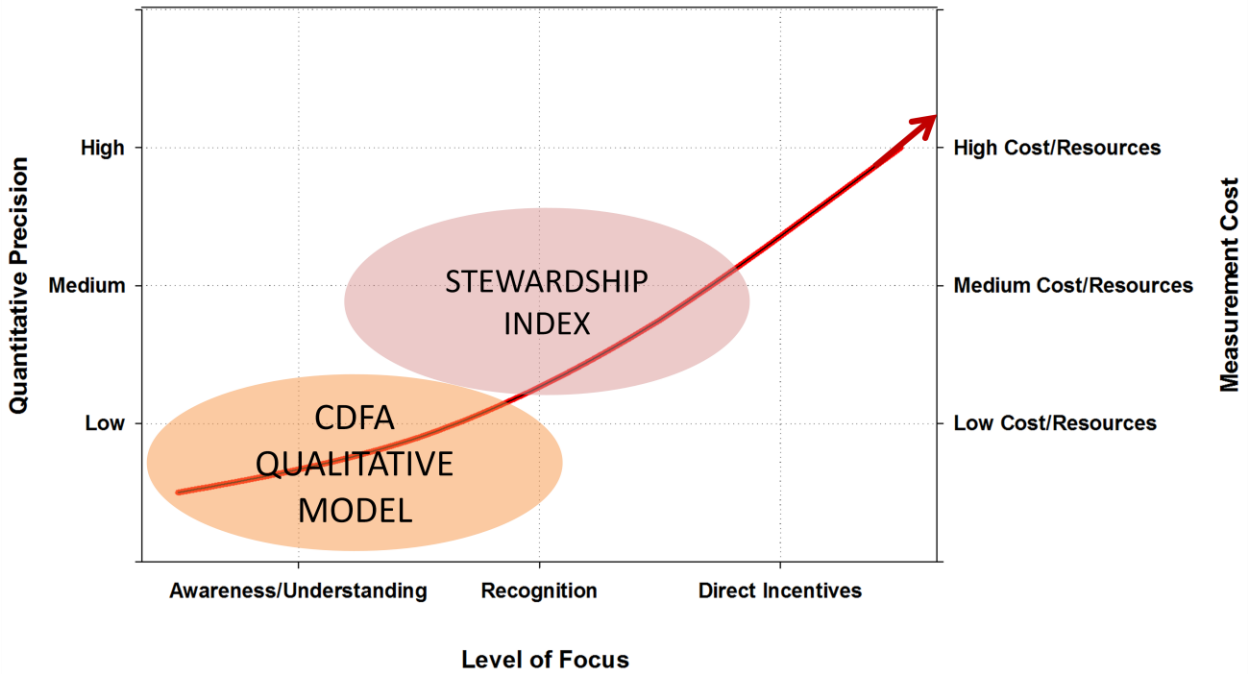
The first objective is complete.[2] EFA SAP recognized that management practices that contribute to improving the net environmental quality can be classified as Ecosystem Services. Ecosystem Services are defined as "the multiple benefits we gain from farming and ranching including crop and livestock production. In addition to maintaining valuable open space and wildlife habitat, the management decisions and conservation practices of farmers and ranchers also enhance environmental quality, provide recreational opportunities and offer social benefits." The definition is supported by several categories.[3] Objectives 2 and 3 involve the development of a qualitative assessment model and identifying monetary and non-monetary incentives to growers. These three objectives will help further the implementation of management practices to enhance the environment in agriculture. This document discusses the qualitative assessment model developed by CDFA with the assistance of the science panel, methods associated with it, and expected current and future use.

QUALITATIVE ASSESSMENT MODEL

A range of qualitative and quantitative assessment models have been developed to estimate the net environmental benefits of management practices implemented on farms and ranches. Examples include the Stewardship Index for Specialty Crops (http://www.stewardshipindex.org/), the Sustainable Winegrowing Program (http://www.sustainablewinegrowing.org/swpcertification.php), and Nutrient Tracking Tool (http://nn.tarleton.edu/NTTWebARS/). These assessment models vary in their degree of precision (Figure 1). However, a qualitative assessment model that is formulated to specifically educate and promote awareness of management practices that contribute to the net environmental quality of a farm and ranch does not exist for California agriculture. EFA SAP has developed a qualitative assessment model to communicate the benefits of management practices that contribute to the net environmental quality and potential social benefits of agricultural working landscape. The differences between the quantitative and qualitative assessment models are presented in Figure 1. Figure 1 shows that the level of quantitative precision and measurement cost associated with the CDFA qualitative

assessment model is less than the quantitative Stewardship Index model. The CDFA qualitative assessment model is expected to be further developed through integration into more quantitative models such as the Sustainable Winegrowing Program. Any future developments in the model will result in new versions with a different level of quantitative precision. The intended audience, methodologies, and opportunities for use of the assessment model are provided below.

Figure 1. The relationship between the CDFA Qualitative model and more quantitative models such as the Stewardship Index for Specialty Crops.



AUDIENCE

The CDFA qualitative assessment model will be used to inform and educate a wide audience, including the general public, policy makers, regulators, farmers and ranchers, and other stakeholders about the net social, economic, and environmental benefits, including tradeoffs, of implemented management practices. This assessment model will be used primarily by CDFA to fulfill the objectives noted above.

METHODOLOGY

The assessment model uses categories, established as part of the Ecosystem Services definition (http://www.cdfa.ca.gov/EnvironmentalStewardship/Ecosystem Services.html) to show changes in an agricultural system. The different categories were identified in the process of developing the Ecosystem Services definition and support the definition; "the multiple benefits we gain from farming and ranching including crop and livestock production." The science panel and CDFA recognize that not all activities in agriculture have positive effects on the environment and may include tradeoffs. Tradeoffs are net negative impacts that occur for a specific category as a result of implementing a management practice in a different category. In general the category of Food will be green since agriculture is the main economic sector that provides this Ecosystem Service (e.g., fruit, vegetable and livestock production). The different categories compiled as part of the definition and utilized in Figure 2 (visual representation of the CDFA qualitative assessment model) are listed below.

- Wildlife Habitats – Encourage resident and transient wildlife populations (Costanza et al., 1997; Stallman, 2011; Jedlicka et al., 2011).
  There are two subcategories that were identified for this category.

        - Terrestrial habitat benefits
        - Aquatic habitat benefits
    - Nutrient Cycling - Food storage in soil for plant and microbial use (Costanza et al., 1997; Stallman, 2011; Sandhur et al., 2010)
    - Food, fiber, fuel production - Sustains a growing population (Costanza et al., 1997; Stallman, 2011; Sandhur et al., 2010; Swinton et al., 2007)
    - Recreational opportunities – Provides activities for society (Costanza et al., 1997; Stallman, 2011; Sandhur et al., 2010)
    - Soil structure, formation, and fertility - Enhances the soil environment, promotes organic matter buildup and carbon sequestration, and prevent disturbances (Stallman, 2011; Sandhur et al., 2010; Swinton et al., 2007; Dale and Polasky, 2007)
    - Biodiversity conservation (Stallman, 2011; Swinton et al., 2007).
      There are two subcategories that were identified for this category.
        - Terrestrial biodiversity
        - Aquatic biodiversity
    - Water cycling - Maintains soil moisture and regulates water movement (Stallman, 2011)
    - Atmospheric gas/climate regulation which maintains chemical composition (Sandhur et al., 2010)
    - Water Quality - Reduces salinity and organic/inorganic constituents in surface and ground water
    - Pest control – Alternative management practices use control pests and weeds. (Sandhur et al., 2010; Jedlicka et al., 2011; Dale and Polasky, 2007)
    - Pollination services - Contributes to fruit, nut and vegetable production (Swinton et al., 2007; Kremen et al., 2004; Kremen et al., 2007)

Expert opinion and a peer review process will be used to establish directional color changes from red and orange to green (net positive impact) or from green to orange to red (net negative impact or tradeoff). Directional changes from one color to another color for the categories will be made by experts knowledgeable on ecosystem services and agriculture in CDFA. Color changes will be supported by scientific literature as well, when available and applicable.

The CDFA qualitative assessment model uses a three-color scheme to represent the status of each category associated with the Ecosystem Services definition. A detailed description of the color scheme is described in the caption of Figure 2. EFA SAP examined several potential options for this model. They include showing positive ecosystem services on working landscapes using a plus/minus scale (Millennium Ecosystem assessment, 2005 – page 19), a multidirectional arrow based system with a three color scheme (Millennium Ecosystem assessment, 2005 – page 16), and several other industry based assessment models such as Field to Market. The three color scheme for the CDFA assessment model, in combination with the categories, was chosen because the benefits of management practices on the net environmental quality of a farm or ranch can be easily communicated to broad audience.

There are several scenarios where the colors of the assessment model can change depending on the implemented practice. For example, the green status can change to orange first and then red if there is a net negative impact to a category as a result of a tradeoff.

OPPORTUNITIES FOR USE

The CDFA qualitative assessment model is intended to be used for two different scenarios:

1. A “before” and “after” scenario – in this scenario, using case studies of already completed conservation work, the “after” scenario will be developed first. The “after” scenario refers to a conservation practice that has been applied to a farm or ranch. The net environmental benefits to agriculture will be noted. Using this “after” scenario as a positive baseline, the “before” scenario can be established. This “before” scenario includes listing how the ecosystem services categories were impacted before the conservation measures were implemented on the working landscape.

By creating a “before” and “after” scenario, a visual representation of the net environmental benefits can be clearly observed and understood.

2. Future projections scenario – in this scenario, the model is designed to establish what the current status of the working landscape is and then projecting into the future what the landscape will look like “if” specific practices were implemented. Using the future projection scenario with the qualitative model will help a broad audience understand the benefits of management practices that may need to occur to move the working landscape from the existing status, with potentially negative environmental impacts, to one that offers more net beneficial “Ecosystem Services” (previously defined).

The model example presented in Figure 2 uses a “before” and “after” scenario to highlight the net environmental benefits of management practices used to enhance water cycling, wildlife habitats (aquatic) and nutrient cycling categories. The case study used for this example is the Agricultural Water Enhancement Program; Northern San Joaquin River water Quality Project (AWEP, 2011). The case study describes how NRCS funds were used to improve the environmental quality of impaired waterways from sediment, nutrients, and pesticides. Specific irrigation and farming practices, such as micro-irrigation systems and tail water recirculation systems, were implemented on 5,229 acres by growers to meet requirements of the Central Valley Irrigated Lands Regulatory Program. The completed work resulted in two, of three, waterways meeting state standards for pesticides and toxicity. The assessment model shows the qualitative benefits of the management practices that improved the net environmental quality in Northern San Joaquin River waterways. Color changes from red to green are noted from the “before” to “after” scenarios in Figure 2 for water cycling as a result of micro-sprinkler irrigation which significantly reduce surface water runoff compared to furrow or flood irrigation, aquatic wildlife habitat improvements by meeting state regulatory requirements for pesticides in waterways, and nutrient cycling from the development of tail water recirculation systems and holding ponds.

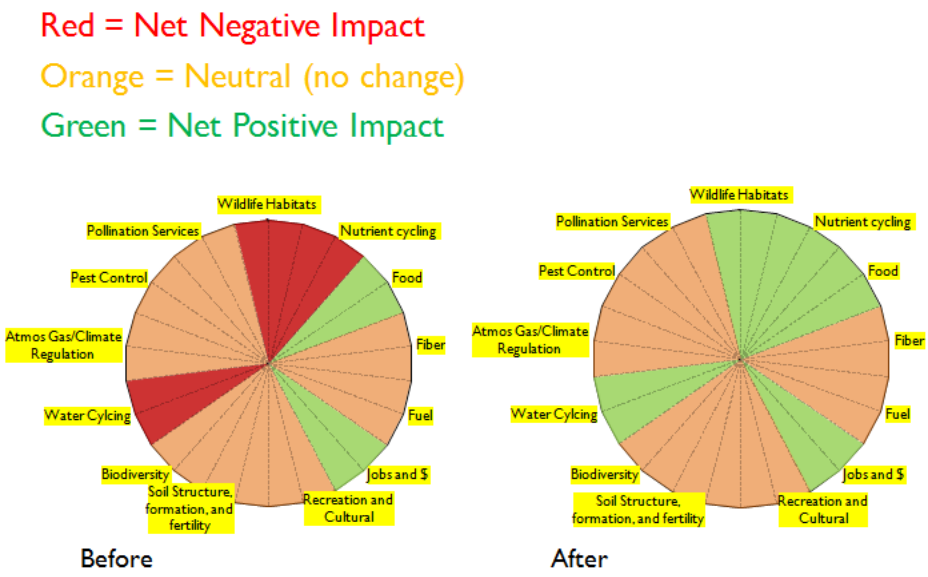


Figure 2. The qualitative assessment model developed by CDFA. The orange colored regions are net neutral status and can remain unchanged in each scenario or change to green as a result of applied conservation measures. Red color regions are net negative status of a category where the current environmental baseline is impacted or where ecosystem services have not been implemented. Green color regions are net positive impacts on the environmental quality of a farm or ranch.

Explanation boxes will be provided next to each category to describe the reason for a color change. Such descriptive explanations are designed to eliminate overly subjective assessments being made of an ecosystem service. Caution should be taken in moving a category from a specific color to another color. If there is insufficient justification for this transition, conservative predictions should be made in changing

colors (e.g., red to orange as opposed to red to green change). Conservative measures should be used in all cases if uncertainty in the data/information exists.

A list of NRCS practices will be included as part of the CDFA qualitative assessment model. Referencing these practices and applying them to case studies or future scenarios will be beneficial. NRCS practices are the acceptable "standard" for conservation measures. They have been extensively vetted to show conservation benefits over time. Their use in agriculture and reference to the ecosystems services in the qualitative assessment model is extremely beneficial. With each change in category color, the identification and listing of specific NRCS practices will be useful.

REFERENCES

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