An Environmental Win-Win: Building Solar-Pollinator Habitat

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Introduction

Solar energy is expected to contribute 14% of all the energy used in the United States of America by 2030 (USDOE, 2012). With a large spatial footprint of up to 6.2 ha land per MW of solar facility, a large land area will be required in order to meet the goal (USEIA, 2015). In addition to the land requirement, it is important to explore the ways to reduce the impacts on land in cost effective way.

The creation and maintenance of pollinator habitat at renewable energy development could mitigate ecological impacts of energy development and improve the landscape compatibility of these developments. Habitats development at solar sites could be a win-win for local community and energy developer because:

1) For **local community**, it could increase the overall welfare through increased agricultural production, biodiversity benefits, and social values (e.g., public relations, ecotourism).

2) For **energy developer**, it could reduce operations and maintenance (O&M) costs

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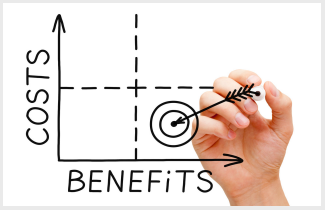
Benefits of pollinators

- The United State has the world's largest market for pollination service for honey bees (Marini *et al.*, 2015).
- The value of pollination service in the US is estimate up to US $14.6 billion (Summary Table)

Author, Year	Year	Method	Crops	Economic Value/Temporal Trend
Calderone, 2012	1992-2009	Production Function, Dependence Ratio	All (directly and indirectly depended)	Diminution in pollinator population could threaten crop production in US
Morse & Calderone, 2000	1989	Production Function, Dependence Ratio	All	9.3 billion in US dollar
	2000		All	14.6 billion in US dollar
	1996-1998		Almond	959.2 million in US dollar
Losey & Vaughan, 2006	2001-2003	Production Function, Dependence Ratio	All	>= 57 billion in US dollar
Southwick & Southwick, 1992	1986	Production Function	Almond	847 million in US dollar
Greenleaf & Kremen, 2006	2002	Field Trails	Sunflower	431,000 in US dollar
Isaacs & Kirk (2010)	2008	Field Trails	Blueberry	65 209 per ha
Kremen, 2001	1999-2000	Field Trails	Watermelon	$1116 per flower per day
			Cantaloupe	$30 per flower per day
			Eggplant	$93 per flower per day
			Strawberry	$344 per flower per day

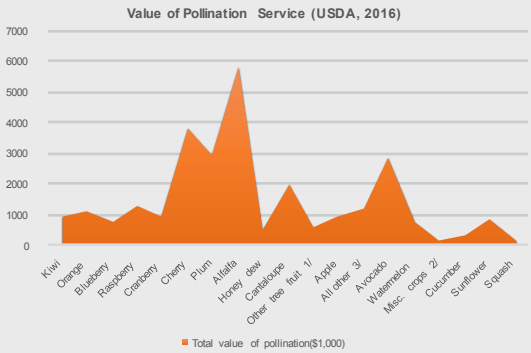
Method

The cost-and-benefit analysis of building pollination habitat at local level provides information for developing pollinator habitats.



Local Farmers Benefit from Reduced Pollination Service Fee

- The pollination service provided by a beekeeper for placing his hives on a farm may be valued in terms of honey, or in terms of money fee, or a combination of both.
- In the past decades, the declining pollinators has threatened to some extent food security. Pollination market has been increasing. In California, alone farmers pay a rent of $167/bee colony for pollinating their almond crops.
- Local farmer would benefit from pollination habitat created at energy companies.
- Table below gives information on price per colony and total value of pollination for main crops (except Almond)



Companies Benefit from Reduced Vegetation Management Fee

- Based on farm-level financial model developed by STRIPs research paper (Tyndall, *et al.*, 2013) the present value of total cost (PVC) for contour prairie strip is:

$$PVC = PV^{SP} + PV^{E} + PV^{M} + PV^{OC} \quad (1)$$

- Then we use capital recovery factor (CRF) to convert the discounted value into equivalent annual cost (EAC), where n is the number of year and i is the real discount rate.

$$EAC = PVC \times CRF \quad (2)$$

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1} \quad (3)$$

- Cost of building pollination habitat is approximately U.S. $76.5 per acre per year.
- Cost of traditional management practice (mowing or herbicide application) varies from US $ 147 to $179 per acres per year

Summary

The creation and maintenance of pollinator habitat at renewable energy sites could mitigate ecological impacts of energy development and improve the landscape compatibility. The value of pollination service in the US is estimate up to US $14.6 billion. Cost of building pollination habitat is approximately U.S. $76.5 per acre per year. Cost of traditional management practice (mowing or herbicide application) varies from US $ 147 to $179 per acre per year. While these are the preliminary estimates of the cost and benefits (and a rigorous exercise is required for robust estimation of the benefits and costs, the difference in costs of vegetation management under traditional vegetation management vis a vis pollinator habitat warrant a potential for the energy company to cut the costs and increase the revenue.

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