The influence of solar panels on local hydrology and plant ecology

Elnaz Hassanpour, Ziru Liu, Chad Higgins

Department of Biological and Ecological Engineering

A33B-0158

Abstract

Photo voltaic solar energy is a clean source of energy with much lower carbon footprint than other sources. However, the vast land requirements of solar energy arrays may make installation impractical when available land is better suited for other purposes. The goal of this research was to investigate changes to the environmental physics, grass production, and grass species diversification under solar panels in an active pasture. To this end, different land characteristics were studied observationally including the length of the growing season, the greenness, the production per acre), and the environmental physical processes.

Figure (1) Rabbit Hills solar array, OSU campus Oregon

Experimental setup

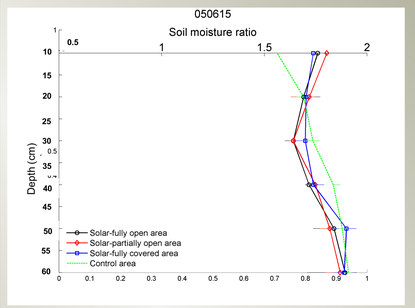
The observation setup involved two microclimatological stations that were installed in the Rabbit Hills solar array, OSU campus Oregon; one in and open area and the other in the solar array. The soil moisture was quantified using a complimentary system of electronic sensors and neutron probe readings. Soil moisture beneath the solar array was significantly higher.

Figure (2)Control area set up

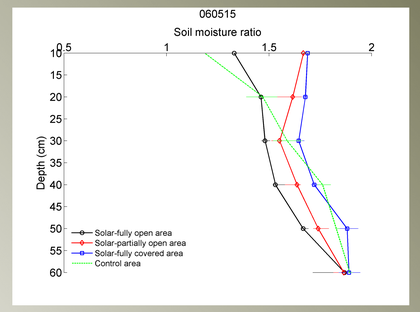
Figure(3) Solar area set up

Figure (4) Neutron probe

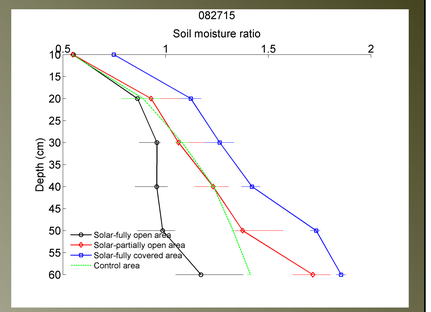
Soil moisture



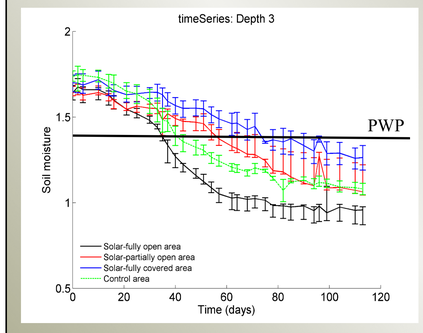
Plot (1) Soil moisture profile by Neutron probe in May 06, 2015



Plot (2) Soil moisture profile by Neutron probe in June 06, 2015



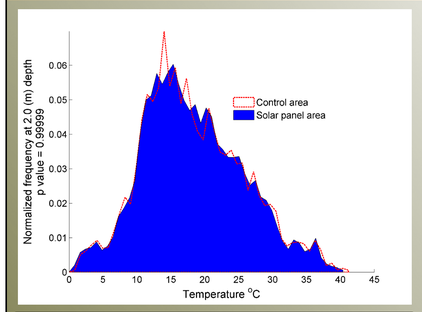
Plot (3) Soil moisture profile by Neutron probe in Aug 06, 2015



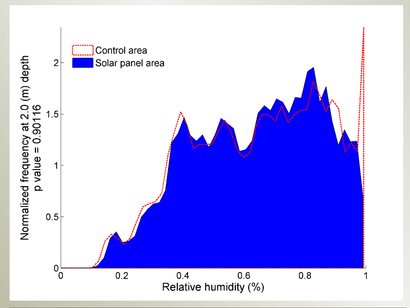
Plot (4)Time series of soil moistures of May, June Jul, Aug 2015

Soil moisture measurements were taken at four locations in study area in April, June, July and August of summer 2015. Plot (1) depicts the soil moisture in April that is saturated and there is no significant differences. As days pass and soil becomes drier in June, the profiles separate. The driest places are the control, and the fully open area within the solar array. Plot (3) is the last day measurements that shows a clear separation of lines. Plot (3) shows the average soil moisture ratio varies dramatically inside the solar panel array by location. Time series in plot (4) shows the occurrence of wilting point at clayey soil that in fully open area is about 40 days sooner than totally covered area.

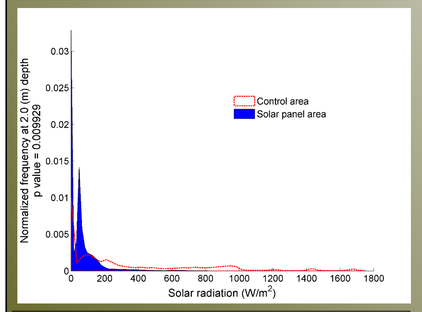
Weather station



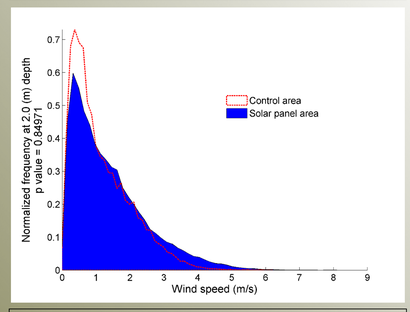
Plot (5)Time series of soil moistures of May, June Jul, Aug 2015



Plot (6)Time series of soil moistures of May, June Jul, Aug 2015



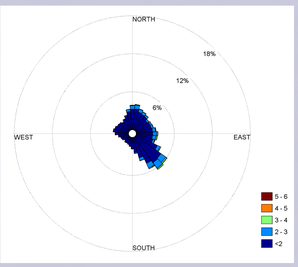
Plot (7)Time series of soil moistures of May, June Jul, Aug 2015



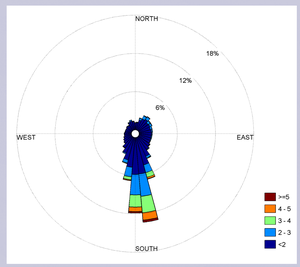
Plot (8)Time series of soil moistures of May, June Jul, Aug 2015

Two weather station collected data: one in control area and one inside the solar panel array. These stations measured the temperature, relative humidity, solar radiation and wind speed. Devices were installed at four heights 0.5, 1.2, 2, and 2.3 meters. These plots are selected from the devices at two meters. Plot (4) shows there is no significant difference between temperature inside and control area. We see the same results for relative humidity in plot (6). But, solar radiation and wind speed have significant differences.

Wind direction



Plot (9) wind speed at control area @ 2m



Plot (10) wind speed in solar panel @ 2m

Wind direction is south west in control area that is 50 meters away from solar panels and it changes the direction to south inside solar panels.

Vegetation monitoring

Grass type		Control area (%)	Inside solar panels (%)
Hordeum		25	10
Agrostis		20	30
Alopecurus		7	50
Schedonorus		9	5
Bromus		22	5
Calamagrostis		6	-
Cirsium		10.5	-
Dactylis		0.5	-

Table(1) grass classification inside solar panel and control area, Red bolded grasses are the most nutritious ones

References

Bazilian, M., H. Rogner, et al. (2011). "Considering the energy, water and food nexus: Towards an integrated modelling approach." Energy Policy **39**(12): 7896-7906.

Marrou, H., J. Wéry, et al. (2013). "Productivity and radiation use efficiency of lettuces grown in the partial shade of photovoltaic panels." European Journal of Agronomy **44**: 54-66.

Contact address

Weniger Hall, Room 635, Corvallis, OR, 97331
hassanpe@onid.oregonstate.edu
http://newag.bee.oregonstate.edu/