Co-location of Solar Power Production and Agriculture to Mitigate Financial Risk

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Background

The Willamette River Basin (WRB) is home to Oregon's most fertile agricultural land as well as more than 60% of Oregon's population. Accompanied by growing food and energy demands, this has made decisions over how to allocate land difficult. **Agrivoltaic systems (AVS)** are a means to simultaneously produce energy from solar panels while growing crops underneath and between the panels.

The co-location of power and agricultural production also **diversifies income** for the land owner and can **mitigate weather risk**. Both power developers and farmers face several risks:

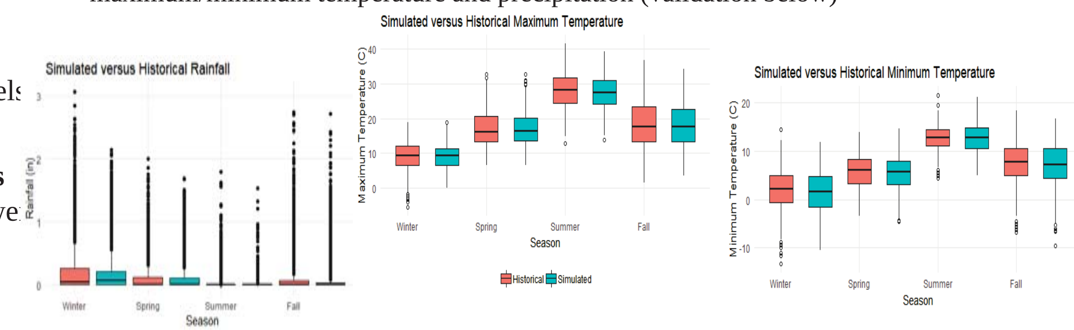
- **Production risk**: variability in irradiation, precipitation, and temperature impact yields
- **Price risk**: for developers in the WRB, energy prices are largely tied to weather and hydropower conditions. While has often been reduced with Power Purchase Agreements (PPAs) these are becoming less common

Key Questions for Advisory Team

1. Solar developers are facing less favorable Power Purchase Agreements (PPAs); what are other price risk mitigation tools and could agriculture provide a secondary source of income?
2. Would farmers' revenues benefit from the inclusion of solar power – which has higher revenues but also larger variability? Could a land lease contract based on a weather index reduce weather risk?
3. Is the limit on maximum acres in AVS only to protect agriculture, or are there other reasons to limit the spread of solar developments?
4. What logistical obstacles do solar developers and farmers face in co-locating power and food production? Trust, reliability, maintenance, etc.? Are these obstacles only surmountable when the developer and the farmer are the same party?

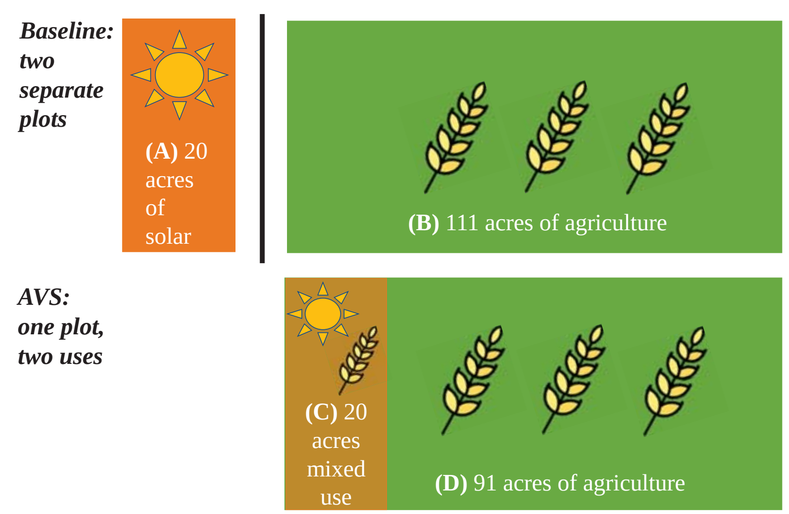
Model Description

Weather inputs from CAPOW! layered with statistical models to generate maximum/minimum temperature and precipitation (validation below)

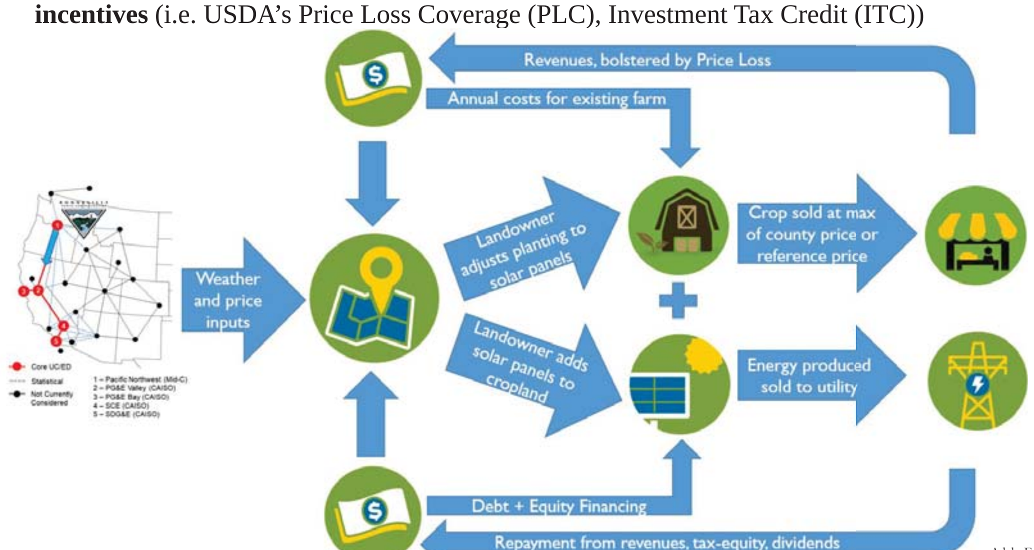


Agricultural yields: Food & Agriculture Organization's biophysical crop model **(AquaCrop).** Parameters in AVS modified to account for microclimate under panels

Solar power production is modelled by a thermodynamic model created and validated based on the OSU solar field (Adeh et al., 2019). **Price data from CAPOW!**



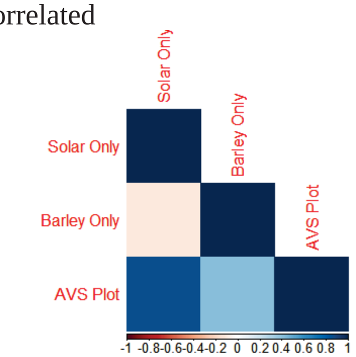
Financial analysis: runs of 30 years (solar lifetime) with annual costs, revenues, and **incentives** (i.e. USDA's Price Loss Coverage (PLC), Investment Tax Credit (ITC))



Preliminary Findings

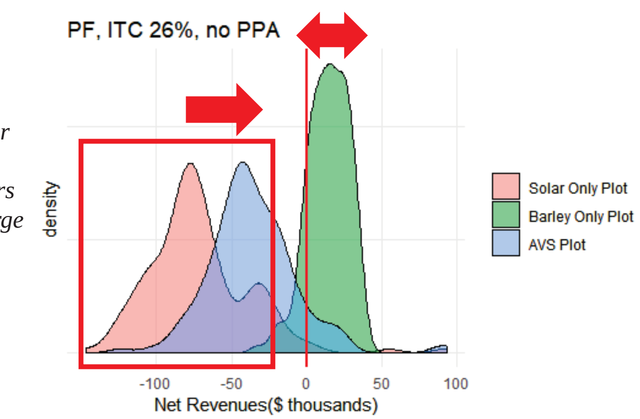
Assuming 50-50 debt to equity ratio, USDA PLC, and ITC at 26%

1. Solar power and agriculture are **uncorrelated** and, at times, negatively correlated

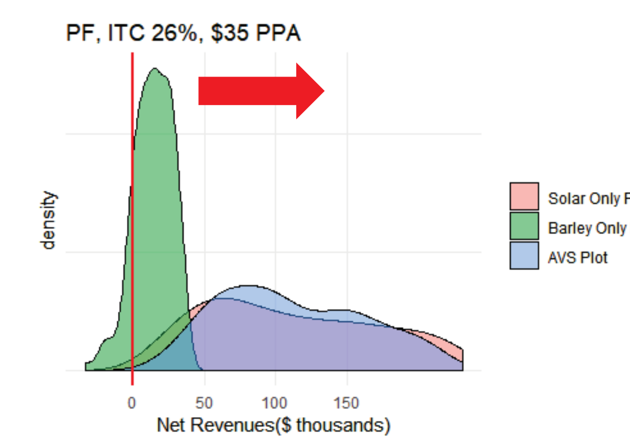


2. Shifting from a solar only plot (A) to an agrivoltaic system (C+D) **increases average net revenues in all scenarios, but especially in the absence of a PPA** (pictured below)

Mean net revenues increase from a solar only plot to an AVS plot, whereas farmers experience much large variability



3. Shifting from an agriculture only plot (B) to an agrivoltaic system (C+D) **can increases risk of negative net revenue,** but depending on the value of the PPA, can offer the **opportunity to increase average net revenues** (as in a scenario with a high PPA)



Adeh, E. H., Good, S. P., Calaf, M., & Higgins, C. W. (2019). Solar pV power potential is Greatest over croplands. Scientific reports, 9(1), 1-6.

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