Decision-Support Models

Rodrigo Ulloa - Hector Flores - Rene Villalobos

Model Features

- Agronomic Potential
- Planning Tools
  - Strategic Planning
  - Feasibility Assessment
  - Coordination: Participants Allocation and Negotiation

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Why modeling?

- Mathematical Representation
- Solve Complex Problems
- Results Interpretability
- Assist Decision Making Processes
- Analyze Problem Characteristics
- Allows to simulate and predict interactions and results

HELP THE ARTICULATION OF A SUPPLY CHAIN

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Agronomic Potential

- Production Yields
- Consider climate conditions
- Identify Complementary Regions
- Allocate resources and production schedules

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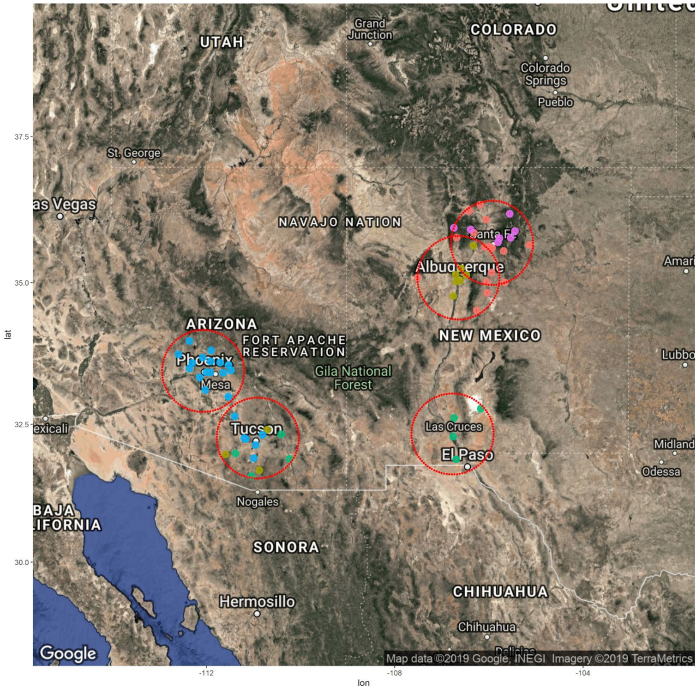
Agronomic Potential: Regions Clustering

Cluster Identification:

- 5 Cities : 50 miles radius
- 64 weather stations
- 5 Clusters



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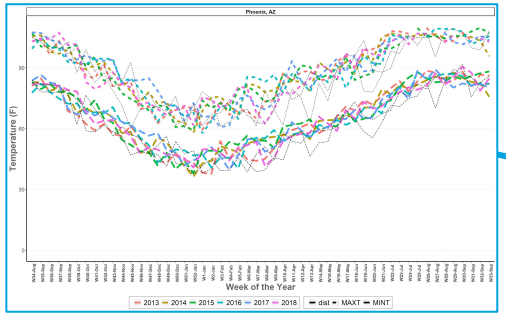
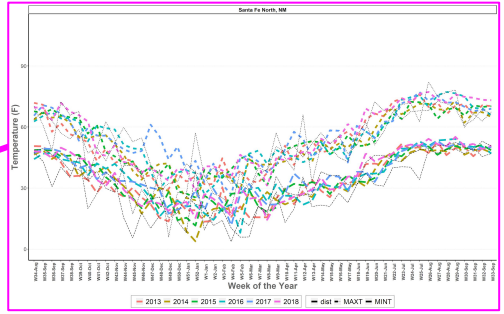
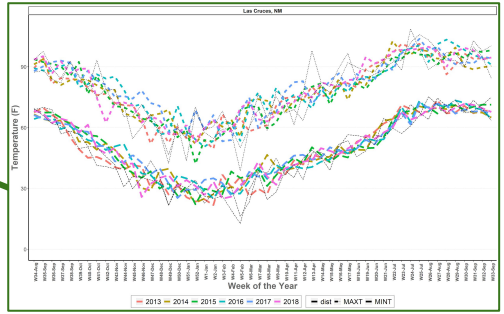
Agronomic Potential: Complementary Weather







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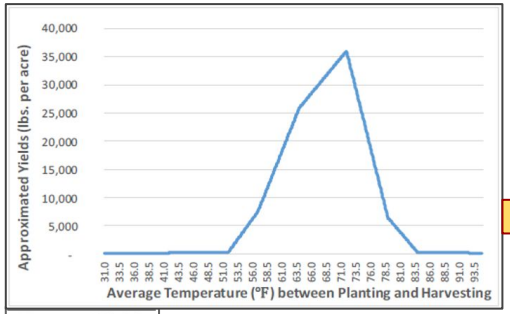
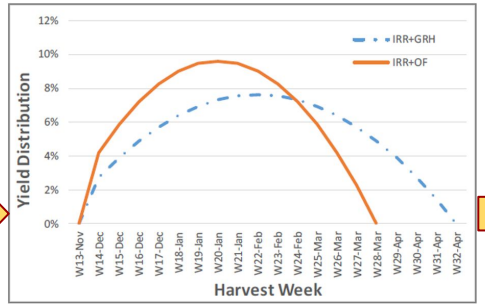
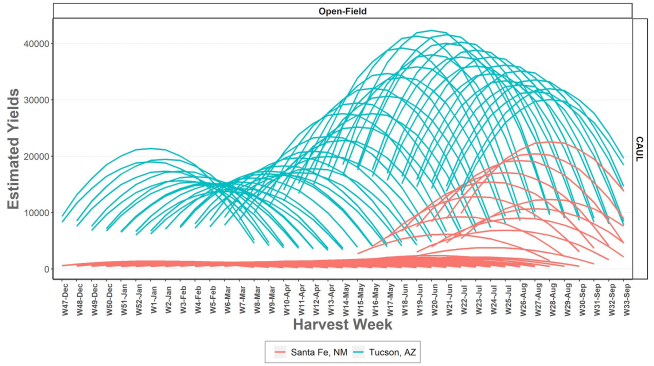
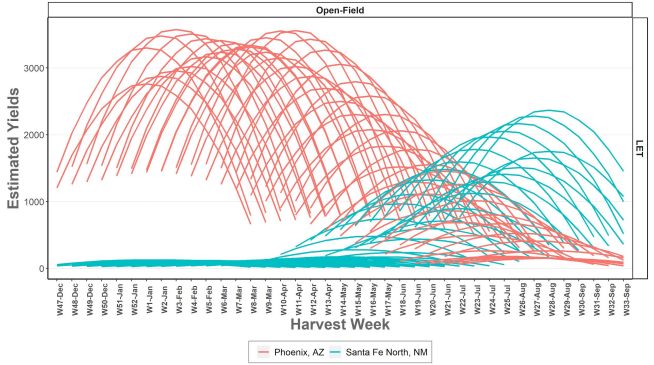
Agronomic Potential: Yield Prediction



Temp (°F)	Yield (lbs)
52	36
57	7,560
64	25,920
72	36,000
75	6,480
84	36







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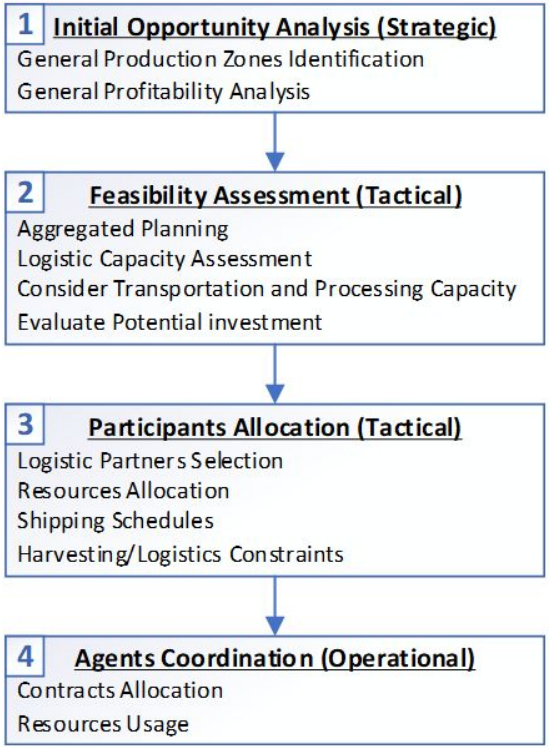
Planning Tools

- Opportunity Articulation Process
  - Identification
  - Allocation
  - Deployment

- Decision-Support Tools



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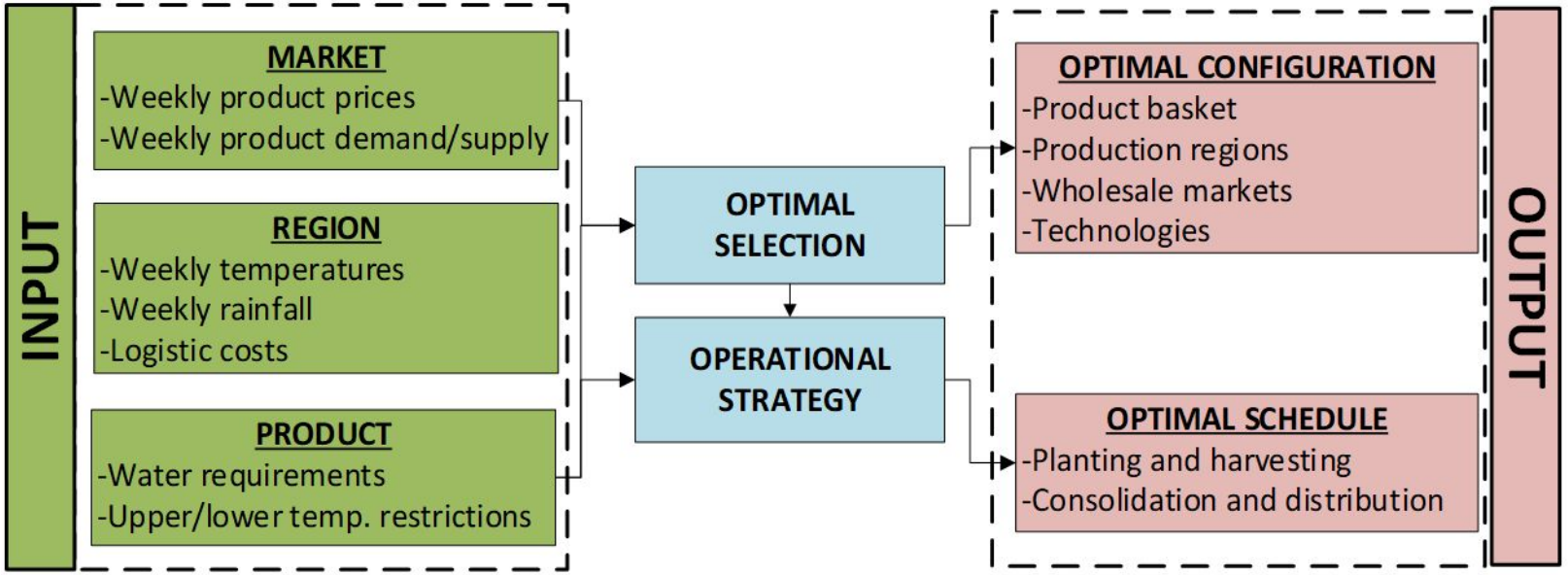
Planning Tools: Strategic Planning

- Initial Profitability Assessment
- Match Market Opportunity with Production Potential
- Allocate resources: investment and tasks
- Allocate demand to Regions

Planning Tools: Strategic Planning



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Planning Tools: Strategic Planning

Maximize:

$$\sum_{jdmt_h tc:t=t_h+LT_{dc}} SDC_{jdcm}^{t_h,t} * Mpr_{jc}^{t}$$
$$- \sum_{jqzt_h t} Invw_{jz}^{t_h t} * Cw_z - \sum_{jqdt_h t} Invd_{jd}^{t_h t} * Cd_d$$
$$- \sum_{t_p t_h z} WA_z^{t_p t_h} * Cwater_z - \sum_{z,t_h,j} Pack_{z,j}^{t_h} * Ccase_j$$
$$- \sum_{jdmt_h tc} SDC_{jdcm}^{t_h,t} * CTDC_{dcm} - \sum_{jzt_h td} SZD_{jzdm}^{t_h,t} * CTZD_{zd}$$
$$- \sum_{jft_h tz:f\in F(z)} SLZ_{jfz}^{t_h,t} * CTLZ_z$$
$$- \sum_{z} AddWCap_z$$

Decision Variables:

B_{jfu}: $\begin{cases} 1 & \text{if technology } u \text{ is made available to farmer } f \in F(z) \text{ for crop } j \\ 0 & \text{otherwise} \end{cases}$

$X_{jfu}^{t_p}$: Yield of crop j by farmer f when planted at t_p using technology u

$MicroHarv_{jz}^{t_h}$: Amount of crop j harvested during t_h within zone z

$Pack_{jz}^{t_p,t_h}$: Amount of crop j packaged during t_h planted in t_p within zone z

$WA_z^{t_p,t_h}$: Additional water allocated to region z between t_p and t_h *(if rainfaill is not enough)*

$SLZ_{ifz}^{t_h,t}$: Qty. shipped of crop j from farmer m *to* region z at time t harvested at t_h

Subject to:

$$\sum_{juf:f\in F(z)} B_{jfu} * Ctech_{uz} \le Cavail$$

$$\sum_{t_p} X_{jfu}^{t_p} \le Land_f * B_{jfu} \qquad \forall f, j \in J, u \in U$$

$$\sum_{uf} B_{juf} \le CropOper_j \qquad \forall j$$

$$X_{jfu}^{t_p} \le maxl_j * B_{jfu} \qquad \forall t_p \in T_p, j, f, u$$

$$\sum_{t_p u} X_{jfu}^{t_p} \ge minl_j * \sum_{u} B_{jfu} \qquad \forall t_p, j, f$$

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Planning Tools: Feasibility Assessment

- Consider available resources: growers, logistics and transportation
- Preliminar profitability assessment
- Assess new investment allocation

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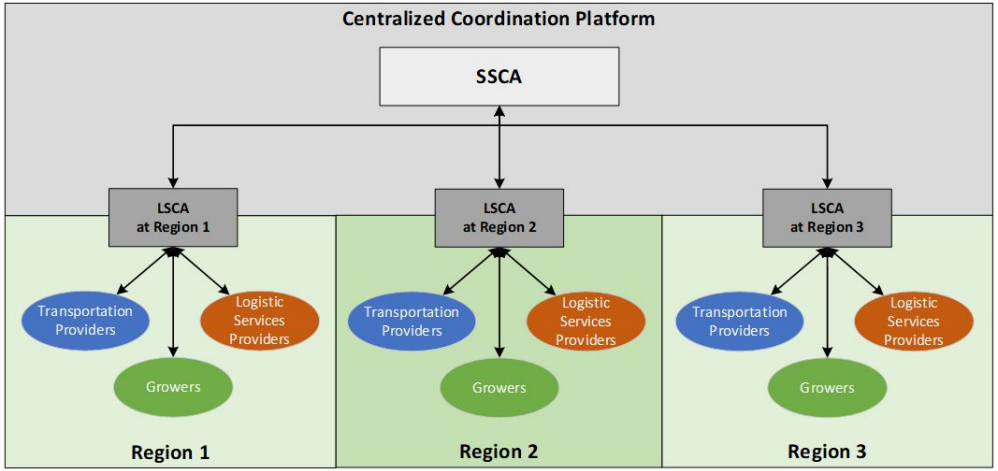
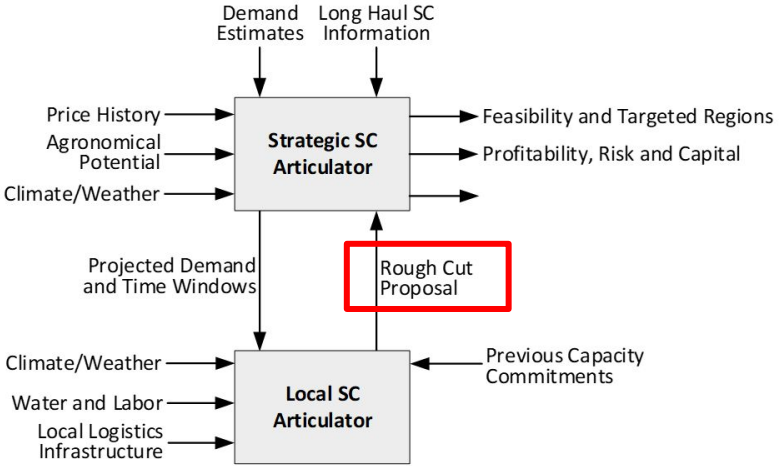
Planning Tools: Feasibility Assessment





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Planning Tools: Coordination

- Assign production and logistic tasks
- Define Planting and Harvesting Decisions (schedule)
- Allocate contracts:
  - Prices, volumes, time windows, cost subsidy, etc.
- Ensures the collaboration for the duration of the opportunity

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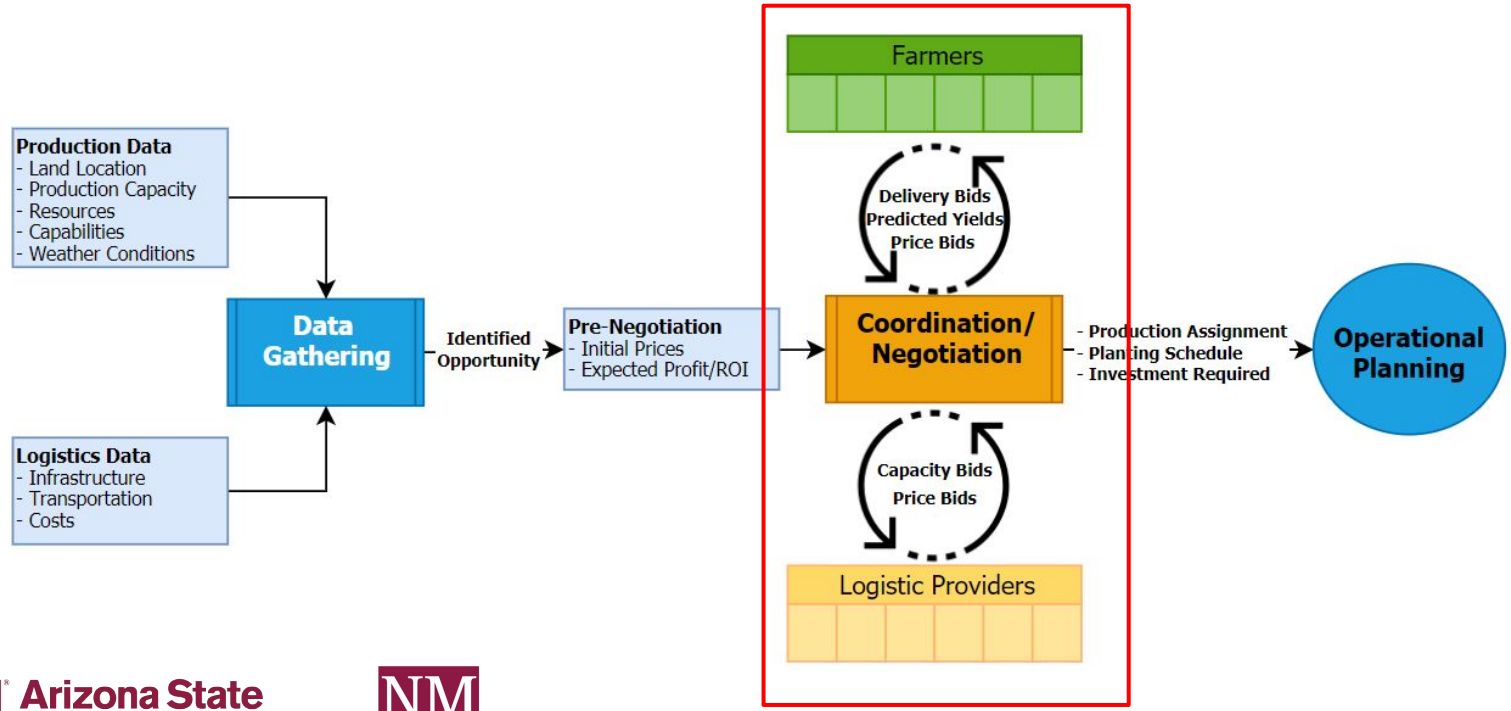
Planning Tools: Coordination



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How to make this work?

- Understand the **system** to be modeled
- Input parameters
- Validate the models
- Validate results

Interact with industry: producers, logistics and consumers

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Decision-Support Models

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