Coordinating Growers for Effective Collaboration

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Outline

- The Coordination Problem
- Coordination Benefits
- Guidelines to Achieve Coordination
- Modeling Approach

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The Coordination Problem

After the centralized solution is obtained, the next step is to get the required participants (growers) to participate:

Issues to overcome:

Growers' preferences, risk involved, innovative plans, operational coordination, aggregation, contract definition, etc.

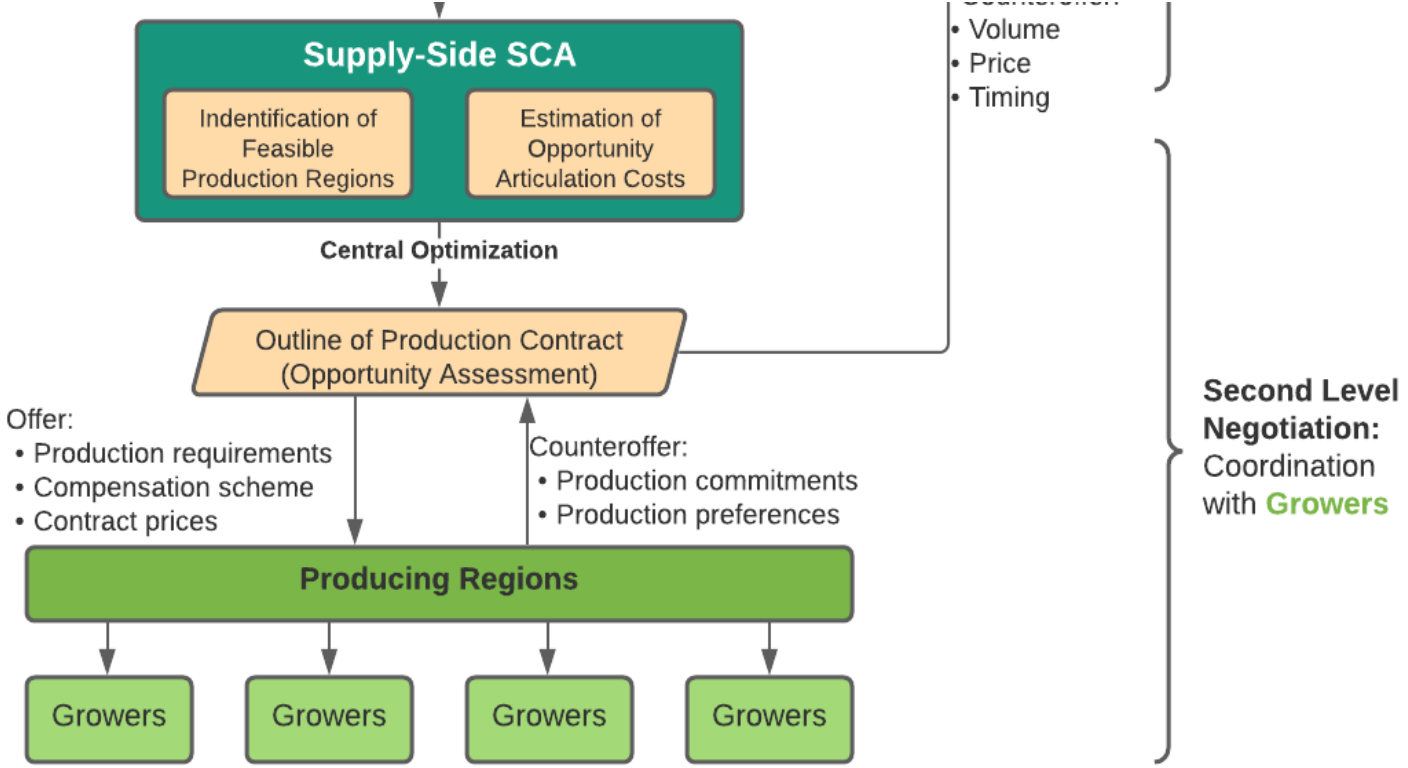
Coordination Benefits

Growers' working under a collaborative scenario:

- Access to **capital and financing**
- Access to **shared resources**
- Lower risk (**risk pooling**)
- Lock in **volume contracts**
- Possibility of **produce aggregation**

and others…

Guidelines to Achieve Coordination



Problem Definition

Negotiation between the **SC Articulator** and the **buyers**:

*“How to get a contract that can be transformed into a procurement plan to **benefit all participants**?”*

Has to consider:

- Consumer needs
- Production capacity
- SC Coordination needs

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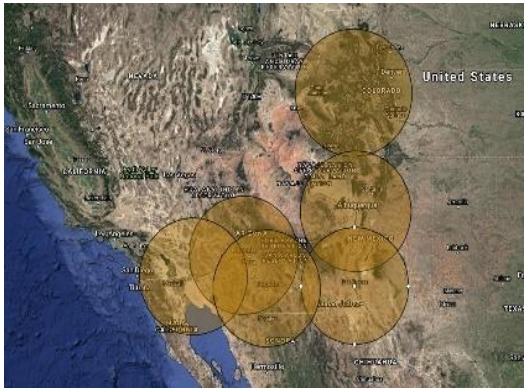
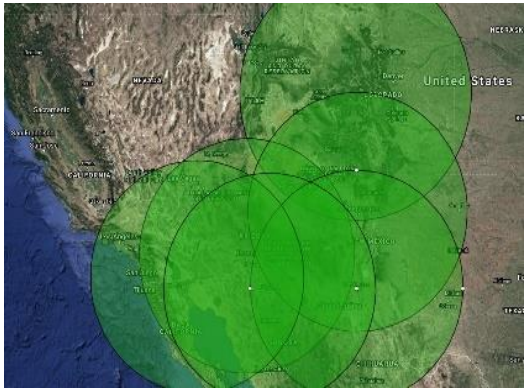
Problem Definition

Example: Buyer's preference for **local production**

Local Produce Definition:
within **50 miles**



Local Produce Definition:
within **100 miles**



Local Produce Definition:
within **150 miles**

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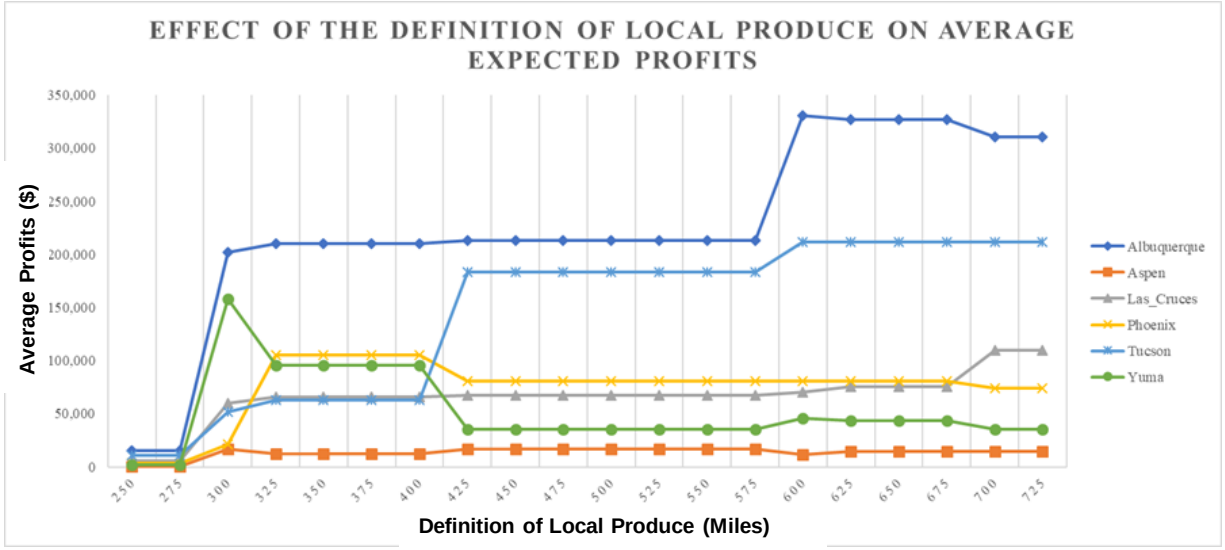
Problem Definition

Example: A buyer looking to procure **local produce**

market: Las Vegas, NV



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Problem Definition

Negotiation between the **SC Articulator** and the **growers**:

"How to offer a contract appealing to the growers?"

Has to consider:

- Production capacity and restrictions
- Expected Profits and Risk Level

Contract Accepted if $U(contract) > U(no\ contract)$

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Modeling Approach

From a grower's perspective, the options under the SCA's offer are

Not to accept the contract	Negotiate the contract	Accept the contract
- Free to produce - Subject to yields variability - Subject to market variability - Less risk control	- Indicate their needs and preferences - Could result in a better solution	- Commit to production plan - Subject to yields variability - Market variability reduced via contract - More risk control/management

$$\boldsymbol{Risk\ Adjusted\ Profit\ (RAP) =}$$

Utility function for the growers considering the risk-level that they can withstand

Estimates the attractiveness of a contract given its expected profits and risk (variability)

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Modeling Approach

Mathematical formulation using Linear Programing to maximize the Risk Adjusted Profit (RAP)

$$\textbf{maximize R}\boldsymbol{AP}: \qquad \boldsymbol{E[Profit] - \lambda * Risk}$$

Subject to:

- Available resources (land, capital, etc.)
- Agronomic potential (i.e.: crop budget and yields)
- Satisfy the demand (production or spot market)

$\boldsymbol{\lambda}$: Risk Aversion Parameter

Modeling Approach

With the use of planning models and historical information we can estimate the profits and benefits that different growers can expect.

Without coordination to supply a contract:

	No Coordination		
	E[Profit]	Std. Dev	Utility
Albuquerque, NM	$153,412	$22,802	$151,132
Aspen, CO	$ 30,787	$ 4,713	$ 30,316
Las Cruces, NM	$ 86,281	$ 7,635	$ 85,518
Phoenix, AZ	$ 64,248	$ 7,855	$ 63,462

Can the opportunity provide higher benefits?

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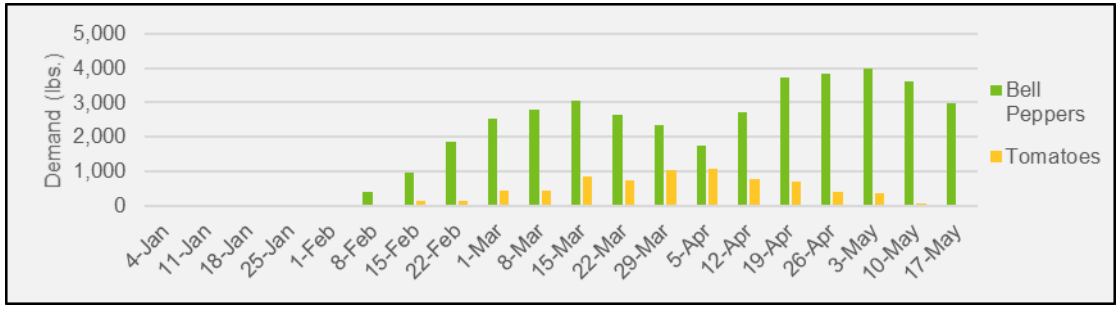
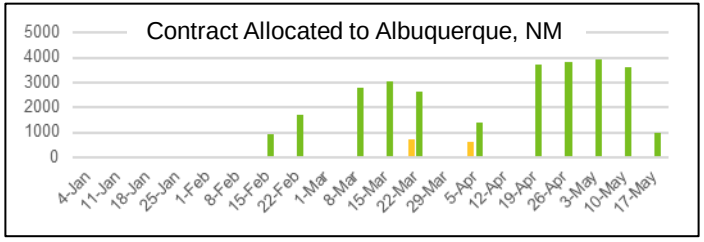
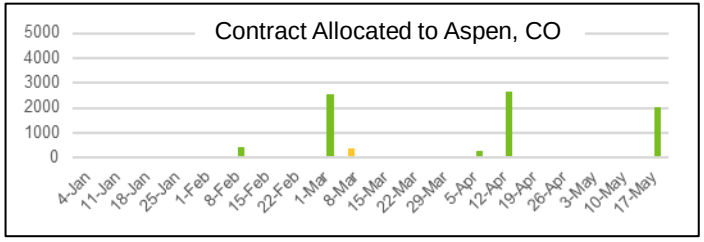
The Contract (an example)

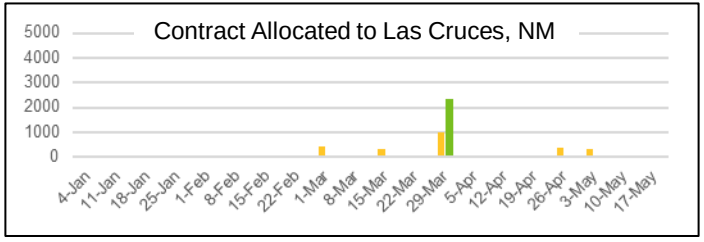
Original Contract:
(Buyer's Request)

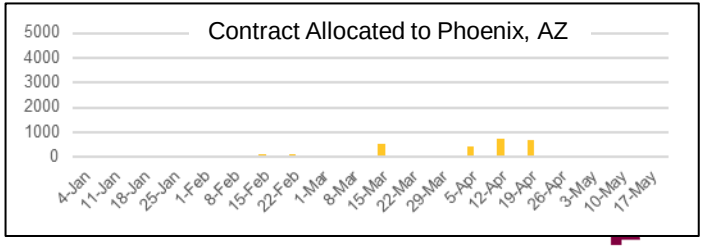


Contract Allocation









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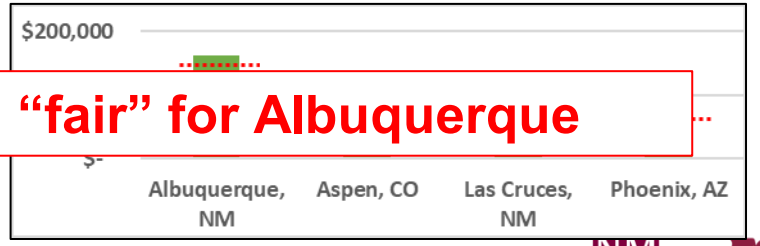
Modeling Approach

The extra revenue can be used to assist the coordination and make the opportunity appealing:

Example: Maximize the minimum RAP for a specific contract

	No Coordination			Coordination			Benefit of engaging
	E[Profit]	Std. Dev	Utility	Base	Extra	Total	
Albuquerque, NM	$153,412	$22,802	$151,132	$ 161,467	$ -	$ 161,467	$ 10,335
Aspen, CO	$ 30,787	$ 4,713	$ 30,316	$ 17,287	$ 21,211	$ 38,498	$ 8,182
Las Cruces, NM	$ 86,281	$ 7,635	$ 85,518	$ 90,892	$ 2,808	$ 93,700	$ 8,182
Phoenix, AZ	$ 64,248	$ 7,855	$ 63,462	$ 59,131	$ 12,513	$ 71,644	$ 8,182



Problem: This may not be "fair" for Albuquerque

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Participation of External Investment

- Assist new entrants who have no or little capital
- In order to reduce the risk, external investment can be considered
- An external investor would be an agent willing to invest capital in exchange of a return in profits
- Investors may have different risk aversion levels, allowing to take some of the risk away from the growers
- They must be compensated according to the risk they are taking

Conclusions

- These are preliminary models that still need some validations
- We need partners' collaboration to validate and review these models
- The advantages of participating in validation stages is to apply these models to partners operation, with their data
- Currently working on more robust profit allocation mechanisms
- Operational models will assist the operational execution of the plan (i.e.: packing, transportation, etc.)

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Modeling Approach

Analysis of optimal allocation of different contracts (price and volumes):

	Contract #	Albuquerque, NM		Aspen, CO		Las Cruces, NM		Phoenix, AZ		Extra
		RAP	Δ RAP	RAP	Δ RAP	RAP	Δ RAP	RAP	Δ RAP	Revenue
Lower price	1	$ 161,467	$ 10,335	$ 17,287	$ (13,029)	$ 90,892	$ 5,374	$ 59,131	$ (4,331)	$ 36,532
	2	$ 162,006	$ 10,874	$ 17,938	$ (12,378)	$ 91,451	$ 5,933	$ 59,305	$ (4,157)	$ 34,609
	3	$ 162,545	$ 11,413	$ 18,589	$ (11,727)	$ 92,010	$ 6,493	$ 59,478	$ (3,984)	$ 32,686
	4	$ 163,085	$ 11,953	$ 19,239	$ (11,076)	$ 92,570	$ 7,052	$ 59,652	$ (3,810)	$ 30,764
	5	$ 163,624	$ 12,492	$ 19,890	$ (10,425)	$ 93,129	$ 7,611	$ 59,825	$ (3,637)	$ 28,841
	6	$ 164,163	$ 13,031	$ 20,541	$ (9,774)	$ 93,688	$ 8,170	$ 59,999	$ (3,463)	$ 26,918
	7	$ 164,702	$ 13,570	$ 21,192	$ (9,124)	$ 94,247	$ 8,729	$ 60,172	$ (3,290)	$ 24,996
	8	$ 165,241	$ 14,109	$ 21,843	$ (8,473)	$ 94,806	$ 9,288	$ 60,346	$ (3,116)	$ 23,073
	9	$ 165,780	$ 14,648	$ 22,494	$ (7,822)	$ 95,365	$ 9,847	$ 60,519	$ (2,943)	$ 21,150
	10	$ 166,320	$ 15,188	$ 23,145	$ (7,171)	$ 95,924	$ 10,406	$ 60,693	$ (2,769)	$ 19,227
	11	$ 166,859	$ 15,727	$ 23,796	$ (6,520)	$ 96,483	$ 10,966	$ 60,866	$ (2,596)	$ 17,305
	12	$ 167,398	$ 16,266	$ 24,447	$ (5,869)	$ 97,043	$ 11,525	$ 61,040	$ (2,422)	$ 15,382
	13	$ 167,937	$ 16,805	$ 25,098	$ (5,218)	$ 97,602	$ 12,084	$ 61,213	$ (2,249)	$ 13,459
	14	$ 168,476	$ 17,344	$ 25,749	$ (4,567)	$ 98,161	$ 12,643	$ 61,387	$ (2,075)	$ 11,536
	15	$ 169,015	$ 17,883	$ 26,400	$ (3,916)	$ 98,720	$ 13,202	$ 61,560	$ (1,902)	$ 9,614
	16	$ 169,555	$ 18,423	$ 27,051	$ (3,265)	$ 99,279	$ 13,761	$ 61,734	$ (1,728)	$ 7,691
	17	$ 170,094	$ 18,962	$ 27,702	$ (2,614)	$ 99,838	$ 14,320	$ 61,907	$ (1,555)	$ 5,768
	18	$ 170,633	$ 19,501	$ 28,353	$ (1,963)	$ 100,397	$ 14,880	$ 62,081	$ (1,381)	$ 3,845
	19	$ 171,172	$ 20,040	$ 29,004	$ (1,312)	$ 100,957	$ 15,439	$ 62,254	$ (1,208)	$ 1,923
Higher price	20	$ 171,711	$ 20,579	$ 29,655	$ (661)	$ 101,516	$ 15,998	$ 62,428	$ (1,034)	$ -

There are extra revenues that could be allocated