Terra-Fresh

Finding Best Partnerships to Meet Demand with Coordination Tools

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Technical Feasibility Methodology

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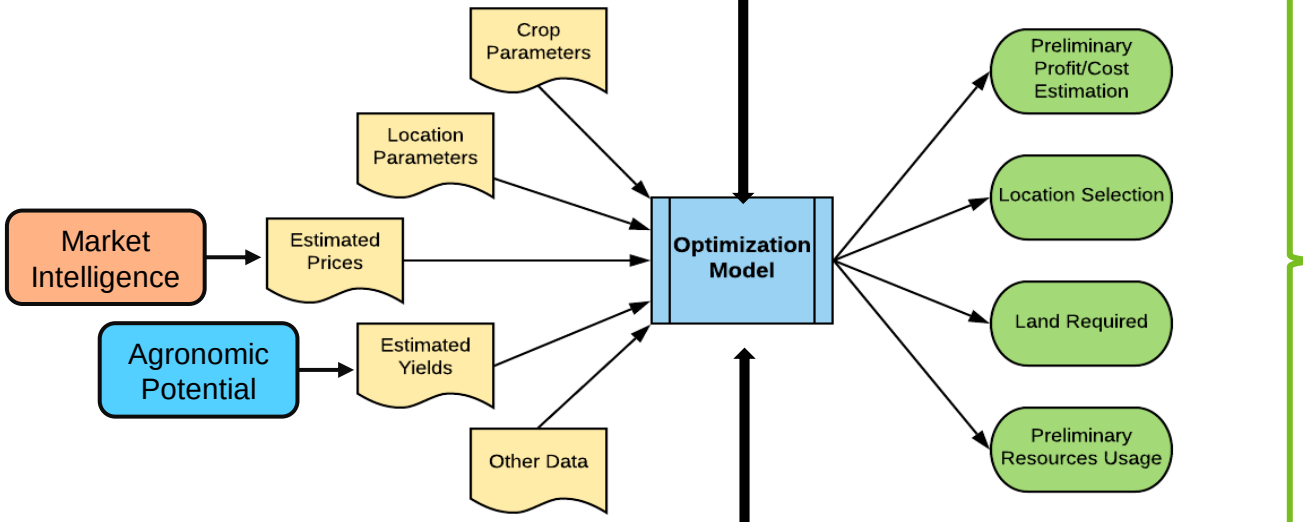
Through statistical and mathematical programming techniques, this module finds the best match of the available resources to the opportunity.

Possible Objectives:
- Maximize Profits
- Reduce CO2/water footprint
- Maximize Local Produce

Model Inputs:

Specific parameters that helps modelling the planning process



Model Outputs:

Results that can be used to assist the planning process, depending on the desired objective

Tools:
- Linear/Mixed Integer Programming
- Stochastic Programming
- Benders Decomposition/Column Generation

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Celery Opportunity

Terra-Fresh

- **Goal:** Given the detected market opportunity, capture as much value as we can given the available resources (land, labor, etc.)

- Note that here we consider the **market opportunity** to be a potential price spike identified by the market intelligence module

- This price spike may not have been identified by traditional forecasting, such as looking at last year's trends alone

- Hence, here we are showcasing the utility of being able to quickly identify price spikes by monitoring social media platforms, google trends, etc.

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Celery Opportunity

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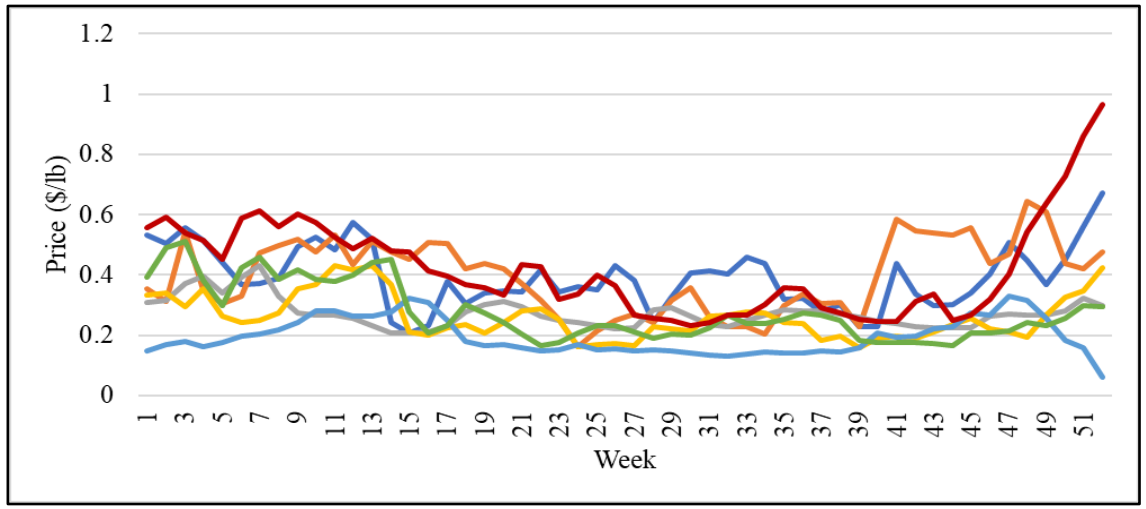
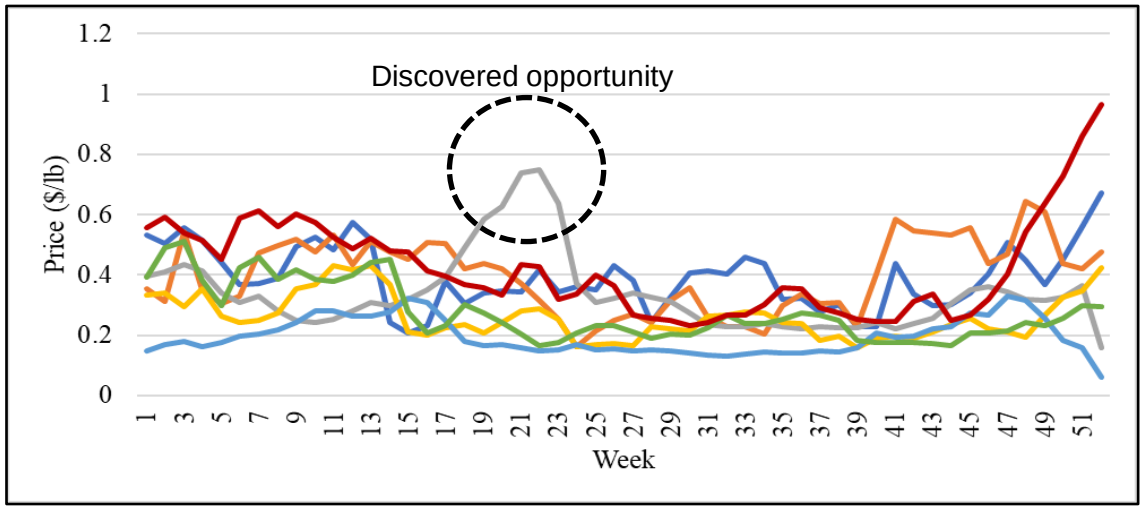
- The decisions made depend on the specific goal, such as maximizing profits, minimizing risk, or maximizing fulfillment of some contract

No Market Opportunity



With Market Opportunity



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Celery Opportunity

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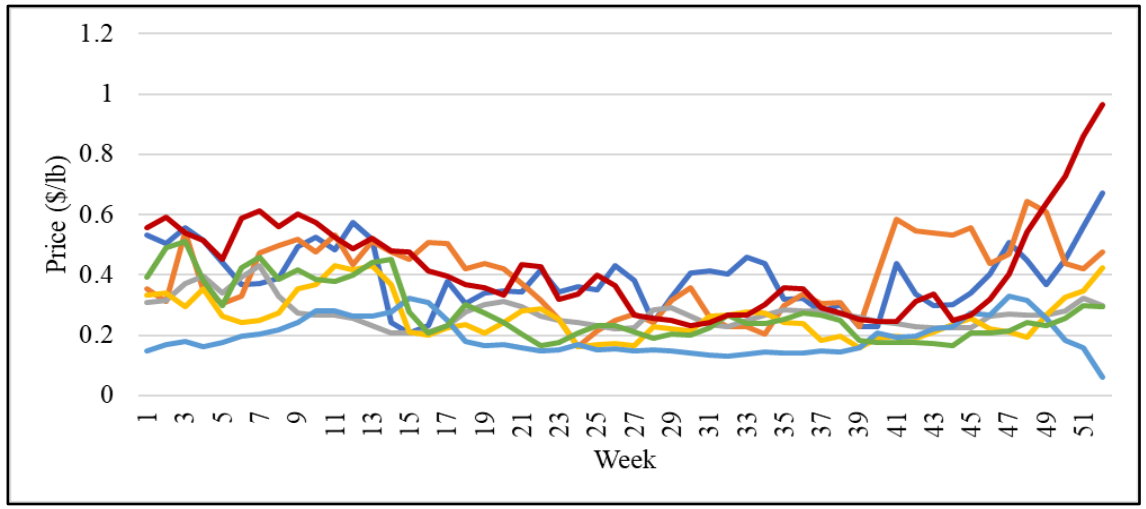
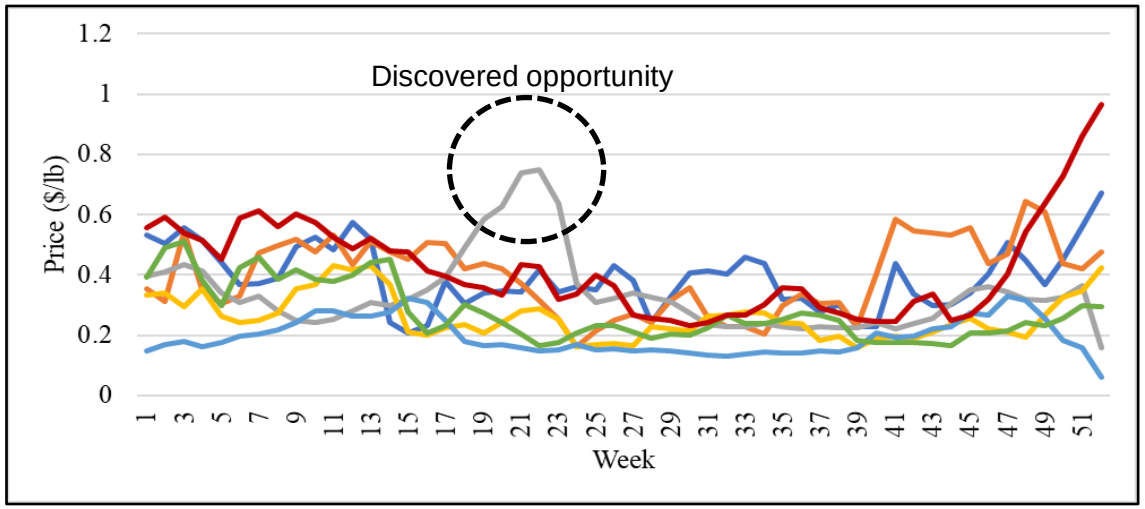
- To demonstrate technical feasibility, we consider all the available locations acting cooperatively in order to maximize the overall profits
- The collective farmers may choose sell the products on the spot market, or fulfill a pre-existing volume contract

No Market Opportunity



With Market Opportunity



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Contract Design

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- Once an opportunity has been discovered, we need to determine the volumes to target
- In practice, we envision a negotiation process that takes place between the Supply Chain Articulator (acting on behalf of the coalition of growers) and the buyer
- This process will allow the grower to deal with a single entity, rather than several individual small growers

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Contract Design

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- To demonstrate the use of the model here, we assume that the negotiation process has already taken place

- The resultant contract is used by the Supply Chain Articulator in order to make the tactical planting decisions that bring the most benefit to the coalition of farmers as a whole

- These **tactical** decisions (what to plant, when to plant) will be used to guide our decisions downstream, where more granular decision models will be used for **operational** decisions

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Process Flow

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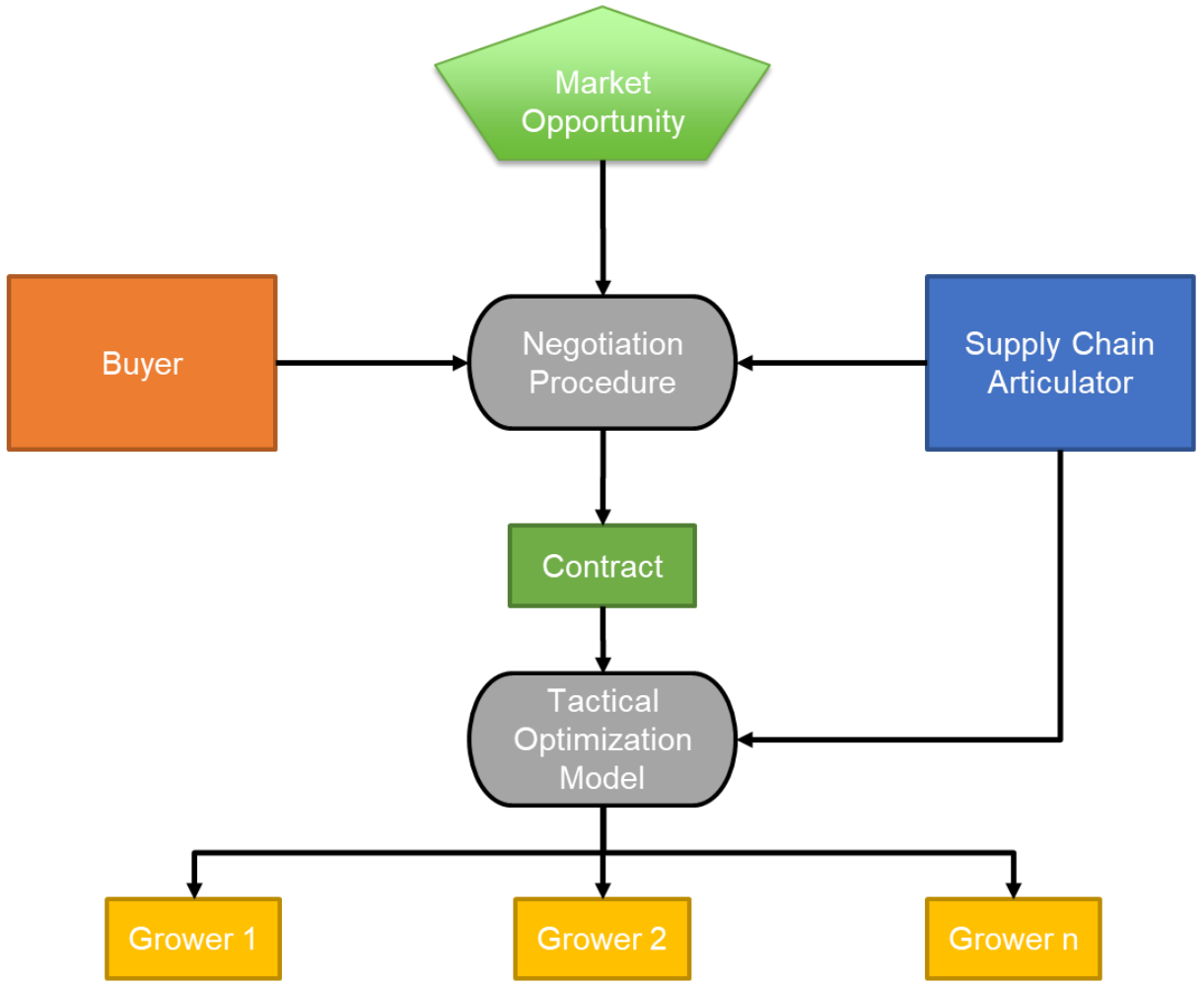
Step 1: Identify market opportunity

Step 2: Negotiate a contract

Step 3: Perform tactical optimization



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Planting Decisions

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No Market Opportunity

		Planted Acres						
Location	Acres Available	Green Beans	Cauliflower	Celery	Cucumber	Lettuce	Bell Peppers	Tomatoes
Albuquerque	60	0	0	0	0	0	0	**60**
Aspen	10	0	0	0	0	0	0	**10**
Las_Cruces	30	0	0	0	**30**	0	0	0
Phoenix	40	0	0	0	**40**	0	0	0
Tucson	30	0	0	0	**30**	0	0	0
Yuma	30	0	0	0	0	0	0	**30**

Location	Plant Week
Albuquerque	8-Feb
Aspen	22-Feb
Las_Cruces	22-Mar
Phoenix	8-Mar
Tucson	15-Mar
Yuma	8-Mar

With Market Opportunity

		Planted Acres						
Location	Acres Available	Green Beans	Cauliflower	Celery	Cucumber	Lettuce	Bell Peppers	Tomatoes
Albuquerque	60	0	0	0	0	0	0	**60**
Aspen	10	0	0	0	0	0	0	**10**
Las_Cruces	30	0	0	0	**30**	0	0	0
Phoenix	40	0	0	**40**	0	0	0	0
Tucson	30	0	0	**30**	0	0	0	0
Yuma	30	0	0	**30**	0	0	0	**0**

Location	Plant Week
Albuquerque	8-Feb
Aspen	22-Feb
Las_Cruces	22-Mar
Phoenix	8-Mar
Tucson	8-Feb
Yuma	8-Mar

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Harvest Volumes (lbs.)

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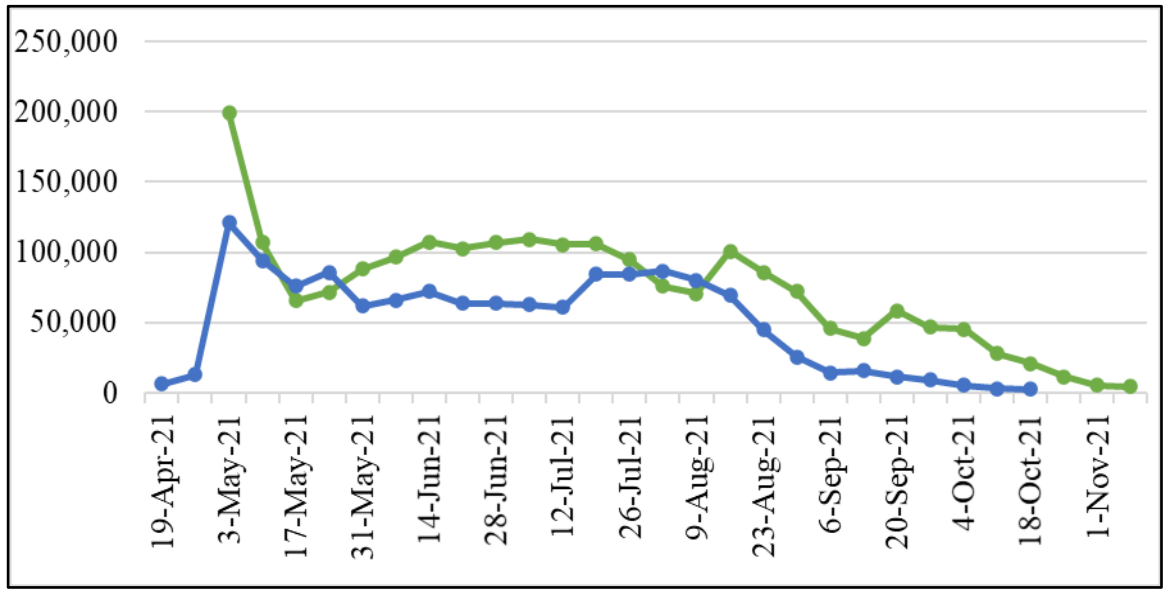
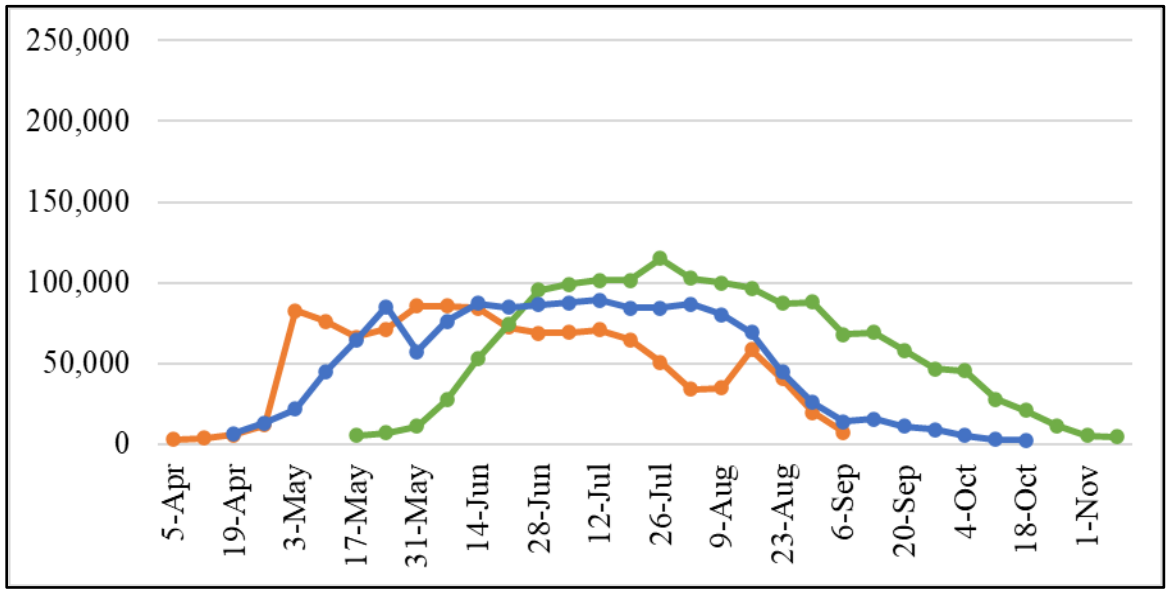
No Market Opportunity



With Market Opportunity



Celery Cucumber Tomatoes

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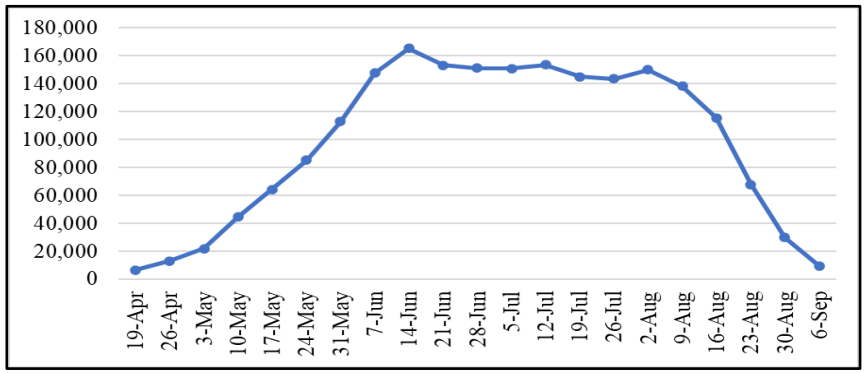
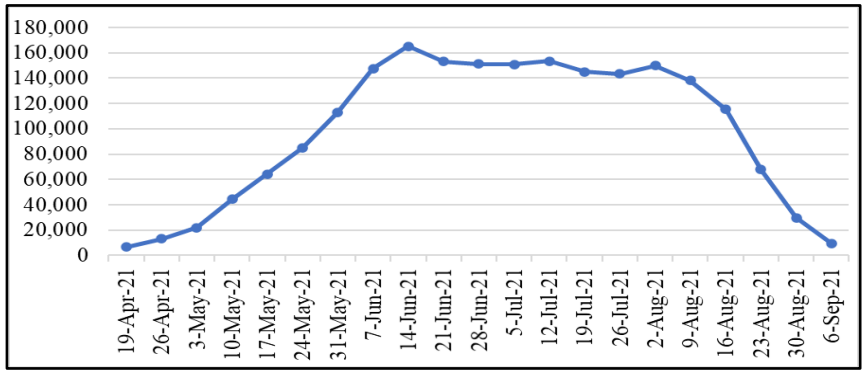
Harvest Volumes (lbs.)

No Market Opportunity

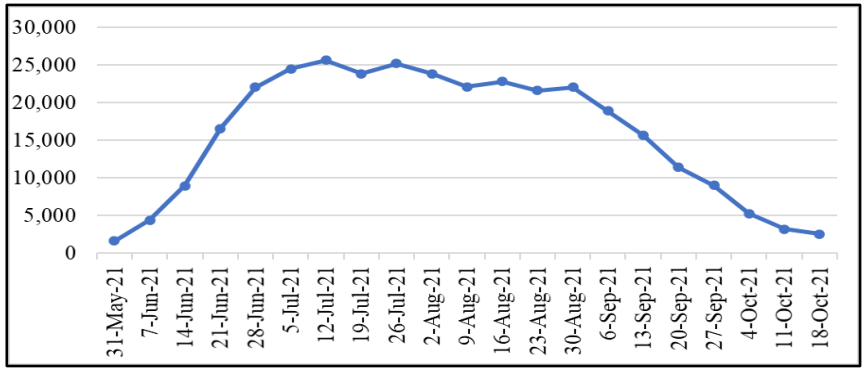
With Market Opportunity

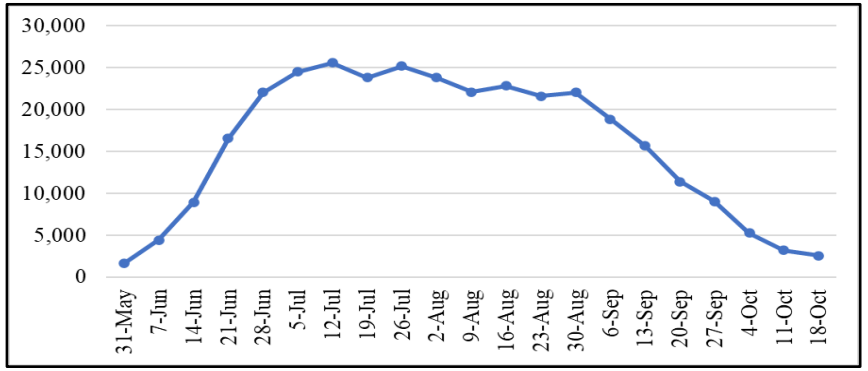
Albuquerque NM



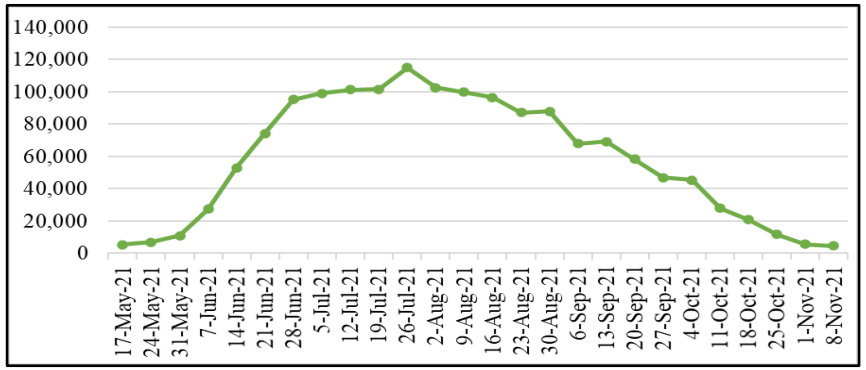


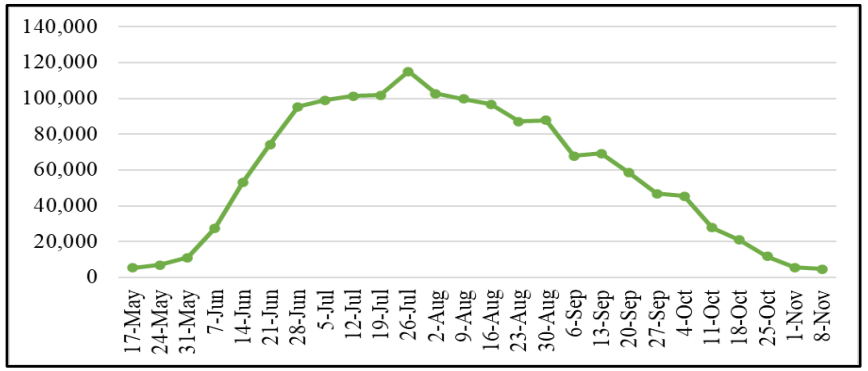
Aspen CO





Las Cruces NM





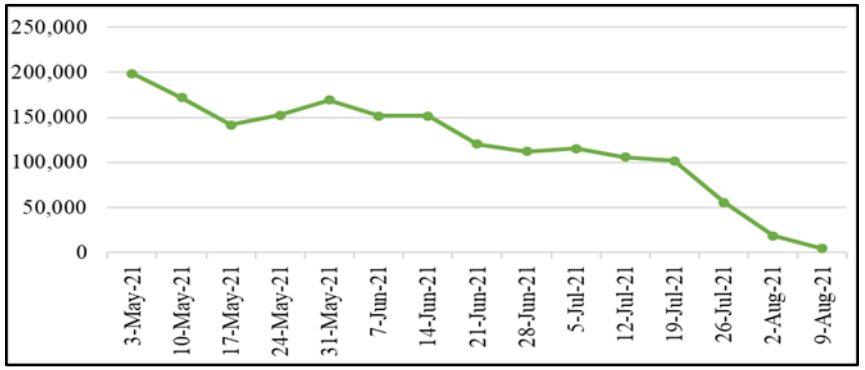
Celery Cucumber Tomatoes

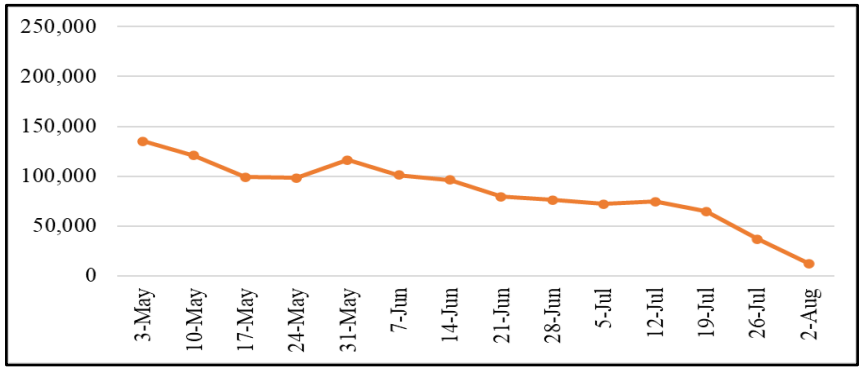
Harvest Volumes (lbs.)

No Market Opportunity

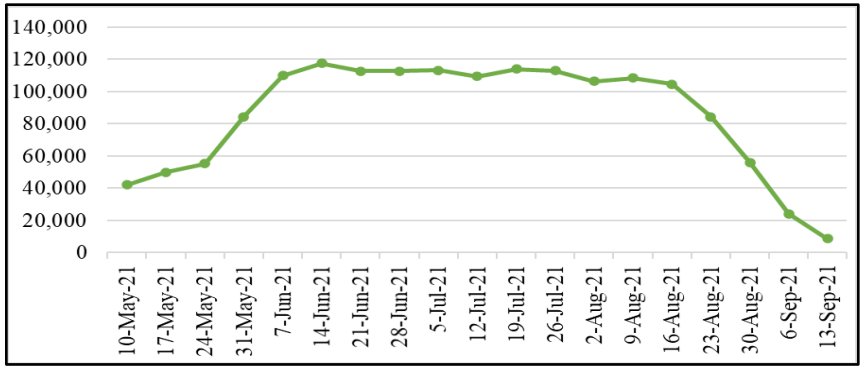
With Market Opportunity

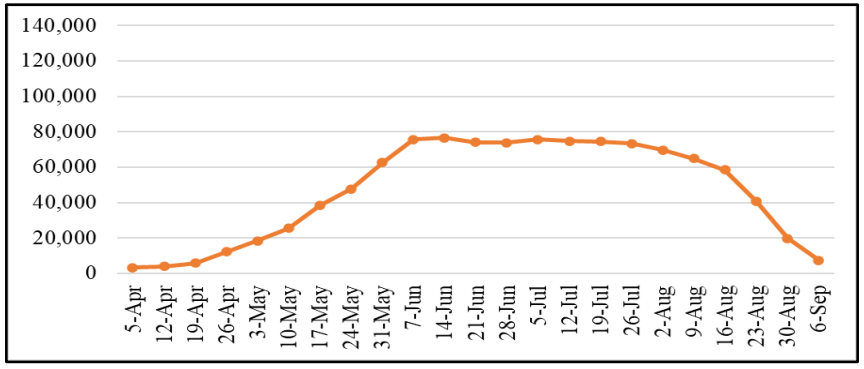
Phoenix
AZ



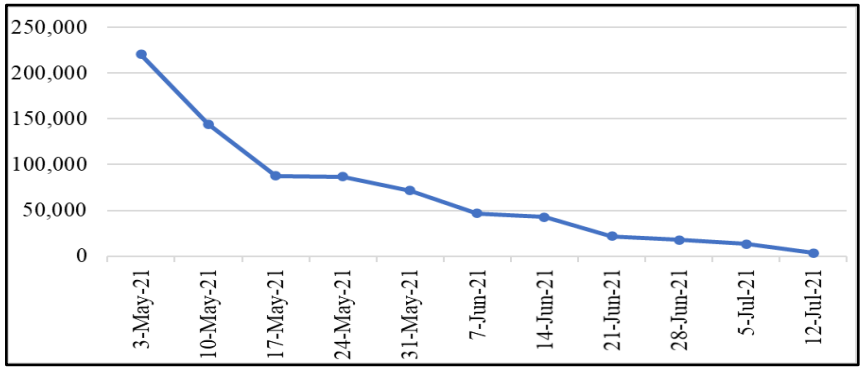


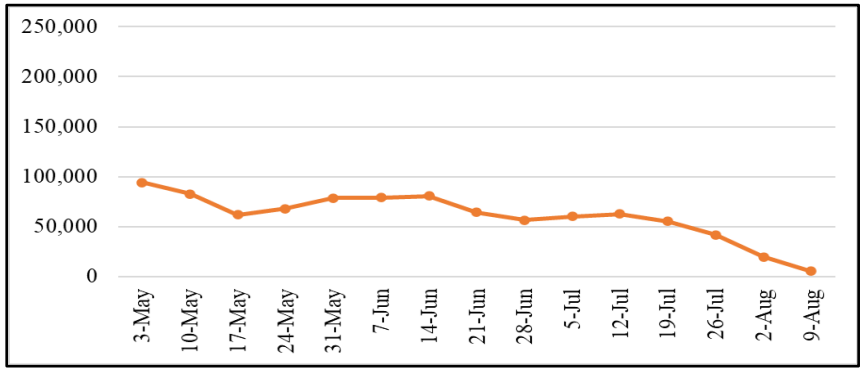
Tucson
AZ





Yuma
AZ





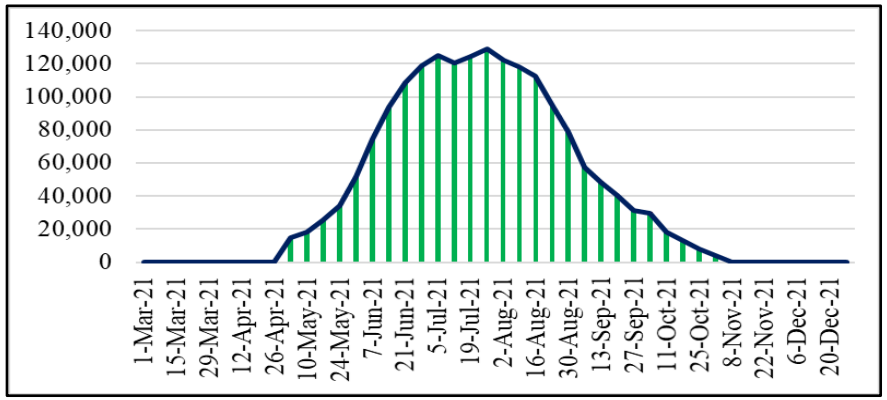
Celery Cucumber Tomatoes

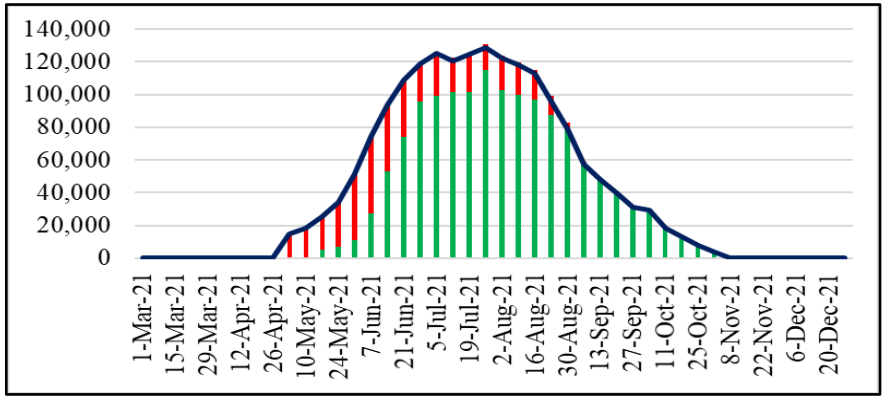
Contract Fulfillment

No Market Opportunity

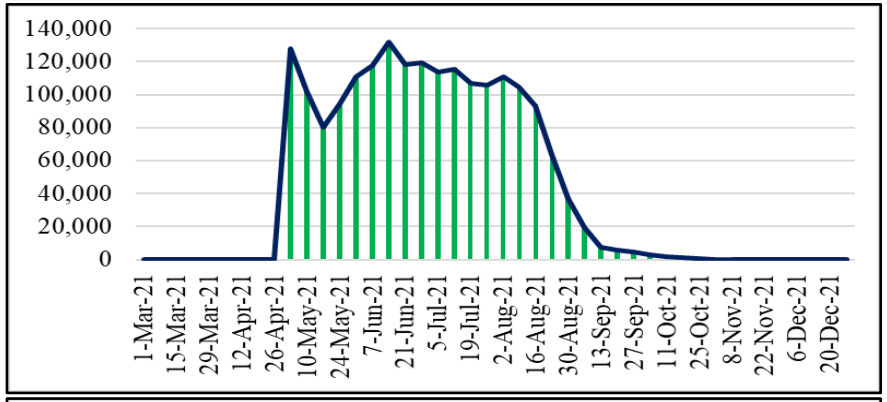
With Market Opportunity

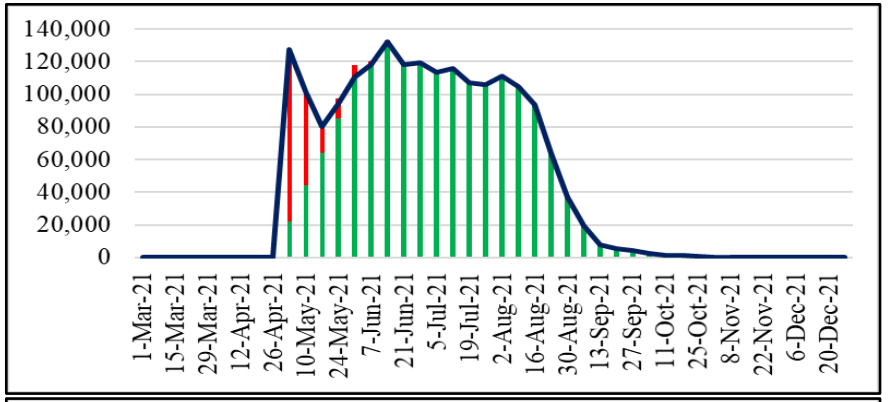
Cucumber



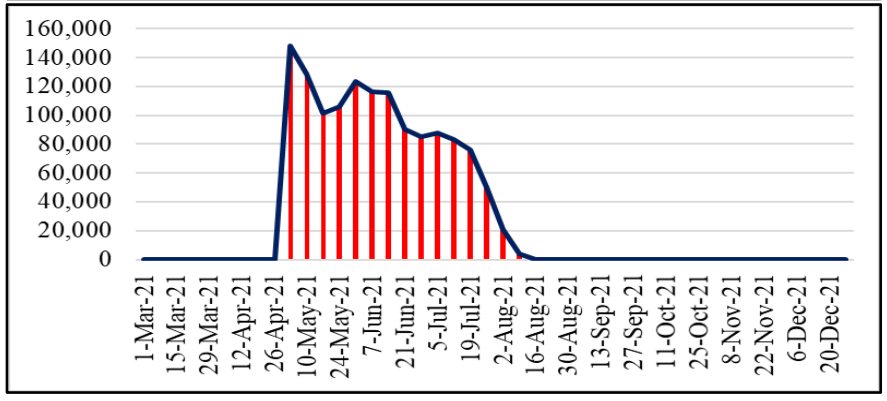


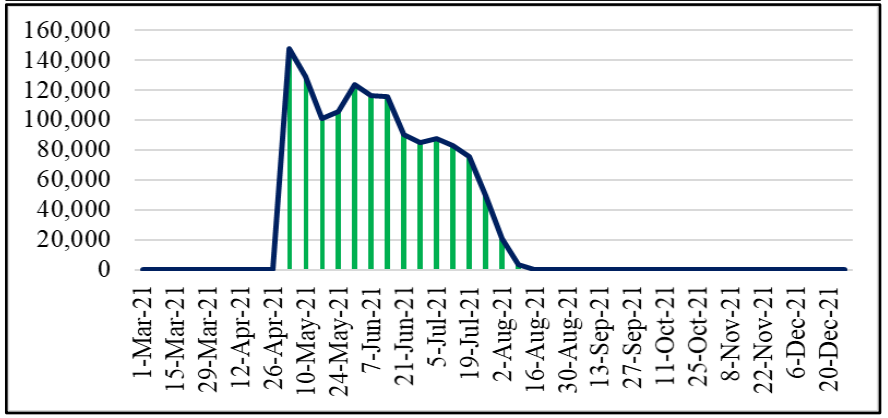
Tomato





Celery



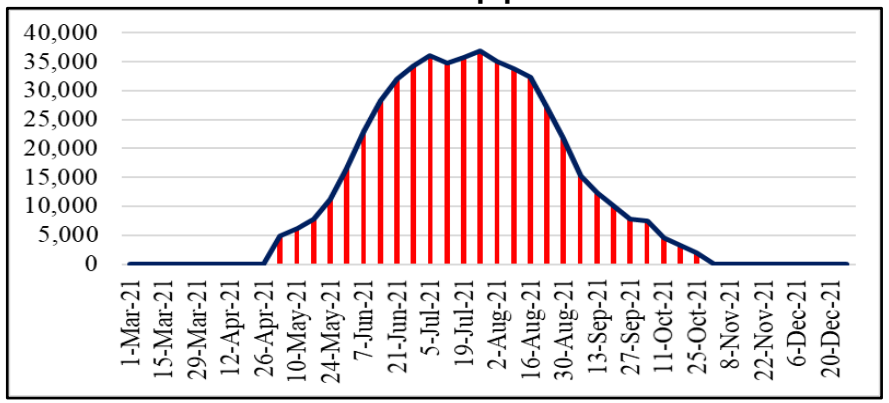


Contract Fulfillment

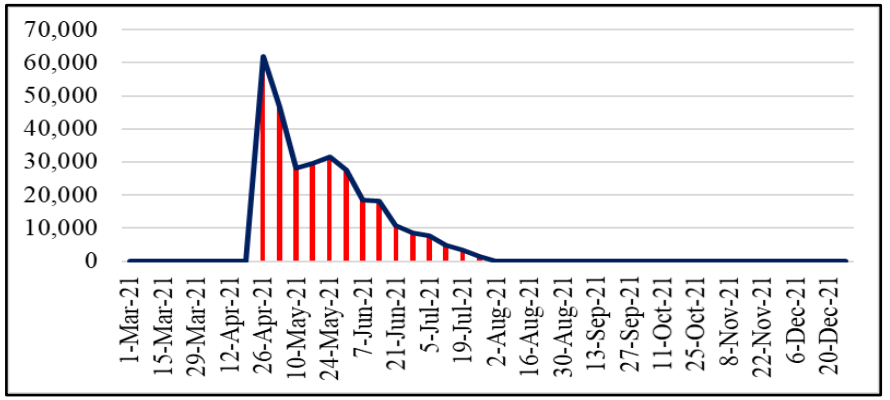
No Market Opportunity

With Market Opportunity

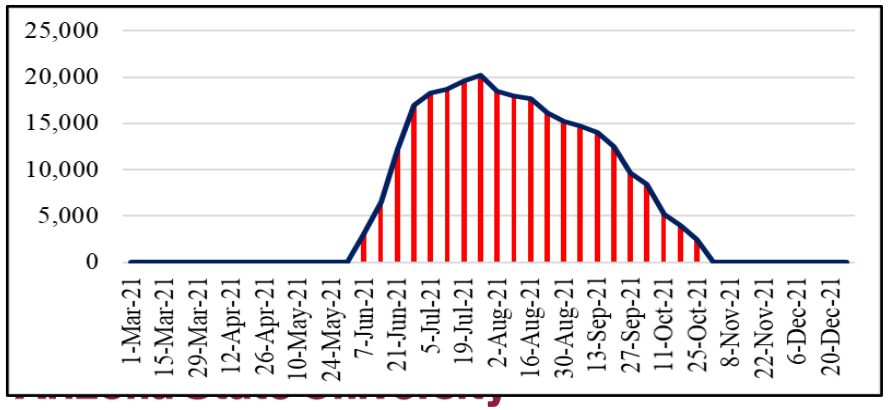
Bell Peppers



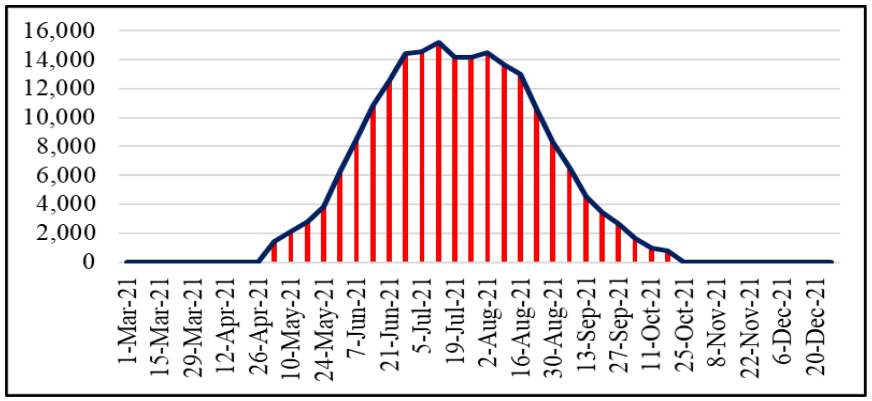
Cauliflower



Green Beans



Lettuce



Risk and Variability

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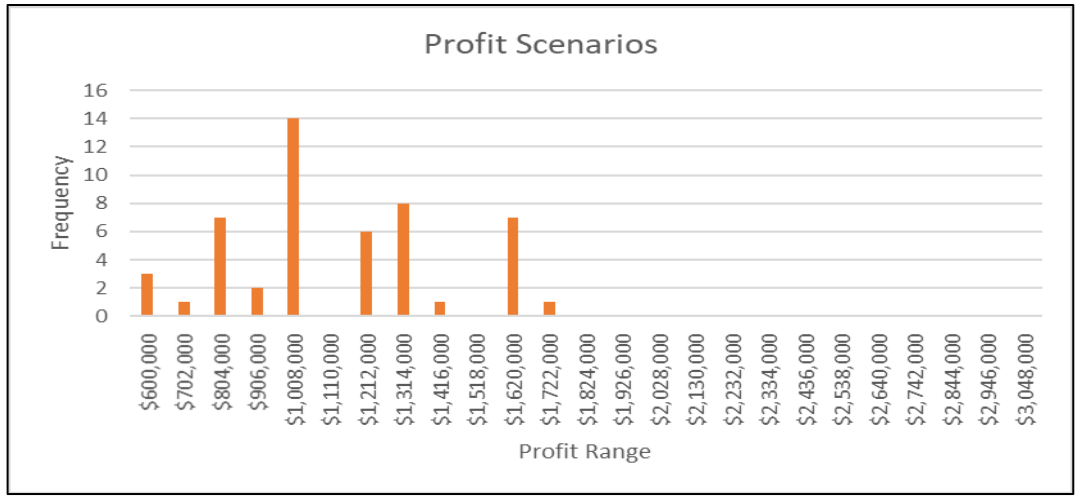
No Market Opportunity

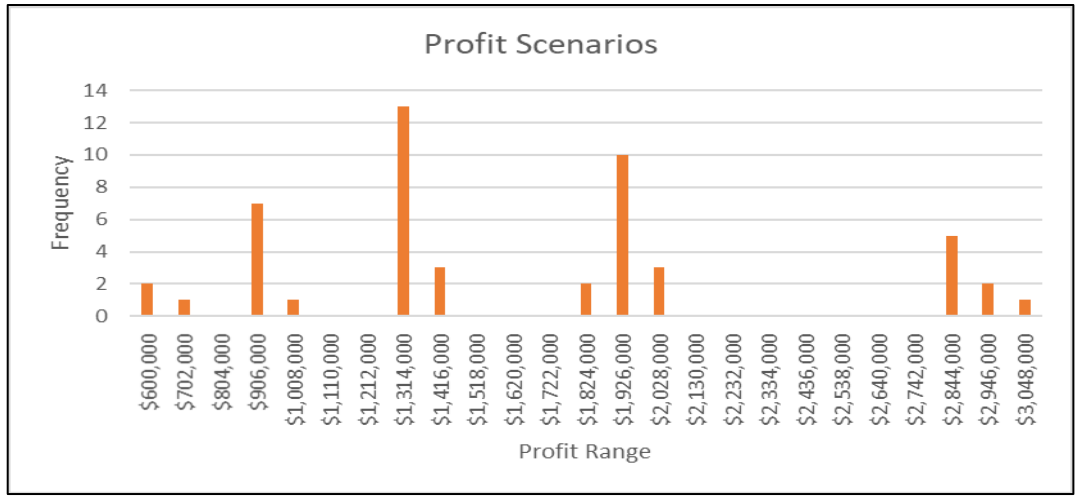
Expected Profit	Standard Deviation	Coefficient of Variation
$ 1,170,015	$ 306,148	26%



Smaller range of profits (less uncertainty) vs. Lower Expected Value

With Market Opportunity

Expected Profit	Standard Deviation	Coefficient of Variation
$ 1,703,274	$ 679,529	40%



Wider range of profits (higher uncertainty) vs. Higher Expected Value

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Technical Feasibility Insights

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- This tools provide a preliminary assessment of the **value of a market opportunity** given available resources and constraints
- Operational planning models can assist to evaluate further impact of a market opportunity in operational decisions (i.e.: logistics)
- The outputs of the models are highly dependent of the inputs being used
- For demonstrative purposes, we have considered a central decision-maker, this is being expanded to a **negotiation** process between the growers and the Supply Chain Articulator

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General Conclusions

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- Centralized decision making assumes a single decision maker, without considering independent agents (i.e.: growers)
- How the risk is accounted for can result in different solutions, and will affect the likelihood of an effective coordination
- Following the tactical planning decisions, there is a need to translate them into coordination contracts, and to analyze the operational implications
- To validate these models, we need to collaboration of growers and other potential participants who will have access to these tools

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Thank You

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