Terra-Fresh

TERRa-Fresh
Logistics Under Regular and Disrupted Conditions

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- Tracking and Traceability of Shipments
- Relevant Factors for the Fresh Produce Supply Chain
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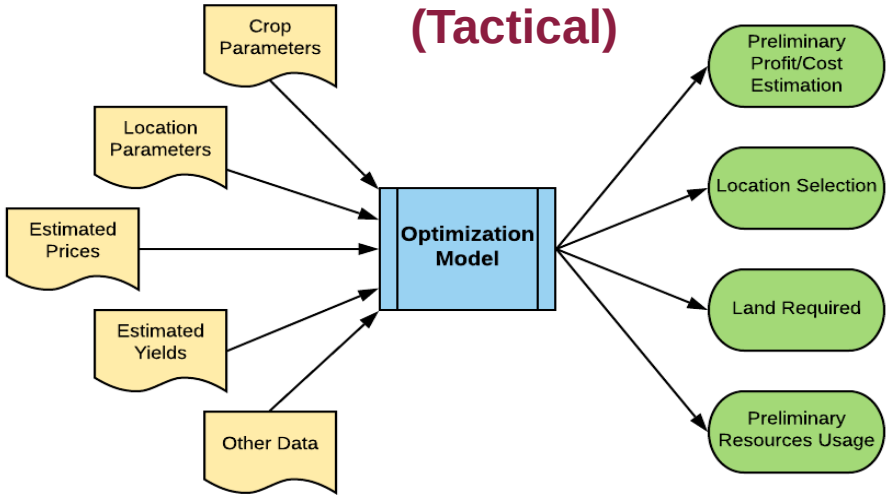
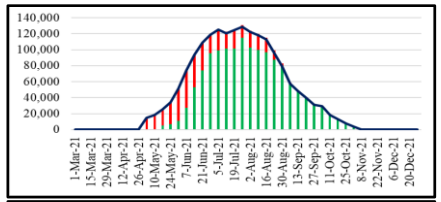
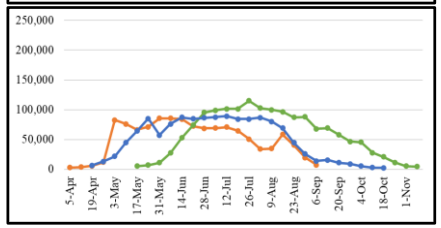
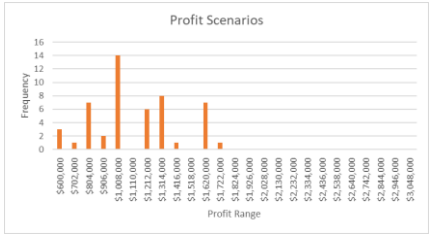
Background

PHASE I
Production Planning
(Tactical)









PHASE II
Planning Deployment
(Operational)

Some decisions

- Aggregation of grower production for transportation
- Fleet Routing
- Inventory at distribution nodes control
- Internal environmental control of fresh produce conditions to maximize shelf life
- Among many others…

- Tactical planning based on expectations of input parameters, deployment conforms the next step
- What happens if the **expected** does not occur? How can it be possible to successfully fulfill contracts within a timely manner if conditions are adverse or different?
- How to take advantage of the data generated during the deployment phase, to increase product **traceability** & supply chain **visibility**?

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Case Study Review

- Growers in **6 regions and 7 crops**
- Planning tools aim to identify best production/supply plan for a given contract for demand in Las Vegas
- The optimal production plan for the growers in the selected regions is analyzed for a contract **with & without the market opportunity**
- Results are **highly dependent** on the inputs used for the model & current operational conditions

Location	Land Available Acres)
Albuquerque	60
Aspen	10
Las Cruces	30
Phoenix	40
Tucson	30
Yuma	30

Cucumbers

Tomatoes

Bell Peppers

Celery

Cauliflower

Green Beans

Romaine Lettuce

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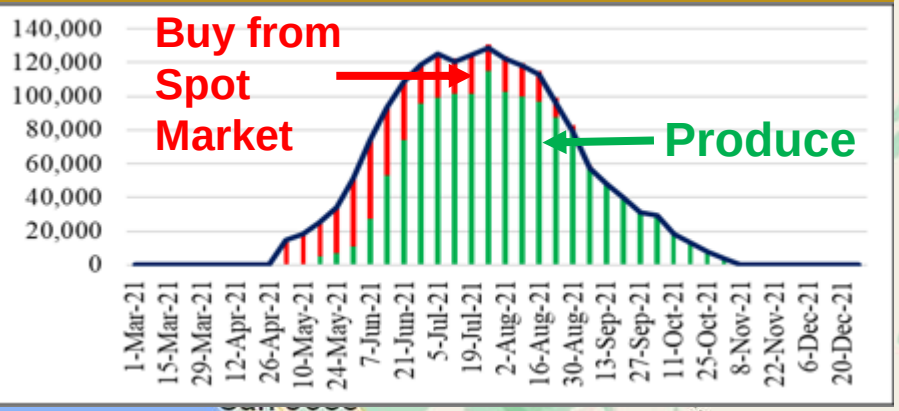
Sample output: Contract fulfilment with Market Opportunity for Cucumbers



Target Demand Node

Aspen

Las Vegas

Yuma

Phoenix

Tucson

Albuquerque

Las Cruces

United States

Salt Lake City
Provo
UINTAH AND OURAY RESERVATION
Fort Collins
Denver
Grand Junction
UTAH
COLORADO
Moab
Colorado Springs
Durango
St. George
Fresno
CALIFORNIA
NAVAJO NATION OFF-RESERVATION TRUST LAND
NAVAJO NATION
HUALAPAI INDIAN RESERVATION
Santa Fe
Bakersfield
Amarillo
Los Angeles
Anaheim
Long Beach
ARIZONA
FORT APACHE RESERVATION
SAN CARLOS RESERVATION
NEW MEXICO
Lubbock
San Diego
Tijuana
Mexicali
Midland
Odessa
Ciudad Juárez
Nogales
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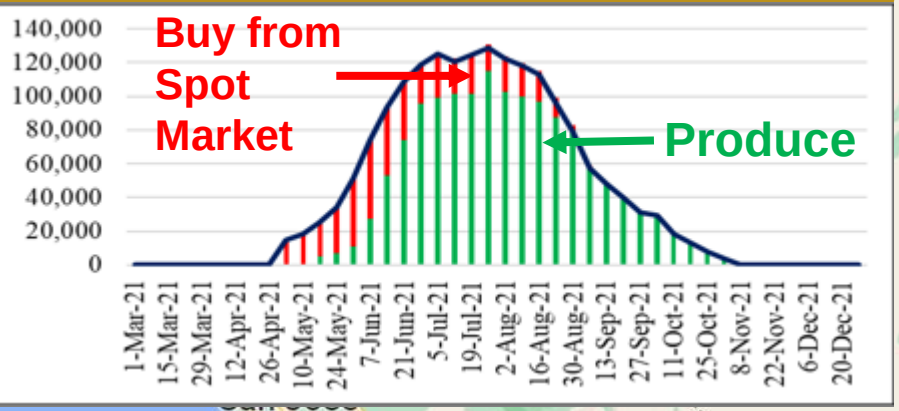
Sample output: Contract fulfilment with Market Opportunity for Cucumbers



Target Demand Node

Aspen

Las Vegas

Albuquerque

Yuma

Las Cruces

Phoenix

Tucson

Los Angeles

San Diego

Tijuana

Ciudad Juárez

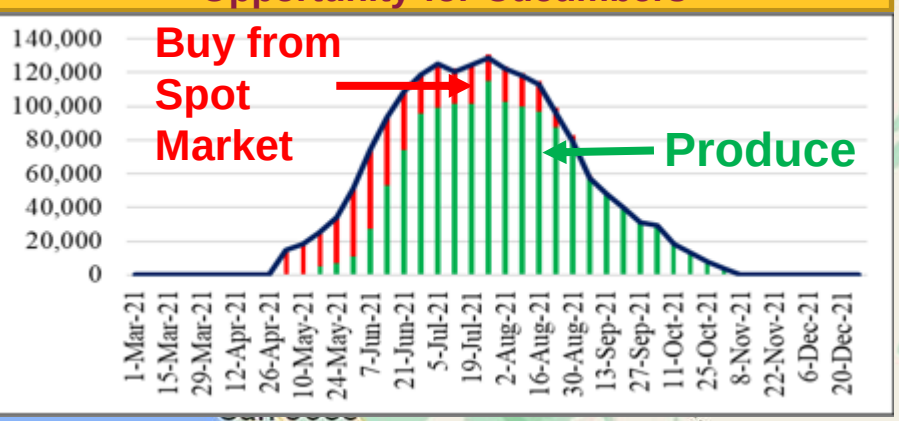
United States

Some operational decisions for under a **data-rich environment** and **fully automated logistics** scheme:

- Aggregation of grower production for transportation
- Fleet Routing
- Inventory at distribution nodes control
- Internal environmental control of fresh produce conditions to maximize shelf life
- Among many others…

Layers

Sample output: Contract fulfilment with Market Opportunity for Cucumbers



Potential sources of variability

- Weather and climate (yields)
- Prices
- Demands
- Labor costs & accessibility
- Resource availability & accessibility (water & energy)
- Among others…

Target Demand Node

Some operational decisions for under a **data-rich environment** and **fully automated logistics** scheme:

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Example – Unexpected Yields

Scenario I: The season was extremely productive, and excess of fresh produce was harvested. What should be done with production excess?

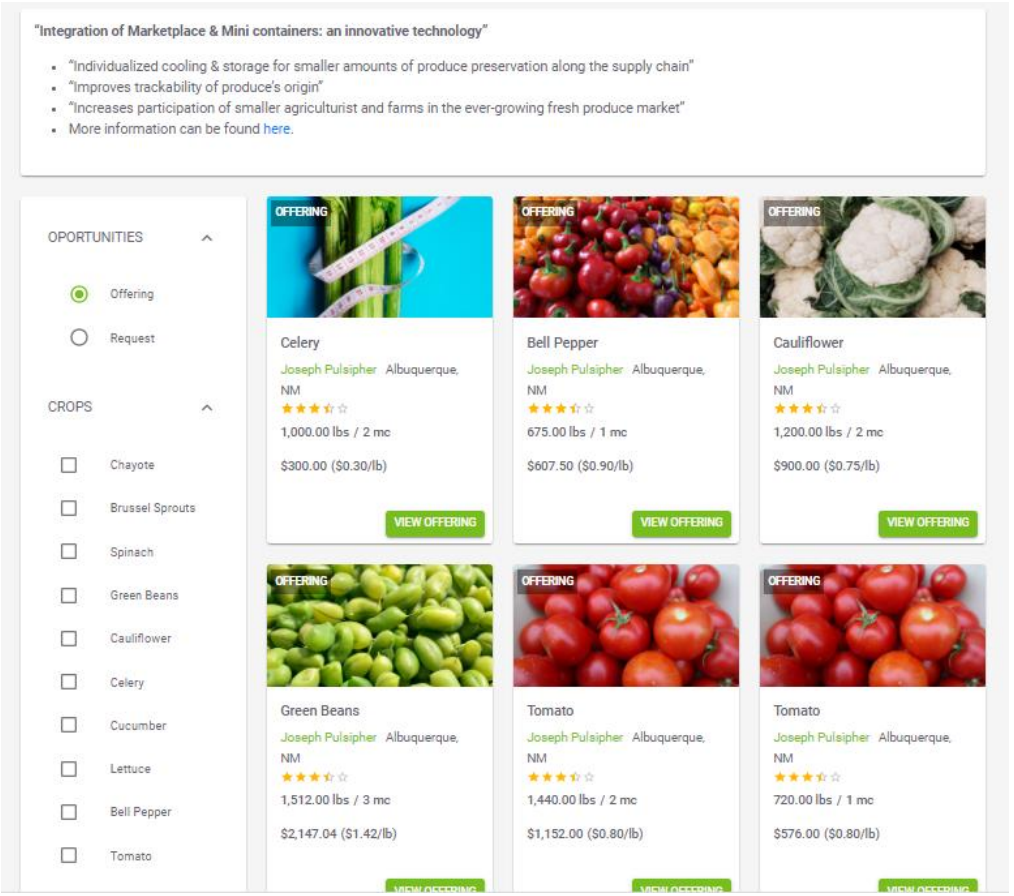
- Sell excess at a spot price
- Send product to another market
  - Which market has higher spot prices?
  - Which market has low demand fulfilment?
  - Is it possible to monitor markets?

Scenario II: Suppose the season produced low harvest yields, not enough to fulfill demand contracts

- Buy spot product

TERRa-Fresh Spot Marketplace:

https://www.terra-fresh.com/Marketplace



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Unexpected Situations and Disruptive Events

- Multiple situations can arise during the deployment of a production plan.
- Planning under uncertainty has been widely addressed
- **Complementary to planning with uncertain conditions, it may be useful to anticipate to these situations. Are adverse conditions or supply chain disruptions predictable?**
- Three levels are identified

Long-Term Trends

Possible to plan and adjust

Climate change

Demographic phenomena

Transitory Trends

Possible to plan and adjust w/ proper tools

Celery opportunity

Demand spikes

Harsh weather conditions

Unpredictable Events

Not possible to plan, possible to adjust

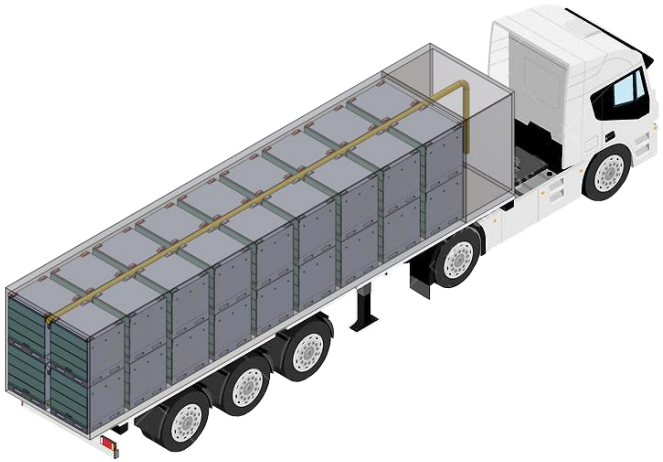
Natural disaster

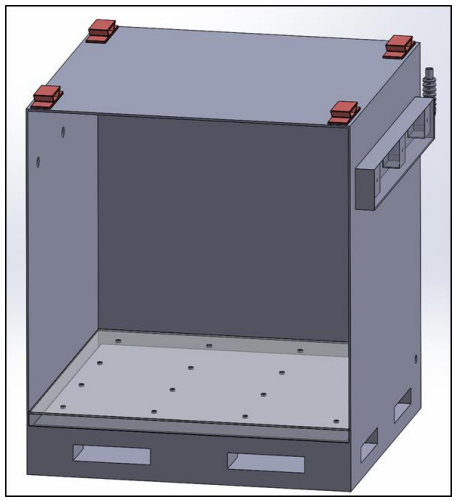
Social outburst

Pandemic

Supply Chain Monitoring Module

- Develop a system that detects anomalies, triggers alerts and create actionable **recommendations** to restore or improve the supply chain performance (prescriptive actions, to minimize disruptions and maximize product shelf life at delivery nodes).
- Using information provided by **sensors and other real-time data sources such as cyber-enabled mini-containers**





- Sensor/Traceability module Inside
- Temperature
- RH
- CO2
- Ethylene
- Vibration
- Transmission/recording/monitoring in real time of location and environmental conditions
- Unique ID for traceability purposes

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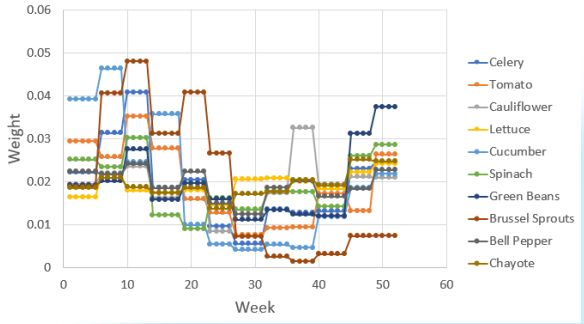
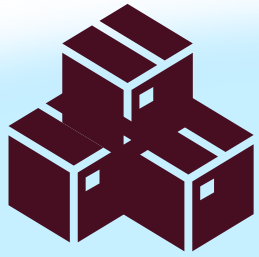
Relevant Factors in the Fresh Produce Supply Chain

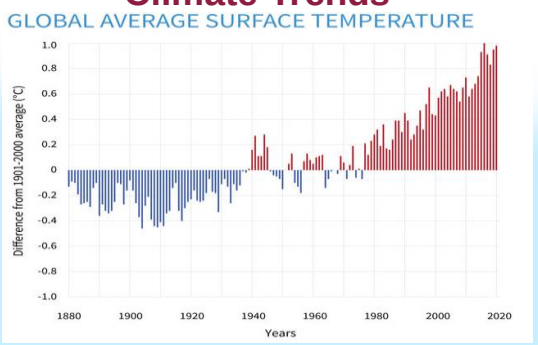
Demands



Inventory at Retail Locations



Climate Trends



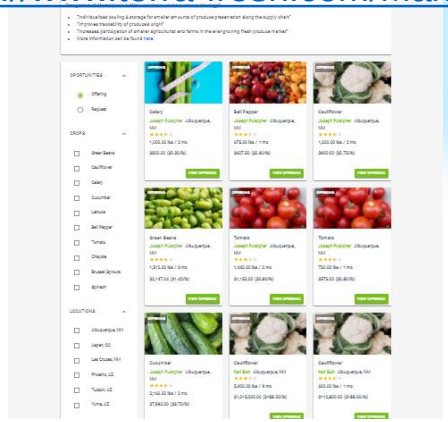
Weather

Production → **Processing/ Packaging** → **Storage** → **Distribution** → **Consumption**

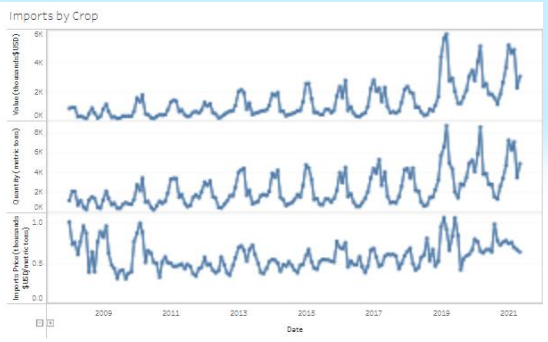
Information Rich Environment

Spot Prices

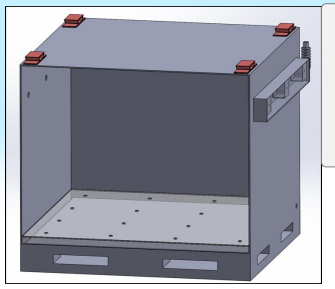
https://www.terra-fresh.com/Marketplace#



Fresh Produce Imports



Transportation Internal Conditions & Distribution Status



- Temperature
- RH
- CO_2
- Ethylene
- Vibration
- Location
- Environmental conditions

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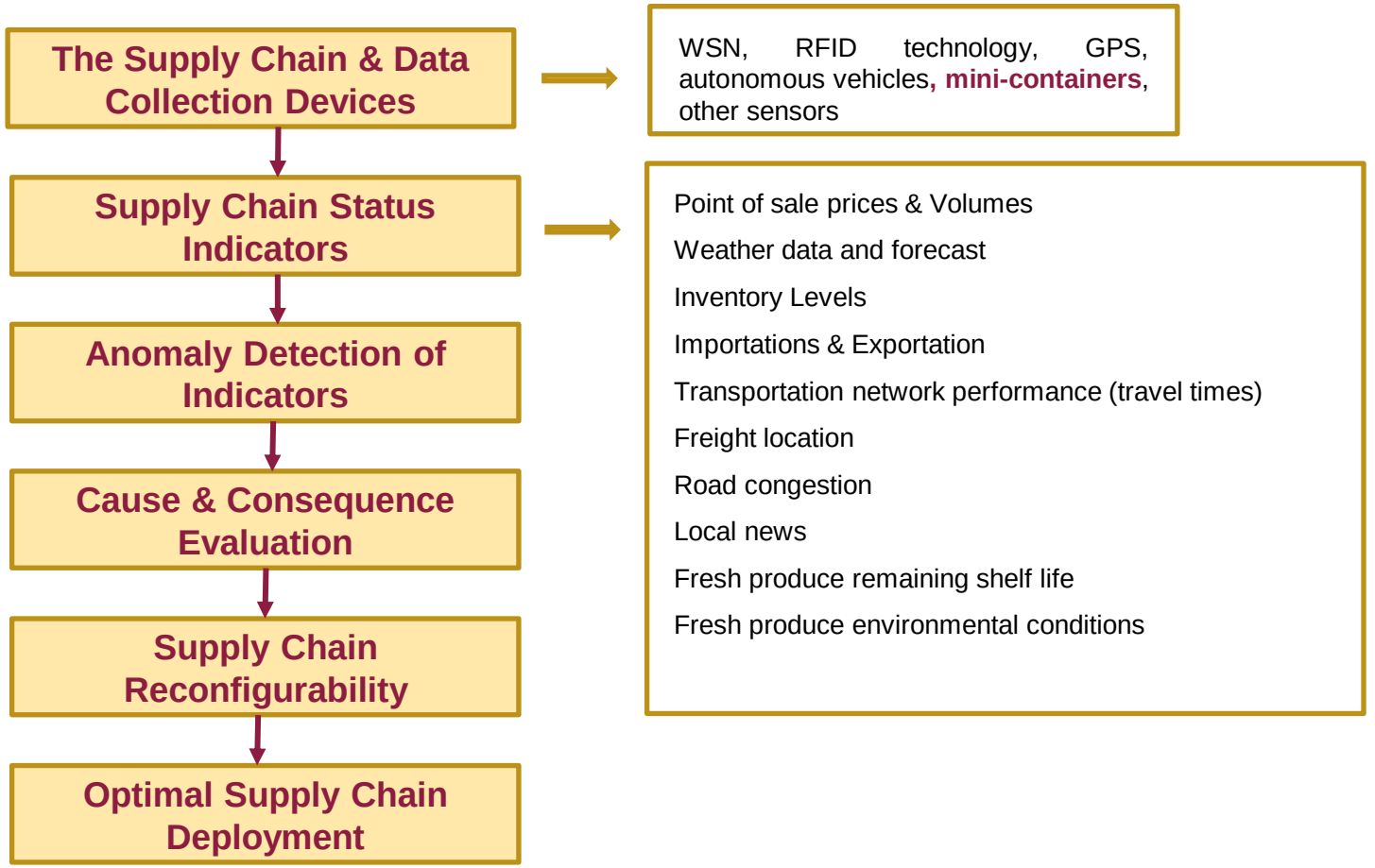
Envisioned Scheme for the Supply Chain Monitoring Module



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Benefits of the Supply Chain Monitoring Module

- Increases in product traceability and supply chain visibility
  - Consumer awareness trends
  - Food safety
  - Competitive advantages for smaller and new participants
- Quickly reconfigurable supply chains & prediction of disruptive situations and changing environments
  - Reduction in food waste, food scarcity, environmental impacts & increase product shelf life at delivery nodes

Producers

- Competitive advantages generated local consumption, food safety consumer awareness, environmental footprint tracking trend
- Enjoy economies of scale

Distributors

- Increased supply chain visibility
- Reduce likelihood of altering the continuous distribution process
- Reduce overall distribution costs

Consumers

- Increased food safety
- Increased product quality
- More information available about product consumed
- Increased food accessibility
- Increased healthy food availability

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Conclusions

- Overview of relevant decisions on deployment of production plans

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- Impact of potential adverse situations upon deployment of production plans

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Hypothesis

*A fresh produce supply chain operating in an information rich environment, along with the integration of the mini-containers as transportation units can increase product **traceability** and increase supply chain **visibility***

- Competitive advantages for smaller and new participants
- Participation of stakeholders → Invitation to the Small Grower Forum

Thank You

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