



# Multi-Level Impacts of Extreme Climate-Related Events on Food Supply Chain: Idaho Potato's Case Study

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*Changing the World's Energy Future*

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## Introduction

- Increased frequency and severity of climate related events threaten food security. While impacts on growers are well-studied, less is known about other stakeholders in the food supply chain (SC).
- This study aims to quantify the impacts of different extreme climate events on different stages of a potato SC.

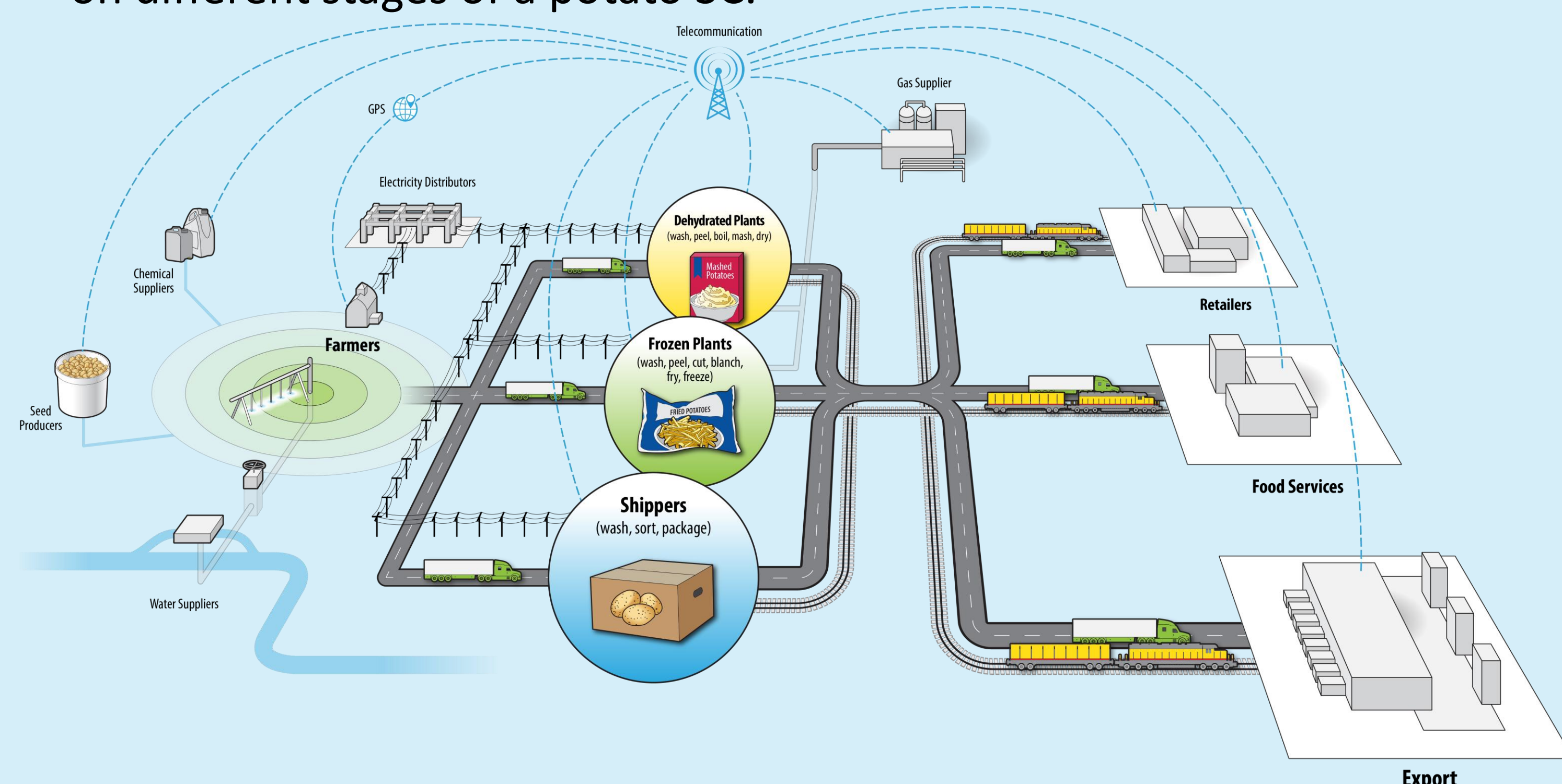


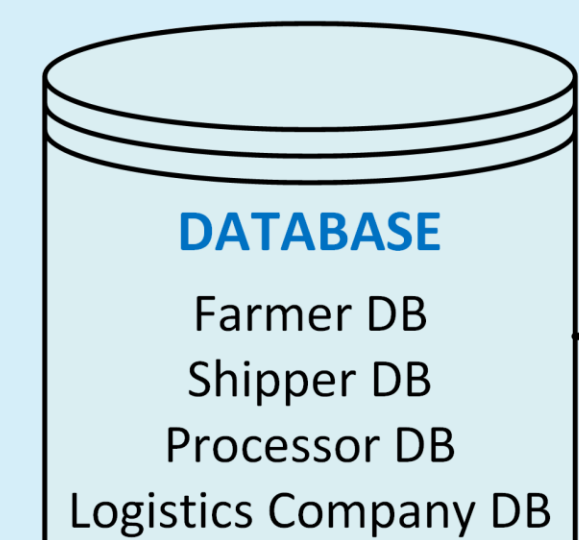
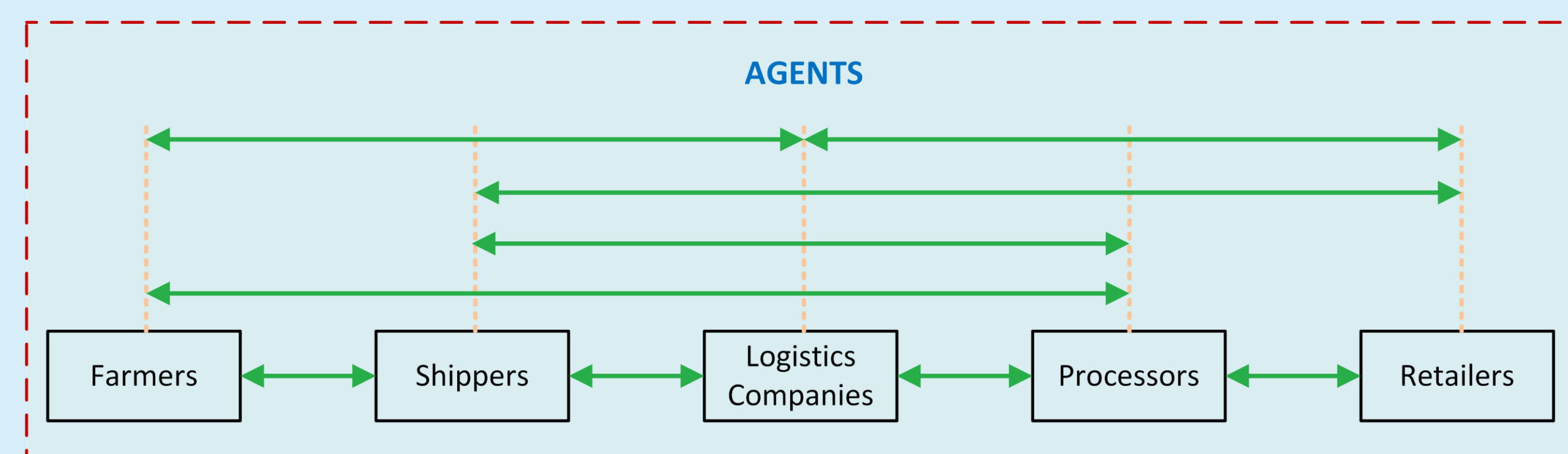
Figure 1: Potato supply chain stakeholders, supporting infrastructures, and required inputs

## Methods

- Agent-Based Modeling (ABM) was used to build a digital twin of the SC
- Software and programming languages used: AnyLogic, Python, Scikit-Learn

Legend

↔ Connection among agents



### SIMULATION ENGINE

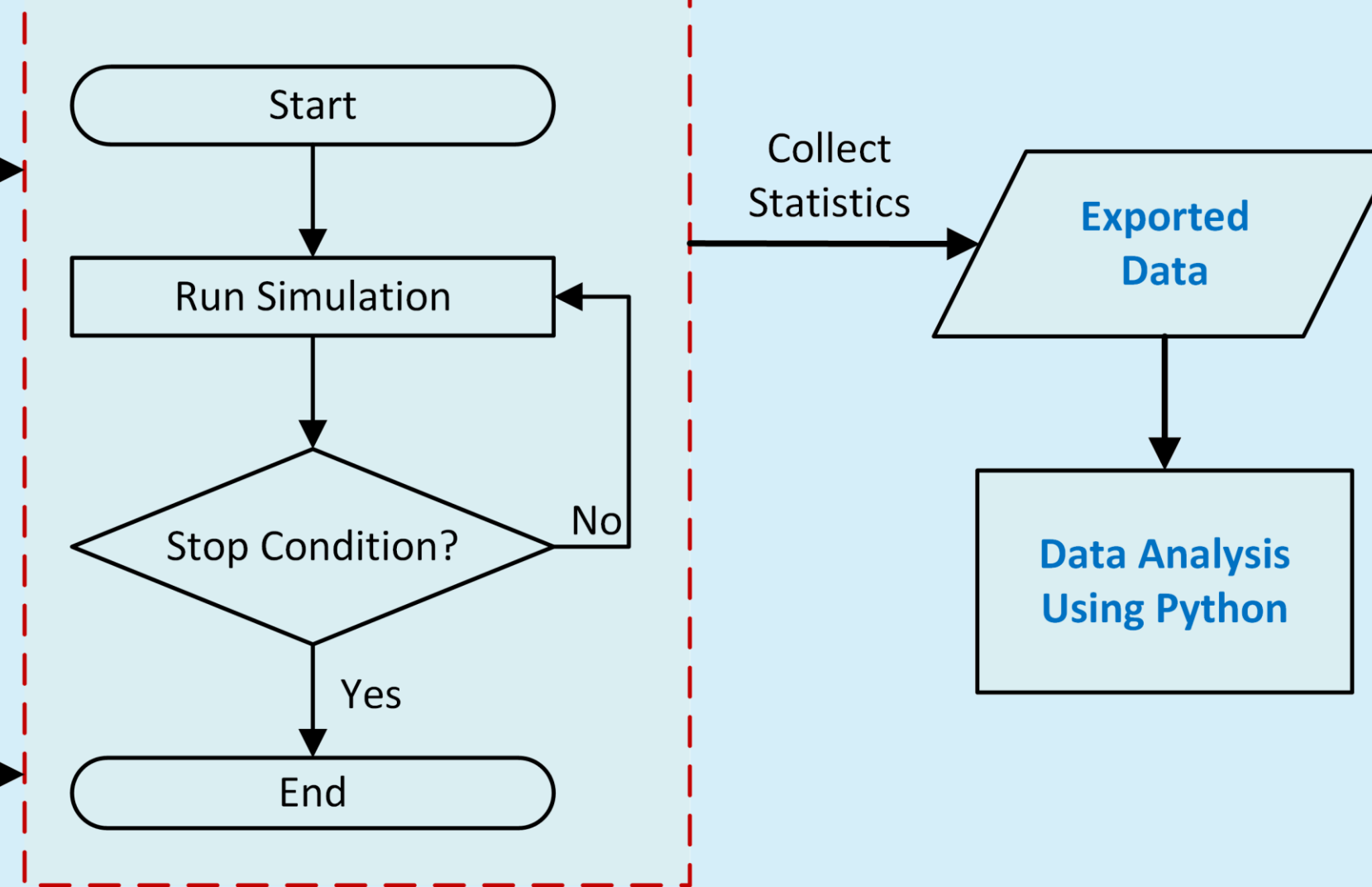


Figure 2: Conceptual framework of the simulation model and integration with different components

## Experiments

Scenario	Disruption event description	Duration	Directly impacted stakeholders	Direct Impacts
1	Severe drought, 50% of required water for irrigation is available. The contract price between farmers and processors increases by 20%.	Growing season (early May to early August)	Farmers	• Reduced yield
2	Extreme weather, early frost or snow. The affected farmers lose 30% of the harvest. The speed of the delivery vehicles reduces by half.	Early October for 1 week	• Farmers • Logistic companies	• Harvest loss • Delayed delivery

## Results

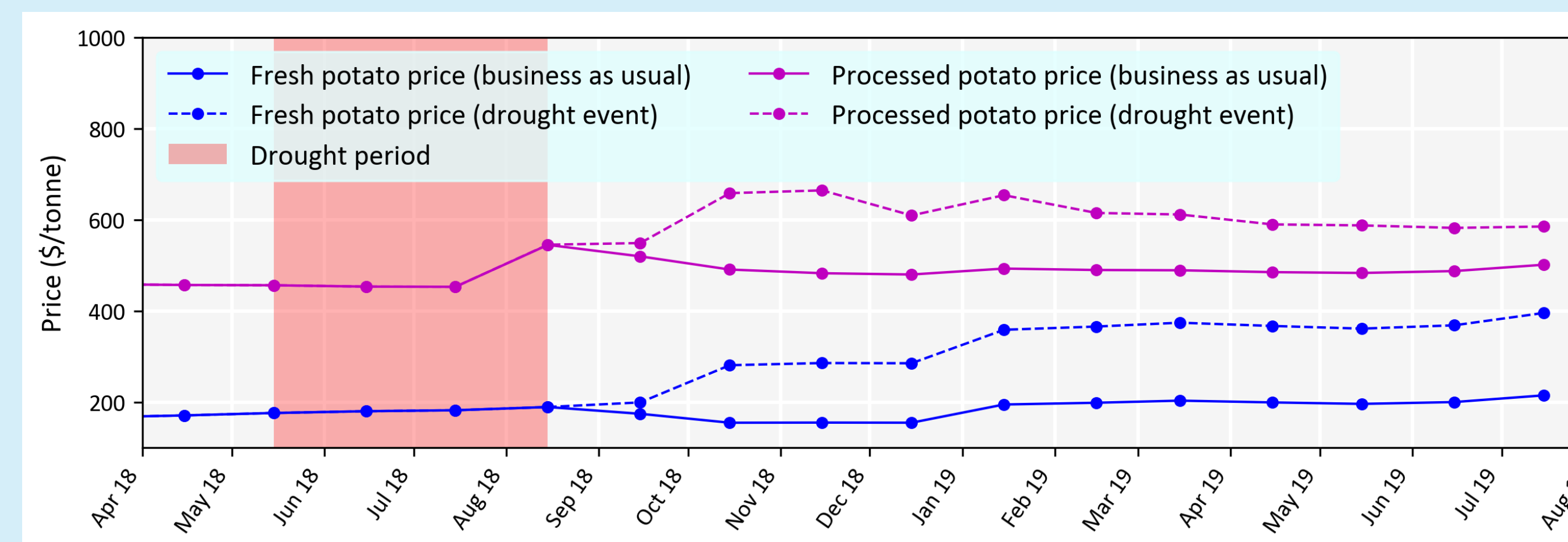


Figure 3: Impact of drought event on potato price

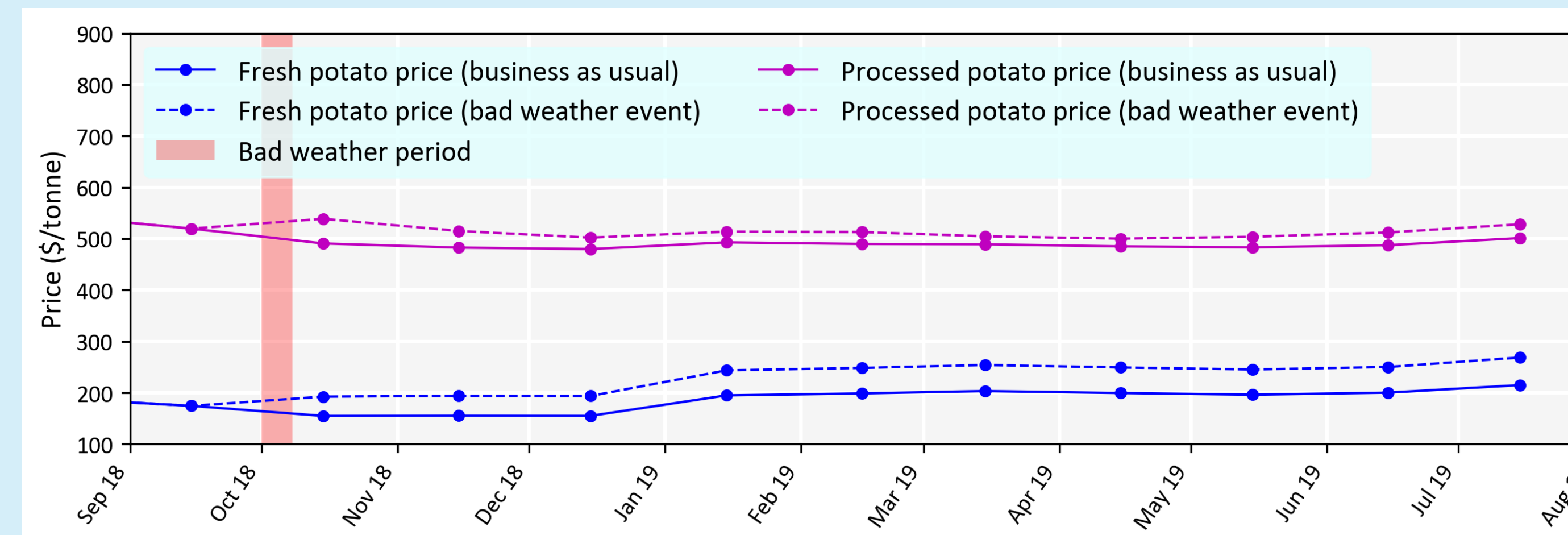


Figure 4: Impact of bad weather (snowstorm) event on potato price

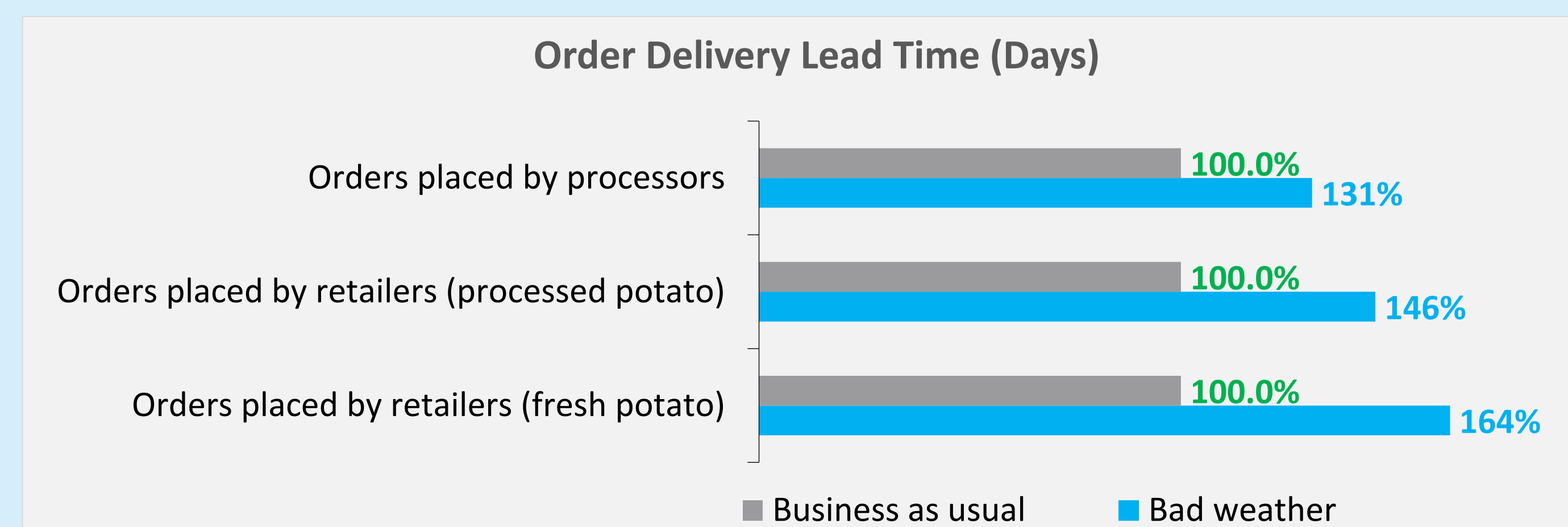


Figure 5: Impact of bad weather on order delivery lead times

## Results (continued)

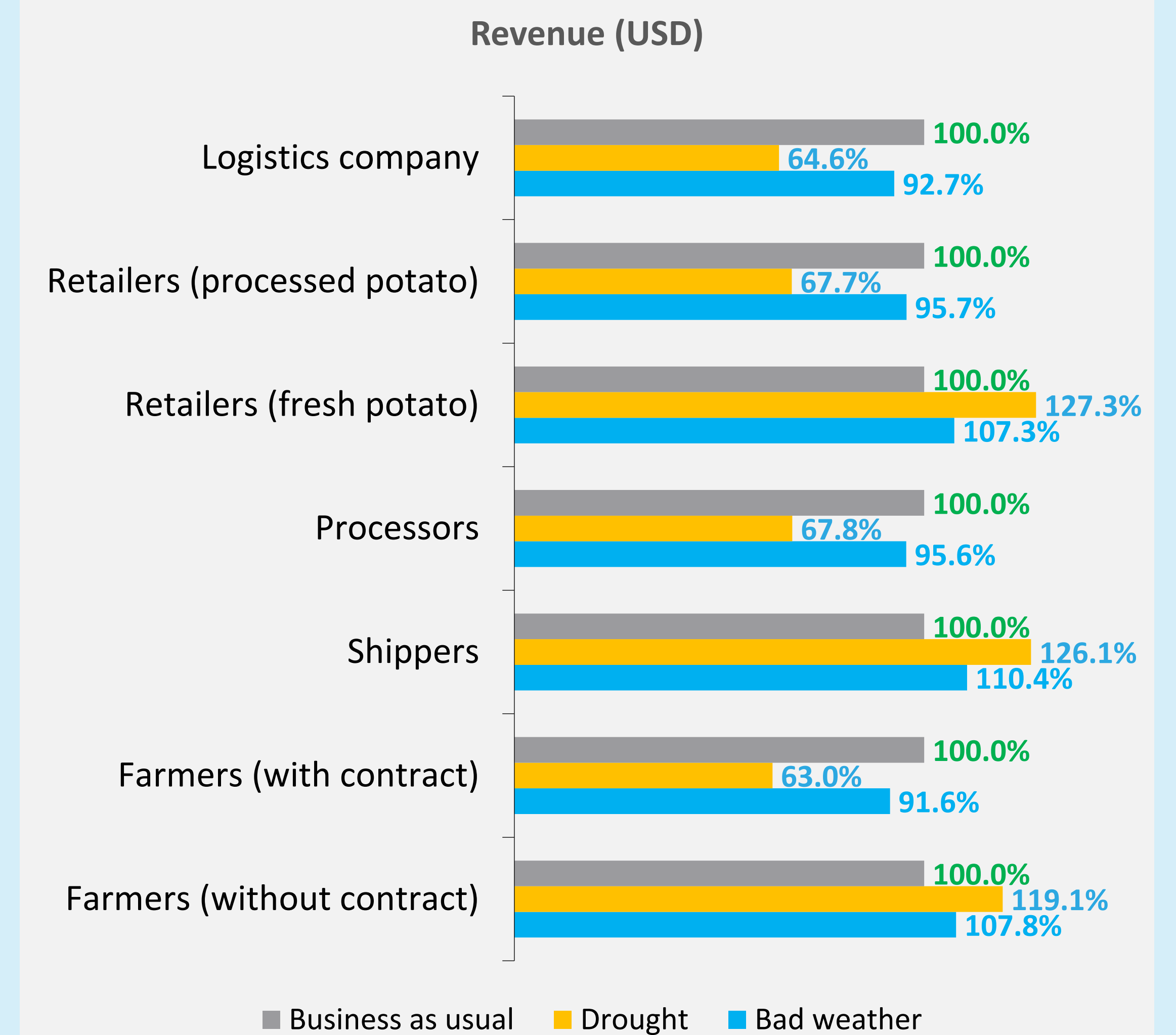


Figure 6: Impact of disruptions on revenue of different stakeholders

## Conclusion

- The impacts of the disruption events were different on different agents in the supply chain for different product categories.
- The price hike of fresh potatoes was way higher than processed potatoes during disruptions. For example, during drought, the price of fresh potatoes increased by 78.2% while the price of processed potatoes increased by 20.9% only.
- Non-contracted farmers gain additional revenues from the disruptions whereas contracted farmers incur a loss due to lock-in price and lower than usual harvest.
- The bad weather event caused 31% to 64% higher delivery lead times, while there was no impact from drought.

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