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How are apple farmers adapting to climate change?

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Abstract

Farmers, more than anyone else in the world, depend on predictable and stable weather patterns to do their job. Climate change, therefore, poses a significant threat to food production worldwide. Agriculturalists have been doing their best to adapt to these changes, but we don't really know exactly what the farmers have been doing (or why).

We attempted to solve this mystery by interviewing apple farmers in three regions: two in Japan and one in South Africa. We divided our findings into two types: actions that the farmers initiated themselves (bottom-up) or actions recommended by institutions around them (top-down).

How farmers sell their crops was the main factor determining which type of action they took. After collecting data on their adaptation strategies, we realized that a combination of both types of activities could provide the best adaptation to climate change. To be sure, though, further on-farm studies are needed to confirm this recommendation.

Introduction

Responding to extreme weather events and climatic variability is a big challenge for farmers. We are optimistic that they will find good strategies to deal with these climate change events, but we don't know enough about how they are adapting and why.

There's a lot on a farmer's mind besides climate change: like the costs of running a farm and making a profit. We chose to get inside the mind of a farmer by getting onto the farm and studying apple farmers in three different regions: Kazuno and Nagano in Japan, and Elgin in South Africa.

Figure 1. Apple trees in Nagano.

Figure 2. Peaches from Kazuno ready for shipment.

Figure 3. Study sites in Japan. Click the links for a virtual tour on Google maps

Each of these regions have different climate suitability for growing apples now and into the future; Kazuno has the best prospects going forward, Nagano is in the middle, and Elgin faces the greatest challenges because it's already getting too hot to grow apples. Even though they still have good prospects in Kazuno, farmers have already begun adapting by starting to grow peaches as well, which are more heat tolerant. Similarly, farmers in Nagano and Elgin have mostly switched to more heat tolerant varieties of apples.

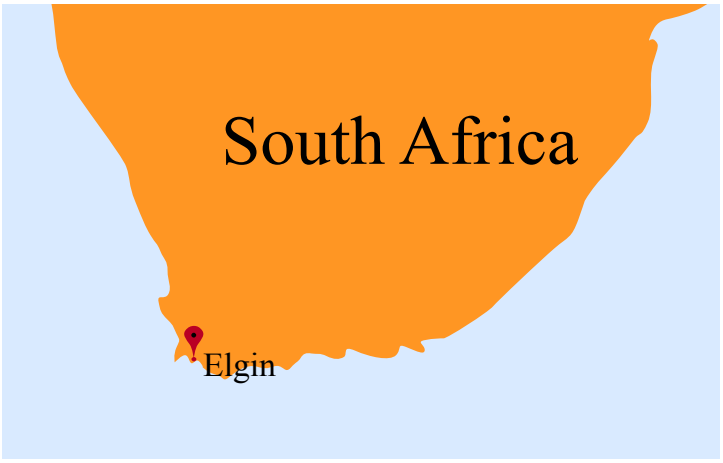

Figure 4. Study site in South Africa

Our objective is to figure out why farmers take certain actions instead of others. We also want to find out the role institutions play in the adaptation process, and categorize farmer actions as "bottom-up" or "top-down." If we better understand farmers' decision-making processes in response to climate change, we will better be able to support adaptation activities with a high chance of success.

Methods

We collected the data using a field study method of semi-structured interviews. We interviewed 40 farmers in Kazuno, 26 in Nagano, and 11 in Elgin. The farmers were asked two sets of questions, first just about their farming practices, general details of the apple trees on their farms, and how they sold their apples. The second set asked more about their experience of good and bad farming years, their experience of any long-term trends in production over those years, and what actions they have taken in response to the trends they've noticed.

The questions were left open-ended to avoid bias. This allowed farmers to express how and if they perceived any changes and whether or not they believed the changes were climate-based. We as researchers then tried to understand whether their adaptation activities were in response to climate-related events. We also talked to local apple production experts to confirm the responses we heard from farmers, and were able to conclude that the responses we received were representative for all farmers in the three regions we studied.

Results

We noticed a big difference depending on whether the farmers belonged to a co-op or not. A co-op farmer means the farmer sells over half their fruit with the help of a cooperative organization that works with many

	Kazuno and Nagano, Japan	*Elgin, South Africa*
The country's worldwide rank in amount of apples produced in 2010	16th	18th
Apple variety	Fuji, Tsugaru, Golden Delicious, Jonagold	Golden Delicious, Granny Smith, Royal Gala, Starking, Cripps' Pink, Fuji
Where sold?	Domestic consumption	Exported
Farmers' organization	Cooperatives and individual farmers	Cooperatives only
Number of farmers	350 in Kazuno, and about 1200 in Nagano	130
Climate	Cooler	Warmer
Other produce?	Some peaches	Some peaches & pears

Figure 5. Comparison between the study sites.

farmers; a non-co-op farmer sells their apples directly to customers or stores.

Changes reported by Kazuno farmers included typhoons, droughts, hail and frost, a fungal root rot disease, and reduced sales. Non-co-op farmers responded by planting some peach cultivars in a portion of their orchards. When a peach cultivar proved to grow well in the local climate and sells well, more farmers adopted this change. Non-co-op farmers also established their own company to sell juice from their apples. Co-op farmers with no direct customers of their own did not adopt such changes as planting peach or settling a juice company. Later on, however, co-op farmers adopted peach with the technical and financial supports from the local government and the farmers' co-op. They eventually managed to get a share in the mass market.

In Nagano, farmers reported problems such as paler fruits (which receive a much lower price), later ripening, increase of pests, and sunburn of fruits (due to higher temperatures in summer), all mentioned in relation to changes in climate. To deal with these problems, co-op farmers followed the advice of the experts and exposed their fruits to full sun by picking off the leaves around the apples while they were growing. Co-op farmers also practiced bagging the fruits to improve color, and planting new types of apples recommended for better coloring. Non-co-op farmers did not practice color-enhancement measures, claiming these did nothing to improve the quality of the fruit, and sold their apples as "apples without leaf-picking." They also did not change to new varieties. Both groups of farmers purchased crop insurance to protect against crop loss from hail and storms.

In Elgin, all the farmers belong to a co-op. The farmers reported worse harvests due to warmer winters. This is because trees need low temperature in winter to break "dormancy" and start producing fruit. They also reported heat waves in summer leading to "sunburn" of the apples. Farmers responded by changing the mix of chemicals they apply to bring trees out of dormancy, and by planting other types of apples that grow better with warmer temperatures in winter.

Discussion

The three regions we studied all showed different responses to changing climate patterns. We divided these responses with three aspects:

1. **intent** (whether responses were planned or independent)
2. **timing** (whether responses were reactive or pro active to the changes taking place)
3. **direction** (whether responses were top-down or bottom-up).

In our cases, non-co-op farmers took more proactive, bottom-up actions than co-op farmers, who were more reactive and top-down. It therefore seems like the type of adaptation action taken depends on the type of farmer. We must now investigate the roles of both individual farmers and farming institutions (co-ops) in adaptation policy. How can we link the actions of individuals and institutions for the best possible adaptation?

The key was the farmers' sales channels through which they establish relationships with consumers. If the farmers are directly connected with consumers, they can receive direct positive or negative feedbacks on new products such as peaches or "apples without leaf-picking." This makes bottom-up adaptation more likely. The top-down and bottom-up adaptation actions can indeed work together. Take the case of growing peaches (in addition

to apples) in Kazuno. This bottom-up innovation was born by trial-and-error by only four farmers. Later on, it was viewed as successful and adopted by institutions in a top-down manner, and then the co-op farmers joined for even greater success. It's also worth mentioning that not all adaptations were made only because of climate change; there is a range of factors that farmers consider when making changes, and adapting to climate change is just one element of the multiple challenges they face.

Conclusion

Farmers face a lot of decisions, especially with the additional unpredictable effects of climate change. Consumers can support them by getting to know them better and valuing farm products by genuine quality rather than just appearance or brand name. Oddly shaped fruits can be great for smoothies, jams, and juices for example! In this way, you can join the farmers' attempts to adapt to climate changes and enjoy the fruits of the farmers' efforts.

Students can all learn the challenges, such as adaptation to climate change, that affect their food system and realize that consumers can play a more active role in the challenges by "voting with their dollars". It is important to know the efforts of local as well as overseas farmers amongst today's changing environment. If you're really passionate about the idea of farming and climate change, become an "adaptation scientist" and perform more studies, because we need more results to make our food system better adapted to the changing world!

Glossary of Key Terms

- Climate change = a change in climate patterns apparent since the mid 20th century and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels. Example: Many scientists attribute climate change to man-made causes such as fossil fuel energy use.

- Bottom-up actions = Actions or adaptations that are initiated by individual farmers. Example: The Kazuno farmers started a bottom-up action of growing peaches in addition to apples.

- Top-down actions = Actions or adaptations initiated by co-ops or institutions and recommended to all farmers associated with that institution. Example: The Elgin farming association told all its farmers to plant apples that grow better in warmer winters as a top-down action in response to a change they noticed.

- Adaptation = actions of adjusting practices, processes, and capital in response to the actuality or threat of climate change. Example: a farmer decides to grow a diverse variety of crops as an adaptation. That way, if one fails due to drought, another more drought-resistant variety may succeed.

- Consumer = a term in economics that refers to a person who purchases good and services for personal use. Example: Every time you go to a store and buy something you are a consumer!

References

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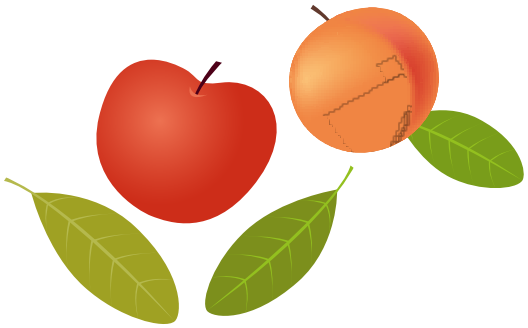
Additional resources on farm adaptations to climate change:

http://blog.nature.org/science/2013/06/25/climate-change-farming-adaptation/

Teacher's guide

Grade level: High school

Key terms: climate change, adaptation, policy, agriculture, Japan, South Africa, apple, farming, case study