

# To Farm or Not to Farm

## Teacher's Guide



### Overview

The Financial Instruments Sector Team (FIST) at the International Research Institute for Climate and Society (IRI) at Columbia University helps people overcome climate risks and improve food security by using climate information and forecasts to create financial tools like index insurance. This lesson introduces the concept of weather index insurance and follows a farmer's decision-making process as they understand the risks that could affect their farms from year to year. In the activity, students will be put in the place of farmers planning for the future and model financial decision making as well as crop strategy under uncertainty.

### Glossary

Climate Change- a change in the average conditions — such as temperature and rainfall — in a region over a long period of time. NASA scientists have observed Earth's surface is warming. (Source: NASA)

Drought- a drought is a period of unusually persistent dry weather that continues long enough to cause serious problems such as crop damage and/or water supply shortages. (Source: NASA)

Food Security- availability at all times of adequate world food supplies of basic foods to sustain a steady growth of food consumption and to offset changes in food production and prices. (Source: United Nations)

Insurance- a means of protection from financial loss. It is a form of risk management, primarily used to safeguard against the risk of a contingent or uncertain loss. (Source: Wikipedia)

Risk- exposure to the chance of injury or loss; a hazard or dangerous chance. (Source: Merriam-Webster)

### Lesson Information

Subject: Science

Grade Level: Middle and High School

NGSS:

MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

MS-ESS3-2 Earth and Human Activity

MS-ETS1-1 Engineering Design

### Learning Objectives

- Students will learn about the impacts of drought on certain parts of the world.
- Students will be able to understand how index insurance can help address climate risk.
- Students will interpret the different pressures farmers face when making financial plans

### Materials Needed

- Container
- Different colored markers
- Tokens (representing money)
- Playing cards

### Additional Resources

- Introduction Video
- Recording of Lesson
- Earth Institute Lesson
- Adaptation Video

# Activity 1: To Farm or Not to Farm

Time Required:  
45 minutes

## Background Information

Both climate variability and climate change impact agriculture all over the world. Climate variability consists of the natural processes that can cause periods of rainfall or drought, but man-made climate change is making impactful climate events more intense. Roughly speaking, climate variability is a song with high and low notes, but climate change impacts the song, changing all the notes (e.g., a key change), sometimes making the song more difficult to sing.

Climate change uniquely impacts different regions of the world. Certain places experience increased periods of drought, while others experience extreme precipitation that causes flooding. Some places will experience both!

This means that farmers will experience poor crop years more frequently as the climate changes. It is important to build resiliency in farms by getting as much productivity out of good years as possible. Such a cushion created by the good years will alleviate damage done to farmers when a bad year comes.

That's where insurance comes in. Index insurance shrinks the risk of loss while growing the opportunities for the farmers to do well each year, by using rainfall and satellite data around the world. Satellite imagery and index insurance help farmers assess risk, make more money in the good years, and access insurance payouts in the bad years.

## Goal of the Activity

The goal of the Financial Instruments Sector team is to develop projects with farmers to help them have better yields and thus make more money. When farmers make more money, they have the opportunity to buy insurance to protect against bad years, take out loans for higher quality seeds, and access other resources.

In this activity, students will learn first hand what it is like to manage a farm under good and bad years and will be able to understand how index insurance can help them to protect their resources.



# Activity 1: To Farm or Not to Farm

Time Required:  
45 minutes

## Reducing Risk

In this activity, students will be focusing specifically on drought risk and the impact on insurance decisions. The reason there is a risk with planting crops for farmers, especially while climate change is intensifying, is that precipitation patterns are changing and becoming less predictable. This means that there will be years when the weather will be fine, which we will call “ok years” in this activity, and years when there will be drought or bad years.

As climate change begins to change landscapes all over the world, farmers need to take advantage of the ok years while they can, and adapt their farms to an ever changing climate. Local climate variability can cause different precipitation patterns and droughts, but as the global mean temperature rises, these natural variability processes can be strengthened - ensuring that farmers will see more bad years in the future.

There are several ways to reduce risk like changing crop patterns, building savings, working with community networks, or purchasing drought insurance. The FIST team works to see which would be the most successful for the farmers in their communities.

## Getting Started

There are two options for completing this activity, one without a monetary (math) component, and one with a monetary (math) component. See the last page in this document for the monetary (math) game option. After selecting which option of the game to play, educators can choose whether to have students complete this activity in teams (recommended for larger classrooms) or individually. Students can keep track of their farms on their own on pieces of paper or handheld whiteboards, or keep track on a whiteboard or chalkboard for the class to watch along.

In this activity, the students will have a hat, or some sort of container they can place things in, and four items. One of the four items should be different from the rest or be marked to differentiate it from the other three. For example, three blue markers and one red marker.

The three similar items will represent the ok years while the different item is a drought year. This represents a probability distribution with a 75% chance of having an ok year and a 25% chance of there being a drought year.



# Playing the Game



## Part 1: Drought

The instructor will now have the students pick their own “years” out of the container, but as a class, they will collectively discuss the result. Note: if it is too difficult to have each student pick their own “year”, the instructor can pick one year for the entire class.

Without looking inside, have each student randomly pick one item out of the container. What “year” did you get?

The students will answer with either drought or ok year. It is important to note that even though there is a one in four (25%) chance of getting the drought (or red marker), that it may not always happen. There will probably be a mix of students that had drought or non-drought years. This is a great way to illustrate that there may be a higher probability of having a non-drought year, but there is still a risk that they will have a drought year.

There is also the possibility that they can go multiple years without a drought because the process resets each turn, but it is also possible to get a drought year every time. The question then becomes: how can farmers manage risk?

The instructor will have all the students place their items back in the container to pick again with the next question.

## Part 2: Seeds

This round, students have the opportunity to buy high-quality, locally bred seeds. If they have an ok year in this round, they will receive a yield twice as large as the yield using the old seeds. However, if there is a drought, they cannot buy any new seeds in the following round because they did not produce any crop, and they could risk losing their farm. Students should then answer the next question:

Would you like to take the chance with high-quality seeds or not take the chance?

The students will have to choose whether or not they would like to take the risk. Once they have decided, the students will shake their container and then randomly select an item from the container, still with a 25% chance of drought. If they elect to take the risk and get a good year, they will double their earnings. But, if it is a drought year, they lose their farm. Many farmers face these difficult odds when making business decisions.



# Playing the Game

## (Continued)



### Part 3: Insurance

This round, students can pay a fee to protect themselves from the risk of drought. With this plan, if there is a drought, they can get a payout to cover their losses so they do not lose the farm. This is drought insurance. It would cost 25% of their earnings, each round. Educators should ask:

Do you want to pay the fee?

The students will decide on whether they would like to buy insurance or not. The instructor should explain that students will not gain anything if they choose insurance and it is an ok year; however, if there is a drought year, they will at least not lose their farm.

### Part 4: All Together Now

Now they have discussed insurance, students have the ability to choose both which seed they would like to plant, and whether or not they would like to buy insurance. Teachers can ask:

What financial decisions would you like to make this round?

If the students choose insurance, they will be more protected from drought with their high productivity seeds, and will not lose their farm. The instructor should emphasize that there are many uncertainties in probabilities which is why these decisions are so difficult and important for farmers to make. These questions can be repeated multiple times in a variety of orders. There is freedom and flexibility to change the length or focus of the lesson.



# Conclusion



## Final Questions

If you were a farmer, would you want to buy insurance? Why or why not?

Teachers can help guide the discussion by encouraging students to think of their own experience in the game and whether the insurance benefitted their farms.

Why may some farmers still be hesitant to buy insurance, even after this lesson?

Teachers can help guide the discussion by highlighting the fears that some farmers may hold about paying a lot of money for a service that is not guaranteed to be needed each season.

## Wrap Up

This methodology is used by the FIST team to see if farmers would be interested in index insurance. These games help inform research questions, teach insurance concepts to the farmers, and help design insurance concepts to fit an individual region.

Index insurance allows the FIST team to measure the demand of the farmers without creating the product first. Additionally, such insurance can be refined based on local contexts and preferences, like whether farmers would buy insurance as individuals or as groups, or if informal lending mechanisms are more effective than formal insurance. Finally, researchers have found that these simulations do increase the demand for insurance if it is offered in the area.

### Subject Connection: MATH

This lesson focuses predominantly on probability. There is an opportunity for the instructor to integrate coursework for middle school math or statistics by further emphasizing the statistics behind this game.

# Optional Extra Challenge

Time Required:  
1 hour

## (Math Component)

### Instructions

In this version of the game, there are monetary consequences for the decisions students make. There is a separate slide show for this version of the activity. Students should keep track of their purchases on a piece of paper. The game will still be played by drawing objects out of a container, with a 25% chance of drought.

However, in this version, if a student draws an ok year, they get \$100. If a student draws a drought year, they get \$0. Everyone starts this game with \$50 and the ability to purchase one packet of seeds. Money is rolled over each round, but money made in previous games does not rollover. Players lose their farms when they no longer have the ability to purchase a packet of seeds.

Each game should have 3-5 rounds, or until only one farm remains. If someone loses their farm in rounds 1-3, they can re-join and continue playing.

### Round 1

In this round, students will only have the choice of low quality seeds and will draw to see if they are experiencing a drought year or an ok year.

### Round 2

In this round, students will choose between low-quality seeds and high-quality seeds. If they have an ok year with low-quality seeds, they get \$100, but if they have an ok year with high-quality seeds, they get \$200. However, if they have a drought year, they get \$0 regardless of seed quality and risk losing their farm if they don't have enough savings.

### Round 3

In this round, students will only have the choice of low-quality seeds, but they can choose to purchase insurance to protect themselves from drought losses. Insurance costs \$25 and does not add any value to ok years, but during drought years, it gives students a payout of \$100. Insurance must be re-purchased each round.

### Round 4

In this round, students will have the ability both to choose which seed quality they want and whether or not they want to purchase insurance. The purpose of this game is to see how long each student's farm can last, based on their financial decision-making.

