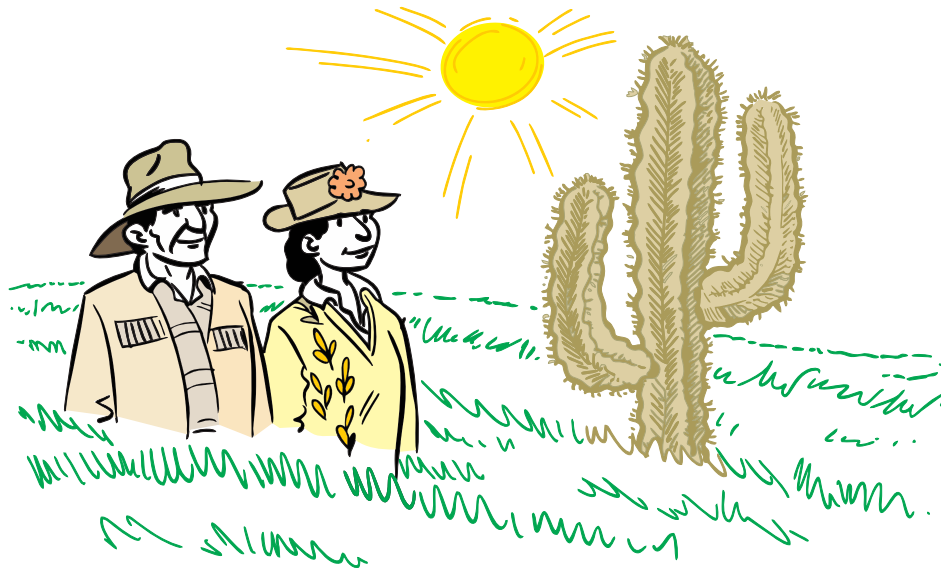


# FEEDING NINE BILLION: CLIMATE CHANGE AND FOOD SECURITY



[HTTP://WWW.FEEDINGNINEBILLION.COM/](http://www.feedingninebillion.com/)

HELLO, MY NAME IS EVAN FRASER AND I WORK AT  
THE UNIVERSITY OF GUELPH IN ONTARIO CANADA.

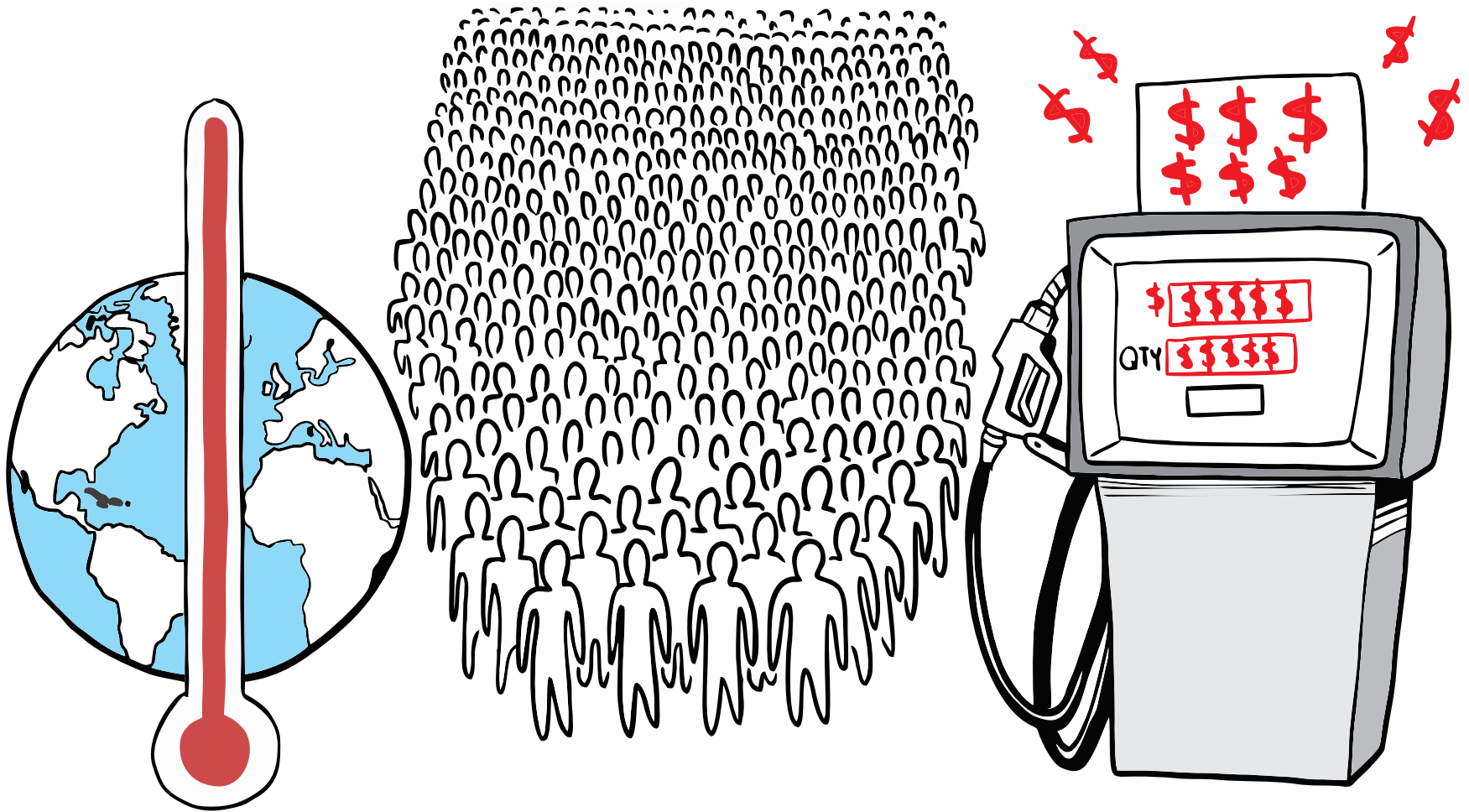


MOSTLY, WHAT I DO IS TO TRY AND UNDERSTAND ONE OF THE BIGGEST ISSUES  
FACING OUR WORLD OVER THE NEXT 50 YEARS ... HOW CAN WE FEED 9 BILLION  
PEOPLE?

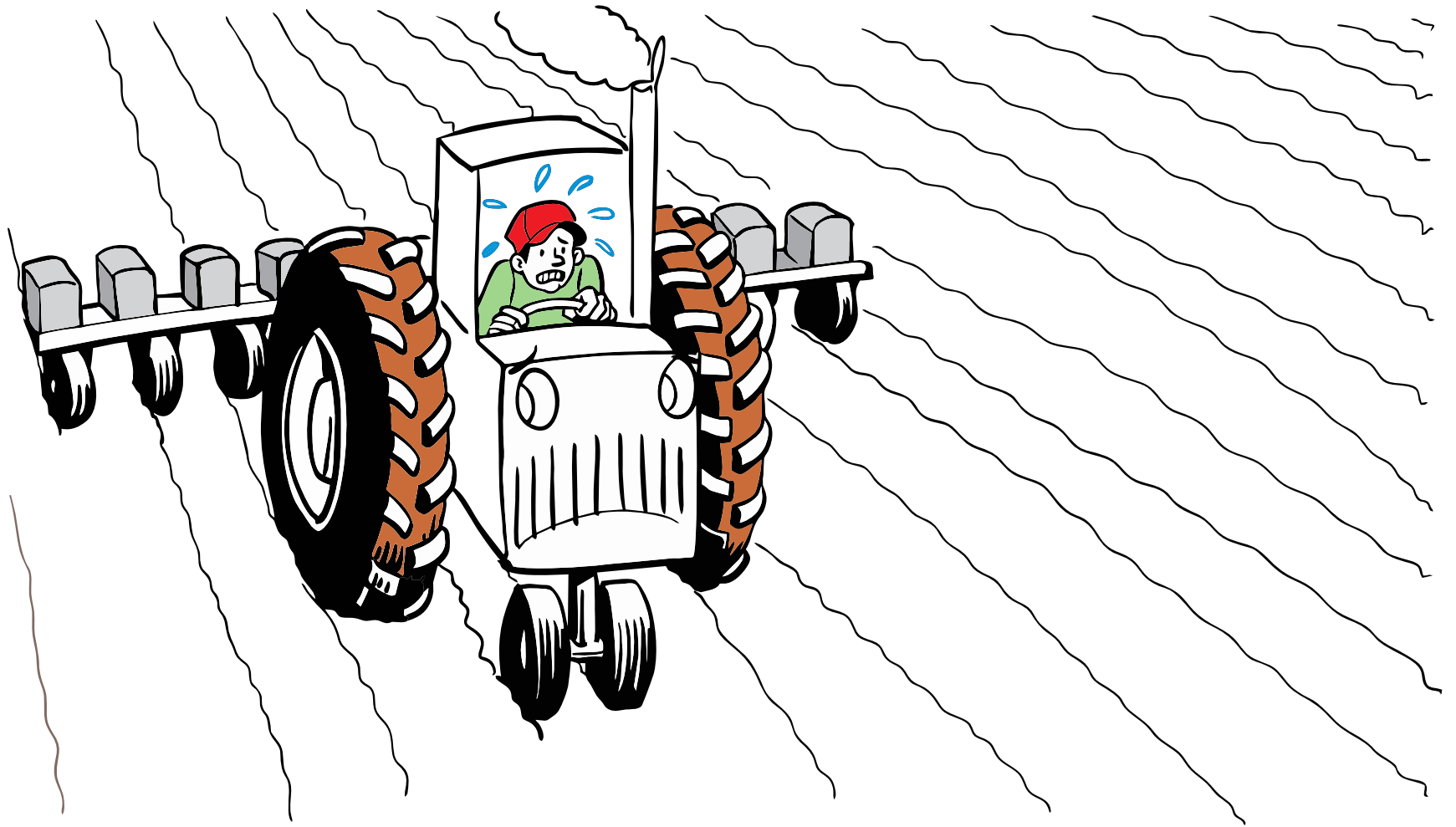
UNIVERSITY  
of GUELPH

CHANGING LIVES  
IMPROVING LIFE

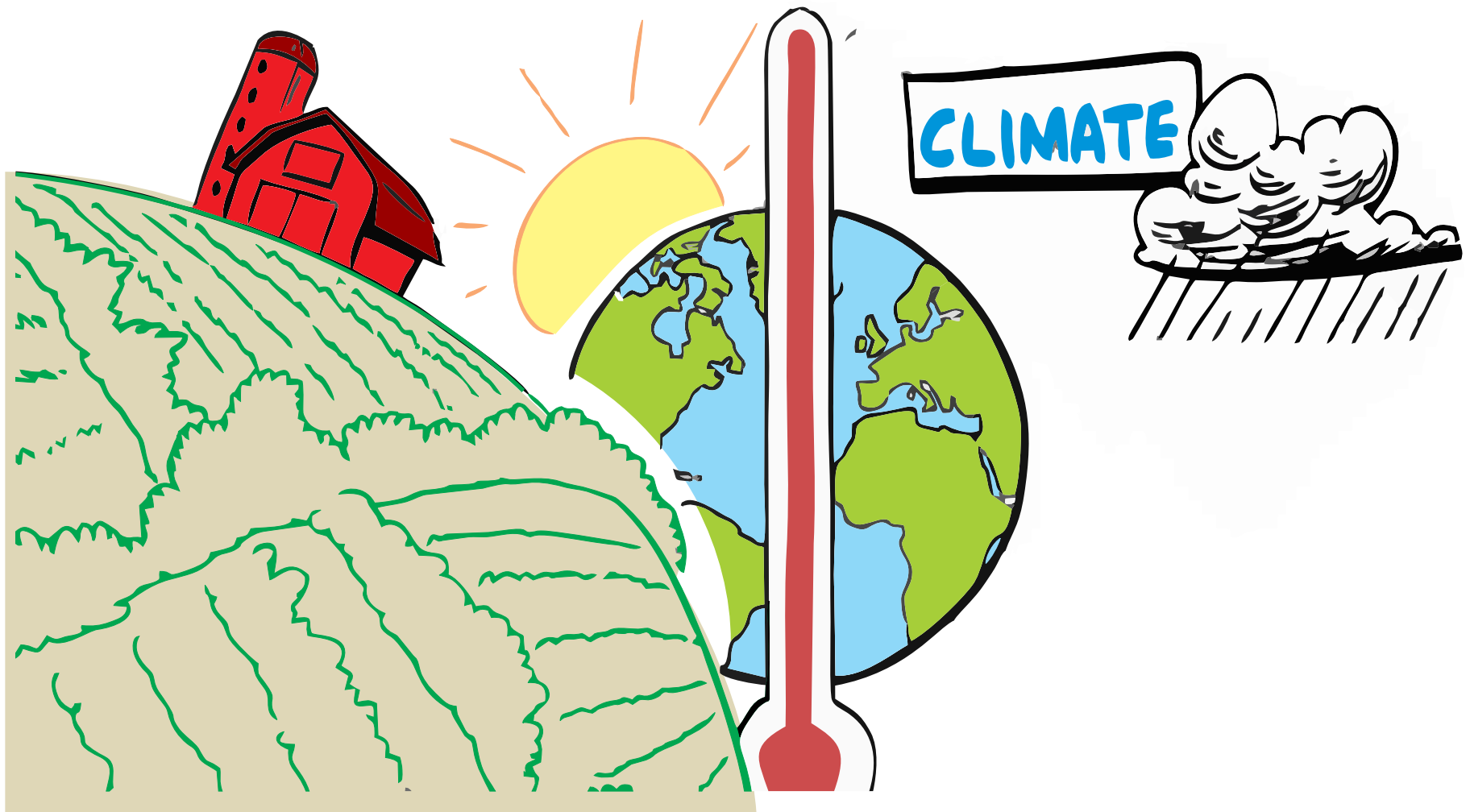
THIS VIDEO SERIES SHOWS THAT CLIMATE CHANGE, POPULATION GROWTH, AND HIGH ENERGY PRICES. . .



... MEAN THAT FARMERS MAY STRUGGLE TO PRODUCE ENOUGH FOOD FOR ALL OF HUMANITY  
OVER THE NEXT GENERATION.



THIS VIDEO IS GOING TO EXPLORE HOW CLIMATE CHANGE MAY AFFECT GLOBAL FOOD SECURITY.



THE LITERATURE ON CLIMATE CHANGE AND GLOBAL FOOD SECURITY IS, QUITE FRANKLY, SCARY. IN IT, WE LEARNED THAT THE WORLD IS GOING TO BECOME HOTTER AND DRYER IN SOME KEY REGIONS(1) . . .

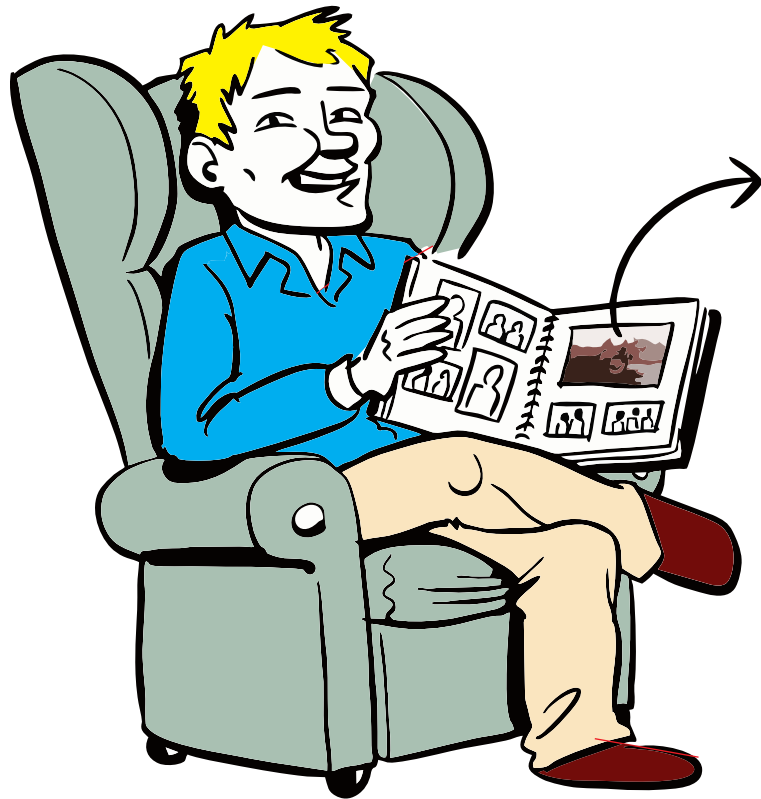


AND WHILE CROPS ARE LIKELY TO FLOURISH IN AREAS SUCH AS PARTS OF CANADA THAT WILL ENJOY LONGER GROWING SEASONS(2), OTHER AREAS ARE LIKELY TO SUFFER; SUCH AS MUCH OF AFRICA, AND IN SOME OF OUR MOST IMPORTANT GRAIN PRODUCING REGIONS LIKE THE US GREAT PLAINS AND AUSTRALIA(3).

BUT ONE THING WE DON'T KNOW ALL THAT MUCH ABOUT IS HOW FARMERS ARE GOING TO REACT TO THIS PROBLEM. THIS IS AN EXTREMELY IMPORTANT ASPECT OF THE EQUATION.







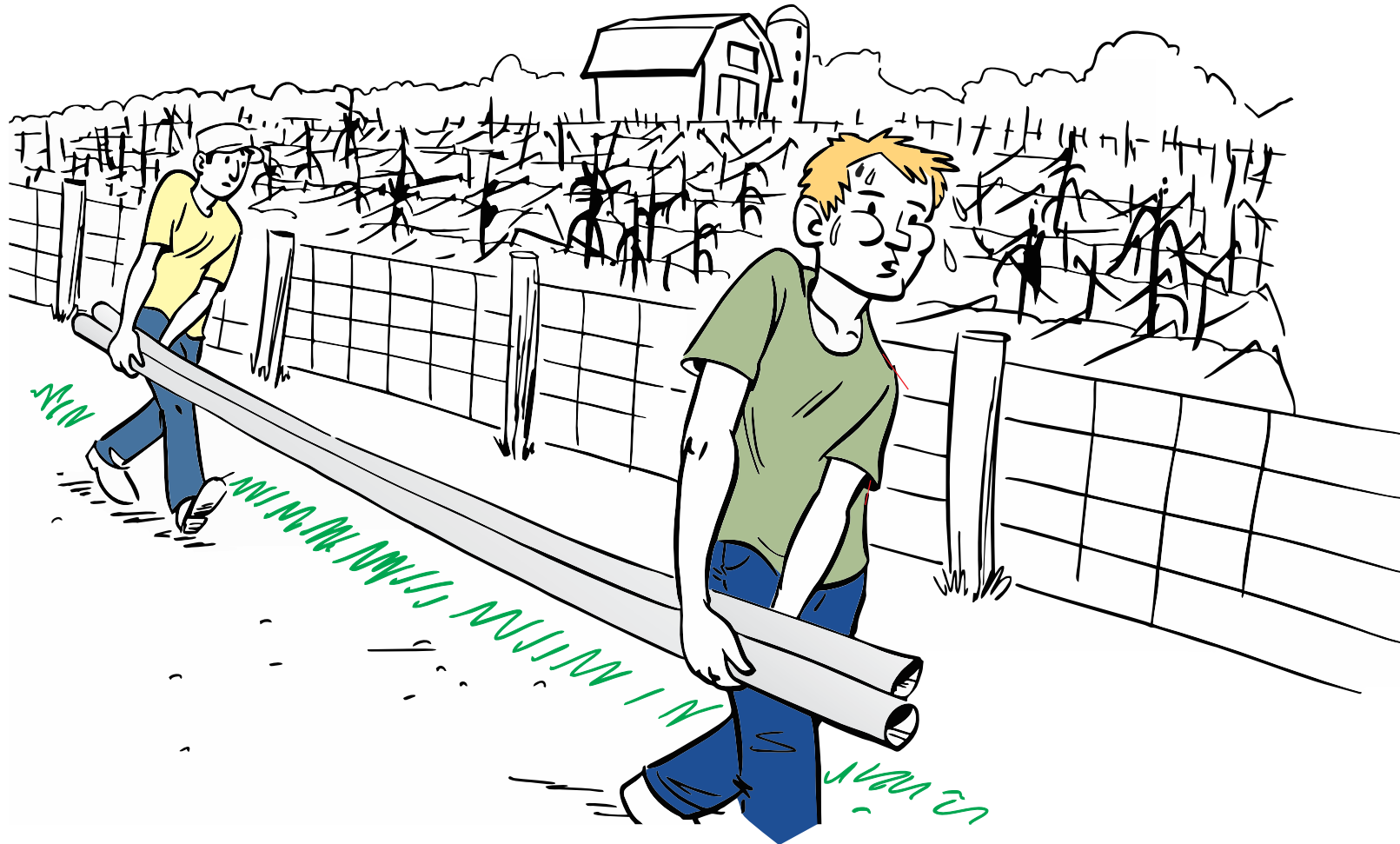
TO ILLUSTRATE THIS LET ME TELL YOU A STORY ABOUT MY OWN CHILDHOOD. MY GRANDFATHER WAS A FARMER CLOSE TO NIAGARA FALLS IN CANADA. (AND THIS IS A PICTURE OF ME SITTING ON HIS LAP WITH MY BROTHER NICK AND MY COUSINS DAVE AND IAN IN THE BACK.)





ONE SUMMER WHEN I WAS ABOUT 17 WE HAD A BAD DROUGHT. THE SOIL BECAME QUITE DRY AND CRUMBLY AND THE CORN CROP STARTED TO FALL OVER. BUT MY GRANDFATHER DIDN'T DESPAIR.

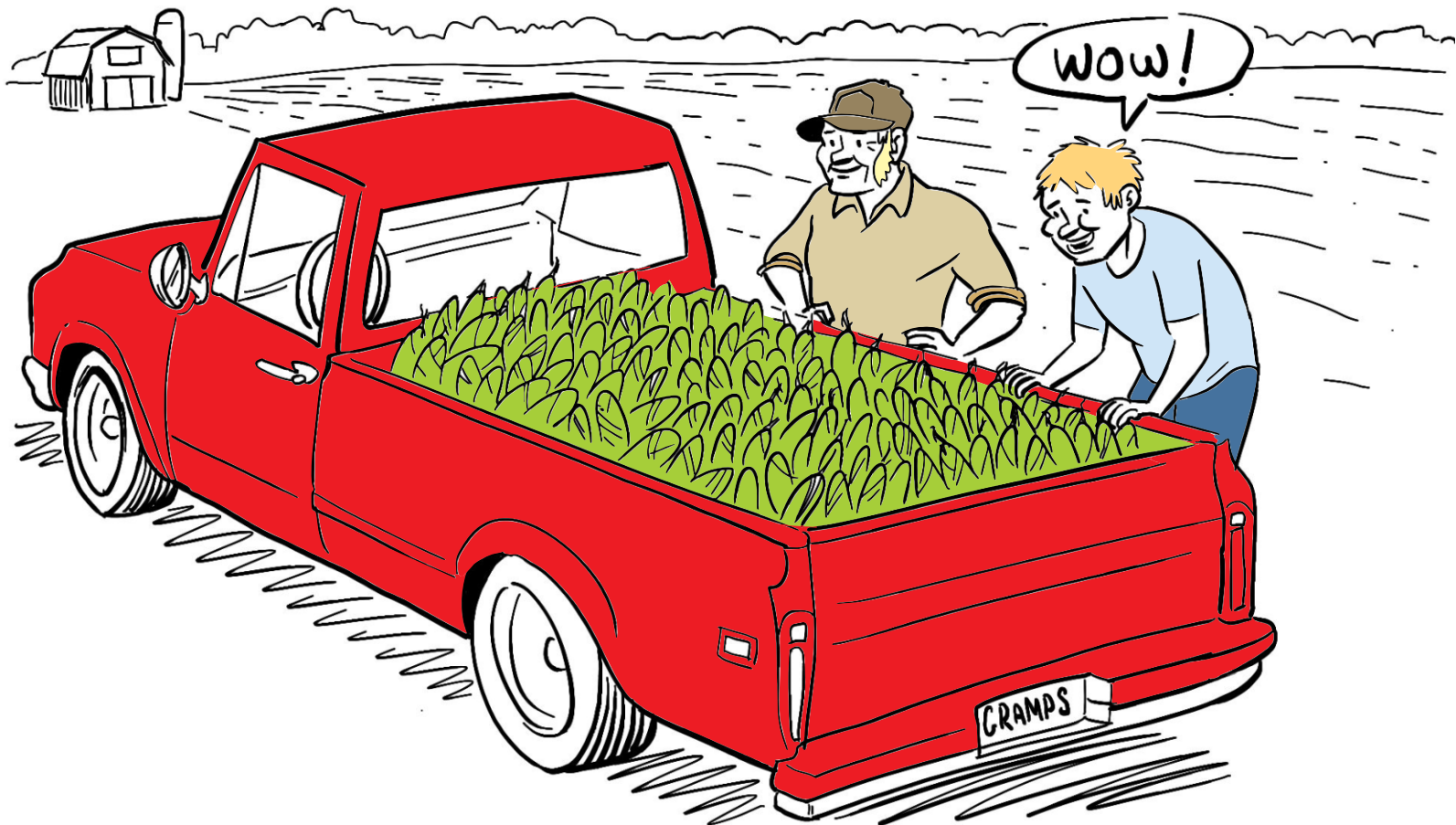
HE HAD ME AND ANOTHER LAD SPEND A VERY ARDUOUS FEW DAYS DRAGGING IRRIGATION  
PIPES ALL OVER THE FARM.



WE ALSO EASED OUR WAY BETWEEN THE GROWING PLANTS, HELD EACH ONE UP IN TURN,  
AND THEN, WITH OUR FEET, BUTTRESSED EACH PLANT WITH A SMALL PILE OF SOIL.



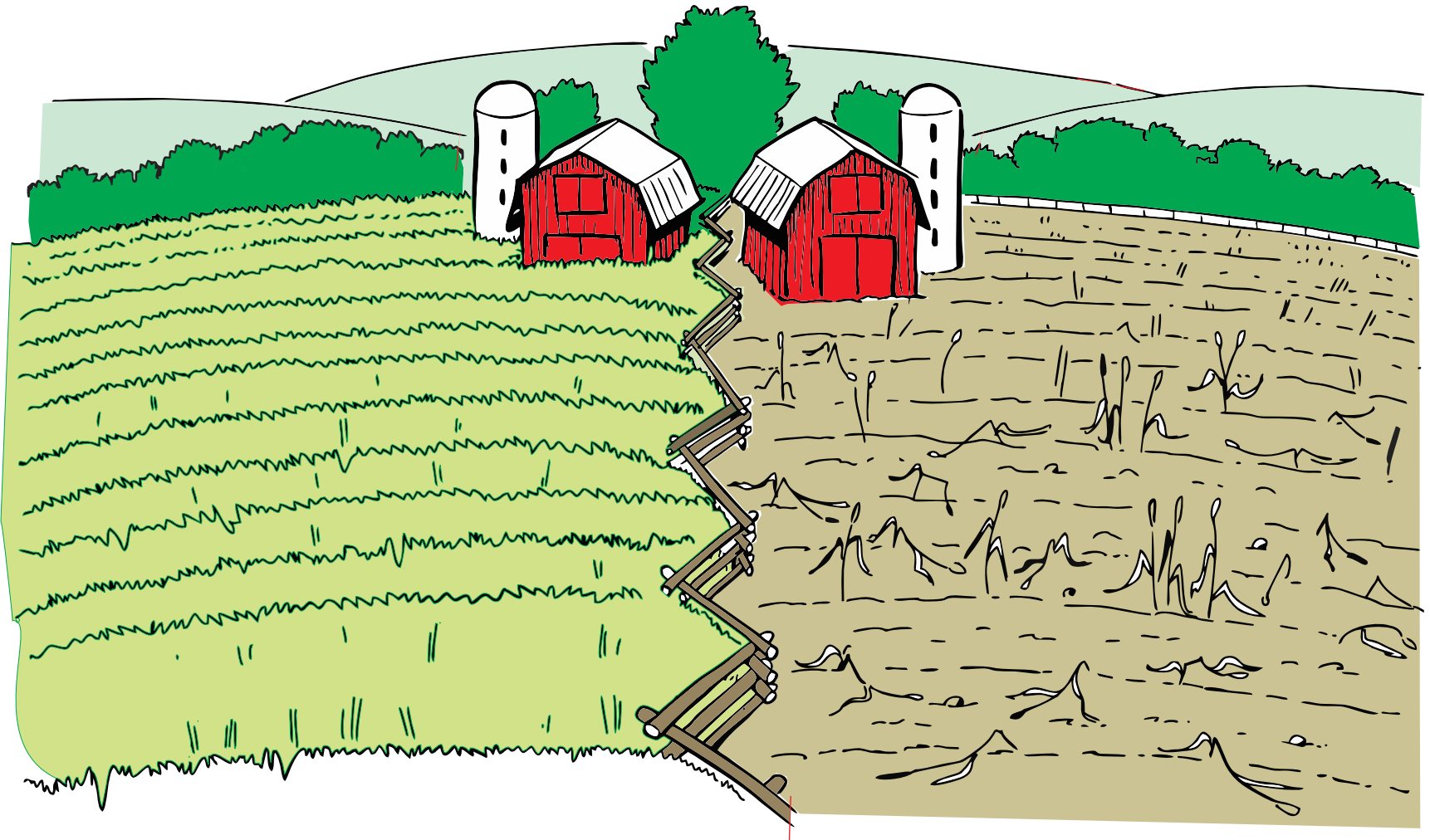
AS A RESULT OF THESE ADAPTATIONS, WHEN I RETURN TO THE FARM TO HARVEST THE CORN,  
I WAS IMPRESSED THAT THE YIELD SEEMED FINE.



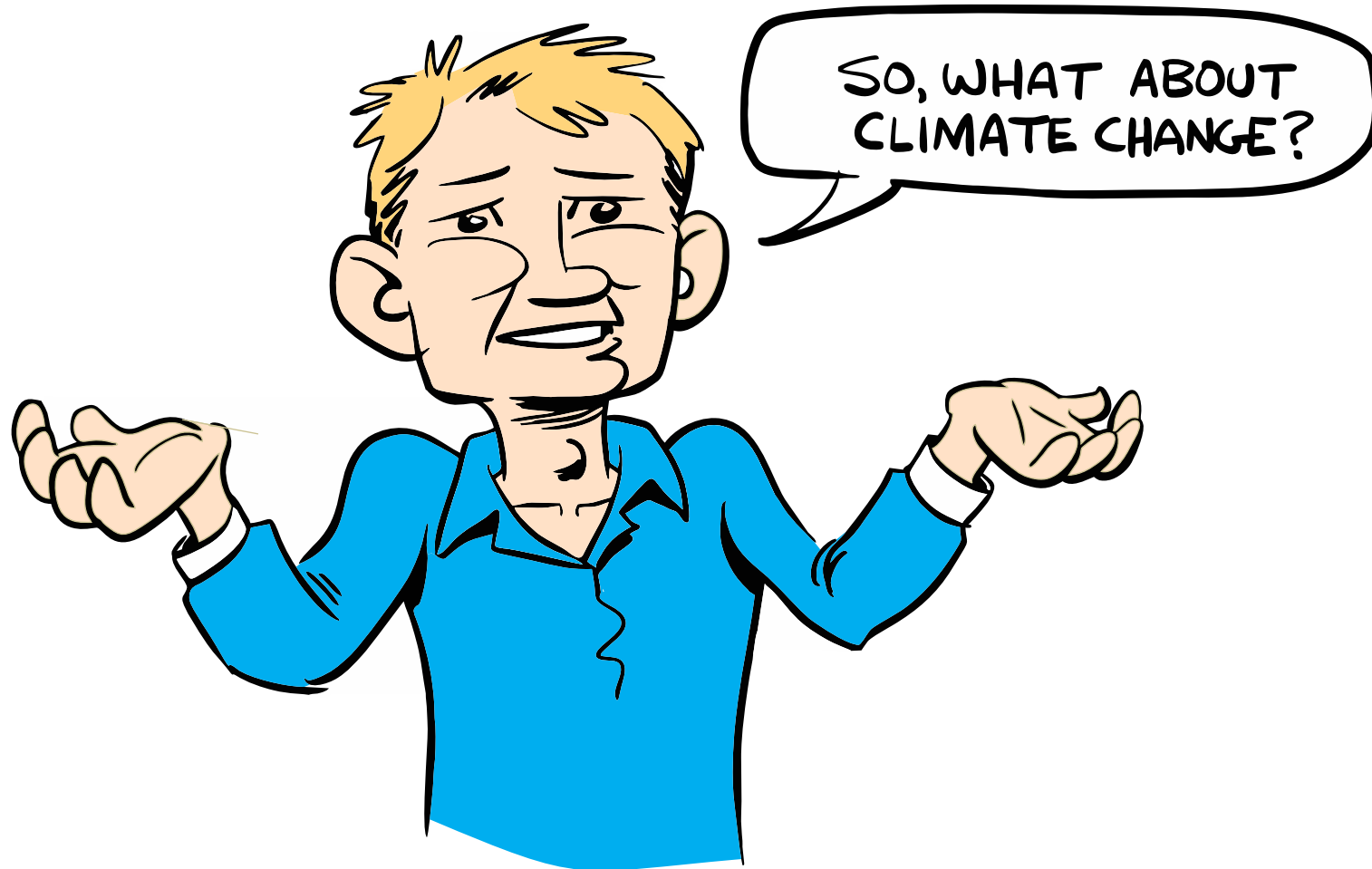
ABOUT 10 YEARS LATER, MY GRANDFATHER WAS IN HIS LATE 80S, AND ANOTHER DROUGHT HIT. BUT BY THEN, MY GRANDFATHER WAS TOO OLD TO FARM, AND I WAS LIVING IN THE CITY. SO THE LABOUR WASN'T AVAILABLE TO ADAPT TO THE DROUGHT AND THE CORN CROP WAS RUINED.



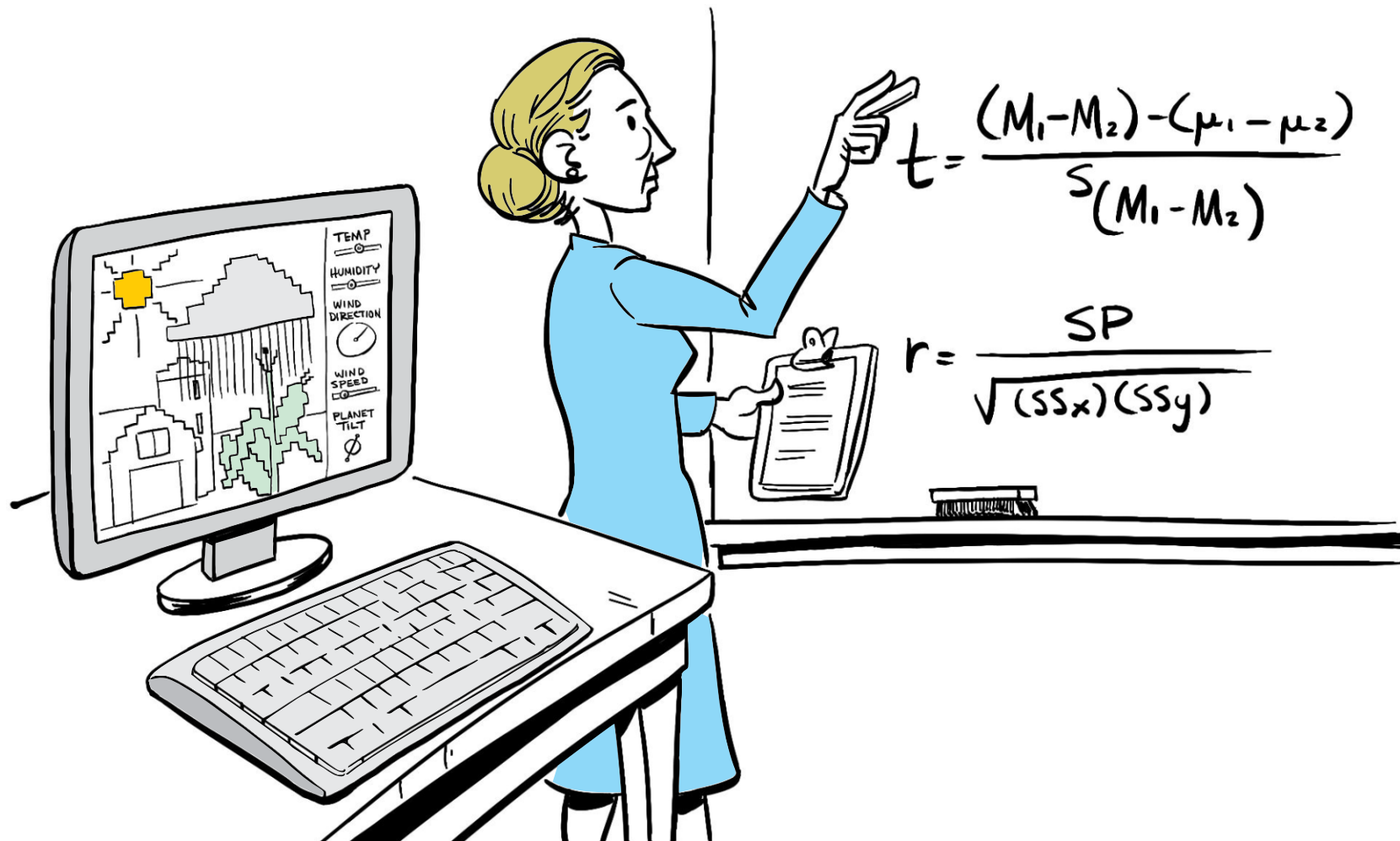
**THIS STORY IS IMPORTANT BECAUSE IT ILLUSTRATES HOW THE SAME FARM WITH THE SAME CROP AND EXPERIENCING THE SAME WEATHER-RELATED PROBLEM CAN PRODUCE VERY DIFFERENT EFFECTS.**



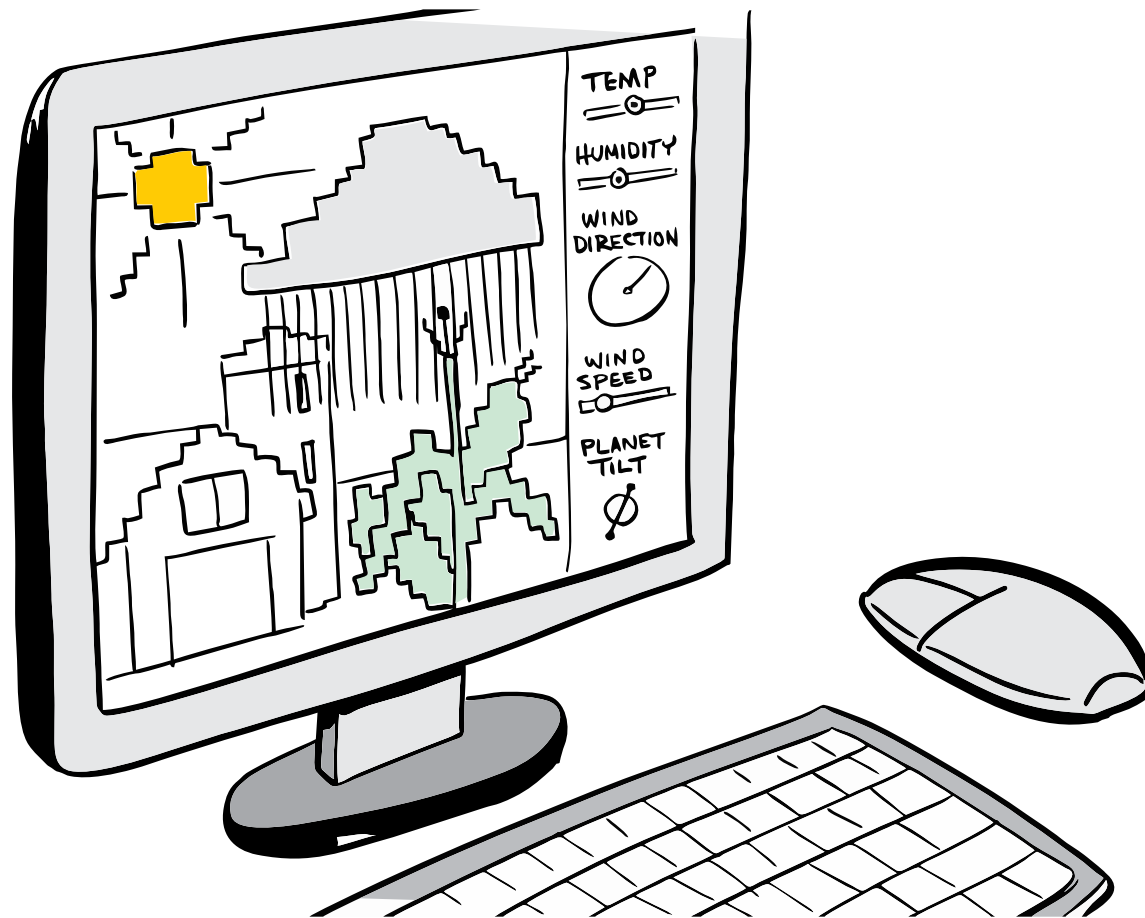




CLIMATE MODELLERS USE MATH, CHEMISTRY AND PHYSICS TO PREDICT THE EFFECT OF CLIMATE CHANGE ON GLOBAL FOOD SECURITY(4).



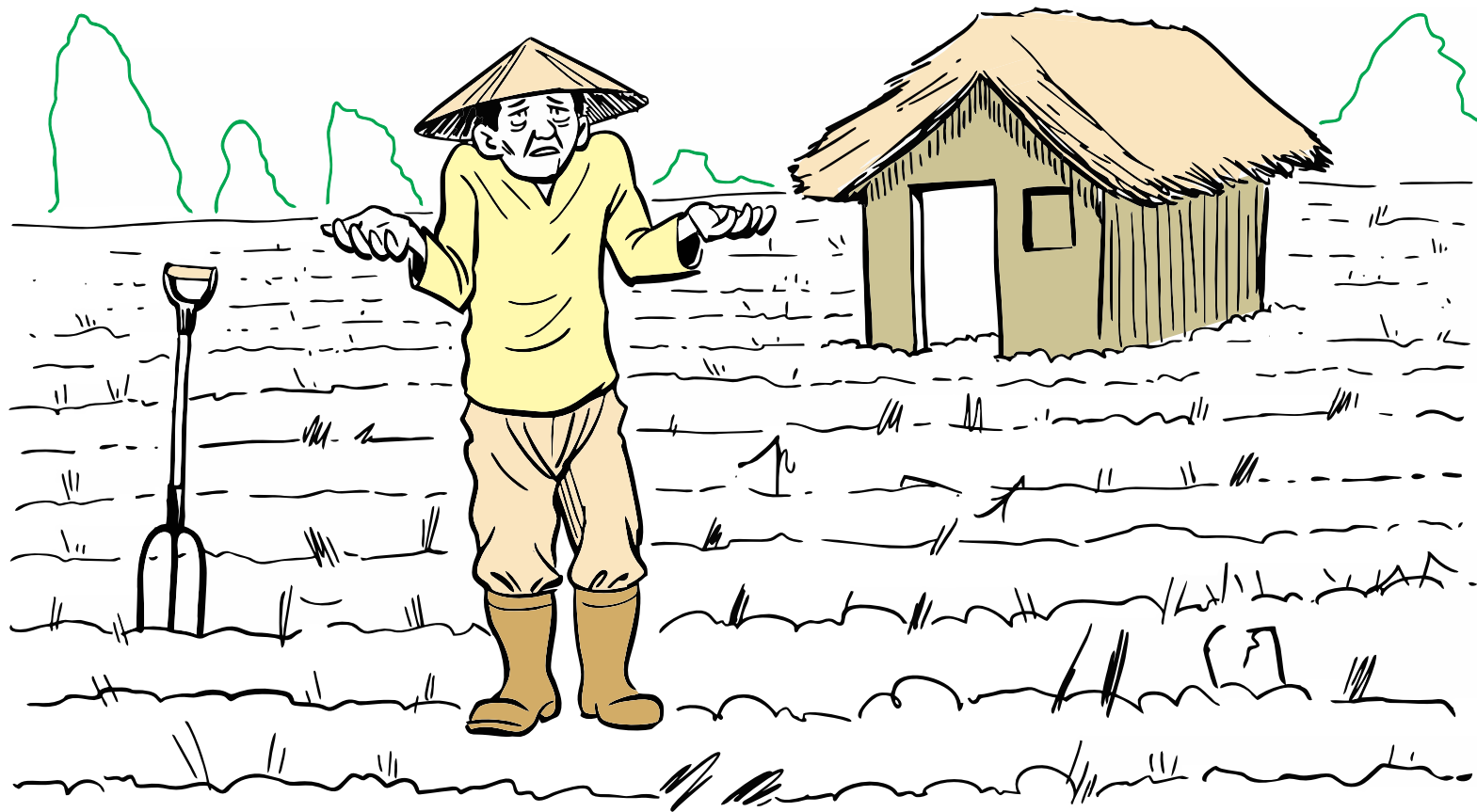
IN ESSENCE THEY HAVE COMPLICATED EQUATIONS THAT ESTIMATE HOW CROP YIELDS MAY CHANGE AS TEMPERATURE AND PRECIPITATION CHANGES.



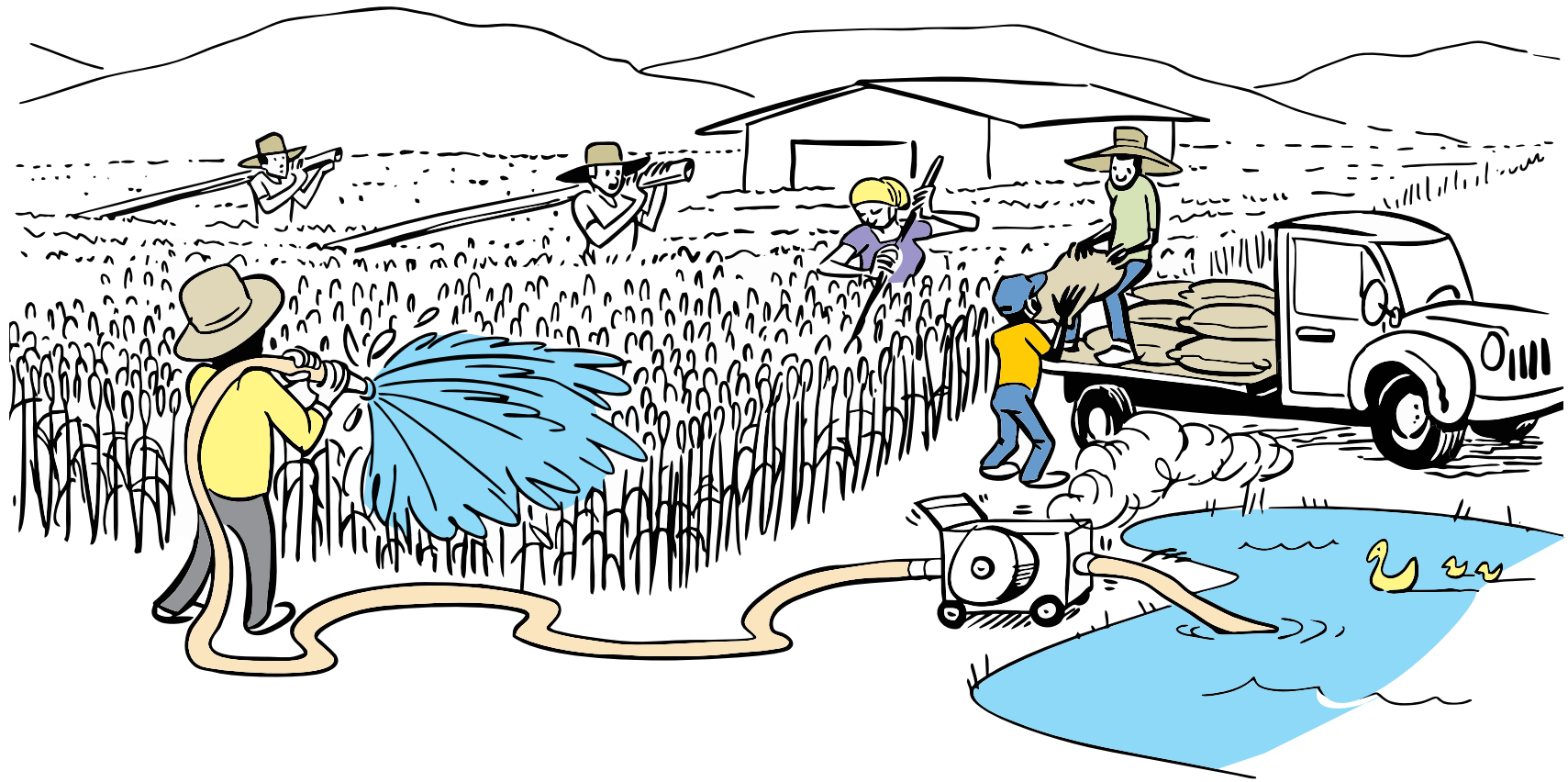


ONE MODELLING EXERCISE THAT I WAS INVOLVED IN TRIED TO ESTIMATE THE EFFECT OF CLIMATE CHANGE ON CHINA'S WINTER WHEAT CROP.(5)

IN THIS STUDY WE WERE ABLE TO DEMONSTRATE THAT IF FARMERS DID NOTHING TO ADAPT THEN THE EFFECT OF CLIMATE CHANGE ON WHEAT COULD BE CATASTROPHIC. (6)

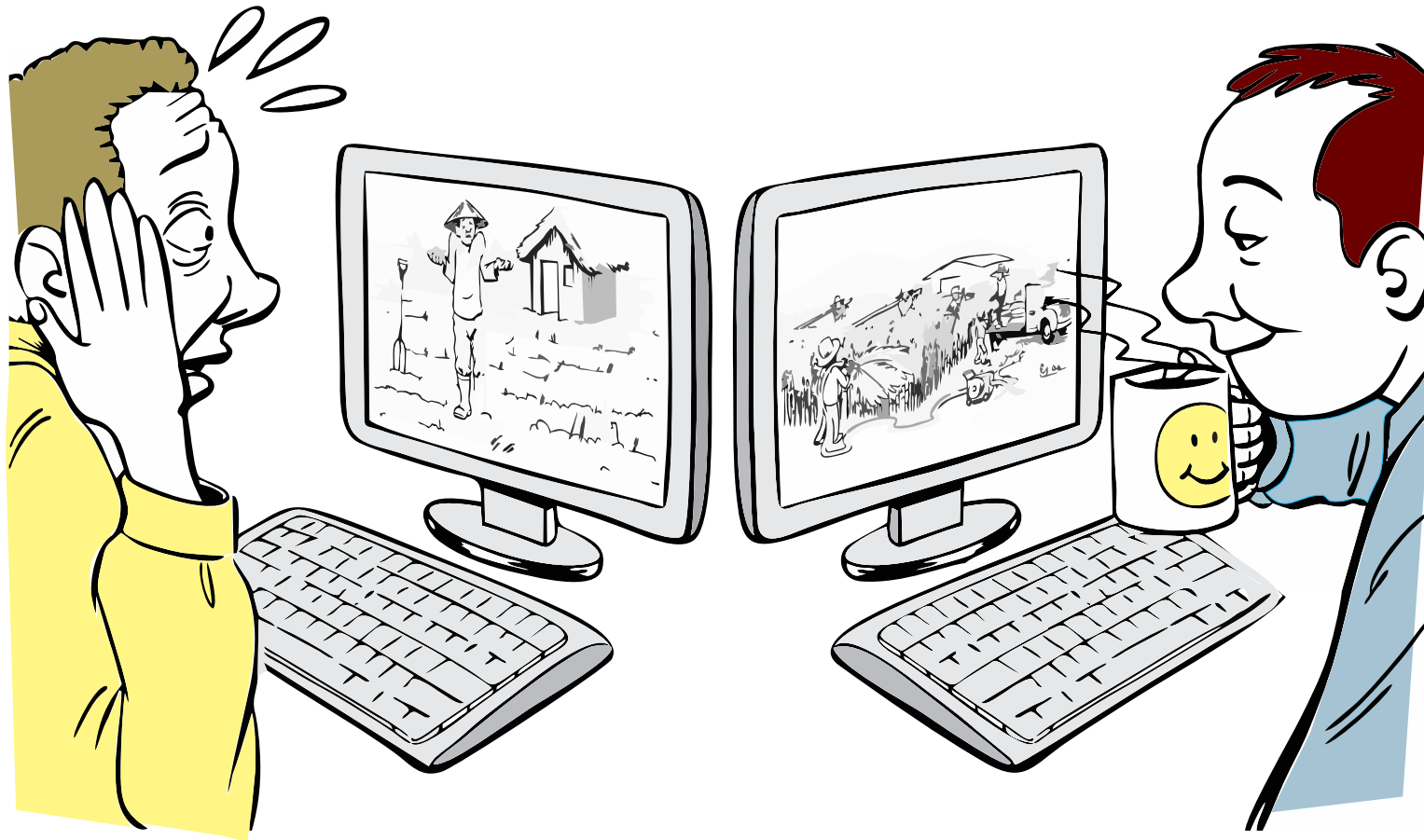


BUT IF FARMERS WERE LIKE MY GRANDFATHER IN THE FIRST DROUGHT...THAT IS IF THEY HAD ACCESS TO THE TOOLS THEY NEEDED IN ORDER TO ADAPT TO THE HOTTER DRIER CONDITIONS OF THE FUTURE THEN CLIMATE CHANGE WAS NOT PROJECTED TO HAVE ALL THAT SIGNIFICANT AN EFFECT ON YIELD(7).





IN ESSENCE OUR CLIMATE MODELS GIVE US DIFFERENT VIEWS OF THE FUTURE(8). SOME OF THESE VIEWS ARE VERY SCARY.



BUT THE MODELS ALSO ARE OPTIMISTIC IN THAT THEY SHOW US HOW AND WHERE CLIMATE CHANGE ADAPTATION CAN BE MOST EFFECTIVE.

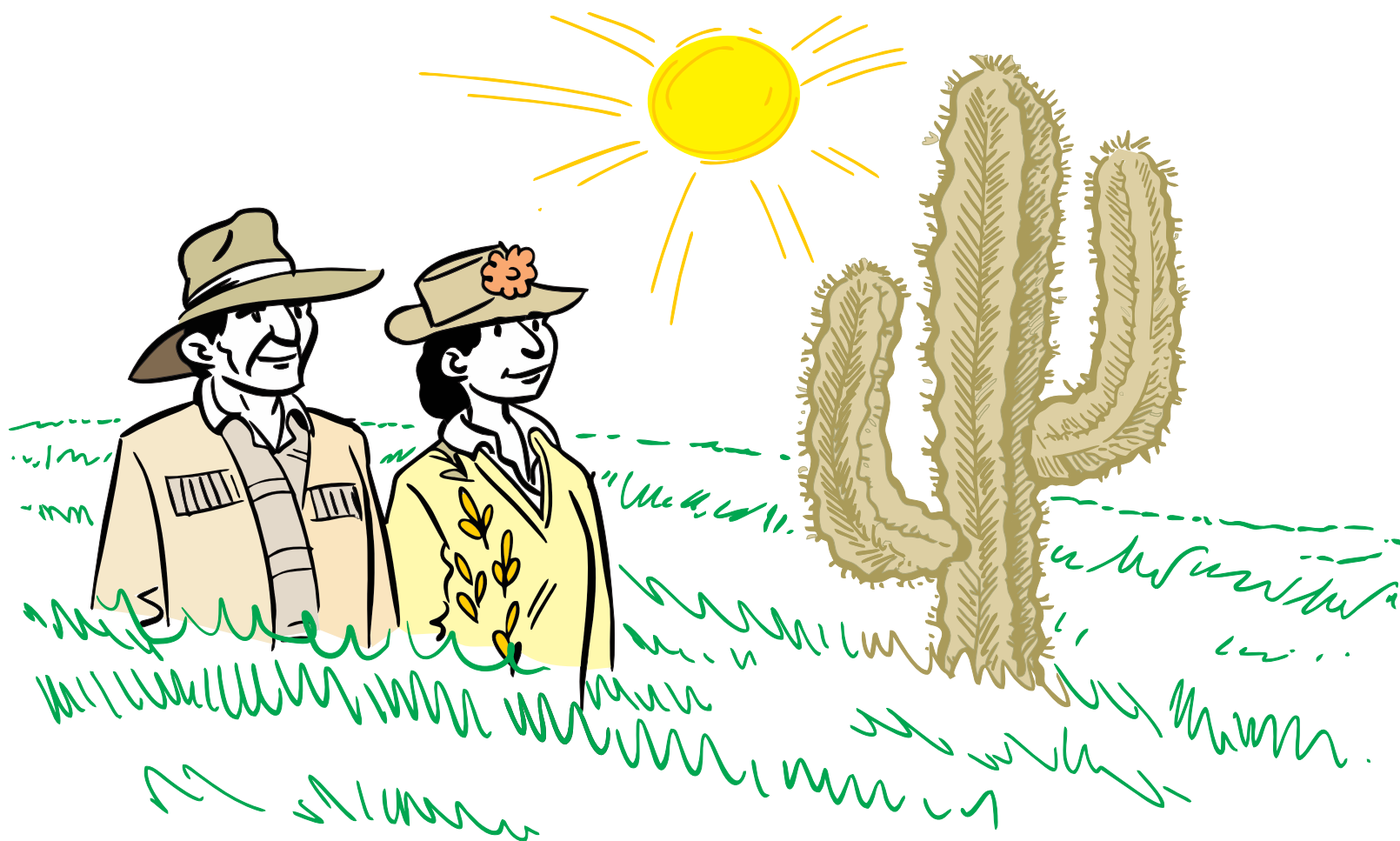


WHAT THE MODELS DON'T TELL US IS WHICH FUTURE WE ARE GOING TO INHABIT.

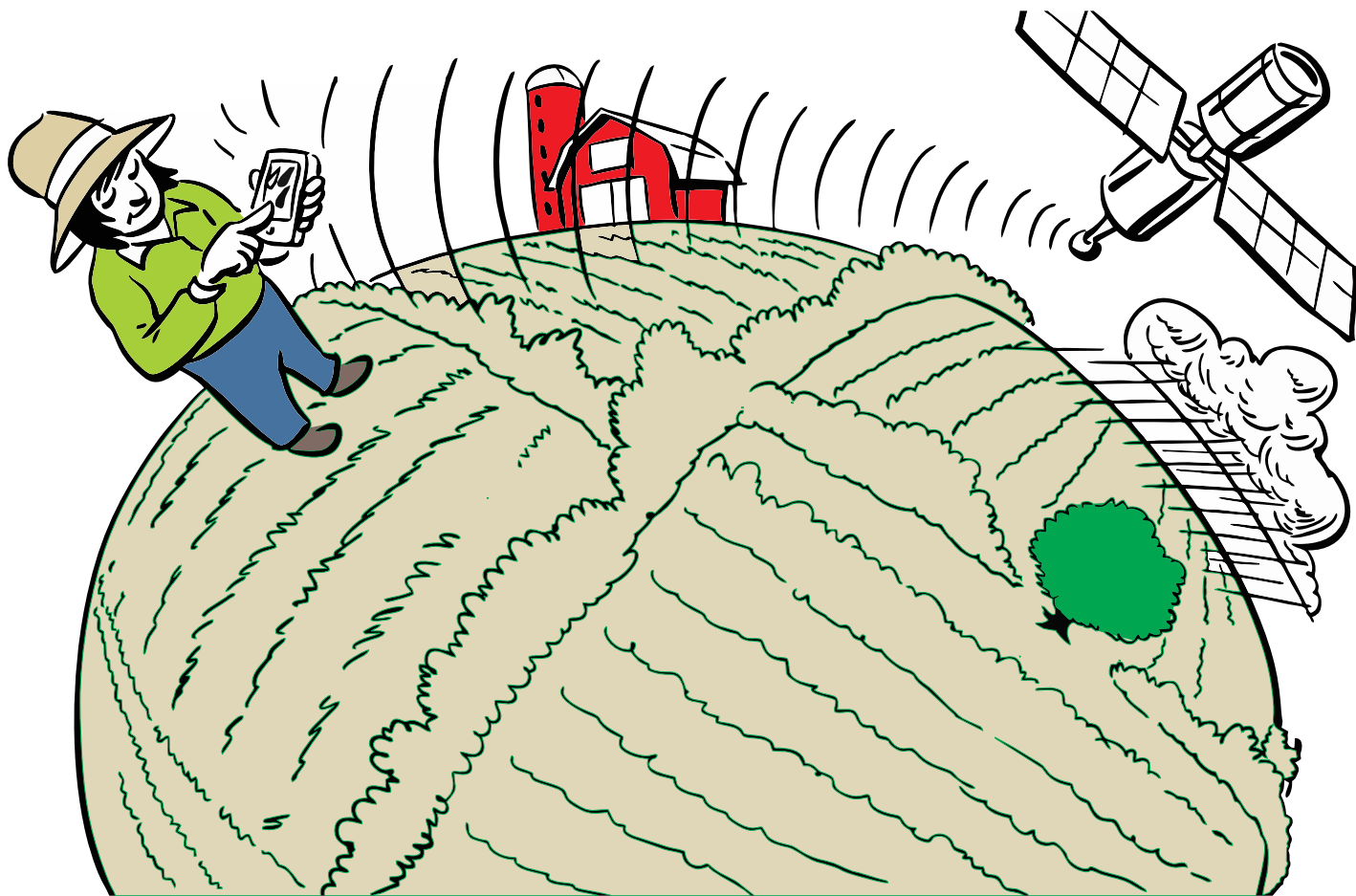
THAT'S BECAUSE WHETHER WE LIVE IN A SCARY FUTURE OR ONE WHERE CLIMATE CHANGE IS MANAGEABLE DEPENDS ON THE POLITICAL, ECONOMIC, AND SOCIAL DECISIONS THAT WE MAKE TODAY(9).



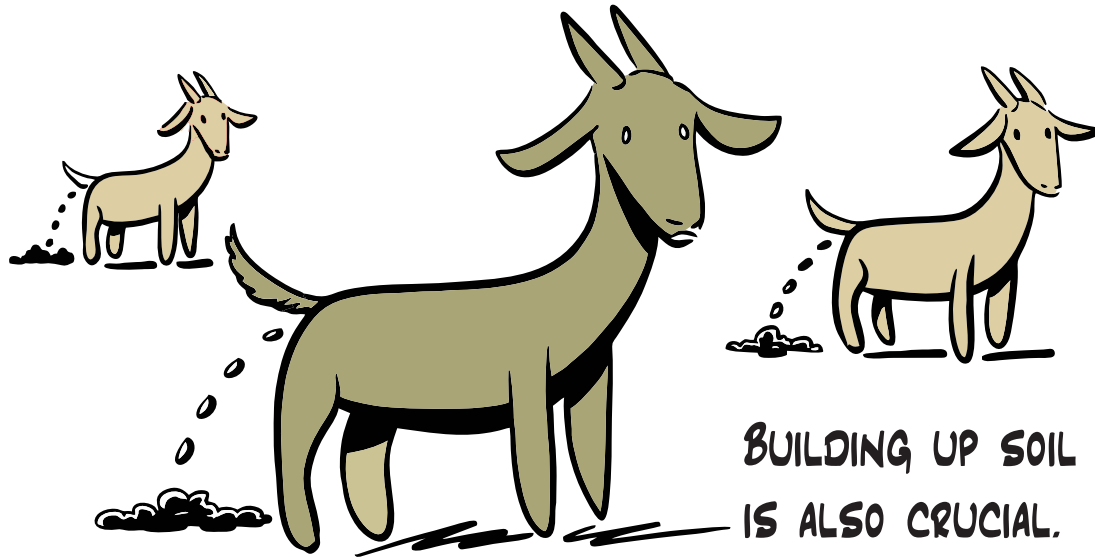
FOR INSTANCE, DEVELOPING DROUGHT TOLERANT SEEDS IS AN EXTREMELY USEFUL WAY OF ADAPTING TO CLIMATE CHANGE.



**DEVELOPING BETTER WEATHER FORECASTING TOOLS SO THAT FARMERS CAN BE PREPARED FOR CLIMATE CHANGE IS ANOTHER GOOD STRATEGY(10).**

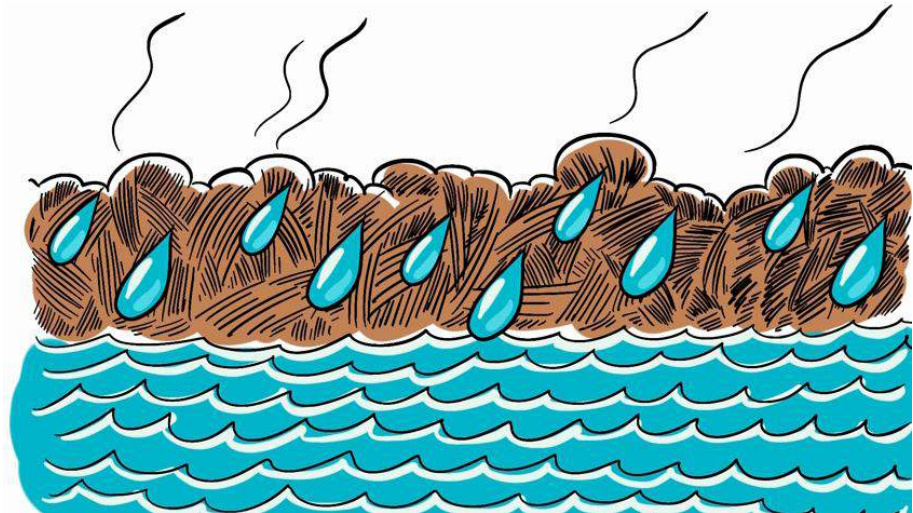






**BUILDING UP SOIL ORGANIC MATTER ON FARMS  
IS ALSO CRUCIAL.**

**THIS IS BECAUSE SOIL ORGANIC  
MATTER ACTS LIKE A SPONGE  
TRAPPING WATER AND KEEPING IT  
FOR DRY PERIODS(11).**





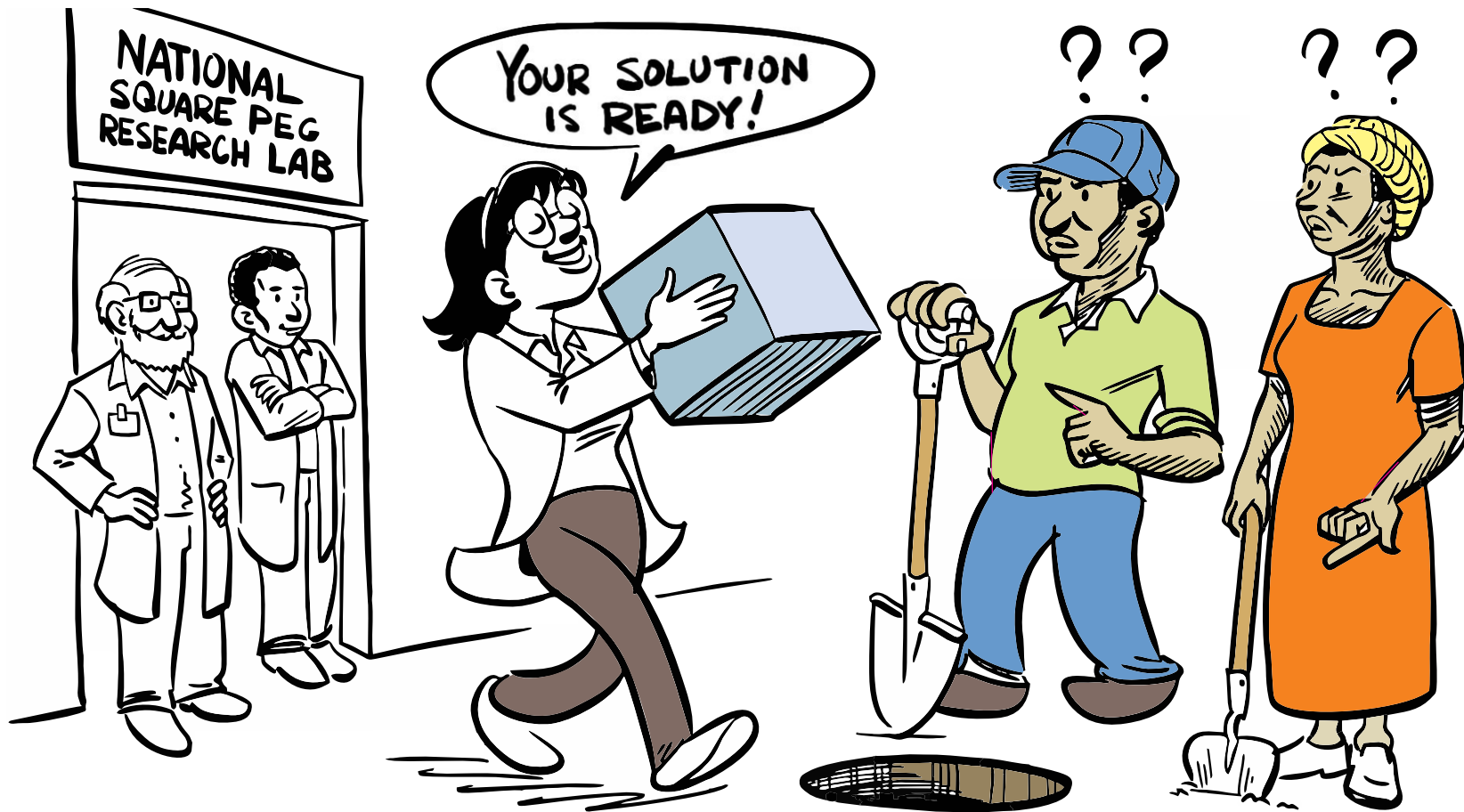
AND HELPING FARMERS DEVELOP BETTER AND MORE ROBUST RURAL ECONOMIES SO THEY HAVE JOBS TO FALL BACK ON IF THEIR CROPS FAIL IS ALSO EXTREMELY IMPORTANT(12).



ONE POINT NEEDS TO BE REMEMBERED THOUGH. TOO OFTEN IN THE PAST, SCIENTISTS HAVE SIMPLY DEVELOPED TECHNOLOGIES IN THEIR LABS WITHOUT CONSULTING ADEQUATELY WITH THE PEOPLE WHO ARE GOING TO USE THE TECHNOLOGIES(13).



THIS RESULTS IN A MISMATCH BETWEEN WHAT FARMERS NEED AND WHAT THE SCIENTISTS DEVELOP.

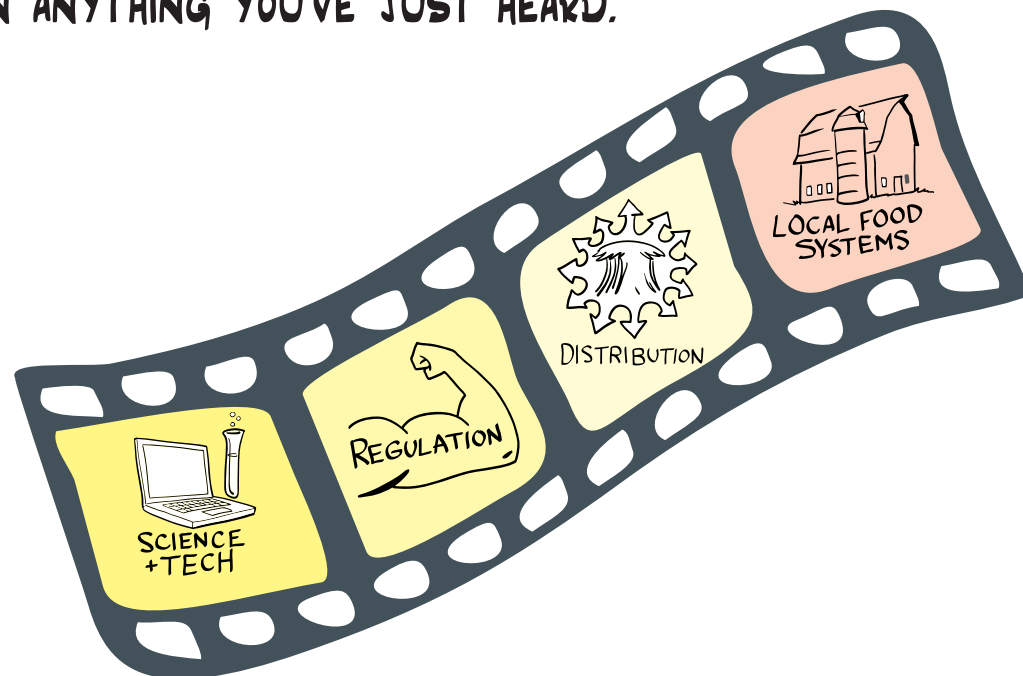


**SO, WHENEVER WE THINK ABOUT DEVELOPING NEW TECHNOLOGIES, WE HAVE TO INCLUDE THE FARMER, AND THE FARMERS' PERSPECTIVES, IN ANY DISCUSSIONS.**

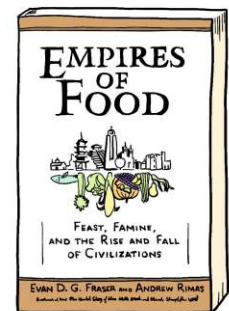
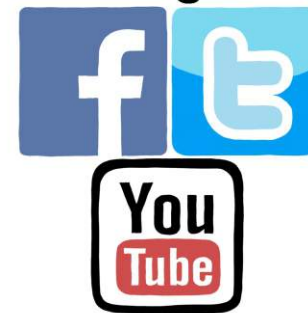


IF YOU ARE INTERESTED IN LEARNING MORE ABOUT THIS AND OTHER TOPICS ON FEEDING NINE BILLION YOU CAN CHECK OUT OTHER VIDEOS IN THIS SERIES, YOU MIGHT BE KEEN TO CHECK OUT MY RECENT BOOK EMPIRES OF FOOD.

ALSO, YOU CAN FIND ME ON YOUTUBE, FACEBOOK AND TWITTER WHERE I REGULARLY POST ABOUT ISSUES RELATING TO GLOBAL FOOD SECURITY. AND THE WEBSITE [WWW.FEEDINGNINEBILLION.COM](http://WWW.FEEDINGNINEBILLION.COM) HAS ANNOTATED SCRIPTS ALONG WITH REFERENCES AND OUR BLOG AND AN ONLINE DISCUSSION FORUM WHERE YOU CAN WAIT IN WITH YOUR OWN THOUGHTS ON ANYTHING YOU'VE JUST HEARD.



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# ENDNOTES

[1] The effects of climate change are likely to be very pronounced in regions of the world that already face frequent food shortages. This report by UNEP explains the dryer, warmer conditions that are likely to affect the Horn of Africa in the future, and what this will mean for food security in the region.

Food Security in the Horn of Africa: The Implications of a Drier, Hotter and More Crowded Future. Rep. United Nations Environment Program: Global Environmental Alert Service, Nov. 2011. Web. 12 Mar. 2014. [https://na.unep.net/geas/getUNEPPageWithArticleIDScript.php?article\\_id=72](https://na.unep.net/geas/getUNEPPageWithArticleIDScript.php?article_id=72)

In addition, the latest Intergovernmental Panel on Climate Change Report has a chapter on food security that explores these issues in detail. See chapter 7 in: <http://ipcc-wg2.gov/AR5/report/final-drafts/>

[2] This report examines the predicted beneficial effects of climate change on agriculture in Eastern Canada and the Northeastern US. Climate change is predicted to lead to warmer temperatures in this region as well as more consistent precipitation, which will allow for a more robust agricultural system as long as climate change adaptation policies are enacted.

Hoffman, Michael P., and Donald L. Smith. Feeding Our Great Cities: Climate Change and Opportunities for Agriculture in Eastern Canada and the Northeastern US. Rep. Cornell University and McGill University, Sept. 2011. Web. 12 Mar. 2014. <http://cuaes.cornell.edu/loader.cfm?csModule=security/getfile&PageID=1040678>.

[3] The era of continuously rising grain production appears to be coming to an end. Warming temperatures are decreasing the productivity of wheat crops, and this article from Scientific American discusses the future of grain production in a warming climate.

Biello, David. "Cereal Killer: Climate Change Stunts Growth of Global Crop Yields." Scientific American. Scientific American Inc, 5 May 2011. Web. 12 Mar. 2014. <http://www.scientificamerican.com/article/climate-change-impacts-staple-crop-yields/>.

Of course, there is a huge level of debate in the literature on this topic, and some argue that biotechnology can help keep yields growing. Here is a briefing note from the seed company Monsanto: [http://www.monsanto.com/products/documents/biotech-benefits/biotech\\_crops\\_yields.pdf](http://www.monsanto.com/products/documents/biotech-benefits/biotech_crops_yields.pdf)

[4] While providing background on how climate models are developed, this article also outlines the predictions of how climate patterns will affect the state of global agriculture and food security towards 2050.

St. Thomas, Ashley. "Merging Models to Compare Food Security Impacts of Climate Change." IFPRI Blog. International Food Policy Research Institute, 27 Dec. 2013. Web. 12 Mar. 2014. <http://www.ifpri.org/blog/merging-models-compare-food-security-impacts-c...>

[5] Credit here goes out to Professor Andrew Challinor from the University of Leeds who led this project (and it is Andy's face that has been drawn into the cartoon). Andy is a really wonderful modeler who is interested in food and climate. You can see a full list of his publications here: <http://www.see.leeds.ac.uk/people/a.challinor>

[6] Here are a few more details on this project. Andrew Challinor worked with a group of us to use climate models to make weather predictions up to the year 2099, and then we studied the impact of changing weather on crop yields. In order to better understand the food security of the region, the team also studied current and projected future socioeconomic conditions.

This press release from the University of Leeds, where the research was conducted, summarizes the study and its results.

University of Leeds. School of Earth and Environment. Crop Failures Set to Increase under Climate Change. University of Leeds, 7 Oct. 2010. Web. 14 Mar. 2014. [http://www.leeds.ac.uk/news/article/1174/crop\\_failures\\_set\\_to\\_increase\\_under\\_climate\\_change](http://www.leeds.ac.uk/news/article/1174/crop_failures_set_to_increase_under_climate_change).

[7] In order to understand future food security, we must make predictions of both future climate conditions, and levels of future socio-economic development. This journal article focuses on the case study of China discussed in the video – this pdf version is free and publically accessible.

Challinor, Andrew J., Elisabeth S. Simelton, Evan D G Fraser, Debbie Hemming, and Matthew Collins. "Increased Crop Failure Due to Climate Change: Assessing Adaptation Options Using Models and Socio-economic Data for Wheat in China." Environmental Research Letters 5.3 (2010): n. pag. IOP Science. Web. 14 Mar. 2014. <https://feedingninebillion.com/sites/default/files/images/users/mcodyre/...>



[8] There are numerous climate models that provide predictions for our future climate. In this article, Environment Canada outlines how nine climate models work, and what their predictions could mean for our future. "Models: Canadian Centre for Climate Modelling and Analysis." Environment Canada. Government of Canada, 14 Jan. 2014. Web. 14 Mar. 2014. <<http://www.ec.gc.ca/ccmac-cccma/default.asp?lang=En&n=4A642EDE-1>>.

[9] The state of the future climate is largely dependent on large-scale human actions in the present and into the future. The IPCC has taken this into consideration, and uses climate models in combination with "storylines" focusing on economic development, population growth, and the rate of adoption of energy efficient technologies. Four of these scenarios are explained in this article by the IPCC.

"SRES Emissions Scenarios." Intergovernmental Panel on Climate Change. United Nations, 17 June 2013. Web. 14 Mar. 2014. <http://sedac.ciesin.columbia.edu/ddc/sres/>.

[10] In order to make informed decisions about when to plant and harvest their crops with changing climate conditions, smallholder farmers need access to weather forecasts. Projects to provide weather stations to smallholder farmers are already in effect throughout the world – in Vietnam, a system has been developed to warn farmers of changing river salinity, allowing them to minimize crop losses. This article by IFAD explains the importance of weather forecasting, and provides several examples of successful implementation of weather stations.

Laganda, Gernot. "Climate Services Provide Timely Information to Help Farmers Plan for a Changing Climate." International Fund for Agricultural Development. United Nations, 29 May 2013. Web. 14 Mar. 2014. <http://www.ifad.org/climate/asap/climateservice.htm>.

[11] Soil organic matter is crucial to successful agriculture, as it provides both a source of nutrients and moisture to crops. This report by IFAD details the importance of healthy soils, and outlines methods such as "no-till agriculture" which can improve and preserve soil health.

Walpole, Matt. Smallholders, Food Security, and the Environment. Rep. United Nations Environment Program, 2013. Web. 22 Feb. 2014. [http://www.ifad.org/climate/resources/smallholders\\_report.pdf](http://www.ifad.org/climate/resources/smallholders_report.pdf).

[12] Using a case study from Ghana, this report by IFAD describes recent economic development programs in rural areas of the country. By emphasizing the importance of providing smallholder farmers with access to financial institutions and risk management practices, the Rural Agricultural Finance Program seeks to support and improve sustainable livelihoods of smallholder farmers.

Demirag, Ulaş. Enabling Poor Rural People to Overcome Poverty InGhana. Rep. International Fund for Agricultural Development, July 2013. Web. 14 Mar. 2014. <http://www.ifad.org/operations/projects/regions/pa/factsheets/gh.pdf>.

[13] Through a case study in which researchers worked to improve livestock breeding programs in the developing world, this report by the FAO emphasizes the importance of making agricultural technology locally appropriate. This report states, "There is growing evidence that if technological innovation makes sense to farmers then extension services, even enhanced, play a marginal role in speeding the process of dissemination".

Smith, G. A. Lessons from Field Development of Livestock Projects with Special Reference to Large Ruminant Production. Rep. Food and Agriculture Organization of the United Nations, n.d. Web. 28 Mar. 2014. <http://www.fao.org/docrep/004/t0582e/T0582E23.htm#ref4>.

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