



Markets and Infrastructure - The Roles of Market Access in Shaping Diets in Bangladesh, Uganda, and Nepal

Webinar transcript.

Yaritza Rodriguez

Welcome to everyone. Thank you for joining today's webinar to learn more about markets, infrastructure, diets and nutrition and to hear from our panelists about evidence from Bangladesh, Nepal and Uganda. I am Yaritza Rodriguez. I am the knowledge management coordinator for USAID Advancing Nutrition, the Agency's Flagship Multisectoral Nutrition Project. Before we begin today's presentations, I would like to note that this webinar is being recorded. Now I will quickly review the Zoom webinar environment and set a few norms for the webinar.

Next slide, yes, thank you.

Today's webinar will be moderated by Shibani Ghosh. Dr. Ghosh will give introductory remarks, and then we will have two presentations followed by a discussion during which the speakers will address your questions. All participants will be needed today, so please make sure to use the chat box on the right bottom side of your screen to introduce yourself, engage with other attendees, or ask for help with sound during the presentation.

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If you're having any technical difficulties today, please send a private message to Andy Colbert so that he can work with you to help resolve any audio or video issues. As a reminder, we will be collecting questions for the Q&A session in the question answer model that you can access by clicking on the Q&A icon at the bottom of the Zoom webinar model. Your experience today may be based on your Internet connection and computer equipment. If you lose connectivity or cannot hear, close the webinar and please reenter the Zoom webinar room by clicking on the link provided via email.

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Now I am pleased to introduce Dr. Shibani Ghosh, associate director for the US Government Feed the Future Innovation Lab for Nutrition, and research associate professor at the Friedman School of Nutrition Science and Policy in Tufts University.

Over to you Dr. Ghosh.

Dr. Shibani Ghosh

Thank you Yaritza. Good morning and afternoon everyone, listening in from all over the world. Before I introduce the topic, let me give a brief introduction to the nutrition innovation lab and talk a little bit about our planned webinar series [inaudible]. We are as Yaritza has noted, a Feed the Future innovation lab. We are supported by the USAID Bureau of Resilience and Food Security, and we have been acting since 2010 supporting research and capacity-building to build the evidence base about the critical questions raised in the area of agriculture, nutrition, and health. As you can see from this map, we are active in many countries in Sub-Saharan Africa and South Asia.

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The Innovation Lab is a consortium of universities led by the Friedman School of Nutrition Science Policy at Tufts University and our US University partners include Purdue, Harvard TH. Chan School of Public Health, John Hopkins School of Public Health, and Tuskegee University. In addition, as you can see from the slide, we partner with institutions and agencies from across the world, from government agencies to UN agencies, to local and international INGOs, as well as universities across the globe. More information on our work and on our partners, can be found on our website at NutritionInnovationLab.org.

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We are in [inaudible] of activities, and as part of the dissemination, we are organizing a series of webinars to present our work from over the past ten years. Here you will see a list of topics that are going to be covered from when we started in June and we're likely to go through December of this year. We have been fortunate to be able to partner with USAID Advancing Nutrition on several of these webinars. And we have worked with USAID Advancing Nutrition on any consultations in the past year and we are excited to continue this collaboration. A huge thank you to the team at USAID Advancing Nutrition for making today's webinar possible. Let me not take too much more time on this, and introduce our topic today and our speakers.

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The webinar today will focus on understanding how markets and infrastructure could be important in shaping diets and improving nutrition in vulnerable populations, a topic that we are all very interested in. The findings originate from our work in Bangladesh, Nepal and Uganda, and are presented by two of my colleagues, Dr. [Gerald Shively] and Will Masters. Dr. Shively is the associate dean and director of international programs in agriculture at Purdue University. He is a faculty fellow for Global Affairs as well as a professor of agriculture economics. He is the principal investigator for the Nutrition Innovation Lab at Purdue University. Dr. Shively received his PhD in agriculture and applied economics from the University of Wisconsin, Madison, in 1996. He is a fellow of the International Association of Agriculture Economists and the African Association for Agriculture Economists, and has more of 30 years of experience in research over 200 scholarly works and numerous teaching awards and research awards in the areas of agriculture development, food security and natural resources management. Dr. Will

Masters is a professor of food and nutrition policy and programs at the division of food, nutrition, policy and programs in the Friedman school. He also has a secondary appointment at the department of economics. Dr. Masters received his PhD in economics and applied economics from Stanford University, and is a key investigator at the Nutrition Innovation Lab in Tufts. He is also the principal investigator for projects like Condasa and Imana, and I would urge you to visit his website to get more information on his projects. He has helped carry appointments in Purdue, the University of Zimbabwe, at Harvard as well as in Columbia. He is a fellow of the Agriculture & Applied Economics Association and has more than 200 scholarly works, including critical undergraduate textbooks, and has received numerous teaching and research awards.

Both of these individuals, colleagues and friends of mine have been a driving force of our work in the realm of linking agriculture to nutrition through an agriculture and applied economics lens. I'm really looking forward, just as I am sure you are, to hearing their parts in the role of markets, infrastructure and diets. So without further undue, let me hand it over to Jerry will be the first speaker of today. Jerry, on to you.

Gerald Shively

Hello everyone, and thank you for joining us. It's so exciting to be here and to see so much interest in the topics that we are going to be discussing today. By way of introduction, I would just like to point out a couple of things. First, although we've advertised this webinar as being focused on diet, actually, our approach today will be a little bit broader than that, and we'll be talking about diet and nutrition, nutrition more broadly defined. The second thing that I want to point out is that we're going to be providing a very broad overview of facts regarding markets and infrastructure and how they combine to affect diets and nutrition. By necessity, the overview will be broad. If you want to do a deeper dive on any of these topics, I suggest that you either engage us in the chat box or use the Q&A, or indeed follow-up with us individually after the webinar. And the third thing I'd like to say to sort of set the stage is that the results that are going to be presented come from more than a dozen published papers, a few working papers that are still in progress. Most of these items are all open access. They're referenced on the individual slides and my understanding is that the slides will be shared with everyone, and so if you want to look more closely at any of the topics, I encourage you to look at the papers that are referenced or to engage with us after the webinar.

So, with that, let's move to the outline.

Just to give you a sense of where we're going to go today, I'd like to begin with setting the stage and a thought experiment. We're going to use that to kind of point out two key features. One that nutrition outcomes depend on diet and health, and that diet and health both depend on a broad set of factors.

As we know, nutrition outcomes are driven, in part, by early-life exposures, and the second part of my presentation will focus on some of the early-life exposures and some of the ways that we've approached studying those. I'll then hand off to my colleague Will Masters. Will is going to present evidence on food prices, nutritionally-adequate diets and some of our work on resilience. And then he'll recap the presentation with some key messages. And for those who might have to leave the webinar early, we might as

well put those key messages upfront, so that you have them in mind as you leave or as you follow along.

First, is that isolation (in all of its forms) creates nutritional risks. We'll talk a little bit about isolation from markets and isolation from infrastructure. We most commonly think of isolation in terms of physical or geographic isolation, and indeed it's a good proxy for other forms of isolation. But I want also to keep in mind that isolation takes many, many different forms, not just physical isolation. Individuals can exist, can reside in environments that are very rich in terms of food availability, but if they don't have the incomes to access food markets, they indeed may be isolated from those markets.

The second key message is that markets and infrastructure help to mitigate the nutritional risks that we observe, and the ways that infrastructure and markets mitigate those risks are through higher incomes, lower food prices, lower food price volatility, greater dietary diversity, and potentially greater resilience. And we'll cover all those in the subsequent slides.

Okay, so let's begin with setting the stage with some data and a thought experiment.

Okay, next slide.

Right, so this is a graph that I think presents in the broadest way possible the relationship between access and or isolation and child growth outcomes. So in the X axis, we placed night time light radiation, that is the amount of light at night, as observed from satellites, and on the Y axis, Height-for-Age Z Score (HAZ) for children. And this graph was constructed using data from 800,000 children in 49 different DHS surveys. And as you can see, the general takeaway message from this is that children are taller where there is more light at night. Of course children are [], they don't grow because they don't get light but they do grow because the things that are correlated with light, especially light at night, general forms of economic development, contribute to the things that children need to be healthy and to grow adequately.

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They are many, many different kinds of investment that are needed to overcome the kind of isolation that proxied by night time light radiation and to improve development outcomes. Here we have the Human Development Index on the Y axis, and its correlation with a wide range of things that are all closely related to one another, they move together, they're difficult to isolate from one another, but we know that they are all important contributors to human development. They include access to healthcare, improved crop yields which come from improved inputs, sanitation, density of road networks, distance to hospitals, and distance to markets.

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And as an illustration of this, I've put up a map from Nepal. Those who are not familiar with Nepal or those who are will know that in Nepal, market linkages are very strongly tied to geography. The map here shows with black arrows the flows of commodities from major markets into regional and local markets. It's true that in Nepal food markets reach everywhere, but in order to reach very, very distant locations, the cost of transport and handling rises, and therefore the cost of providing food and food diversity, dietary diversity, rises. This will come back... we'll come back to this topic a little bit later in the presentation. But the main thing that I want to underscore is that as we move into more isolated areas, it's naturally the case that both opportunities decline, but also the cost of accessing those opportunities, whether they be in labor markets or in food markets, rise.

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So one way that we can think about diet is to think about dietary diversity as it's reflected in the normal bundle of meals that individuals consume. I don't want to spend a lot of time describing exactly what the diagram on the left illustrates, except that we've used latent class analysis to take observed bundles of consumption from three rounds of a national survey in Nepal and allowed these to be grouped in a kind of natural way based on the kinds of combined diets that individuals consume. And so, in the diagram we moved from a basis diet and an improved diet down to basic expanded and diverse diets, and in the four panel diagram at the bottom a broader set of diets that are naturally the kinds of groupings that we see as people combine such things as cereals, starches, oil, spices, tubers, vegetables and fruits, and meat or other animal products into the daily diets that they consume.

One of the exercises that we undertook was to then asked the question: What sort of factors are correlated with those dietary groupings? In other words, what kinds of factors that we observe might explain why some households consume more complex or more diverse diets, and indeed, higher quality diets than other households. We know that a primary driver of dietary consumption is individual choice. People choose to consume foods that appeal to them, either through habit or through culture. Right, but those choices are often very tightly constrained by what's available, what the circumstances in the market where the household might be, the household's knowledge of diet and nutrition, and indeed, incomes and prices. So people may want to consume more diverse diets, but incomes or prices may conspire against that. As you'll see in the lower right hand corner of the diagram, one of the factors that is very positively correlated with the complexity of diets and diet diversity is road density.

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And in fact, if we think about road density as a proxy for a lot of different kinds of access, including access to agricultural inputs, access to income, access to greater food variety or greater health services, it turns out that the most basic form of infrastructure, which we know from broad experience helps to improve access to services, is itself correlated with the Z scores of children. And what we've illustrated here is the simple dose response model where the dose that we've considered is the density of roads for children in the DHS survey in Nepal, and on why access, the height for age Z score is responsive to that density of roads.

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Okay, so that kind of sets the stage. And I'd like to use that as a thought experiment to move to the next stage, which is early life shocks. And the reason why we kind of framed it this way is because, often times, in surveys like the DHS, we observe a child at a particular point in time, but in order to understand the timeline of risk exposure, we have to look backward, and so this timeline kind of illustrates... hypothetically if we observe a 5 year old child measured in 2011 and we want to look backward in the timeline of that child's exposure, there are some periods that are relevant for wasting, short term nutritional deficit, and there are some periods that are relevant for stunting. Those may extend into the distant past to times of the child's birth, period of weaning, or indeed even when the child was in utero. And so for us, as researchers, one of the challenges is to observe a child at a point in time, but then try to reconstruct the timeline of early-life shocks and exposures, both to understand what factors are leading to the outcomes that we observe, but also to think about what sorts of interventions might mitigate those exposures, or indeed provide resilience to the shocks that children receive. And later in the presentation, we'll be talking about our work on resilience.

So, to understand these early-life shocks and this early risk exposure, we have to first ask what periods are critical for child's growth that requires matching on time, and then we secondly have to ask: what periods are relevant for particular locations and particular crops? In other words,

matching on agronomy to think about growing periods for crops that are relevant for children in those areas.

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This is a set of charts from Uganda where each of the Y axes we've plotted the weight-for-height Z score for children under age five, and on the X axis we have the month in which the child was measured, and the charts just display the correlation between the Z score and rainfall in the upper panel, and temperature in the lower panel. The reason we are interested in rainfall and temperature is because, both of those are known to affect crops and crop production, and so there is a very clear agricultural pathway that leads to child nutrition outcomes from the environment, and also through the health pathway, because moisture, temperature, rainfall are all correlated with various kinds of health shocks that children might experience. And as we can see, the weight-for-height Z score for children varies by the month of measurement and its correlation with rainfall and temperature also varies with the month of measurement. So the only thing that I want to kind of underscore here is that when we begin to think about environmental shocks, and whether children are exposed to those, we have to understand very carefully about when those shocks occur, and whether they're relevant to, for example, health insults or damages to crops in the field.

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This chart is constructed from data in Nepal. Each dot is a child observed in the DHS survey, and on the X axis, horizontal axis, we have the greenest as observed of the earth surface from satellite imagery, and on the Y axis, the vertical axis, the weight-for-height Z score. The basic takeaway message here is that there is a positive correlation between greenest as observed from the earth surface and child growth, child nutrition outcomes and that that correlation is stronger during the cropping season than in other periods of the year. So again, the importance here is that when we're looking for particular shocks, it's important to make sure that we're lining up the agricultural calendar with the child's outcomes observations.

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Okay. This is a somewhat complicated diagram, but what we've done is separated the greenness as observed from a satellite into what we would consider anomalies, so in other words, departures from normal. So if you center your attention on zero, on the horizontal axis, zero is considered what might be typical or normal as observed in the mountains or in the plains of Nepal, and as we move either to the right or to the left on either side of zero, we are moving in directions that are departures from normality, and the key takeaway from this diagram is that in the mountains, as you move away from normality, children are far more sensitive than when you make similar departures from normality in plains. And there are two basic reasons for this. One is that agriculture in the mountain zone is more sensitive to weather anomalies than in the plains, and the second is that some of the factors that we might think of as mitigating forces are less prevalent in the mountain zone. So, in other words, children are more isolated, and when those weather anomalies are detrimental to crop growth, there are very few compensating factors or accessing those compensating or mitigating factors is much more costly in isolated environments.

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So, with that, I'd like to hand it off to Will who is going to be talking a little bit about food prices, nutritionally-adequate diets and our work on resilience and picking up on several of the themes that I've just introduced.

William Masters

Thanks Jerry, and thank you so much with really in-depth studies on this Nutrition Innovation Lab agenda that begin really, early 2000s when we first had all this really rich data about individual children, as Jerry explained matching their location and time of birth to their early life exposures. And what we'll do now is to turn to these more systemic questions about resilience in the community as a whole, the food system and the food environment for ... not just for the whole village but the whole region, and indeed the whole country as their food system gets transformed. And we measure that through food prices, through the degree to which diets or overall diets are affordable relative to local incomes, and the way in which a whole community might or might not help households and individual children achieve the resilience that we are hoping to see. So this is moving out from the individual household, agricultural and nutrition linkages of the household own agriculture and their own children that you would find through survey data, and matching individual children to their environmental outcomes to thinking systemically. And this food systems approach that we're turning to now to understand at the population scale what drives resilience in the face of climate shocks, socioeconomic and civil conflict kind of shocks, as well as something like the COVID pandemic, which of course is the biggest single shock that the world has really ever seen in terms of the magnitude of simultaneous efforts. So of course we don't have data on COVID in particular, but I think you'll begin to see a lot of... a lot of insights in the chat box comments about ... and the Q&A section, excuse me, of the chat box, the Q&A part of your screen. You can look there to see how people are engaging in this conversation already. And please do enter in the chat box if you want everyone to see it. I guess the Q&A box as well.

So next slide, we'll begin to look at this systemic features of the food market. So the first thing I'd like to talk about is how we've been assembling data on the prices at specific rural market places for the full range of foods that people would need for an adequate and healthy diet, and getting the nutritional requirements right, in order to measure the proportions of different foods that would be needed at each market place in every month to meet nutrient requirement. So this is work that Jerry did very early on in this turn towards systemic research about food systems. He did it with George Omiat, who is now at Makerere University in Uganda, where they took market price data from what's called a market information system, developed by a private firm, working with the national research on funding in order to inform farmers and farm food markets. They were able to get prices for several dozen items in about 20 market locations. And what you see here is weekly data going back to 1999... 2000, beginning of 2000 through 2011 at 5 different market regions relative to the poverty line of relevance to Uganda itself. So these are corrected for overall inflation in Uganda as a whole. And each item is chosen at each market place in each month to meet nutrient requirement. So this is what we're calling a nutrient-adequate diet, meaning that every protein fat, carbohydrate, plus minerals and vitamins meet minimum adequacy levels. We've been doing, since this early paper by Jerry Shively, and I'll share that in our Malawi webinar in this series that will be happening on October 21st... what we've been doing in the Malawi data is getting even richer information on the composition of foods in Malawi. This work that you're seeing now shows food composition data from Uganda. In the Malawi study you have even newer evidence on food composition, and then even newer evidence on nutrient requirements, and much more spatial and temporal variation than what you see here. But this gives you just a single glimpse of this food systems research as shown for the case of Uganda. And what jumps out at you, what I hope jumps out at you is a couple of things. First of all, look at those price lines for an overall cost relative to the poverty line in Uganda. What you see is that those lines in most months in most locations are well above that poverty line. And of course, obviously there's quite a lot of variation within a given village in levels of income, most Ugandans below that line, especially those in younger households with a newborn or infant child who is most at risk of malnutrition without lifelong consequences for them. And so, this really puts an emphasis on the income side of nutrition. Because if an overall

nutritious diet is out of reach, that is above that red line or whatever the income level of the household is, clearly, food choice is not something that matters, there's nothing they could choose, there's no way for them to choose because it's fully out of reach to have a sufficiently adequate mix of foods, sufficient diverse sources of all the nutrients that they would need.

The second point to make is that not only are these lines above the cost lines or above the red line of poverty, but they are also extremely volatile, and they differ a lot by place. So this gets to market integration, connectivity, linkages, and the experience of isolation that means not only is food expensive, but it's also extremely volatile. So if you are so unlucky as to be an infant in a high-priced year or beginning complementary feeding, for example, around 6 months of age, in a season when food is especially expensive, that means that adequate diets are all the more out of reach for you. And so, this systemic approach looking beyond just a few foods, looking beyond just a few locations, looking beyond the household itself to their food environment, that's really a big agenda for us now.

So the next slide shares how we've been zooming out. If you go one, we've been zooming out more recently, and this is a paper that is in review at Food Policy, that we hope will come out soon, that compares these costs of nutrient adequate diets around the world to a number of benchmarks, including in the chart you see here, comparing the subsistence cost of just daily energy. So someone who is just seeking to survive from day to day and has the lowest level of income needed to do that, to wake up again and work again, to earn a living for the next day, what you see is that the cost to getting to nutrient adequacy, and if you look at the lower left of this map, you can see that the highest quintile of countries has the cost of nutrient adequacy that's four, five, six times the cost of daily subsistence diets. And in the next slide, you can see that this was featured in the SOPHY Report, so this map comes from the SOPHY Report, the UN, FAO, WFP, WHO, UNICEF, and IFAD report on the state of food security and nutrition in the world that was just launched this week. And we've done a bunch of work for them in a technical background paper that includes this map that shows, in addition to what I just talked about of the relationship between cost and nutrient adequacy to the cost of bare subsistence that keeps people alive, here this is showing what are the costs of what people actually spend on food, so affordability relative to actual expenditure. And again, these are simply national average, every country is shown in a single color representing a single level for that country, just to compare countries. And what you see is that our focus... in the case here the Feed the Future countries that the Nutrition Innovation Lab has done this deep dive on location specific within the countries... specific time of year and so forth. These are representative countries to a considerable degree, so they're not that different from their neighbors. They're not particularly worse off necessarily than their neighbors. They're not particularly better off. So we hope that these results are quite generalizable. And what you see here are that in Uganda, the cost of a nutrient adequate diet is colored yellow, meaning that it's one to two times, so not quite double, the amount that people are actually spending, but just significantly out of reach. So, on average, it would take quite a lot of upgrading, and for the poorest within Uganda of course, a lot more safety net income, either cash or in-kind transfers, plus systemic change in the food system that would bring all the foods within reach. Really crucial to see that interplay between, as Jerry was saying at the outset, between income, between food prices, and then between the non-dietary factors that influence nutritional outcomes like stunting and child height that we saw.

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So, going to the South Asia context, back to the geography and the map of food markets that Jerry started this whole webinar with, comparing the mountains in the top chart to the Terai in the bottom chart, and coming back to just the one most documented kind of food price, which is for cereal grains, in this case of course, rice. Remember from the original map of Nepal that Jerry showed, rice plowing from the Terai region up the mountains, and what you see is that in the mountains, the local price that would be available to households is not only higher, but it's

also more volatile. And this really gets to the heart of vulnerability, where what markets do is not just on average help people have food be more affordable, they also cut off the peaks by ensuring that transportation, when it's possible for transportation to get through, and when it's possible for traders to keep larger stocks and move stocks around, can limit those peaks, as you see the mountains having a much higher mountainous peaks of food prices that are so devastating for children who happen to be young at that time of the peak.

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The question of whether children who experience a hardship can recover is really at the heart of what we're thinking about in terms of resilience, and whether markets, and infrastructure and investments of one kind or another and policy changes can help. This chart begins to use the Nutrition Innovation Lab's Poshan survey in Nepal to pioneer some methods to think about resilience at the systemic level of populations ability to help each other and have systems in place, market systems or mutual aid of other kinds that would ensure that people who have had a hardship had, in this case, linear growth faltering, it's what you see on the left vertical axis of this chart is age for height Z scores, so the height of each child relative to a healthy population in Round one of the Poshan survey in the X axis and in Round 2 of the Poshan survey on the Y axis. And what you see it that the 45 degree line, the red diagonal, would be a child who has the same score in the first and the second. And what you see is quite a lot of faltering where from one survey round to the next, a child falls below the 45 degree line. And then there are some rises, where children have done... you know improved on the left. But in the overwhelming situations of widespread stunting and undernutrition, children are falling below. And our question is: All these children who are falling below the red diagonal line, when they worsen, what happens next?

And in the next slide, we begin to get at this question of resilience. So what we're doing in this methodological kind of frontier about resilience is saying: of those children who are, in what you saw in the previous slide below that diagonal, here, these are all the children who are to the left of the vertical. So, for the confusion of changing the orientation, you'll see why this is important in a moment. So everyone to the left of this quadrant here would be a child who had worsened from round 1 to round 2. But in the top half of this are children who worsened from round 1 to round 2, but who improved from round 2 to round 3. So what we're beginning to do is to zoom in on the children who had some setback, but then we saw them improve. And that's really the population that we're interested in is to try to understand: of those who experience the shock, are there aspects of their food environment or their agricultural environment or indeed their care practices and cultural aspects of these communities that would help keep them up after improving. Now the statistical problem, the methodological problem with trying to understand this is that a lot of cyclical variations is just what we call in statistics mean reversion. Reversion to the mean. Reversion to the average. So, if something is just bouncing around randomly, and you observe it having gone down like a child's height for age Z score having fallen below the normal growth, and then you observe it jump up, it could simply be what we call mean reversion, meaning that things are bouncing around and maybe there was a measurement error, maybe there was just randomness in what happened, and what we want to do is distinguish recoveries after the climb from random measurement error and see which part of the recovery is actually resilience, because that's what we need to improve. It's not just bouncing around, which is not what we're looking for. What we're looking for is interventions, investments in policy changes that will help those who fell behind to rise up again more than just average. So the way we do that in this method is to compare the right side of the diagram, who are the children who improved in the first survey... from the first two surveys, and then worsened. So children in the first... on the right hand side – the pink and the green – are observations who initially improved and then worsened. But then that could be just a random fluctuation. What you see is the diagonal line there – the dashed darker diagonal line – would be exactly mean

reversion. And what we're interested in are people in the green quadrant. Can we estimate that this curve is actually asymmetric mean reversion in that something in this environment lifts up those who stumble, something in this environment is a safety net, is a social insurance system, is some kind of a response that says: those who have experienced a setback will be uplifted again more than a random chance would indicate. And that's what we're looking for and trying to understand.

So, the next slide, you see our first estimate of this, literally the first one from the Nutrition Innovation Lab's work with the Poshan Survey, and I'll compare the Poshan survey to other data in a moment. What you see here is a non-parametrical version, so we're not imposing any linearity at all, which is letting the data speak for themselves. What you see is that there was what appears to be significant resilience in that these Nepali women looking at diet diversity scores here, so we're moving from heights to diet diversity for a reason I'll tell you in a moment, is that we do see that the children in left hand ... sorry the women in the left hand part of this diagram in the upper left quadrant who worsened at first and then recovered, they appear to recover more than simple randomness, which I guess there was something in Nepali society that helped women whose diets initially worsened to improve more than simply on average. There would be some statistically significant source of resilience. It's what we're looking for here.

So, in the next slide, we compare that resilience in the Poshan dietary survey data to other kinds of data. And what you see is that... and this is now a statistical hypothesis test correcting for bias and a lot of sort of econometric tools to bear through. Sonia Zaharia who was trained as a financial economist actually and came to the Nutrition Innovation Lab to bring these statistical tools into analysis of the Poshan survey data, and then also the Bangladesh survey and the Uganda survey, all of which the Nutrition Innovation Lab pioneered a number of methods to try to get better richer data about agriculture and nutrition linkages and analyzing this as a systemic population level shows that that resilience, which I described in the diet of Nepali women is statistically significant, controlling for these various possible biases that we addressed in the paper. But in Bangladesh, in the daily diets, we don't see that. And in the heights, on the right axis and BMI for adult women's body weight and relative to their height, we don't see that. So what we're trying to do is to zoom into the statistically significant parts of this idea of resilience - uplift after a decline - and trying to understand what about those communities does confer this recovery. And what you see on the right hand side is just a little bit of a description of our statistical findings so far, that market orientation and access to credit seems to play a big role, so that if a household has had a period of adversity, so a decline in diet diversity for example because of illness, for example because of the death of livestock, for example because of a loss of remittance of income, so it could be many things that could cause a worsening of the diet diversity, so the households that experience that worsening but have access to credit, access to markets, they can recover whereas others cannot. And this classic finding that the more developed infrastructure seems to make a big difference, you know, a number of different dimensions as Jerry said at the outset.

So the next slide, we bring all this together, right. To begin with, this theme of isolation in all its forms, that surely roads matter, surely the night lights, the rural electrification that Jerry began this webinar with, that matters a lot, because electricity plays a role independent to additional to transportation. But there's also a role for isolation in terms of access to health services, isolation in terms of access to market traders, is there only one trader in your village or are there multiple competing traders to buy and sell products? In terms of the food farmers buy, concerned about is there a local market place that might meet once or twice a week, do you have to cross a river or a creek that might be flooded out, are you able when you get there... are there multiple vendors there, all kinds of isolation, not to mention issues of gender and cast that could limit a person's ability to move freely and overcome isolation. And when we think about interventions, I'm sure all of you in each of your specific work environments have different

levers to work with. You are in different kinds of organizations, in different locations with different functions. And people who are in an agriculture development role are primarily playing ... are primarily working with farming as a business, with agricultural activities as a source of income and livelihood plays a huge role. But if you're working in a market setting, maybe your kind of work can play on ... can work on lowering food prices, and especially lowering food price volatility, because that crucial experience of being a young child at a time of the worst hungry season is something we can address through storage and trade, and integration of markets, as we've seen. There's also a role of course for nutrition education and even within people's very limited means, given the availability of food and the prices of food, maybe there are some things, some margin of improvement that can be achieved through nutrition education and diet diversity. All of these are I think fundamentally features of a population, features of a community where the resilience that we're observing is something that we can only first of all detect on average of the population, but maybe so many of these institutional and infrastructural changes and differences across populations are really things that are characteristics of a place, not of an individual household, but there are questions whether the government and the governance institutions of that place, the policies as well as the infrastructural investments are in place. So I think we've had a tremendous amount of evidence, I hope you agree that this is just an extraordinary range and kinds of data sources. A lot of open questions, I think, great activity in the Q&A part of this, and perhaps in the chat box as well, so I look forward to talking with all of you now. Thank you so much for joining.

Dr. Shibani Ghosh

Thank you Will and Jerry, and I have to say that your presentations have caused a lot of discussion in the chat, in the Q&A boxes, and I know we have been trying to keep track as of each of you. I don't know if everybody knows that, but for many of the questions that have been asked for Will and Jerry as well as Patrick, we have stepped in and put some responses in. What I thought would be interesting would be to start up with some of the open questions that have not been answered. But also, I don't think everybody sees the response to the Q&As. There might be some specific ones which might be interesting for the rest of the audience, if that's ok with you Will and Jerry. I think the first question... and I'm going in no particular order here, but there was a question in the chat box from Lamia Antikapati about ... and it's a question for Jerry on the slide with children HAZ in the mountains versus the Terai, and because the key takeaway is that the children are more sensitive to rainfall in the mountain regions.

In these regions, how does having markets mitigate the effects of the environment? That's one question.

The second one is: there seems to be an overlap of the distribution of HAZ in the Terai to the HAZ of the children in the mountains. Can you comment on shared factors for these two overlapped distributions of households, if any?

And finally, the third question from Lamia: if you have any thought of sensitivity analysis of HAD versus HAZ and how would this affect findings?

Gerald Shively

So let's move up to the earlier slide if you could. I think that's the slide that's being referred to. My first comment would be that this comes from a paper that is, I believe, I can't quite see the bottom of my screen, I believe is cited and referenced at the bottom of the screen. It's related to a paper that is cited on a previous slide, that appeared in the proceedings of the National Academy of Sciences, and the answer that I think is most succinct for the purposes of this webinar is that in trying to understand how the environmental risks translate into child growth, in this case height-for-age Z score, we have to be able to control for two kinds of heterogeneity

and variability that are in general hard to observe. One is variability at a location at different points in time, and the other at any given point in time, variation across locations. And so, what we've tried to do in a whole series of papers is to carefully separate the kind of variability that we observe across locations from that that we observe within a location across time, and to use a whole set of observed factors that would affect... that would be expected to affect child growth outcomes, so standard households and community factors to control for the things that we observe, and then to use the experience of children in different places in different times subject to different shocks to tease apart the environmental risk that they experience, and then to ask when we observe children in locations where access to markets is better where road infrastructure is more dense, do we observe a correlation between environmental factor and child growth to be weaker?

So the thought experiment is the following: if you think about a child living in complete isolation, then if that child is reliant on self-provisioning by the household, then all of the food supply, all of the dietary diversity that that child would receive would be locally provided by the household through its own production, and in that case environmental factors and child growth would be very tightly webbed together, so when you have strong signals in the environment, either positive or negative, those would translate directly into the food supply for that child. In that case, a very isolated child is highly sensitive to environmental shocks, but as you begin to introduce linkages to markets, as you begin to introduce roads, and in some of the work that we've done, we've been looking at bridges and the importance of bridges, what you begin to see is that link between environmental signal and the growth signal weakens. It weakens both in magnitude and it weakens in statistical significance. So that's the nature of the kind of research challenge that we're trying to address here. I think that in terms of children in the Terai and children in the mountains being subjected to similar kinds of shocks, it's true that some of the shocks are perhaps the same – the environmental shocks – but in general, we are sufficiently satisfied that children growing up in isolated mountain zones are living in different environments than children who are growing up in the Terai. So, I don't know if that completely answers the question, maybe it's better to treat it offline. I'm happy to engage.

Dr. Shibani Ghosh

Yes, I think it might be because there are many parts to the question. I think you'll have an opportunity, I'm sure, to interact with Lamia. So, there was a series of questions I think around by Nevin Podell, which Will and Patrick did start responding, but I think maybe I should just bring that up so that the rest of the community can hear this. Will, I think the question from Nevin was: why the Terai origin of Nepal even after having dense road density that the minimum dietary diversity is so poor and the nutrition and there is high rates of stunting – of wasting excuse me – and I believe you and Patrick did start answering and I'm wondering whether if you would be able to respond to that to the bigger audience, and then maybe Jerry and Patrick if you want to jump in as well, I think that would be very nice.

William Masters

Yeah, it would definitely be Jerry and Patrick. So, I'm an Africa specialist, I came to the Innovation Lab to work on the Africa data, but it is a great question in Africa as well, and a question for which the Africa-Asia comparison is particularly helpful. So this gets right to the heart of generalizability looking within Nepal and Terai, and also mountains, but also across Africa and Asia. But I think Jerry should answer the question directly. Jerry, did you see the chat, the Q&A?

Gerald Shively

So, I'll answer the question by way of referring to one of the papers that cited --- from Uganda. So we'll mention this paper that George Omia – that came out of George Omia specification –

where we tried very carefully in the context of Uganda to separate the ways that shocks from the environment move through agriculture, in other words through crops, into food production and consumption compared with shocks that move through the health channel. So in other words, you might have a rainfall shock, and it affects crops in one way, but it might affect the health environment in another. And actually separating those two channels I think gives us ... begins to give us some insight into why children who are living in agriculturally-productive environments or environments where there is access to markets and access to resources may nevertheless experience health risks that are not fully mitigated. But I know that Patrick has also spent a long time thinking about this. You know there is a bit of a paradox here, and I would say that we don't completely understand, you know, why that paradox exists.

Dr. Shibani Ghosh

Patrick do you want to add ... and I know you responded to a comment to Nevin? This question was from Nevin Podell and both Will and Patrick have responded. Well Patrick.

Patrick Webb

Well, ok, thanks for inviting me in. I would just say that of course we understand... everyone understands that access to markets is not the only thing that matters for nutrition, and particularly in the Terai, which is where most of the people in Nepal live. There are issues of high population concentration, lack of sanitation resulting from that, along with open defecation which has great health impacts where you have population concentration, and there are certain behavioral practices among groups living in the Terai that are different from those in the mountains. So, you have to control for all of those kinds of factors when seeking to tease out the effect of access to markets and the role of diets. And that's largely what we're trying to do to through this work.

Dr. Shibani Ghosh

Yes, I think Patrick I'm just going to quote you here because I think what you made is very... you said: Markets and roads matter and make it possible for people to access healthy diets, but there are other implementing factors, and I think that's what you were seeing with respect to the differences between the Terai and the mountains. So I think that it's a very critical point to be made here. So then I'm just going to...

Gerald Shively

Can I add to that?

Dr. Shibani Ghosh

Yes please go on.

Gerald Shively

I want to underscore something that my colleague at John Hopkins, Keith West, reminds me of, and to emphasize what Patrick said. You know, we're not arguing that markets and infrastructure are solely important or even the most important. We're just trying to understand how they mitigate some of the risks that children are exposed to. But there are also very strong cultural determinants related to women's empowerment, how food and diets are distributed within the household, and so a lot of the things that we observe at the household level or even at the individual level very much... sort of... leave those kinds of issues a little bit hidden from view. And that's the reason why all of us need to be looking at these issues at different levels of granularity. Will and I gravitate toward looking at these broad issues at sort of the household or

community level, looking across countries or within country, across locations, but there's certainly a role for a far more fine grained analysis for people, researchers are looking at what's happening within the household, because those kinds of studies are the ones that help explain the kinds of anomalies that we sometimes observe in our data.

Dr. Shibani Ghosh

So I think I'm going to jump into another question that's just coming from Sheva Bendabi, which I think just got answered by somebody, but I'm guessing that would be either Patrick or Will. But I'm going to ask this question any way:

When we're talking about markets, what type of markets are we talking about? Are we talking about the shops for example, those often sell rice, lentil, sugar, salt, oil, as we see more shops in Nepal. How do you think these markets will help provide diversity? Or are we talking about hot bazars or supermarkets that sell diverse foods? What type of markets help achieve better diets and more diverse diets? This is the question from Sheva.

Jerry?

Gerald Shively

Yes, so great question. And you know my answer would be all of the above. We want to try to understand the role of each of those, and so I make a plug for a colleague's work from Tanzania. So this is not Nutrition Innovation Lab work, but work of a colleague, Nelupa Geluratna and I can connect people with her if you're interested. She's been doing some very interesting work in Tanzania in sort of peri-urban and urban areas around Dar Es Salam trying to actually map market activity in terms of the density of market stalls, vendors, shops, and supermarkets, and understand how the density and the types of food availability in the market place translates into observed dietary diversity and nutritional outcomes. So it's really interesting and staggering work, and as you might expect, you know, having more vendors may not necessarily improve your dietary quality as those vendors are providing low quality snack foods as opposed to places that might be providing greater access to fruits and vegetables and nutrient foods. So...

Dr. Shibani Ghosh

It's a very good point Jerry, and I think that is one of the concerns when you are in more isolated areas, that what markets bring to people are ultra-processed packaged foods, that then become extremely popular, just because of their shelf life, and their taste, etc. So that's another area when we are talking about markets, we really want to be focused on fresh foods and fresh markets that are bringing fruits and vegetables and high quality foods to those that need them the most.

The next question is from Diane Di Bernardo and it was answered by somebody, Patrick Webb. I'm assuming this is a question that is generic across the three countries:

Could it be that the mothers are overburdened by work in the fields and that people tend to sell the best food for income? I don't know whether Jerry or Will you want to take that on?

William Masters

Actually just to talk about that, I see what Patrick wrote. But there's two different aspects of the question. One concerns the magnitude of labor effort, and that is something that we are beginning to measure with accelerometers on people to get a sense of just how much energy is expended in the chores that include not just the agricultural work, but also water and firewood collection, as well as walking to and from markets, and the work of child care. So, yes it's true that that is quite a lot of calorie expenditure, and particularly in India. It seems that the overall

burden of physical effort on women has declined a lot over time, suggesting it was very, very high in a lot of the malnutrition we may have observed, especially in the past, but in some populations till now, it is actually due to the extreme physical effort required just to work. And the other half of the question concerns ... oh no... I'm blanking on the other half of the question, sorry.

Gerald Shively

Sales and I think the ...

William Masters

Oh yes

Gerald Shively

I think eggs are the classic example of this, where many households that perhaps raise chickens and produce eggs find the value of those eggs in the market place to be a more attractive option than consume the eggs directly. In other words, if you sell an egg, the income it generates can translate into more calories than consuming the egg directly, although from a nutritional point of view, we might like to see individuals in the household, women and children, consuming those protein sources. So that's a big challenge related to not just economics, but also to nutrition knowledge and education.

Dr. Shibani Ghosh

Great, and then, I think Will maybe, the one question I would like you to answer comes from Becky [] in the initial part of the presentation who wanted to know how, because this is based on Bangladesh, Nepal and Uganda, how applicable do you find these findings for other settings? And so the set up comes down to the whole generalizability of the work that we have been doing. And I know Patrick has some thoughts about that as well. So, I'll open the floor to the three of you to see how you want to respond to this because I think....

William Masters

So this is absolutely extraordinary. Biologically, we are all very, very similar. And I'm sure you're aware, the crop species and the animal species that we use to feed ourselves are also remarkably [] because certain species have proved to have the plasticity, like humans have succeeded in colonizing, in living everywhere, moving out of Africa into every imaginable part of the world, and bringing different crops. So the basic biology of us as dietary needs for health and of the plants and the animals that we use are so similar around the world, and yet the cultures and the ways that we use our local resources to feed ourselves and our children differ so much. So trying to find the right balance between research that's adapted to the specific cultural needs of a particular... versus what is the universal has been really challenging. One big breakthrough of course is nutrients, just understanding the specific value of nutrient requirements. The other is food groups, so understanding that the different green leafy vegetables differ a lot from place to place. There's something about green leafy vegetables in general, something about red and orange fruits and vegetables in general, something about eggs and about dairy in general. So lots of forms of dairy are consumed around the world, but dairy as a food category, and of course fish. And fish is a great example of this, where dried and salted fish, you know, plays a huge role. These are universals that then enter in any given community in a very particular way. So our finding is that we find universals when we get the measurement right. We're finding universals when we are measuring the things which we all have in common, and then we identify the place and people specific instance, or example or lever that we can use only when we translate in a context specific way to the right terminology. So in Nepal, what is a hot bazar? In ... working in

Malawi, what is a “boma” market? Understanding what people mean when they say, you know, certain words about food. So I think that the key to generalizability is getting measurements right, so measuring the things that are universal, and then making the round trip back to the country specific terminology, the country specific example, and the cultural or practice... agricultural practices that are adapted to that particular place.

Dr. Shibani Ghosh

Thanks Will, that’s a really great response. Again I’m going into some of the Q&As that have already been answered, and I see there is one that was answered by Jerry and Will from Joan McDermott about:

Does a nutritionally-adequate diet account for any homegrown consumption? And given the sort of focus on nutritious... applied nutrition for homestead gardening and supporting homegrown consumption. It think it might be interesting to give the wider community how, if or if not, these are adjusted for homegrown consumption.

Gerald Shively

So, in general we approach this at a somewhat abstract level thinking about what is the cost of provisional diet from the market place at market prices. Obviously, to do that, you have to assemble the diet and then you have to use income to access that diet. That’s a kind of general snapshot of what it would require for a household to purchase the diet, but obviously, some households choose to produce parts of that diet or indeed all of that diet. So we don’t attempt in measuring the cost of diet to adjust for what portions of that diet might be self-provisioned. We only assume that opportunity costs of any crops that have been produced by the household would have the same value as those crops if they purchased them in a local market place. Well now that may be a little bit imprecise, but for our purposes, it’s a pretty fair comparison. Obviously, if we wanted to move into actually understanding specific household diets and consumption bundles, then we would want to more carefully think about what portion of the income is accounted for from home production and what part of the diet is being self-provisioned versus purchased from the market. At the scale that we’re operating at when we’ve drawn these charts, we’re just asking: if someone walked into the market place and wanted to assemble the nutritionally-adequate diet, what would it cost to do that at a point in time or indeed across time. So it abstracts a little bit from whether the value of those goods diverges from how the household might value those goods if produced themselves.

That may be a little bit too much of an economist answer.

Dr. Shibani Ghosh

Now this is great, thank you so much. Will, did you have anything to add?

William Masters

No that’s good

Dr. Shibani Ghosh

All right, ok. So there is one question that is around COVID-19 pandemic from Ahmed [Ouma Umkebir] who asks whether there is any evidence that shows if the pandemic contributes to the slowdown or to negative change in children, children focused nutrition educators, as you mean it would be anthropometric studies or even if it may go down to the level of the previous year. Maybe Will you might want to talk about food prices and diets in lieu of anthropometric studies. I don’t know Jerry if you’ve been working on this space?

William Masters

I can go first. I can say that there is of course an explosion of attempts to survey households and individuals as quickly as possible. The evidence that I've seen so far says that the largest effect by far of COVID-19 has been the loss of livelihoods, as people stay away from markets places, stay away from interactions because it's a people-borne disease, and then of course, sometimes hand-fisted poorly executed lockdowns make it worse than rather better. Most lockdowns of course make it better because they allow people to get back to work sooner than they otherwise would. But in some cases, a badly executed lockdown actually makes it worse. So the overwhelming effect is loss of income, and that's been already shown to have a big worsening of the food insecurity measures, you know asking people: did you skip a meal, did you go to bed hungry? Those questions are definitely up all around the world. The answer to this question on food insecurity is definitely worse. I'm not aware of any diet diversity surveys and we've just began to analyze the market price data. So what we found is that actually food prices, even though incomes are down, food prices on average seem to be up. And that's suggesting that the impact of COVID-19 on food systems is not just a loss of income and purchasing power, but also supply limitations from workers not being able to either get to work or be at work or in some cases it's a transportation block that causes the higher price. And so, we're just beginning to analyze that, and of course, the anthropometric outcomes are not yet known. The degree to which there is widespread wasting going on right now, we expect there is... there must be by evidence from previous episodes of income loss, but we don't have the data on that yet. But it's likely, I would expect, that this is the single largest mass stunting event if you will, that we've experienced in the world, whilst simultaneously around the world and an entire generation of children will be marked by this forever. And so, the stakes are so high in terms of how quickly we're able to contain this pandemic.

Shibani Ghosh

Jerry did you have anything to add?

Gerald Shively

No, that's great.

Shibani Ghosh

Okay. So we have a few moments left before we're going to wrap up. And there is a question from Michaela J. Low.

Other than distances to roads and road densities, are there any proxies that you would suggest to measure market access, but also the different kinds of markets as mentioned before?

So, maybe Jerry you want to take a stab at this and then Will do you have anything to add?

Gerald Shively

Yes, I think that there is a lot of room at the moment for research in this area both to kind of think about what is a market, how do we characterize and define markets, how do we measure a market in terms of variety of crops, variety of vendors, variety of prices, temporality, distance. I think that we're certainly at a point where those who are interested in these issues could be making contributions both to our conceptual understanding of what a market is, as well as better ways to measure markets and market outcomes. So I guess my answer is we're in need of better methods and better measures.

William Masters

I would just add that going back to something Shibani mentioned at the outset, which is the resilience and food security new conceptual framework begins to focus on this question of the different dimensions that markets do and don't offer, where in addition to what Jerry just said, where this conceptual framework gets at, in part among many other things, is that range of market services in terms of different levels of diet quality. So the kind of ladder of diet quality from the bare subsistence to a nutritionally-adequate diet that would have enough minerals and vitamins, as well as micro-nutriments to an overall healthy diet that has the fruits and vegetables, fish, eggs, and possibly dairy that are really associated with healthy growth beyond just vitamins and minerals. So, all these different dimensions are just beginning to be measured and I think are well reflected in this new conceptual framework. So a big new agenda, not just for researchers, but for practitioners and for measurement, and for the monitoring of evaluation activities, as well as the design of programs.

Shibani Ghosh

Great point. And I'd just like to add that Patrick did respond to Michaela about the fact that when we do surveys, we do measure the food that has been purchased, but also that has been produced. And I think that what has been purchased is determined by distance to markets. Some households are going to be able to purchase in bulk and others not. So there's a lot more nuanced elements that need to be considered as we move forward in trying to assess the use of markets, because some households have to capacity and ability to store and others don't. So there are a lot of other considerations, and then you have the whole issue of perishability and the value of the item that is reaching those markets, which we've also discussed a little bit with respect to healthy foods versus unhealthy foods.

I think there's one last question from Ross Webster who asks:

Where can we see more of the data analysis on the correlations between diet diversity and other factors mentioned in the presentation?

So I'm going to hand... this is the last question we'll take, and I'll hand it over to Will and Jerry to see who wants to respond to this.

Gerald Shively

Okay, so the slide in which I talked about the analysis of diets in Nepal and the factors correlated with diet selection is currently in a working paper that I'm happy to share if you want to send me an email message, and we hope soon to be published.

Shibani Ghosh

Okay, thank you, thank you everybody, this has been a delightful panel discussion and interaction. And I'm so glad there were so many great questions and responses from our speakers and panelists. I'd like to give Will and Jerry the opportunity to say some closing remarks before we end the webinar. Will first, Jerry then.

William Masters

Sure, well first of all, thanks everybody for joining. I think that our new lockdown has also opened us up. We have many more participants in this webinar, about 200 at the start, and with problems people can't stay, 150 now, now that's a lot more than we could ever have in person. I really appreciate the comments in the chat box. I think this is just the beginning of work on a whole

new area of findings that are original Nutrition Innovation Lab kind of agenda opened up, and we can really go forward in the coming years with this kind of dialogue. So thanks for joining.

Shibani Ghosh

Jerry.

Gerald Shively

I appreciate everyone attending today with great questions. It definitely sparks additional thinking on our part, and I'm happy to engage with people offline on other topics. So please feel free to reach out. And I wish everyone, you know, safety and success in their work. Thanks

Shibani Ghosh

Thank you very much Jerry and Will. It's been an awesome hour and a half. I'm not quite sure how fast it's gone. I wish we had a little bit more time to talk. You've really both presented something which is very complex around diet, nutrition, agriculture, access to markets and infrastructure. And the whole sort of idea that isolation and affordability of a nutritious diet needs to be something that we really need to be thinking about. But as our discussion has come up, there are so many other elements in addition to markets and infrastructure that need to be considered. So, I really want to thank you on behalf of everybody who joined us for giving us such a riveting webinar and I want to thank all the participants for staying on asking such phenomenal questions, making my heart light very hard as a moderator because of the fact that the speakers were going back and forth with the long chat and having to make sure that everybody got to hear all the wonderful stuff you both had to say, along with Patrick Webb, thank you for the phenomenal responses and keeping me on my toes here. So I also want to say to everybody who's still online, please keep an eye up. We will have at least 8 or 9 other webinars where we are presenting different facets of our work, and we'd love to have you join us. We'll try to stay within a time zone that will allow everybody from North America out to Asia to join within a reasonable time. So again with that, I'm going to say thank you very much, and I think we can end this very successful webinar. Have a good day, evening, night, and stay safe.



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