

Measuring Resilience

An Approach using Data from Nepal, Bangladesh, and Uganda

18 November 2020

William Masters^{1,2}

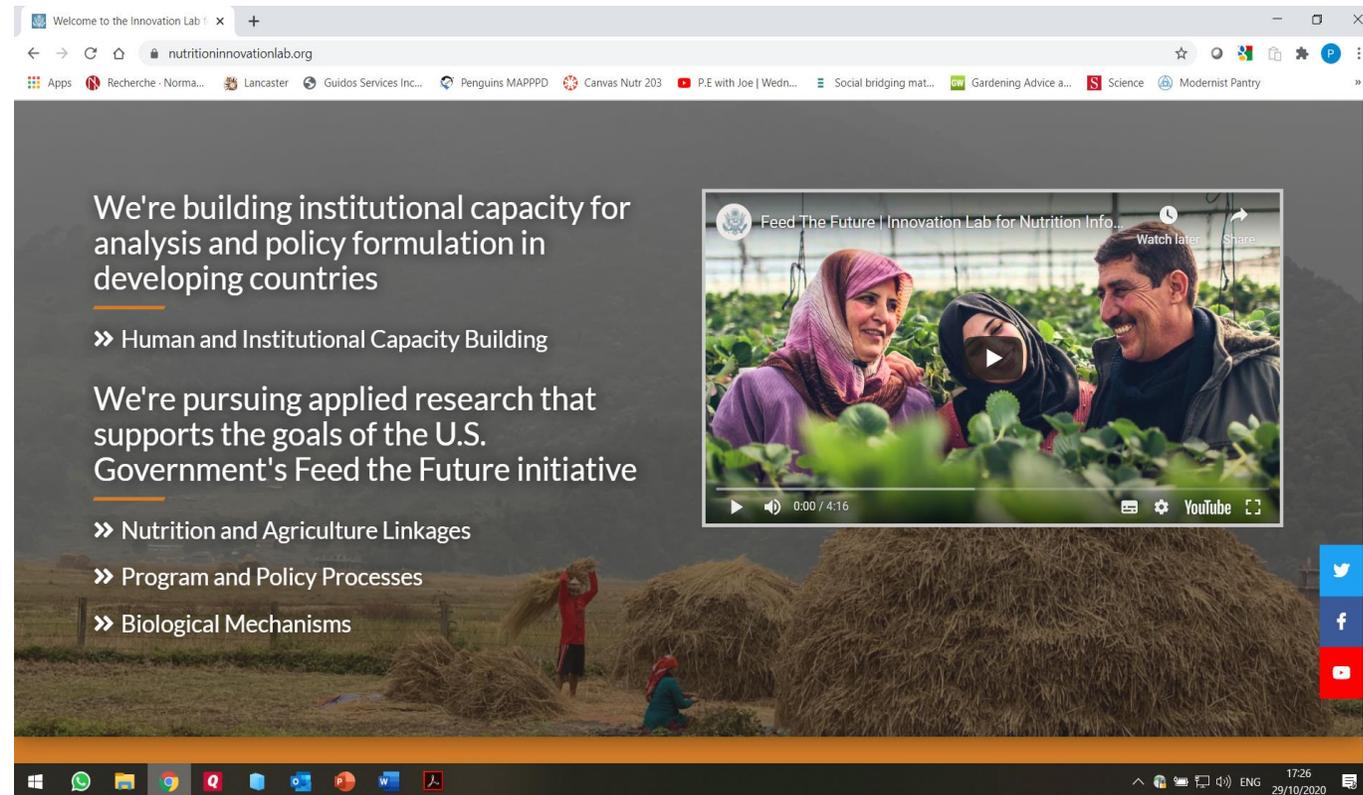
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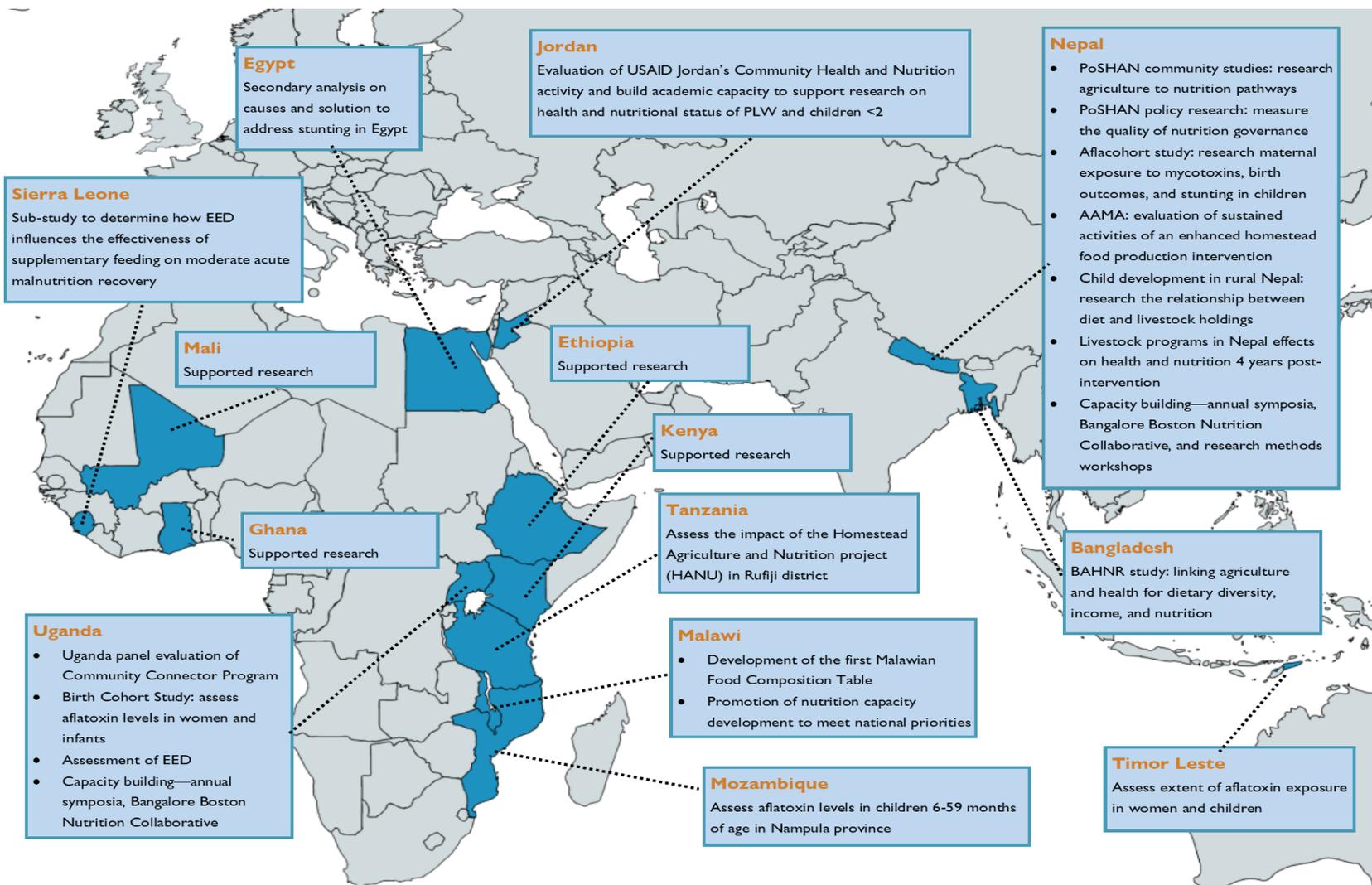
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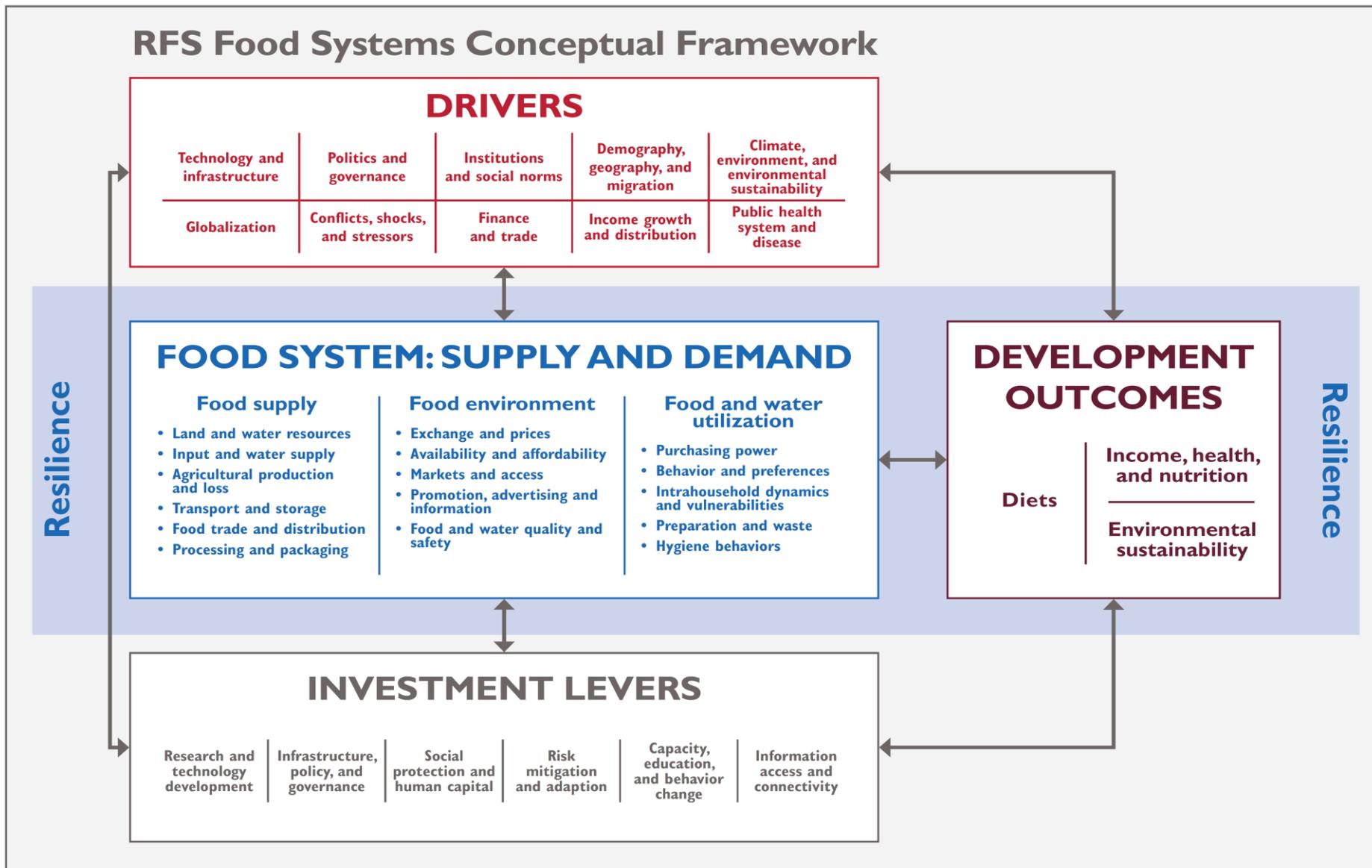
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USAID's resilience definition

USAID defines resilience as *“the ability of people, households, communities, countries and systems to mitigate, adapt to and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth.”*

In other words, it is the ability to manage adversity and change without compromising future well-being.

USAID's resources regarding resilience: resiliencelinks.org



Outline:

- 1. Setting the stage**
- 2. One method to measure resilience**
- 3. Applications to maternal and child nutrition**
- 4. What does it mean for programming approaches?**



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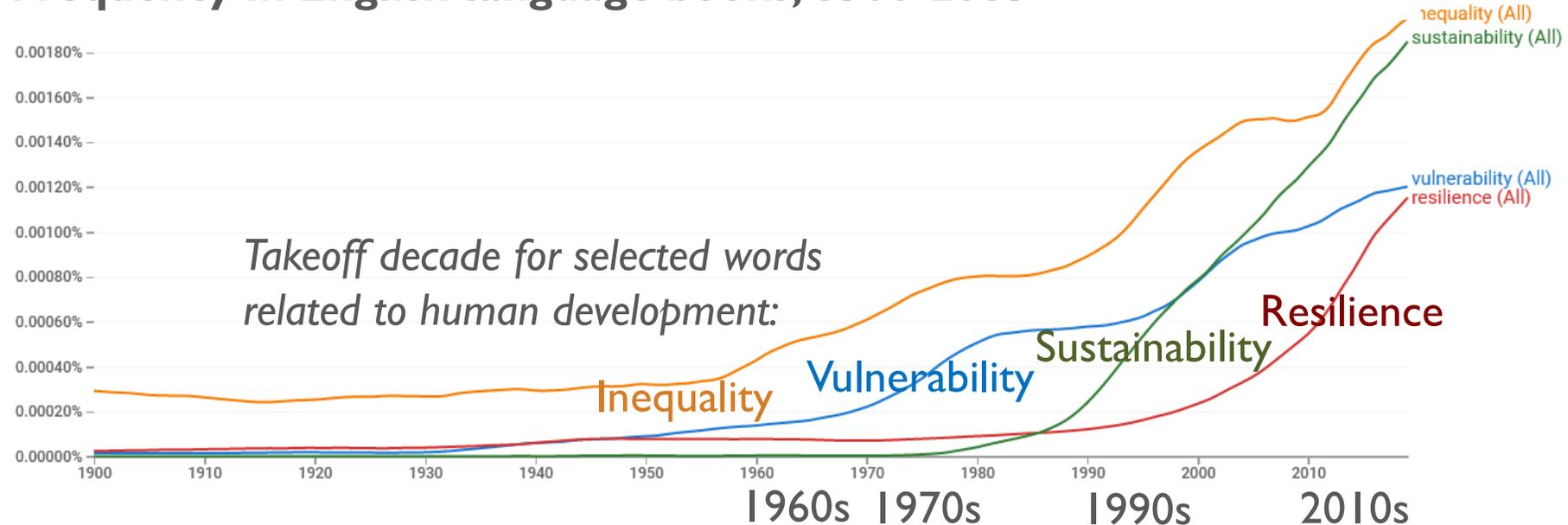
The word “resilience” has come into widespread use

Resilience (*noun*):

1. the capacity to recover quickly from difficulties; toughness.
Example: "the often remarkable resilience of so many British institutions"
2. the ability of a substance or object to spring back into shape; elasticity.
Example: "nylon is excellent in wearability and resilience"

Opposite: rigidity, fragility, vulnerability, weakness

Frequency in English-language books, 1900-2019



Source: Definition is from Oxford Languages (<https://languages.oup.com/google-dictionary-en>)
word frequency is from Google Books ngram viewer (<https://books.google.com/ngrams>), 15 Nov. 2020.

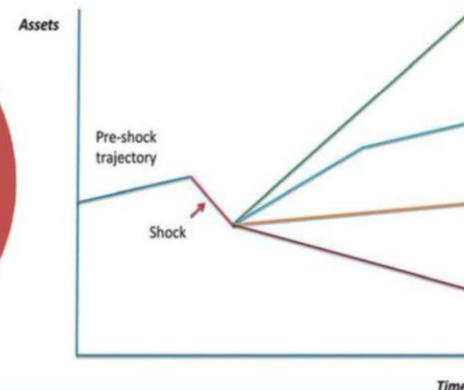
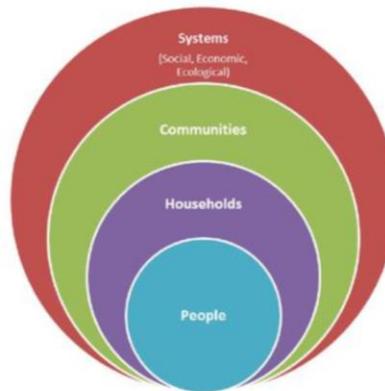
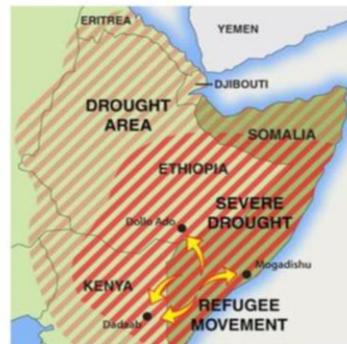
USAID used resilience early, for crisis recovery in the 2010s



Defining Resilience

USAID defines resilience as “**the ability** of people, households, communities, countries and systems **to mitigate, adapt to and recover from shocks and stresses** in a manner that reduces chronic vulnerability and facilitates inclusive growth”

- USAID's Building Resilience to Recurrent Crisis (2012)

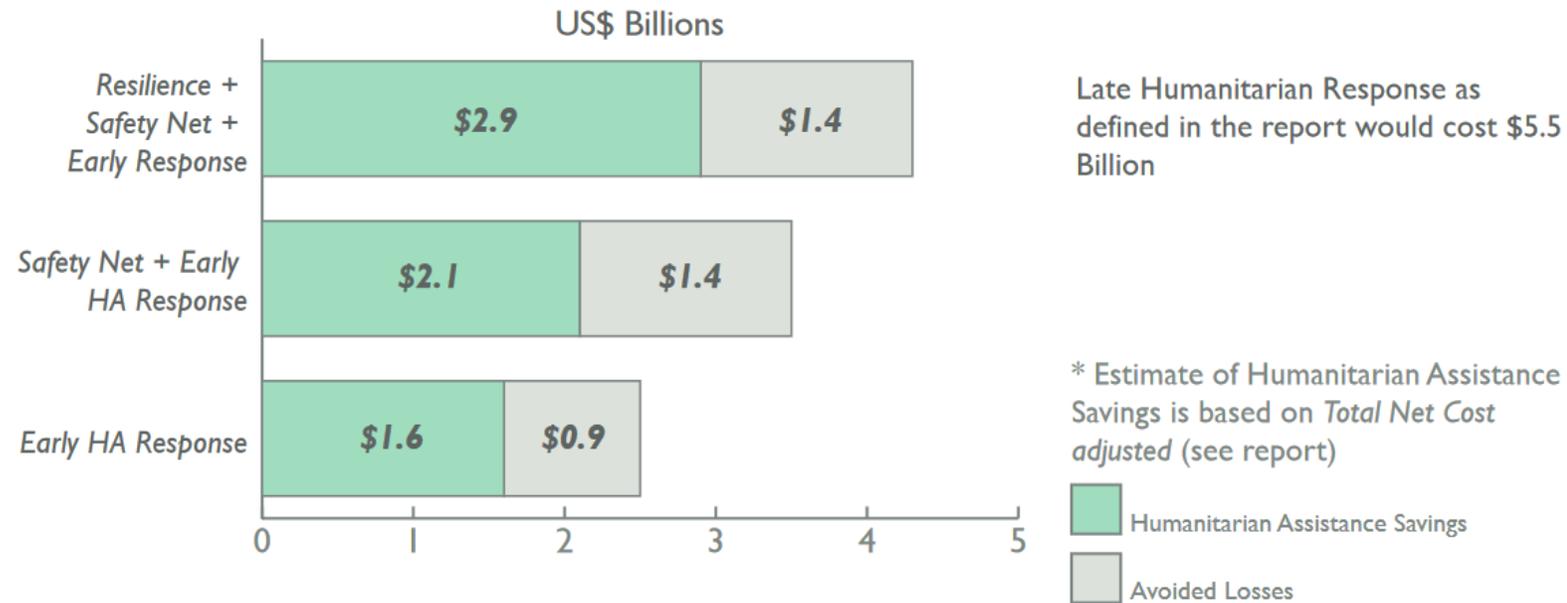


Resilience is more cost-effective than delayed responses

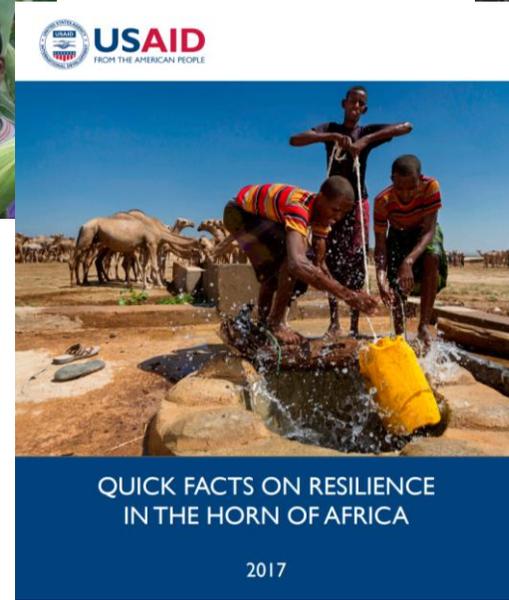
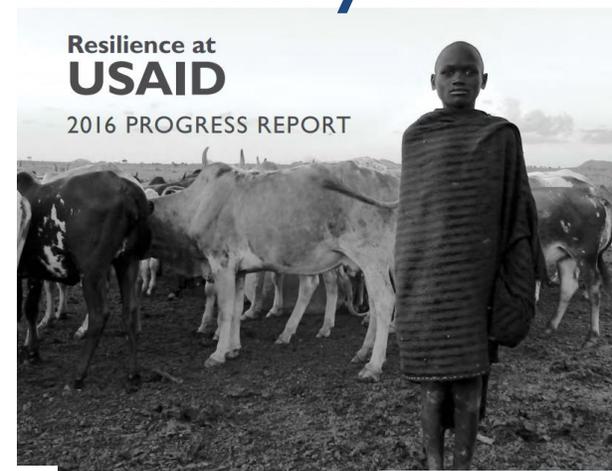
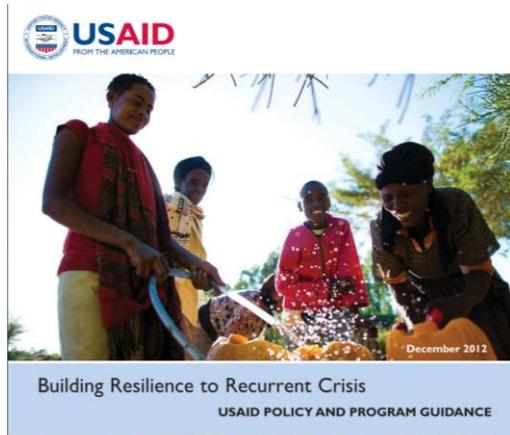
THE ECONOMICS OF RESILIENCE TO DROUGHT IN KENYA, ETHIOPIA, AND SOMALIA

AN OUNCE OF PREVENTION IS WORTH A POUND OF CURE

Humanitarian Assistance Savings* and Avoided Losses Over 15 Year Period for
Population of 15 Million as Compared to Standard Humanitarian Response



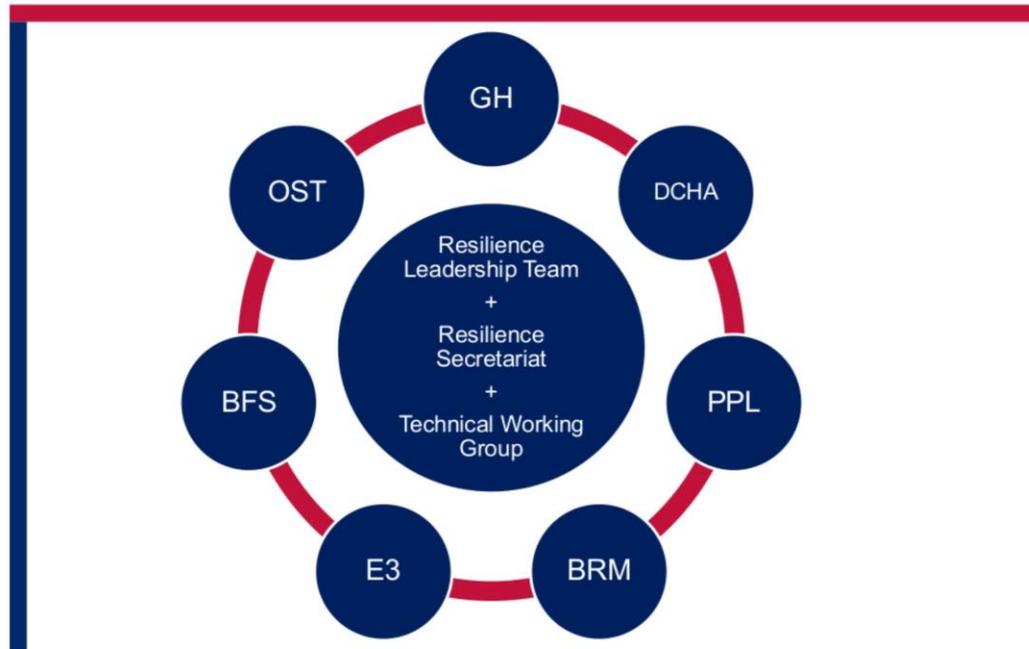
Resilience is now a central theme for many USAID activities



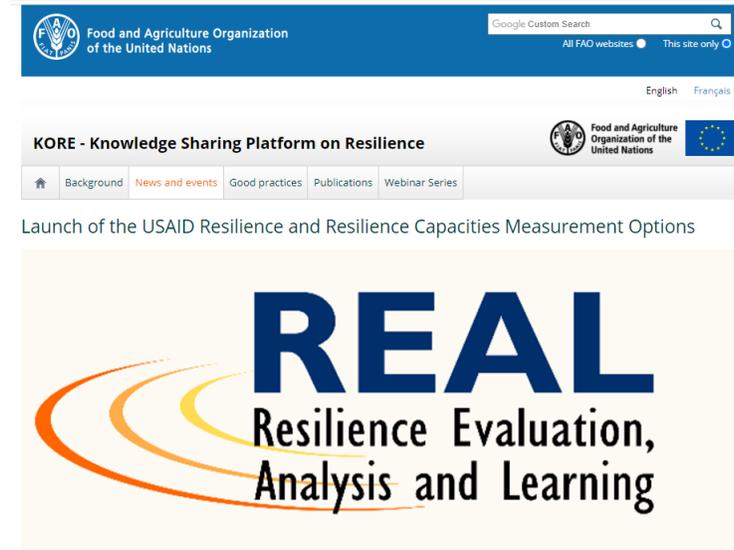
USAID leadership on resilience is important for others as well



Coordinating Cross-Bureau Resilience Efforts across USAID



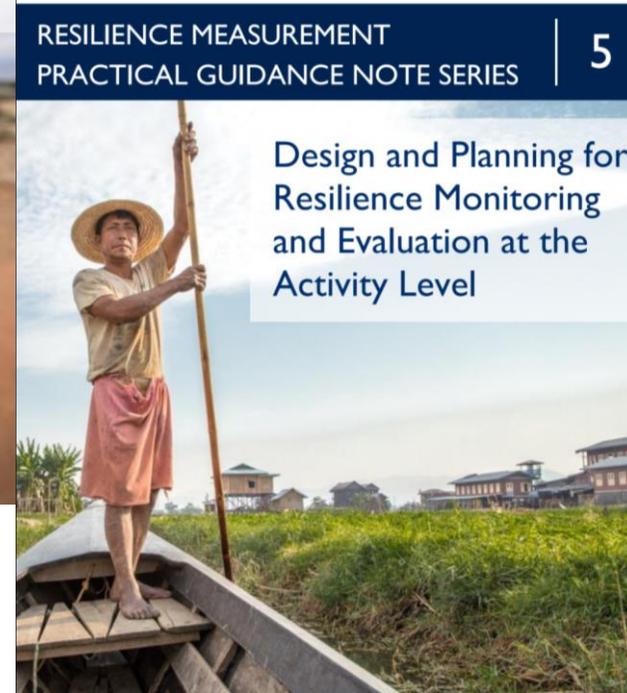
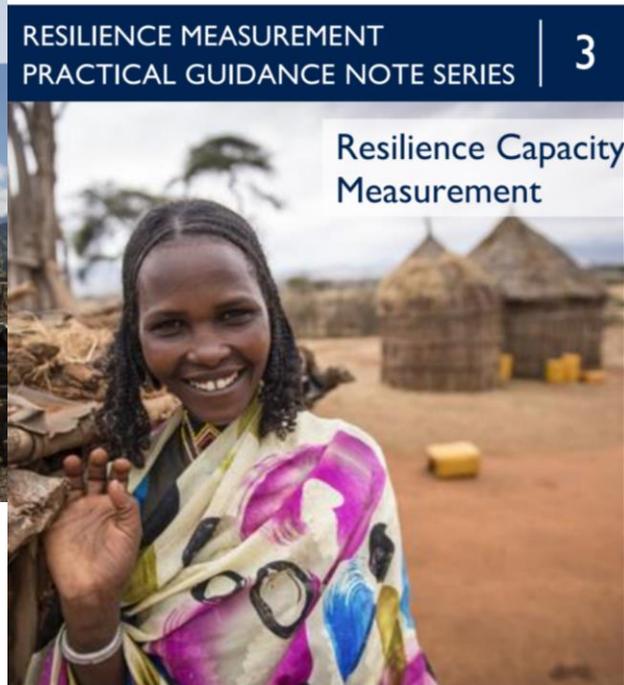
Source: <https://www.slideshare.net/2020resilience/vaughn-institutionalizing-resilience-in-usaid-5-14>



Launch of the USAID Resilience and Resilience Capacities Measurement Options

Source: <http://www.fao.org/in-action/kore/news-and-events/events-details/en/c/1158471/>

Resilience is complex, calling for a range of measurement tools



Resilience is complex, calling for a range of training materials



Resilience 101

Documents | Exit

Menu

- 1. Introduction
 - 1.1. Welcome
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- 6. Conclusion



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FROM THE AMERICAN PEOPLE

Resilience 101

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Resilience is complex, calling for a range of expertise

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Resilience

Tools to anticipate and prepare for market shocks, health crises, political instability and weather extremes gives vulnerable people ways to manage risks and rebound more quickly.

POSTS **AGRILINKS EVENTS**

AGRILINKS EVENT

Current and Emerging Threats to Crops: Building the Knowledge Base

Oct 21, 2020
online

Please join USAID Bureau for Resilience and Food Security as we consider current efforts to combat threats and share a new research opportunity to further the practice.

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RESILIENCE



UPCOMING EVENTS

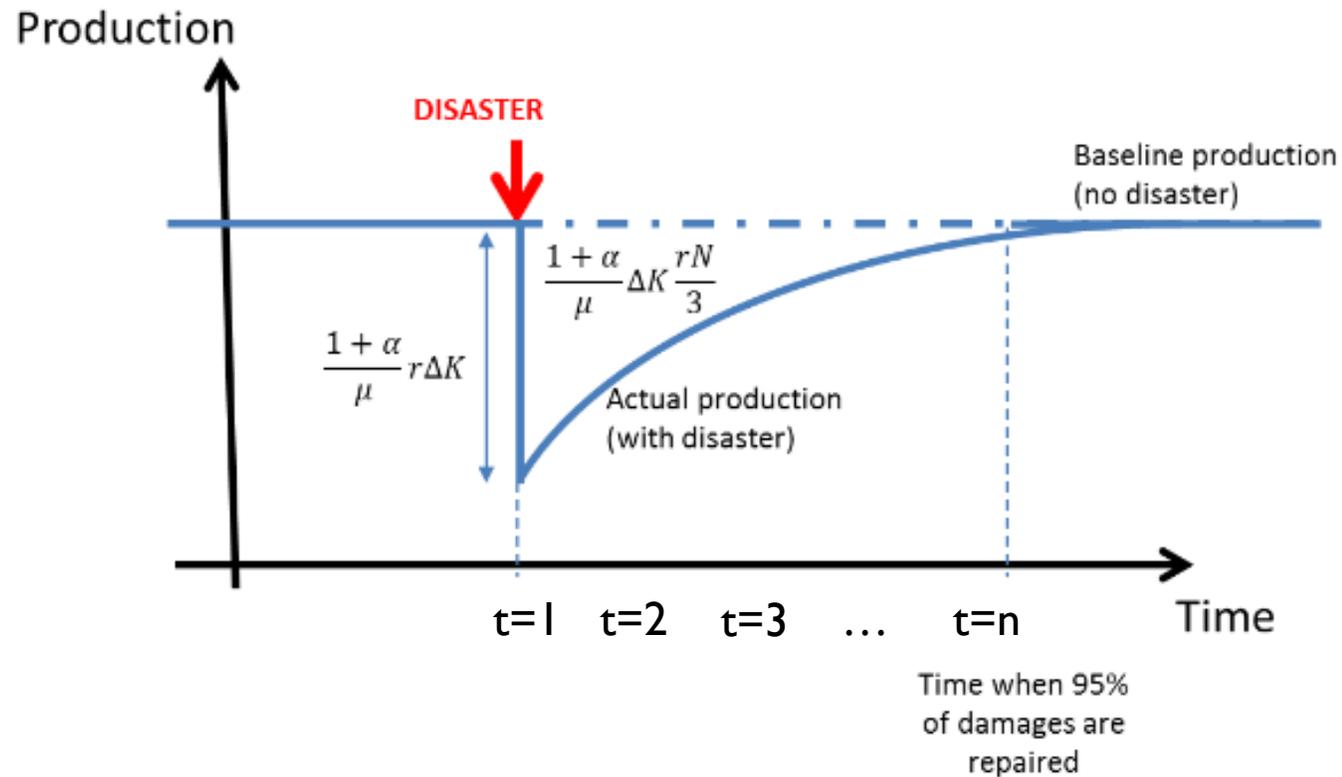
Women and Gender in Development at Virginia Tech Virtual Conference 2021

Feb 23, 2021 to Feb 26, 2021
United States
online

Lessons in Working Towards Global Eradication of Peste des Petits Ruminants (PPR)

Dec 02, 2020
United States
online

Today's focus is measurement, building on economic methods



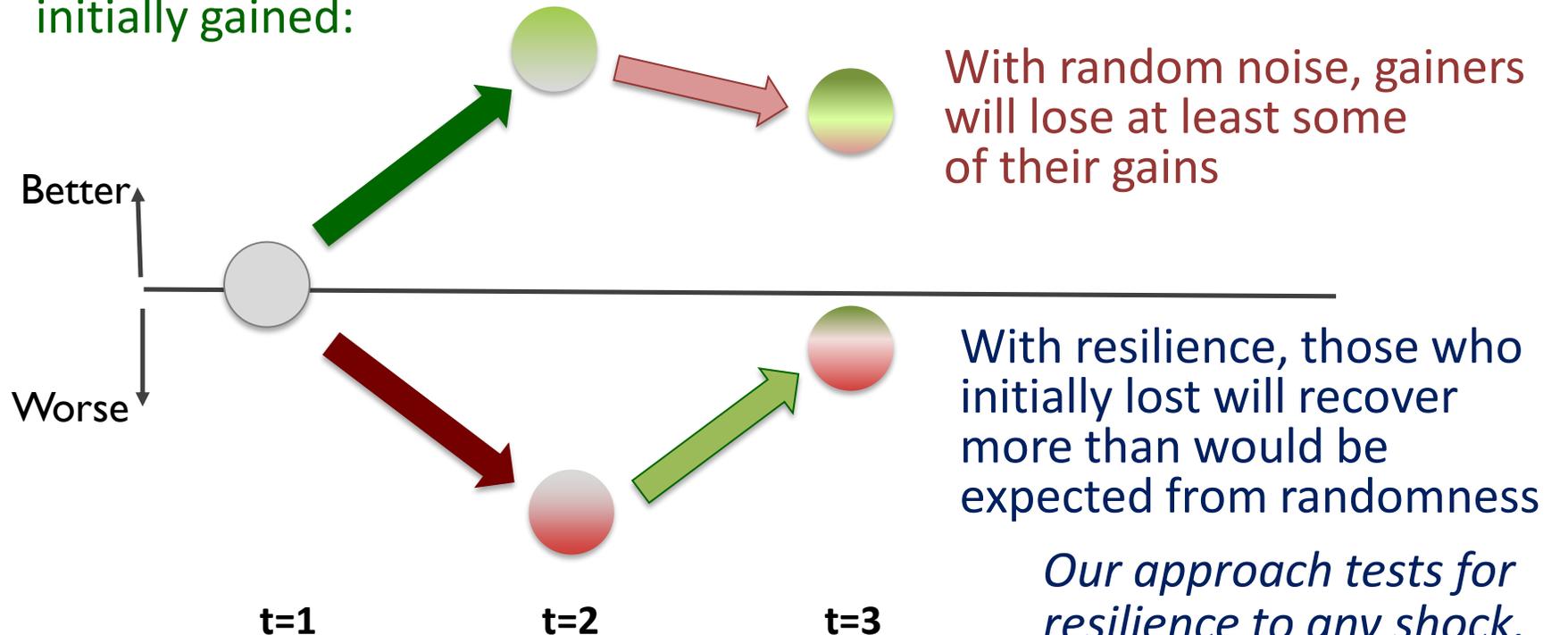


Our approach starts when outcomes are measured 3 times

Resilience is concerned with those who experience a decline and then recover at least some of what they lost.

Are they truly resilient, or did they just experience random noise?

We compare them to others in their community who initially gained:



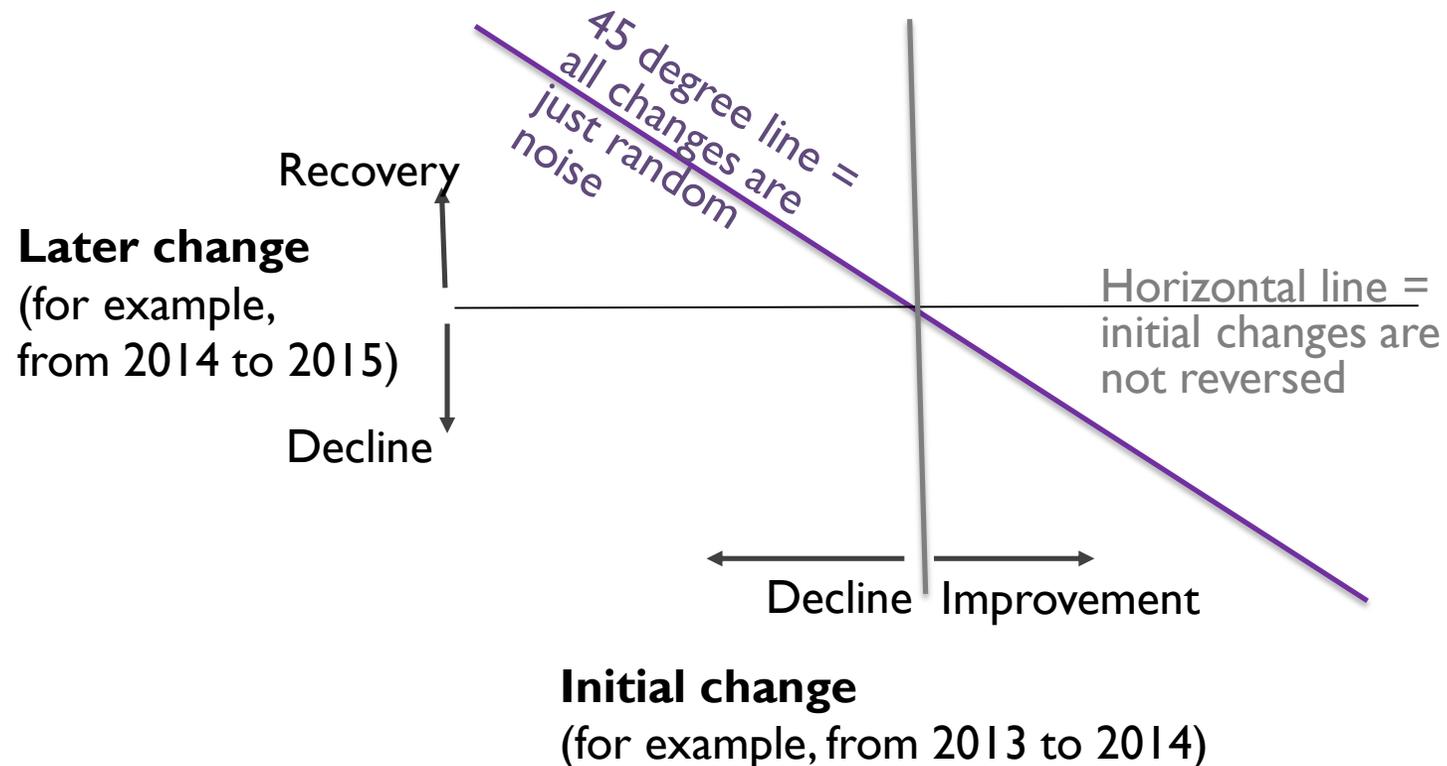
With random noise, gainers will lose at least some of their gains

With resilience, those who initially lost will recover more than would be expected from randomness

Our approach tests for resilience to any shock, as in all-cause insurance.

To measure resilience, we compare two successive changes

Our focus is on recovery after decline,
which we compare to decline after improvement



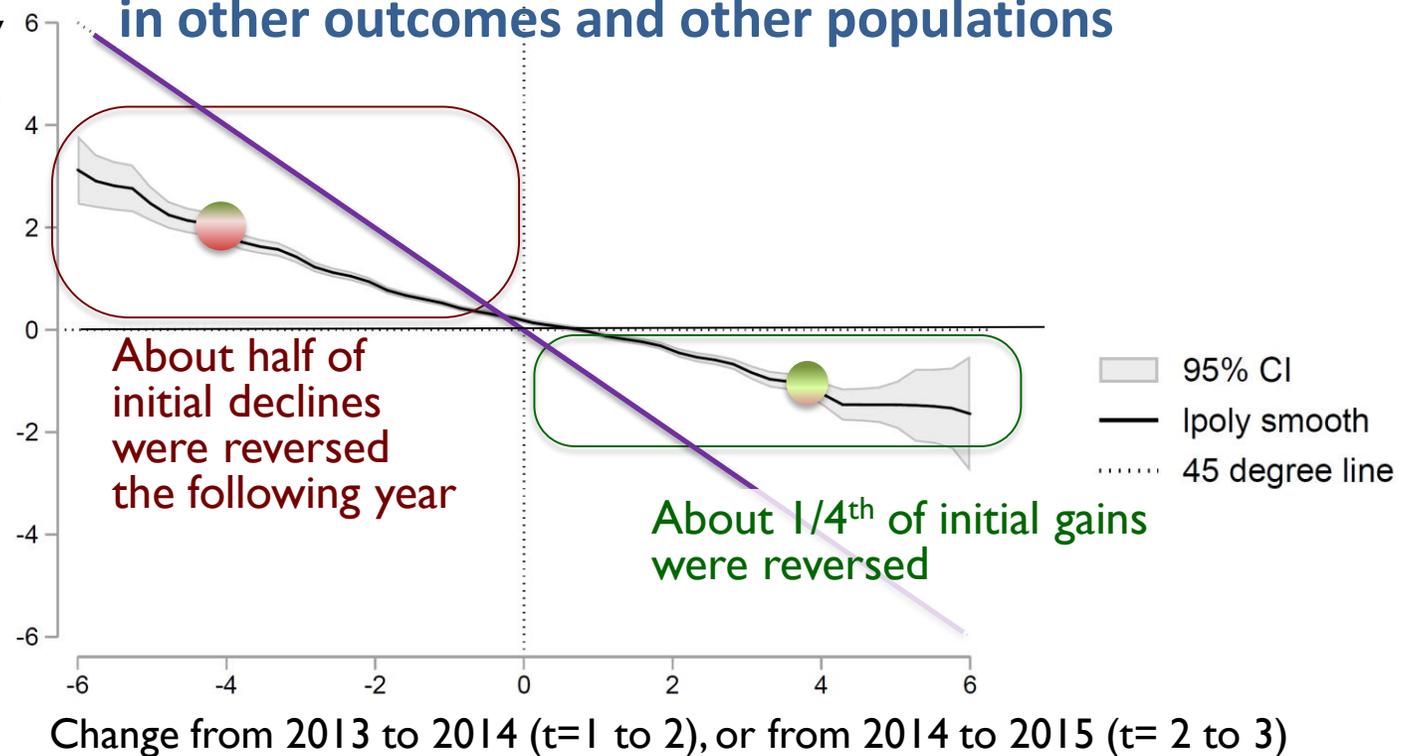
Our longitudinal (panel) surveys reveal dynamics of change

For example, over the four years of the PoSHAN survey (2013-16) in Nepal **women whose dietary diversity declined recovered some of their losses** while those whose diets initially improved kept most of their gains.

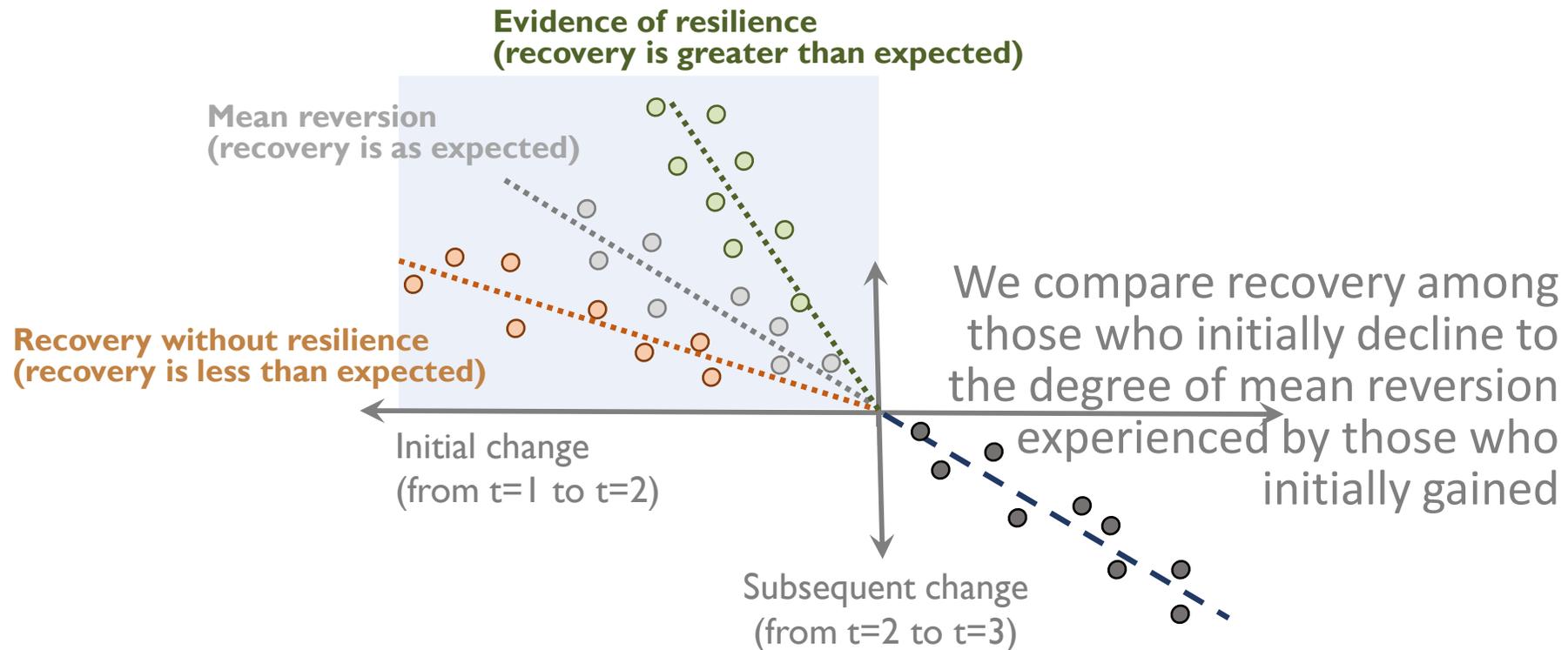
We test for this kind of resilience in other outcomes and other populations

Women dietary diversity scores (Nepal)

Change from 2014 to 2015 (t=2 to 3) or from 2015 to 2016 (t=3 to 4)



The method we use draws on techniques developed for financial markets, and could be applied to any outcome



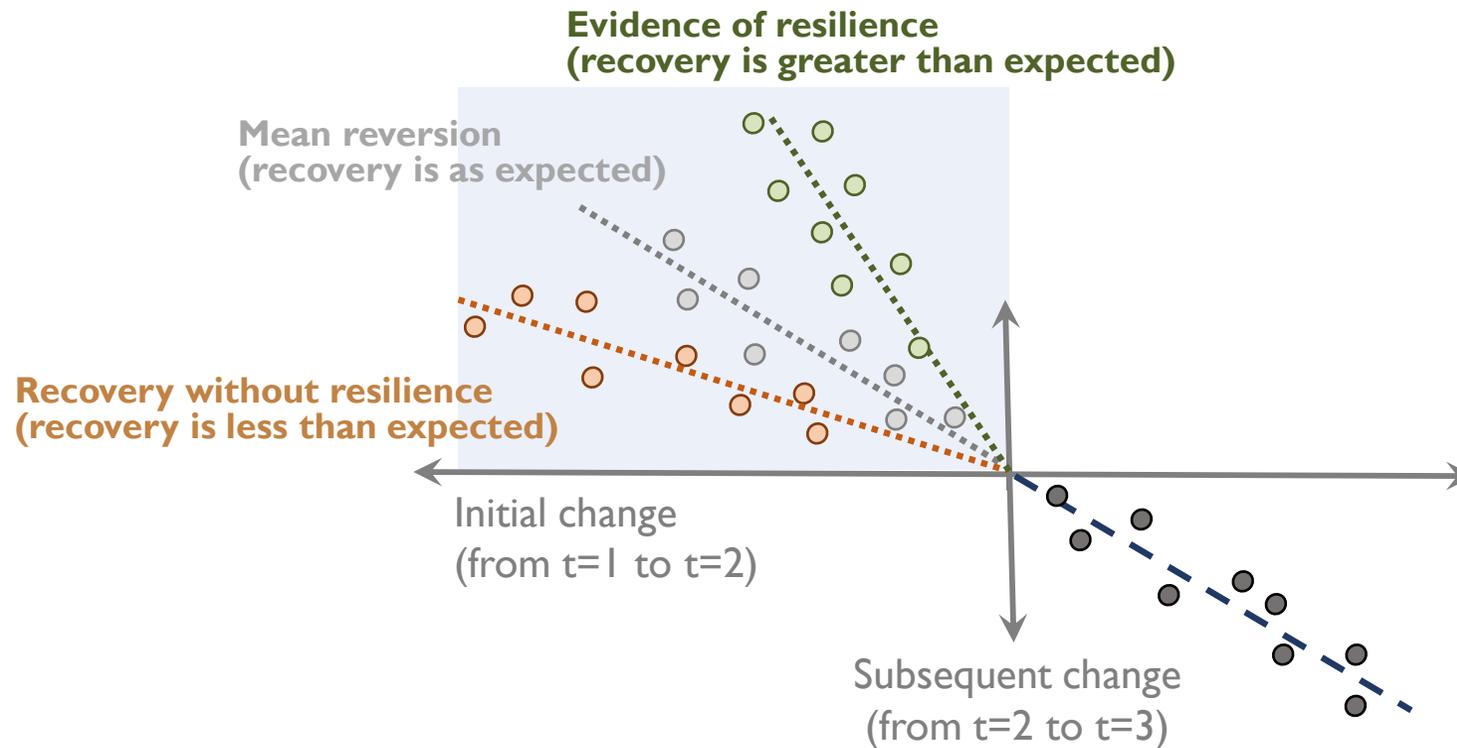


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Observations in the shaded quadrant are improvements after decline.

Is that resilience?



Estimation

$$\Delta y_{i,t} = \alpha^- + \rho^- \Delta y_{i,t-1} + \Delta \varepsilon_{i,t}, \text{ if } \Delta y_{i,t-1} < 0 \quad (1)$$

$$\Delta y_{i,t} = \alpha^+ + \rho^+ \Delta y_{i,t-1} + \Delta \varepsilon_{i,t}, \text{ if } \Delta y_{i,t-1} \geq 0 \quad (2)$$

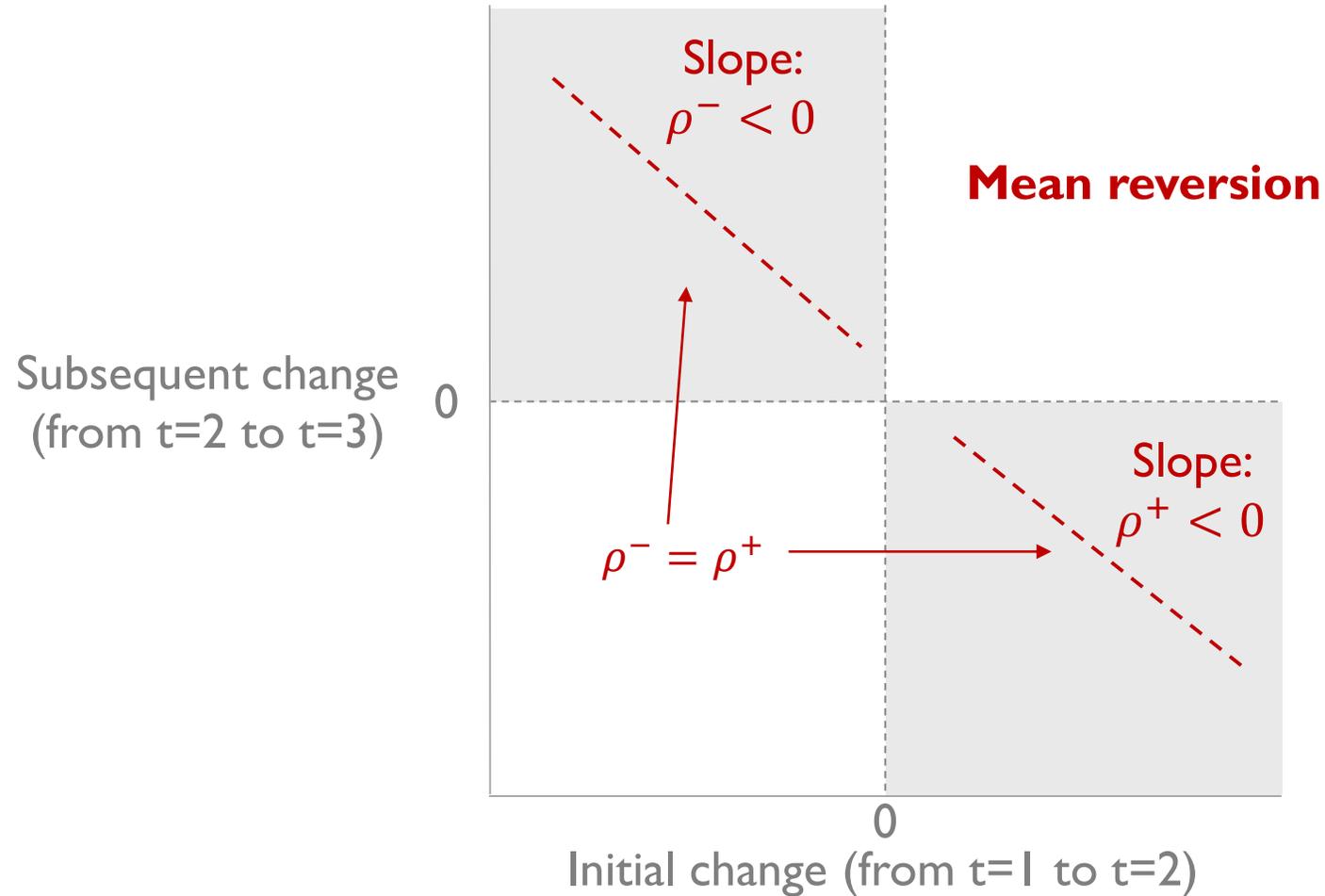
trend reverting tendency

- Where:
 - $y_{i,t}$ is the outcome of interest for individual i at time t
 - $t = 3, \dots, T$ and $i = 1, \dots, N$.
 - $\Delta y_{i,t} = y_{i,t} - y_{i,t-1}$
- Bias correction



$$\Delta y_{i,t} = \alpha^- + \rho^- \Delta y_{i,t-1} + \Delta \varepsilon_{i,t}, \text{ if } \Delta y_{i,t-1} < 0$$

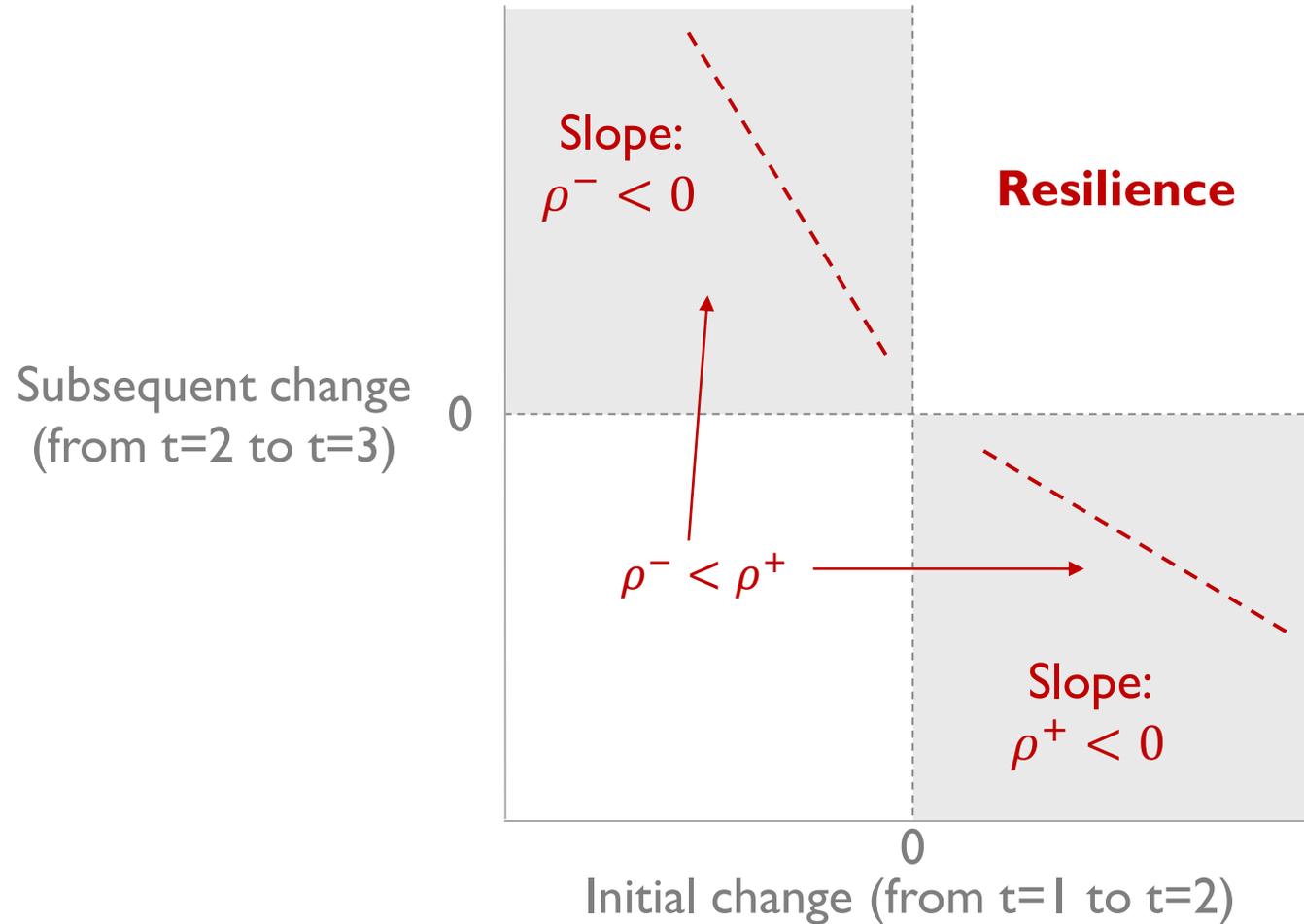
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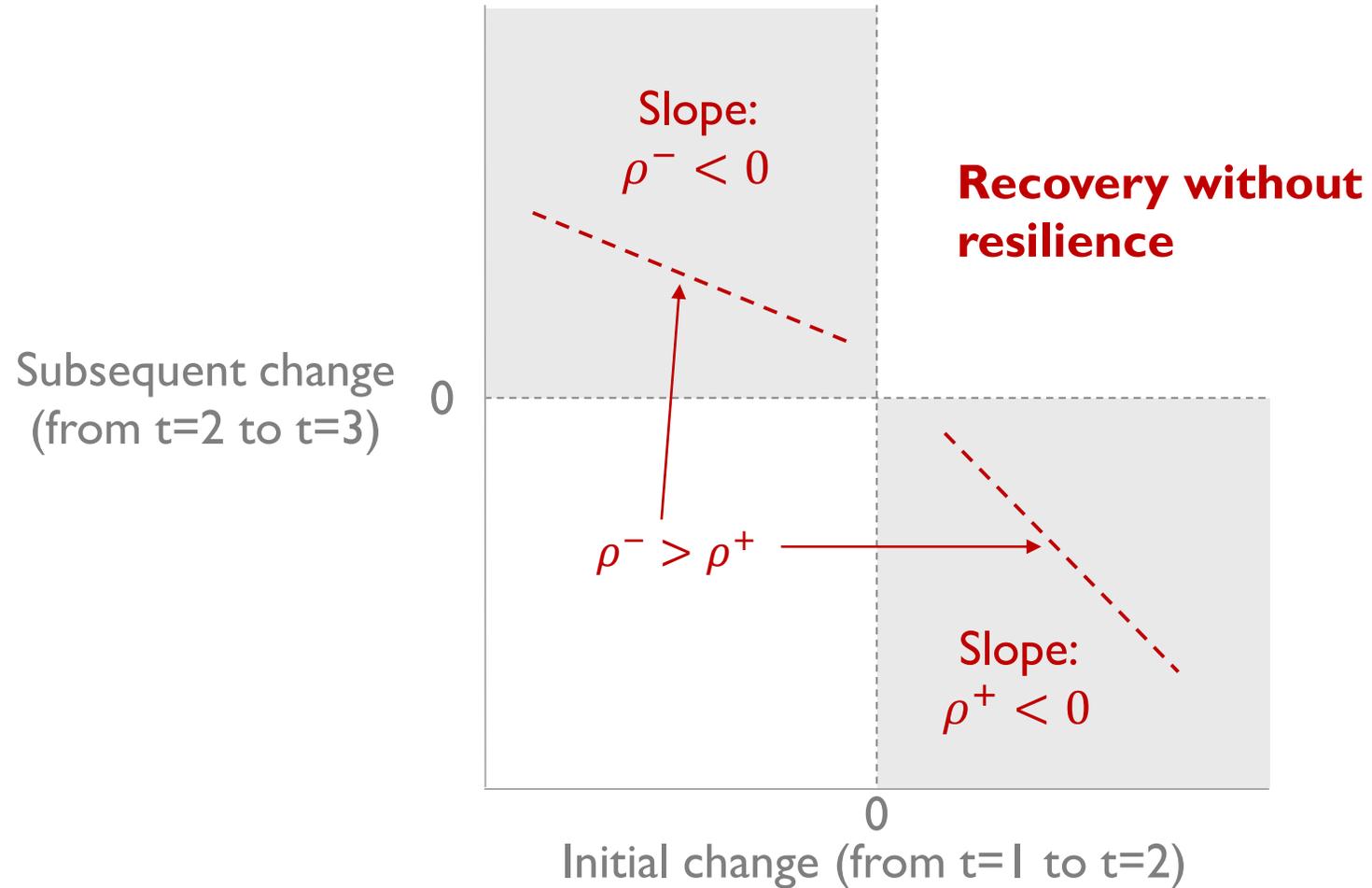


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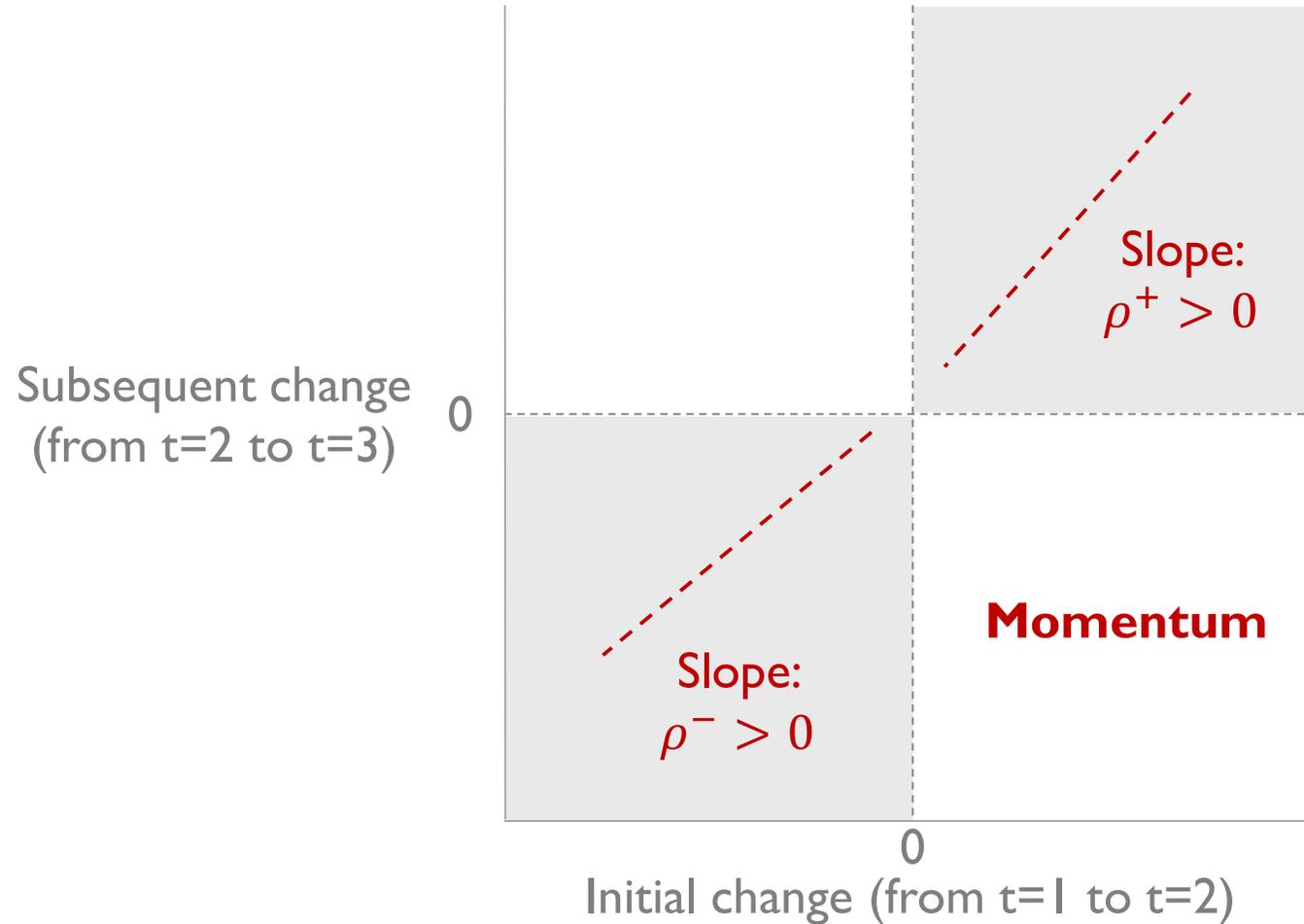


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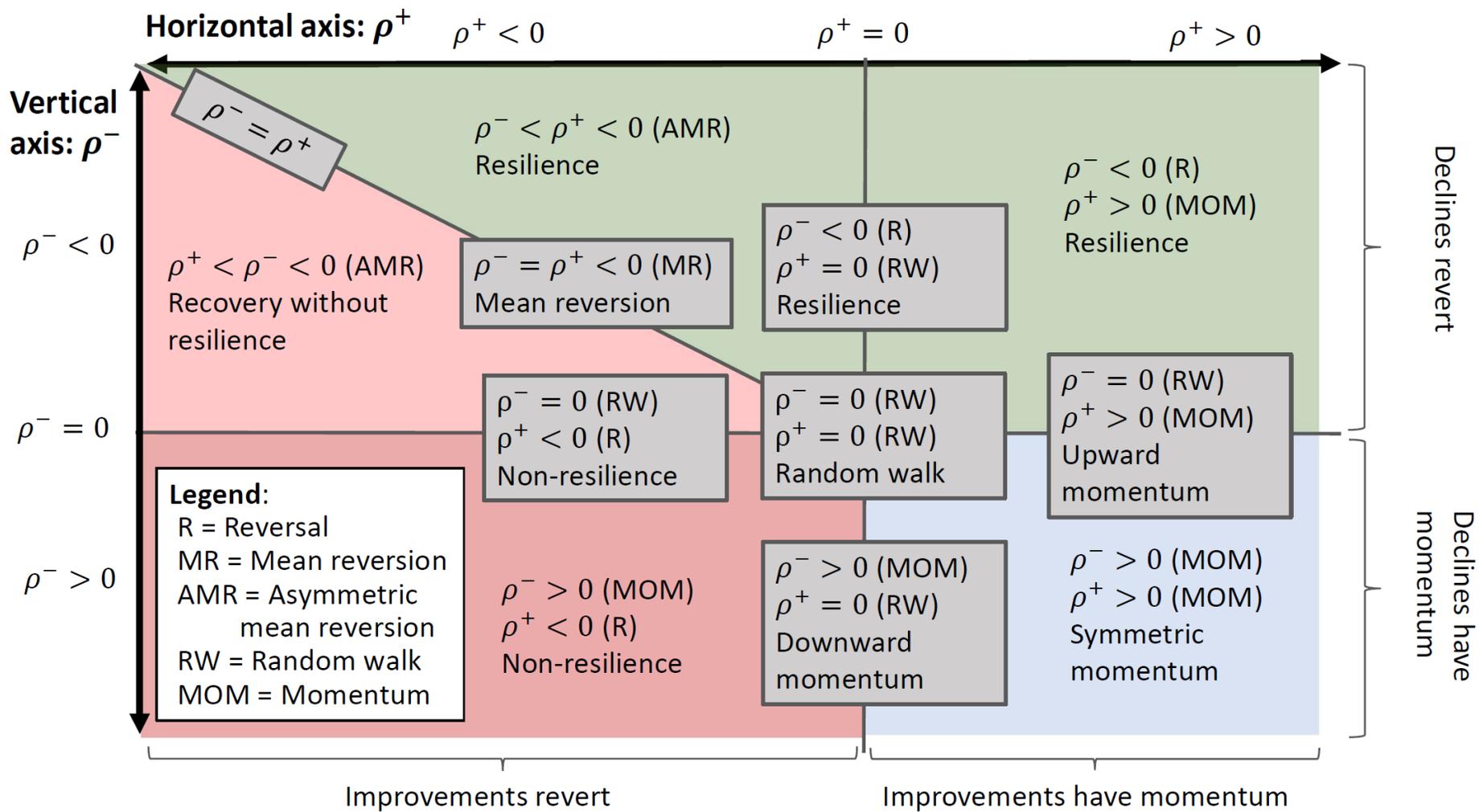
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Source: Zaharia, Masters, Shively & Webb (2020) Measuring Resilience as Asymmetric Mean Reversion. Working Paper, Tufts University.



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Data

Outcome:

Dietary diversity scores (DDS) from 7-day and 24-hour diet recalls

Women's Body Mass Index (BMI)

Children's weight-for-height z-score (WHZ)

Population:

Women (13 to 47 years old) and children (2 to 5 years old)

Geography & time:

Nepal: Terai region, 2013-2016 (yearly)

Bangladesh: Feed the Future Zone of Influence, 2016-2017 (bi-annual)

Uganda: six districts from N and SW Uganda, 2012-2016 (biennial)

Data sources:

Nepal: PoSHAN survey (Klemm et al. 2018)

Bangladesh: BAHNR survey

Uganda: Uganda panel survey

Evidence of resilience in Nepal

Outcome	Reverting tendency of declines (ρ^-)	
Women's weekly DDS	-0.36***	Reversal
Children's weekly DDS	-0.54***	Reversal
Women's daily DDS	-0.03	Random walk
Children's daily DDS	-0.03	Random walk
Women's BMI	0.40***	Momentum
Children's WHZ	0.19***	Momentum

OLS regressions, corrected for bias. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Nepal: $n=3,752$ (women) & $2,203$ (children)

No evidence of resilience in Bangladesh and Uganda

Outcome	Reverting tendency of declines (ρ^-)	
Bangladesh		
Women's daily DDS	0.38***	Momentum
Children's daily DDS	0.13**	Momentum
Women's BMI	0.86***	Momentum
Children's WHZ	0.23***	Momentum
Uganda		
Women's daily DDS	0.48***	Momentum
Women's BMI	0.22**	Momentum

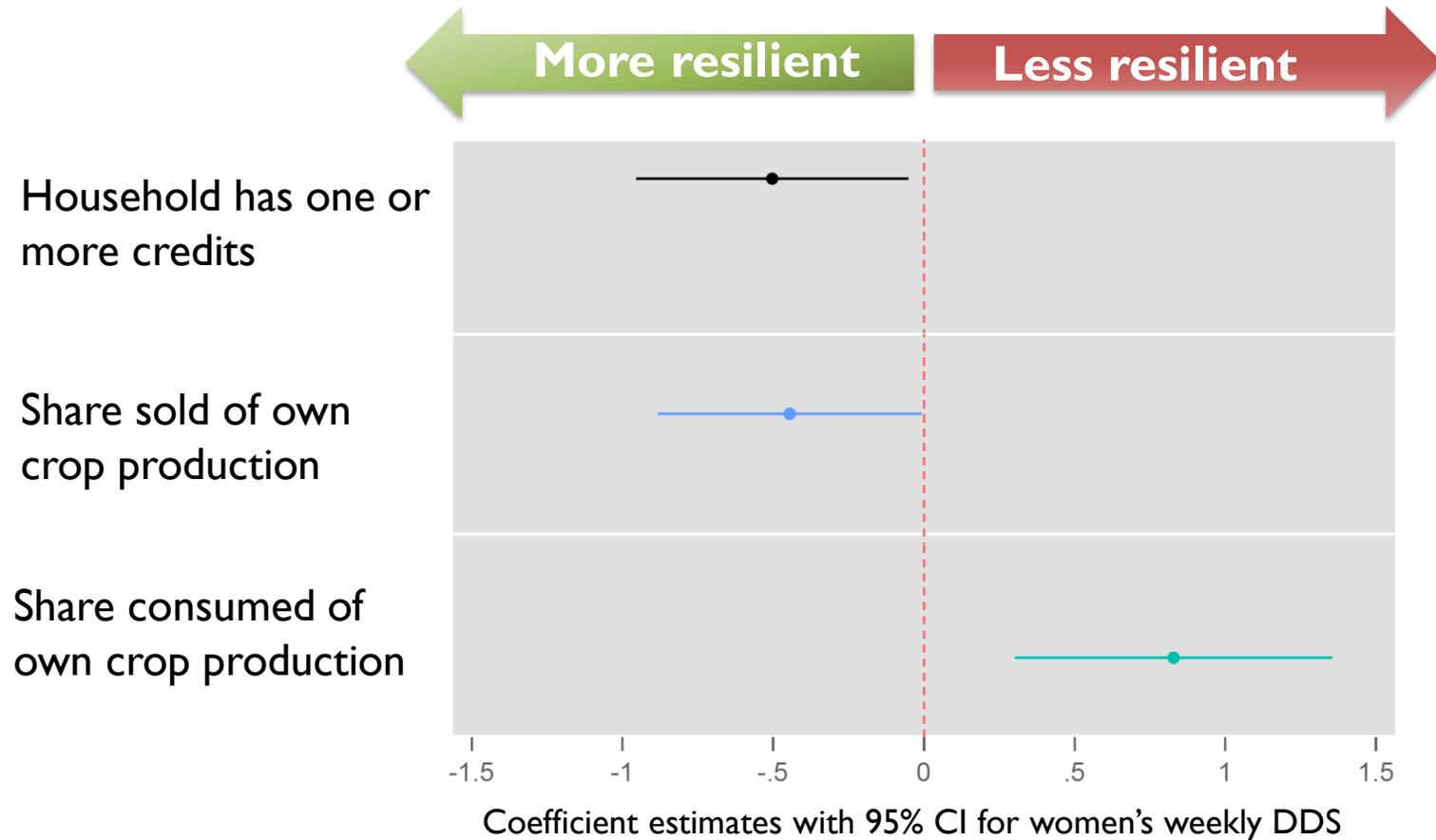
OLS regressions, corrected for bias. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Bangladesh: $n = 2,753$ (women) & $1,547$ (children); Uganda $n = 1,617$ (women).



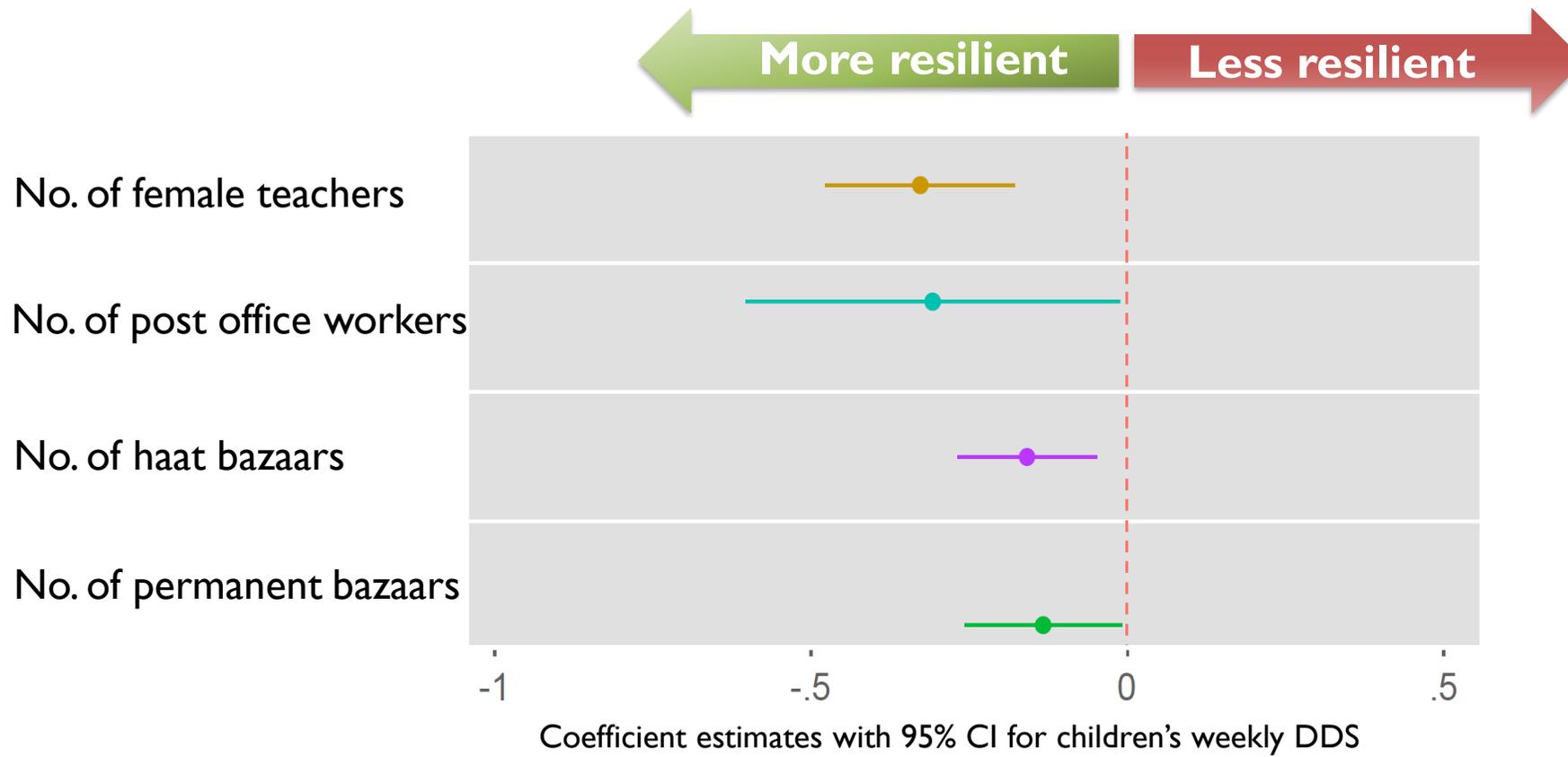
How does resilience vary in the population?

- In Nepal, dietary diversity resilience of women and children varies across **households** and **districts**.
- Who is most resilient?

Women and children from **more market-oriented** households and those with **better access to credit** are more resilient



Women and children from **districts with more developed infrastructure** are more resilient





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Household food insecurity across the year (Nepal 2014)

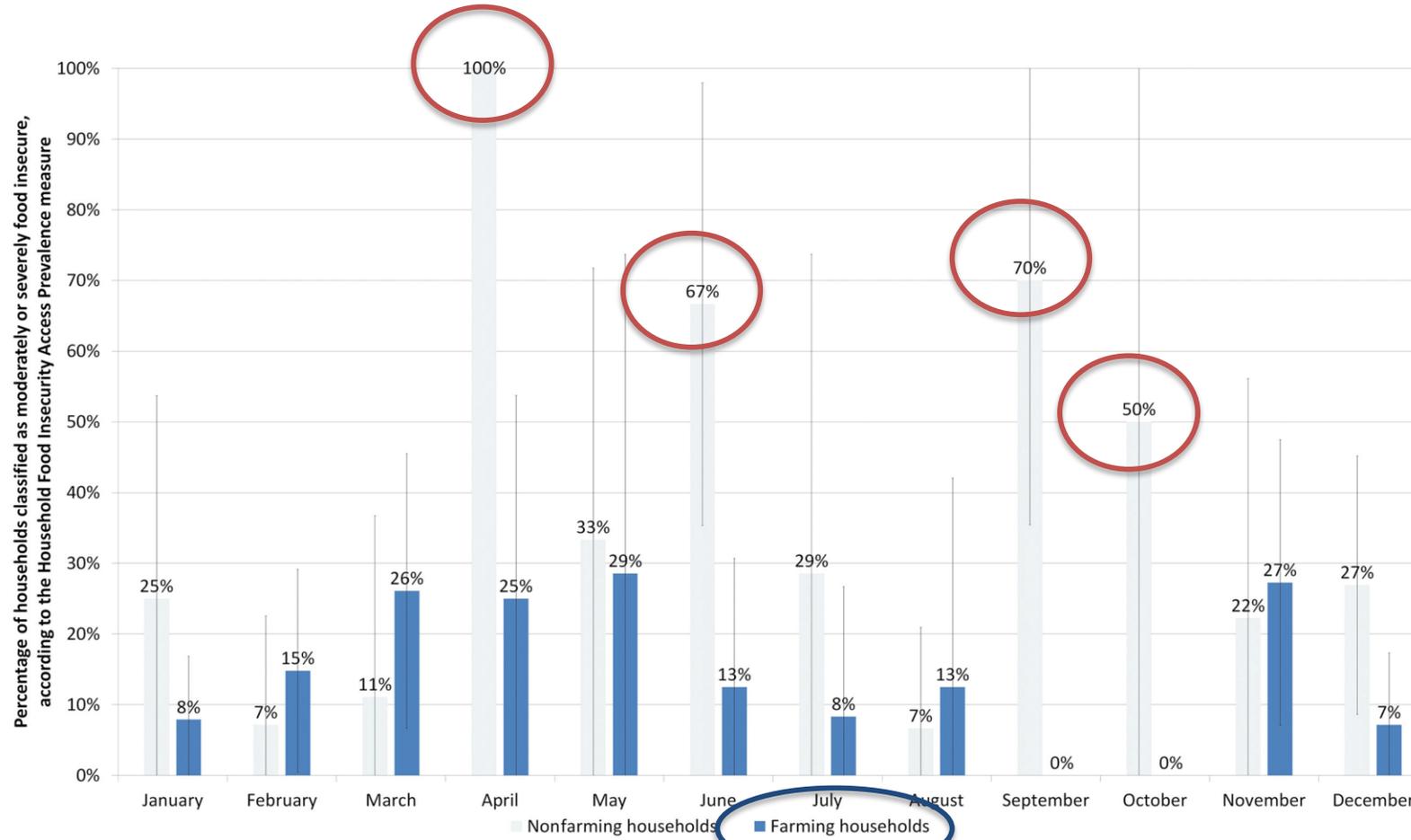


FIGURE 3 Monthly reporting of food insecurity, among farming compared with nonfarming households ($n = 340$ households). Vertical error lines represent 95% CIs.

Livelihood 'resilience' post-earthquake (Nepal 2015)

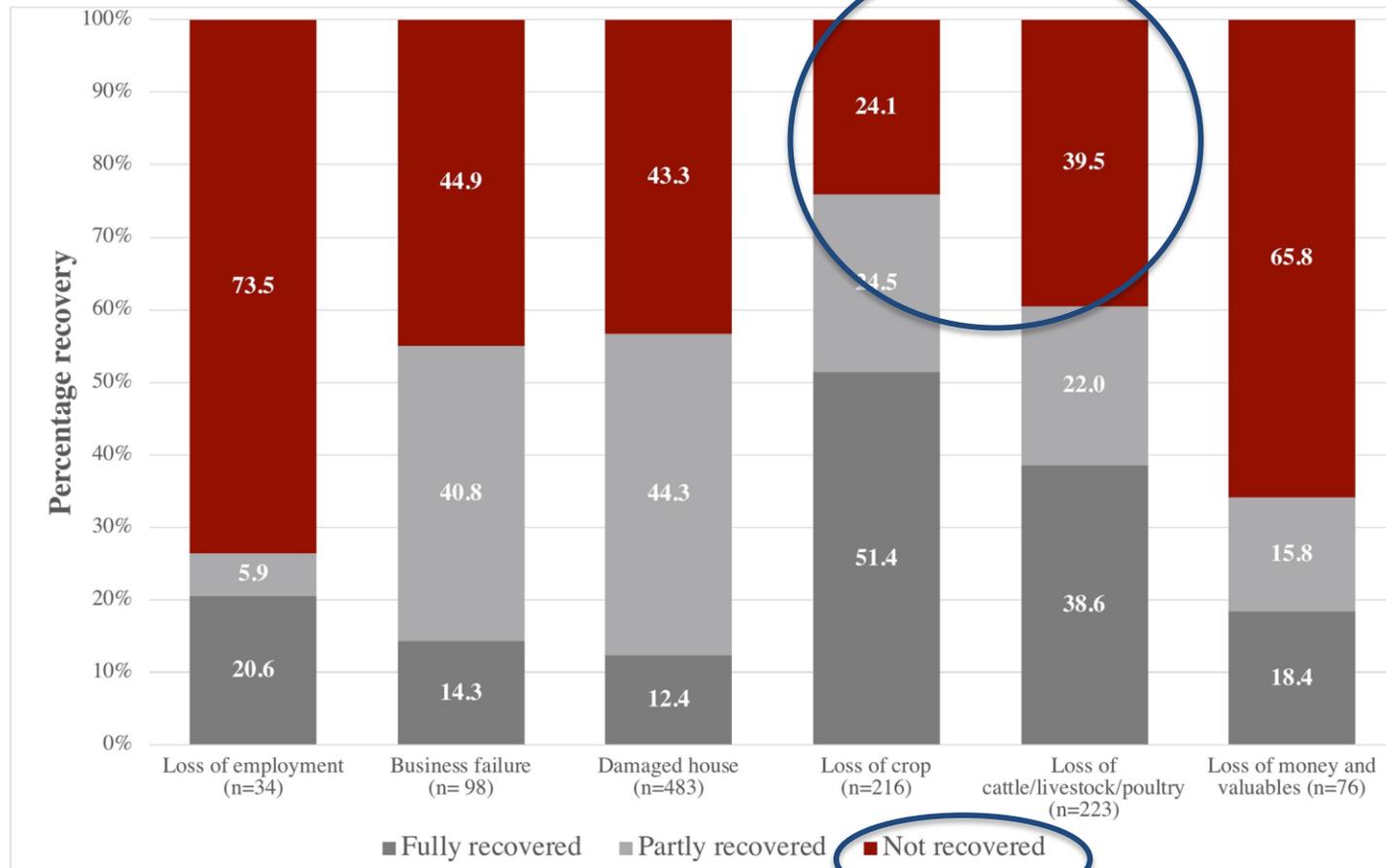


Fig 3. Post-earthquake recovery of households in earthquake-affected VDCs (N = 1056 households).

Implications?

- Program goals could include *'net' resilience* at household or ZOI levels (to allowing for *'churning'*)?
- Co-variate shocks can weaken systems over time. Setting expectations: will your resilience programming reverse this? Over what period?
- Programs need longitudinal data to assess multiple time points (coordinate with national statistics offices)?
- We need to find ways to treat *'past gains protected'* during shocks in ways that value this alongside *'future gains achieved'* without shocks.

Programming implications?

- Delivery systems *made resilient*:
 - Strengthen services, inputs, assets, credit, income *flows* so that the systems *themselves are more resilient*.
 - Resilient systems support outcomes *across the food system* (wealth, jobs, purchasing power).
 - *Preparedness* can be embedded in all parts of food systems.
- Attribution is challenging. What might *not* have happened is hard to measure and value.
- We need to focus much more on supporting resilience policy and programming, via clarity on metrics and evidence.

Acknowledgements

- The research is funded under grant contracts AID-OAA-L-10-00006 and AID-OAA-LA-14-00012 from the United States Agency for International Development (USAID).
- POSHAN community studies – Nepal:
 - Led by Johns Hopkins University with in-country partners; National Agriculture Research Council (NARC), Nepal Technical Assistance Group (NTAG), New Era, Tribhuvan University Institute of Medicine (TUTH IOM), Tufts University.
- BAHNR study – Bangladesh:
 - Tufts University, HKI Bangladesh, Horticulture Innovation Lab, WorldFish, AquaFish Innovation Lab, Dhaka University, Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING).
- Uganda panel survey – Uganda:
 - Makerere University School of Public Health, Uganda; the Uganda Science and Technology Council, Kampala, Uganda.



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Q&A

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