FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Economics of Contract Quality: Part 2

Tara Chiu, Assistant Director
Feed the Future Innovation Lab
for Assets and Market Access

AGRICULTURAL INSURANCE IN UGANDA
KOLOLO COURT HOTEL, KAMPALA
15 FEBRUARY 2019

basis.ucdavis.edu

USAID FROM THE AMERICAN PEOPLE

INNOVATION LAB FOR ASSETS & MARKET ACCESS
BASIS

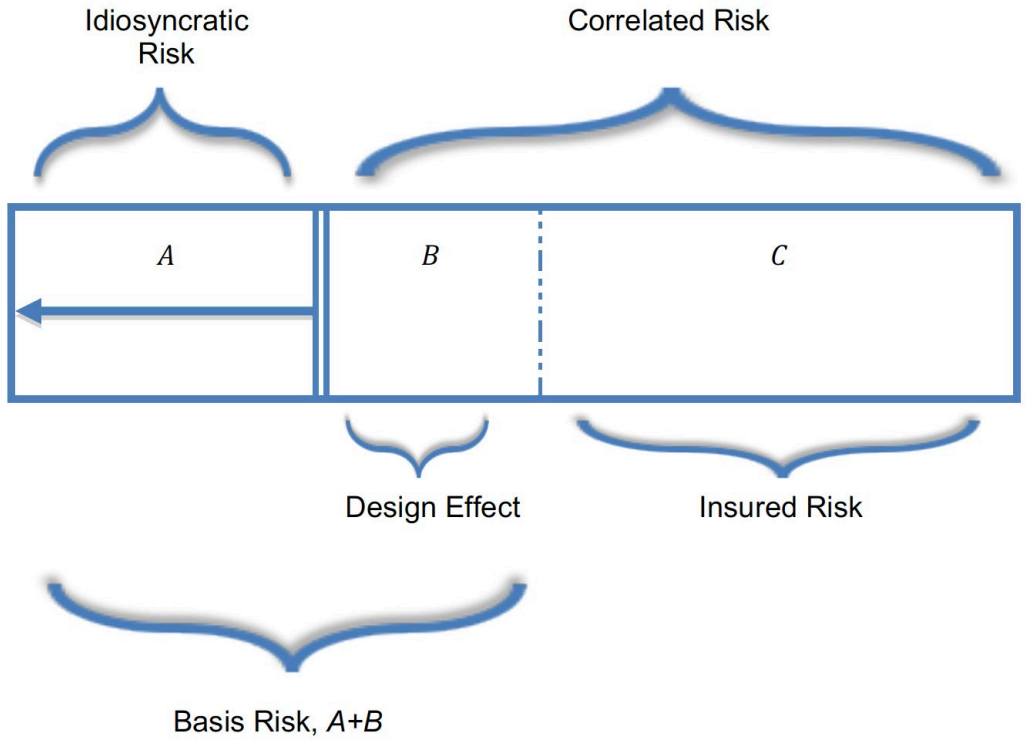
UCDAVIS UNIVERSITY OF CALIFORNIA

Sources of Uncompensated Losses

BASIS RISK

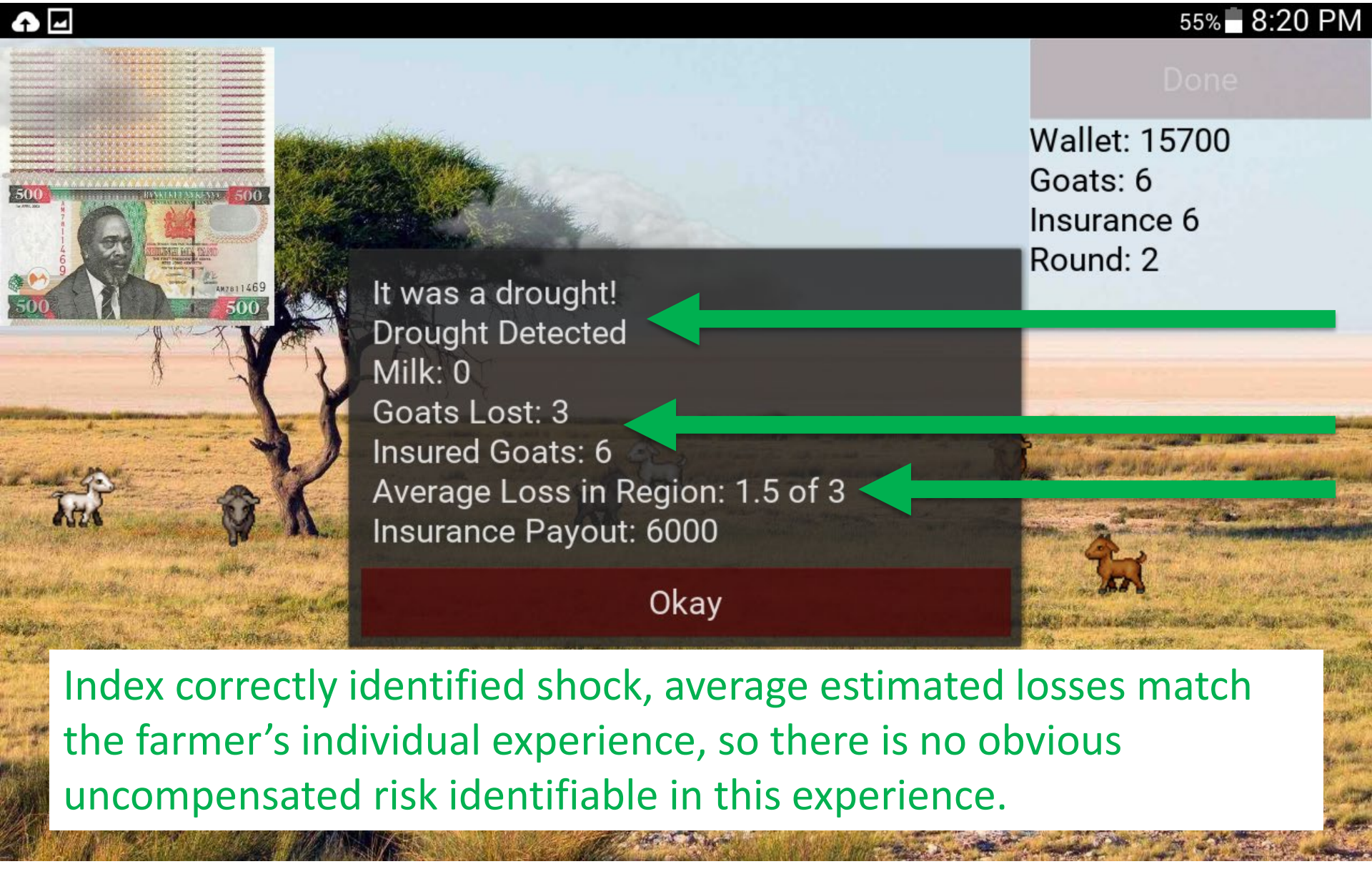
Agricultural index insurance is most effective when:

- **Idiosyncratic Risk (A)** is a low proportion of farmers' overall risk.
- **Design Effect (B)** of the index minimizes the discrepancy between what the index estimates and the reality is on the ground.
- **Insured Risk (C)** – the risk that is successfully transferred by the index insurance product – is maximized.

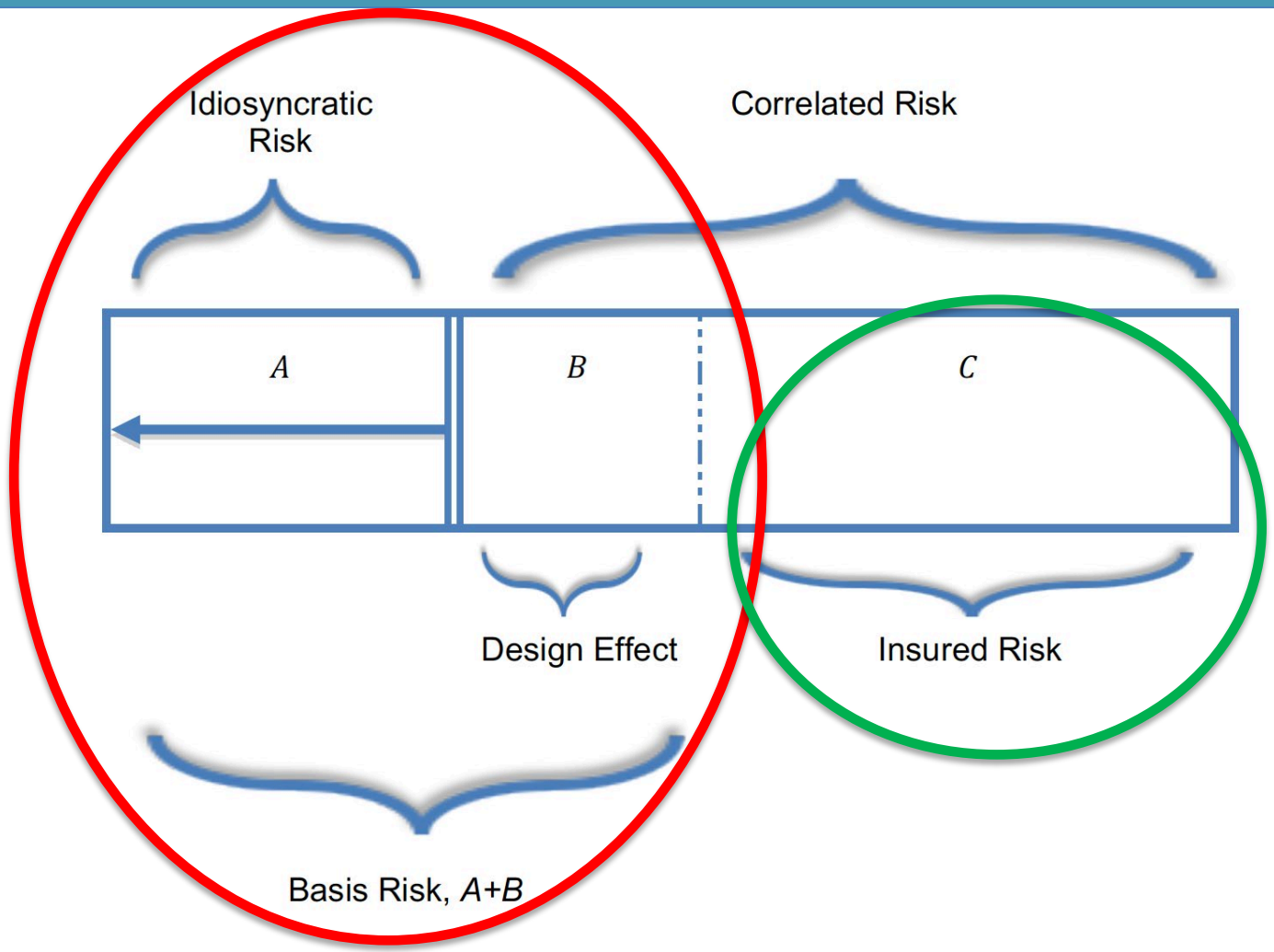


The amount of uncovered losses are included in by A and B.
If these risks are too great, index insurance may not be good policy.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative



Index correctly identified shock, average estimated losses match the farmer's individual experience, so there is no obvious uncompensated risk identifiable in this experience.


Idiosyncratic Risk
Correlated Risk
A
B
C
Design Effect
Insured Risk
Basis Risk, A+B

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Index correctly FAILED to identify shock (and average estimated losses are much less than this farmer's actual losses). This design risk and failure to identify shocks when they occur dramatically reduce value to the farmer – and **may even do more harm than good.**

Uncompensated losses can be created by indices that fail to recognize when widespread losses occur.

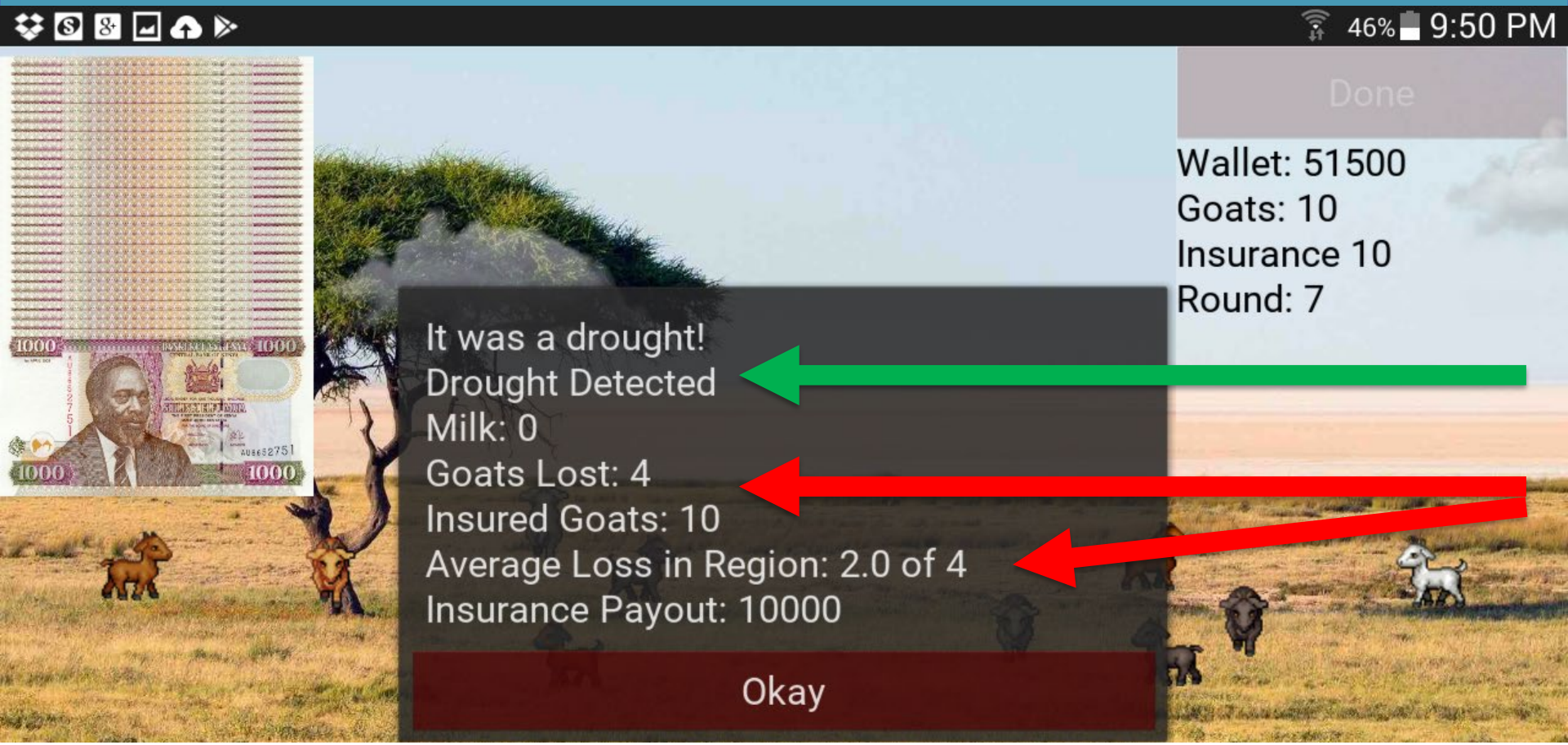
This is a significant source of uncompensated risk. Later we will be discussing ways to design products that can consistently recognize widespread losses, and estimate losses with a high degree of accuracy so products provide value to farmers

Individual Variations from the Estimated Averages

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

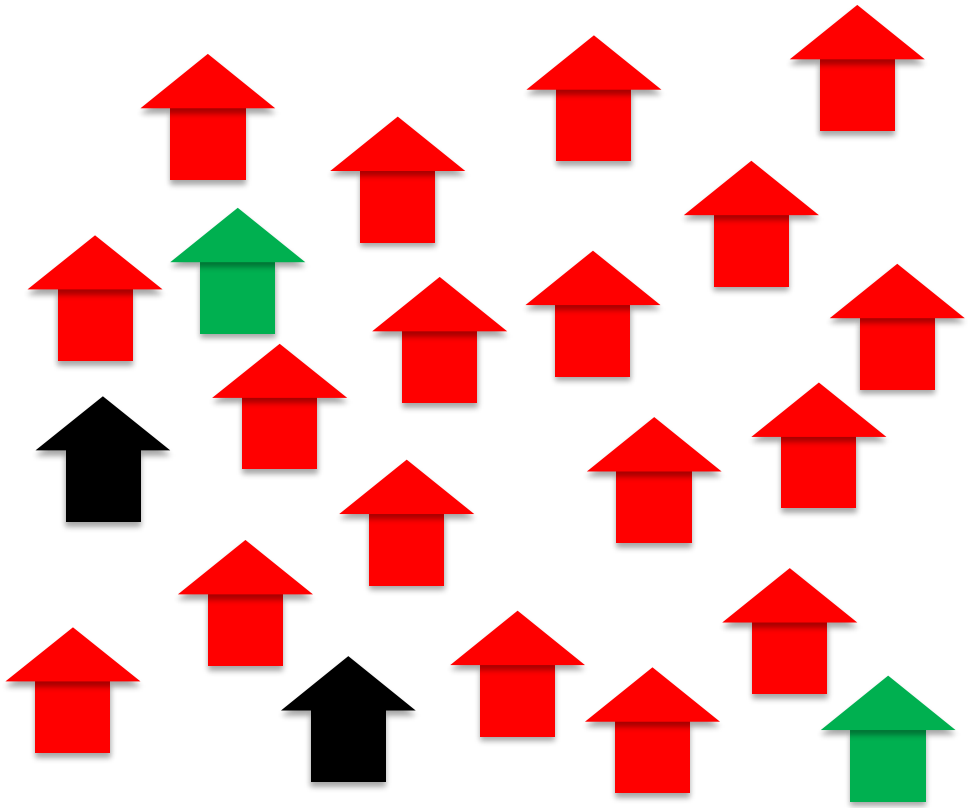
Index correctly identified shock, but there is a significant discrepancy between the losses experienced by the farmer and the average losses in the area. As a result, this farmer was not compensated for all losses.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative



Index correctly identified an estimated shock of 50% of herd, but the farmer here actually lost less than 50% of the herd, so was better off than the average farmer in the area. Despite this he was compensated as if he had lost 50%.

TRY TO MINIMIZE UNCOMPENSATED RISK



Here most households (red) experienced 50% losses.

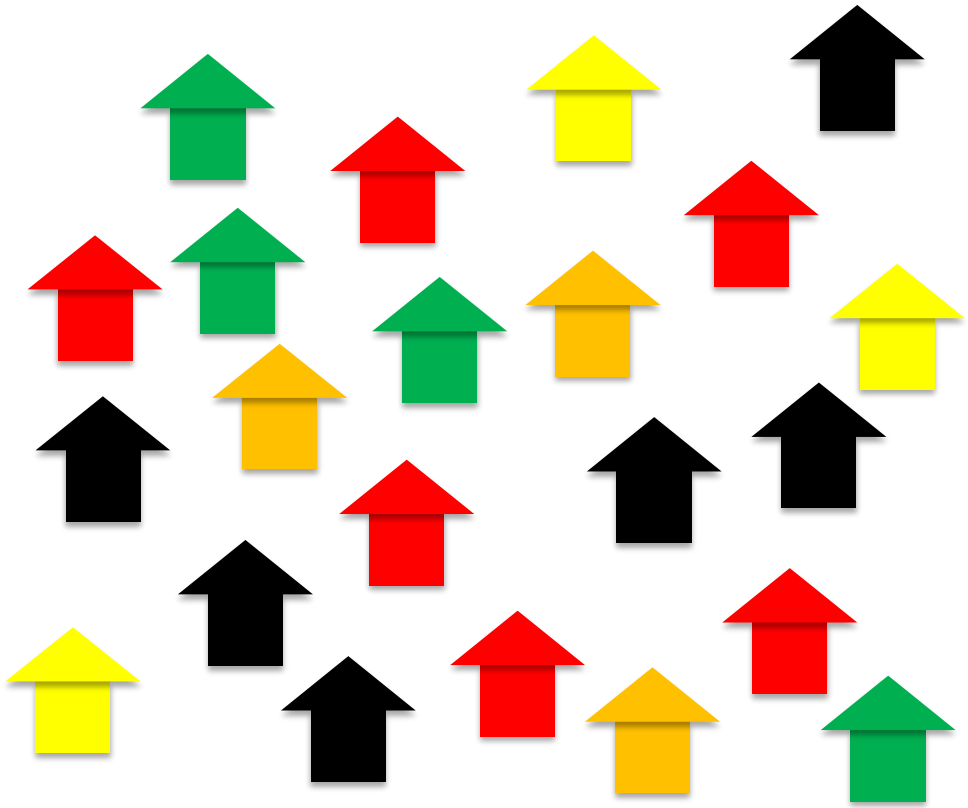
Some farmers (black) lost more than average – say 65% losses – **and did not receive compensation** for their additional losses beyond the average.

Some farmers (green) lost less than average – say 35% losses – **and did receive compensation** per area averages though they were above average.

In the previous examples, there were limited variations from estimated averages in the area.

The more that variation between individual experiences and area averages, the lower the value of the product to most farmers in the community.

INCREASED UNCOMPENSATED RISK



Area averages are the same, but the differences between individuals and the averages are greater.

Average area losses: 50%

lack: 80%
Red: 50%
Orange: 45%
Yellow: 35% losses
Green: 20% losses

Losses can also occur when individual farmers experience significant losses due to shocks that are idiosyncratic rather than covariate.

The individual farmers can experience significant losses due to factors that are not experienced by their neighbors.

IDIOSYNCRATIC SHOCKS

Health Shocks

Livestock Eat Your Crops

Limited, Localized Fires

Index insurance is designed only to detect shocks that lead to widespread loss in communities, not shocks that create losses for individual farmers.

If idiosyncratic shocks are the source of most of farmer losses in a community, **it is unlikely that a high-quality index can be designed**, as an index-based product cannot recognize and protect against the most significant sources of risk that farmers in that community face.

Area Yield & Predicted Area Yield

(vs. rainfall and other partial insurance indices)

INDICES AND IMPLICATIONS

As I've already covered, **there is already inherent risk in the use of index insurance products**: poorly designed contracts fail to protect farmers and individual farmer experiences may be very different than the estimated average for the area.

What kinds of indices can be used to create index-based products, and what are the implications of the different approaches?

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

AREA YIELD-BASED INDEX INSURANCE

Area yield-based insurance contracts may be the most accurate index. These products are based on actual data collected from the field to calculate actual average yields for insurance zones.

USAID
FROM THE AMERICAN PEOPLE

INNOVATION LAB FOR ASSETS & MARKET ACCESS
BASIS

UCDAVIS
UNIVERSITY OF CALIFORNIA

THE CHALLENGES OF AREA-YIELD PRODUCTS

These contracts can be extremely expensive and logistically challenging to implement.

Primarily because of these challenges, innovations are being pursued that are designed **to effectively and accurately estimate or predict average area losses using an outside measure or observation (index)**.

RAINFALL INSURANCE

A rainfall-based index insurance contract uses observed rainfall over a season for each insurance zone to trigger payouts based on rainfall shortages compared to average years in an area.

These estimates are designed by comparing, for the target crop in each insurance zone, historical index data compared to historical average yields.

ONLY COVERS A SINGLE FACTOR OF RISK

When using weather stations in particular, the further you are from a weather station, the less the value of the contract to you. This may be especially true in areas that have a lot of heterogeneity (rolling hills, for example).

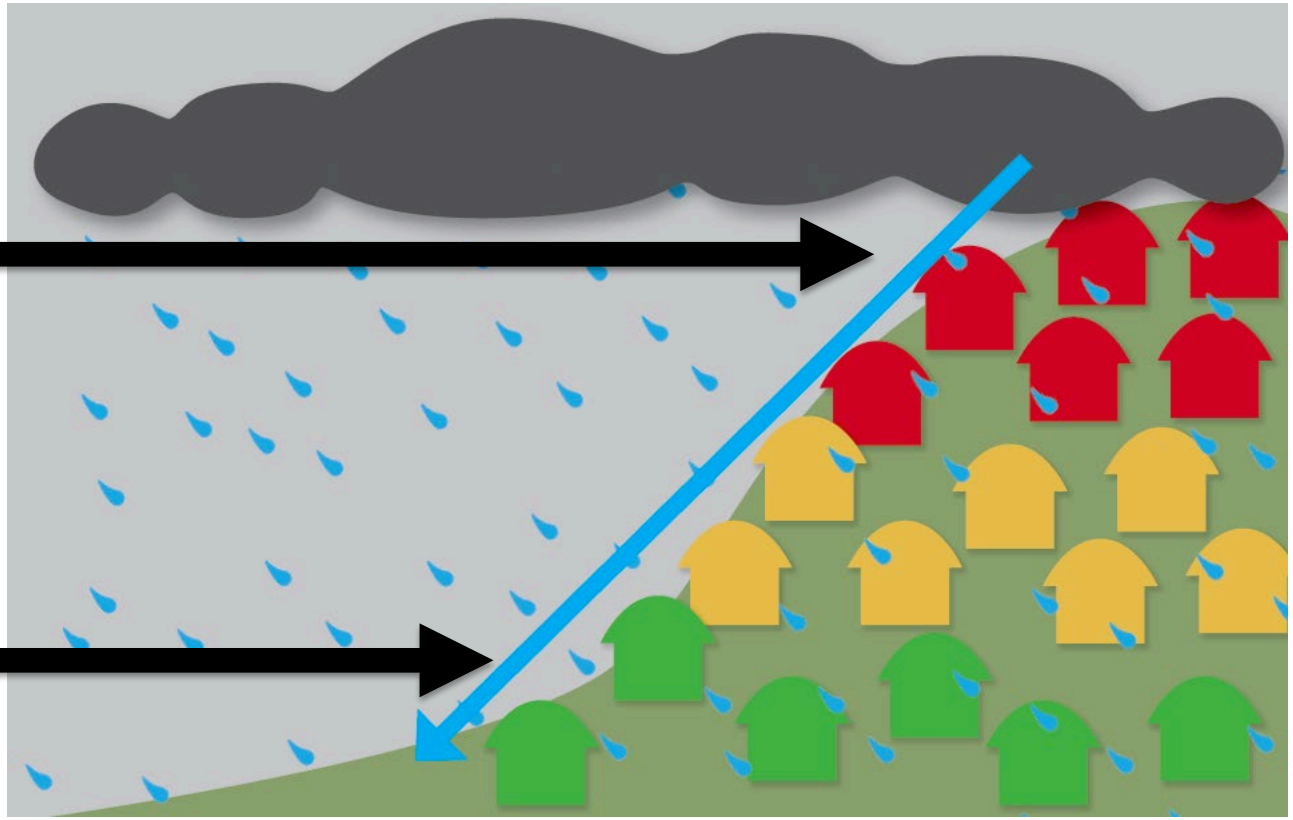
Traditionally rainfall insurance has not typically been able to effectively protect farmers (but rain is **only one of many important factors** input in farmer yields).

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

RAINFALL INDEX IN HETEROGENEOUS AREAS

Rice Farmers Experiences HERE

Vs. the Experiences HERE

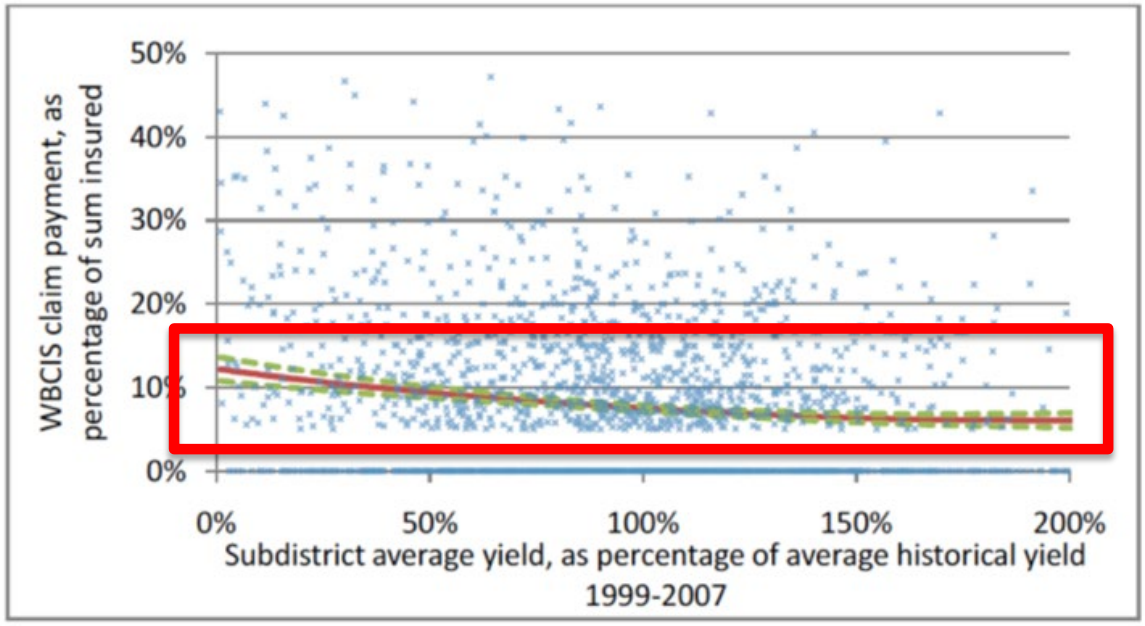


USAID FROM THE AMERICAN PEOPLE

INNOVATION LAB FOR ASSETS & MARKET ACCESS
BASIS

UC DAVIS
UNIVERSITY OF CALIFORNIA

EVIDENCE OF PARTIAL INSURANCE SHORTFALLS



The blue marks intersect at the money paid out by government-subsidized index insurance contracts as a proportion of the estimated loss (y-axis) and the area-wide average yield as a percentage of average historical yields in a representative state in India between 1999-2007. The red line is the average of those individual payments, **showing that the average was roughly the same whether farmers on average suffered a total crop loss or had a crop that was double the historical average.**

IMPROVED PREDICTION OF AVG YIELDS

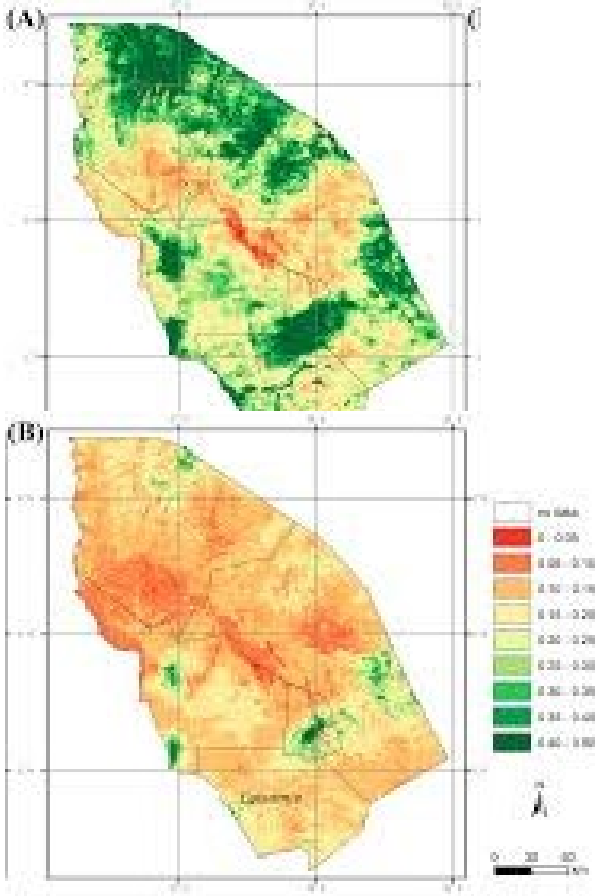
There is a significant opportunity for improvements in the quality design of agricultural index insurance products to increase the accuracy of an index and increasing the value to the farmer. These products can dramatically improve quality over partial insurance products such as rainfall-based index insurance.

As we heard yesterday, some of the **most exciting innovations we are seeing right now is around satellite-based innovations that can be used to more accurately estimate the reality on the ground**. If well-designed, this can perform much more closely to area-yield based products (by estimating area yields) instead of observing a single input and insuring based on that single input (rainfall).

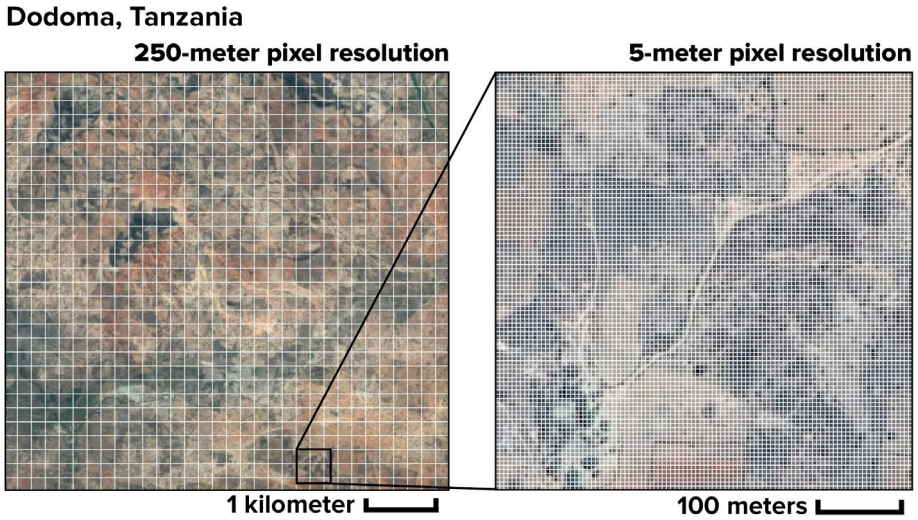
SATELLITE (NDVI) MEASURES

New innovations in satellite technology allow not only for observation of inputs into crop productivity (such as rainfall, etc.) but actually allow for **estimations of actual farmer outcomes with increasing accuracy**.

For example, one of the most common satellite measures used in index insurance is NDVI, the a measurement of live, green vegetation in an area. These images (right) are made up of pixels, where a single pixel represents the average vegetation inside that area. You can see the distinction between years with high forage availability for livestock, and those without.



HIGH-RESOLUTION SATELLITE



New, high resolution measurements of vegetation growth can even more accurately predict/estimate small farm crop yields and detect shocks to the agricultural system.

These measurements, taken by a private earth science company's satellites, **are 50 times more detailed** than those used for many current satellite index insurance products.

OTHER INNOVATIVE APPROACHES

It is also important to keep in mind that there are also possibilities for combinations of more than one measure to improve accuracy in catching shocks. For example, the product being supported by the University of California in Mozambique has two different triggers – rainfall during germination period and estimated average yields.

Because these two recognized components of risk may not be able to be captured by either one index or another, a contract was designed to be able to recognize major shocks with greater accuracy using more than one observation.

FINDING AN INDEX THAT WORKS

Finding an index that works in an agricultural insurance product does not only mean that it triggers when it is intended to trigger (for example, that a rainfall contract successfully triggers payouts when rainfall does indeed fall below the given threshold). It is much more than that.

Finding an index that works means working through the available data and index options to **find a measure that accurately estimates farmer experiences** on the ground such that an index insurance contract can **successfully transfer a significant portion of the risks that farmers face in agriculture away from farmers.**

FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

www.feedthefuture.gov

USAID
FROM THE AMERICAN PEOPLE

INNOVATION LAB FOR
ASSETS &
MARKET ACCESS
BASIS

UCDAVIS
UNIVERSITY OF CALIFORNIA