Bundling Innovative Risk Management Technologies to Boost Food Security in Africa

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Looking Beyond the Averages

- Few of us are average (who has 1.87 children?), and none of us live exclusively in average years
- Trivial observation, but living outside the averages matters a lot for families dependent on agriculture

Per cent of long term mean rainfall in relevant agricultural year by scheme	*Relevant agricultural year*			
	1992/93	*1993/94*	*1994/95*	*1995/96*
Mupfurudzi	107	116	74	131
Mutanda	106	104	68	156
Sengezi	142	104	80	111
Incomes by crop year				
Gross crop income (1992 Zimbabwe $)	5815	4857	1817	6055
Total income (1992 Zim$)	6982	6296	4051	8146

Hunger & Health in Time of Drought

- So what do we think happened in this time of drought to:
  - Adult male body mass?
  - Adult female body mass?
  - Growth of children?
- And what about 4 years after drought?
- Impacts even more striking if look at wealthier and less wealthy households

Hunger & Health in Time of Drought

- So what do we think happened in this time of drought to:
  - Adult male body mass?
    - Fell by maybe a couple of %; Recovered quickly
  - Adult female body mass?
  - Growth of children?
- And what about 4 years after drought?
- Impacts even more striking if look at wealthier and less wealthy households

Hunger & Health in Time of Drought

- So what do we think happened in this time of drought to:
  - Adult male body mass?
  - Adult female body mass?
    - Fell by 10-15%; Recovered
  - Growth of children?
- And what about 4 years after drought?
- Impacts even more striking if look at wealthier and less wealthy households

Hunger & Health in Time of Drought

- So what do we think happened in this time of drought to:
  - Adult male body mass?
  - Adult female body mass?
  - Growth of children?
    - Growth of all children fell significantly, especially the youngest
- And what about 4 years after drought?
- Impacts even more striking if look at wealthier and less wealthy households

Hunger & Health in Time of Drought

- So what do we think happened in this time of drought to:
  - Adult male body mass?
  - Adult female body mass?
  - Growth of children?
- And what about 4 years after drought?
  - Older children had compensatory growth;
  - Youngest remained stunted
- Impacts even more striking if look at wealthier and less wealthy households

Hunger & Health in Time of Drought

- So what do we think happened in this time of drought to:
  - Adult male body mass?
  - Adult female body mass?
  - Growth of children?
- And what about 4 years after drought?
- Impacts even more striking if look at wealthier and less wealthy households
  - Short & long-term growth impacts twice as high for poorer households

What's Ag Got to Do with It?

- Agricultural technological change often discussed in terms of impacts on average yields & productivity
- But reaching SDGs 2 & 3 is as much about stabilizing family incomes in bad years as it is about raising averages across years
- Especially in those broad reaches of Africa that are heavily dependent on the rains (which are becoming increasingly variable)
- So how can we stabilize incomes in bad years without giving up too much "on average"?

Seed & Insurance Technologies to Manage Risk

- Stress-tolerant seed & insurance technologies stabilize farmer income in the wake of adverse climatic events:
- Such protection can in turn create a 'risk reduction dividend:'
  - Flood tolerant rice varieties in India
  - Index insurance for West African cotton farmers
- Can something be done for maize, Africa's most important staple crop?
  - Grown in many drought prone areas
  - Productivity levels are woefully low
- The Drought Tolerant Maize for Africa project developed promising 'DT' seed varieties
  - But these varieties drought tolerant, not drought proof
  - Insurance might potentially complement DT seeds, creating a protection package to break the cycle of risk-low productivity & hunger

Seed & Insurance Technologies to Manage Risk

- Stress-tolerant seed & insurance technologies stabilize farmer income in the wake of adverse climatic events:
  - Index insurance payouts in Kenya drastically reduced Kenyan pastoralists' reliance on costly coping strategies after a drought
  - Submergence tolerant rice varieties reduced losses in India in wake of flooding
- Such protection can in turn create a 'risk reduction dividend:'
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- Such protection can in turn create a 'risk reduction dividend:'
  - Flood tolerant rice varieties in India
    - Protected farmers invested more boosting average yields by 20%
  - Index insurance for West African cotton farmers
    - Protected farmers invested more boosting expected income by 30-40%
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- The Drought Tolerant Maize for Africa project developed promising 'DT' seed varieties
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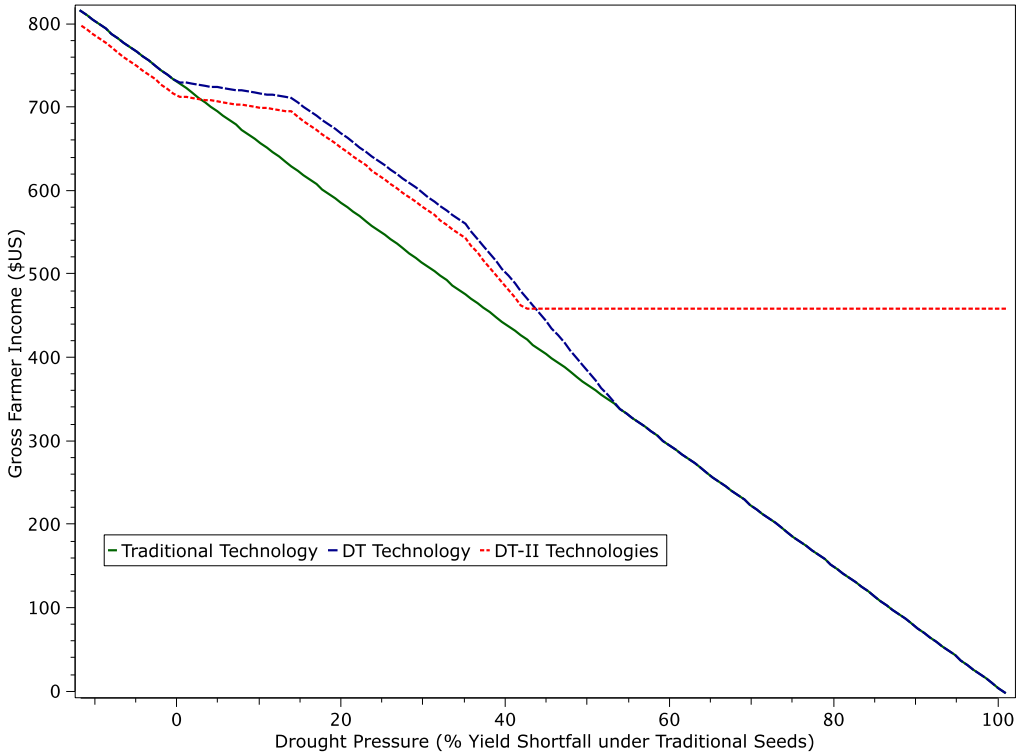
See that there are three kinds of circumstances



Seed & Insurance Technologies

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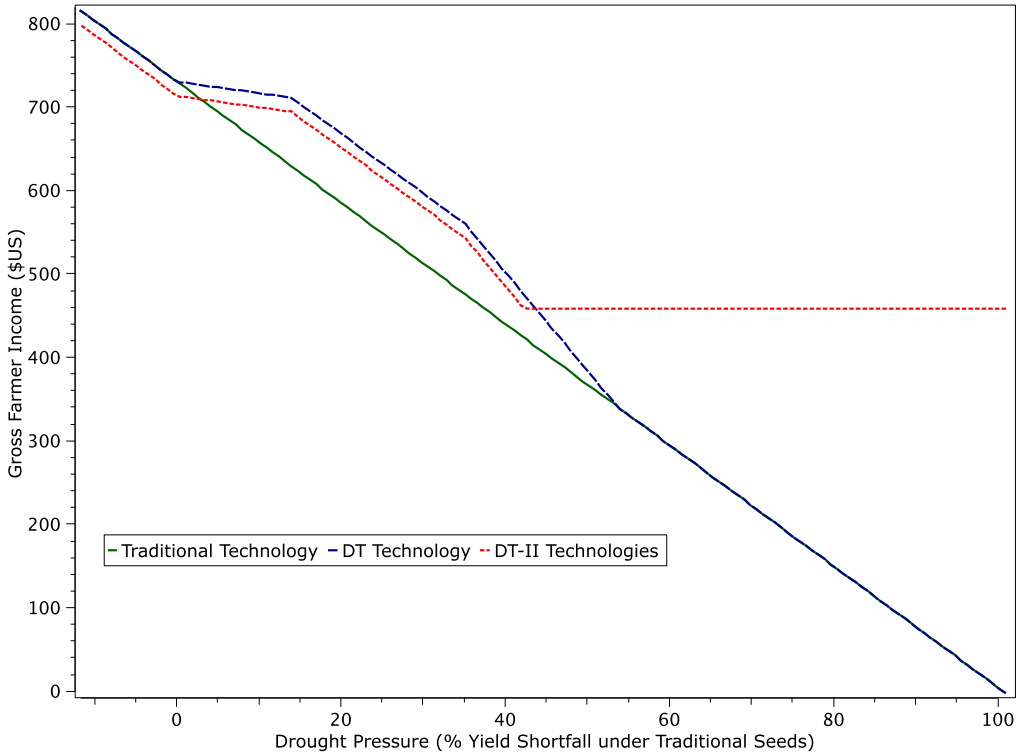

Modest drought pressure under which DT seeds stabilize yields (15% of the time)

Seed & Insurance Technologies

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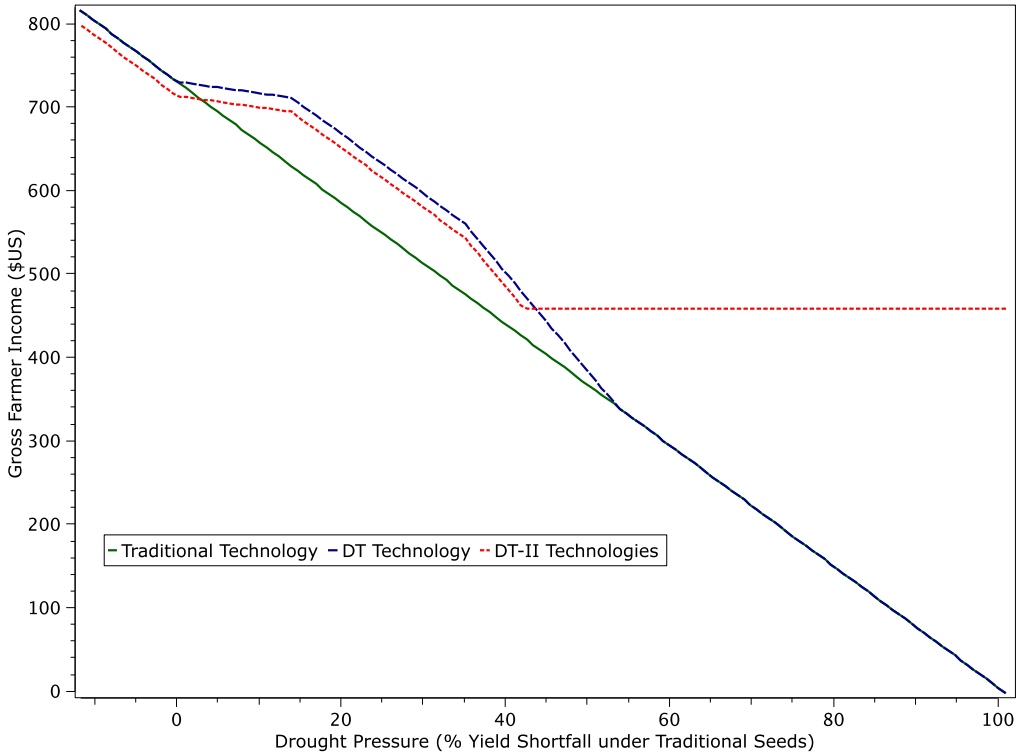

Intermediate events, where benefits of DT begin to reduce

Seed & Insurance Technologies

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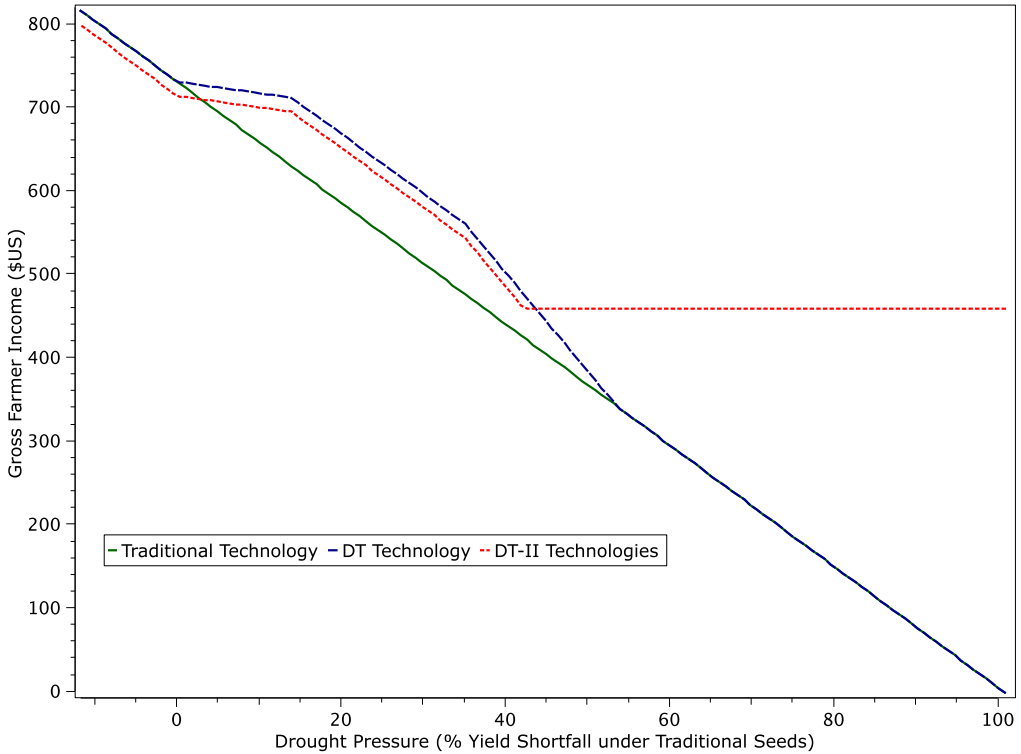
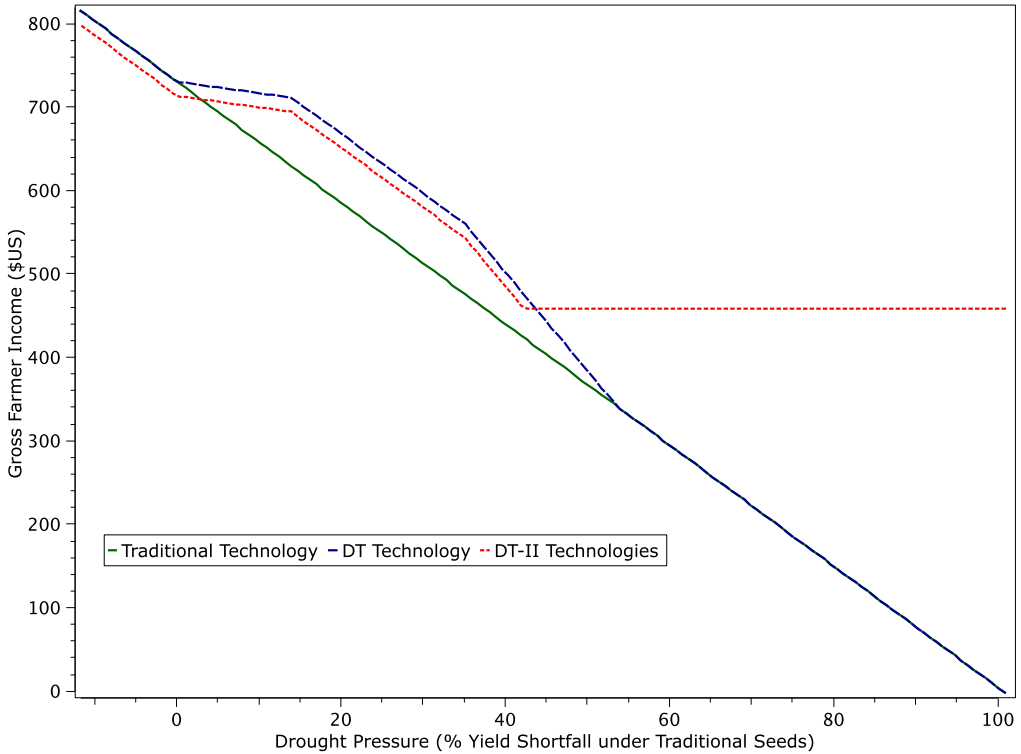


Severe, where DT seeds do no better than other seeds (*red zone* events which occur 5-20% of the time)

See that there are three kinds of circumstances



Complementarity obvious–so let's bundle and have insurance pick up those bad, tail-end events

Easy, right?

- Maybe not: both technologies are commodities with hidden characteristics
  - Farmers need to initially trust that seeds & insurance are reliable
  - Moreover hard for farmers to learn as advantages only revealed in stress years
- And how good are the technologies?
- Cannot speak to the intricacies of maize breeding; Will instead focus on the design challenges of agricultural index insurance

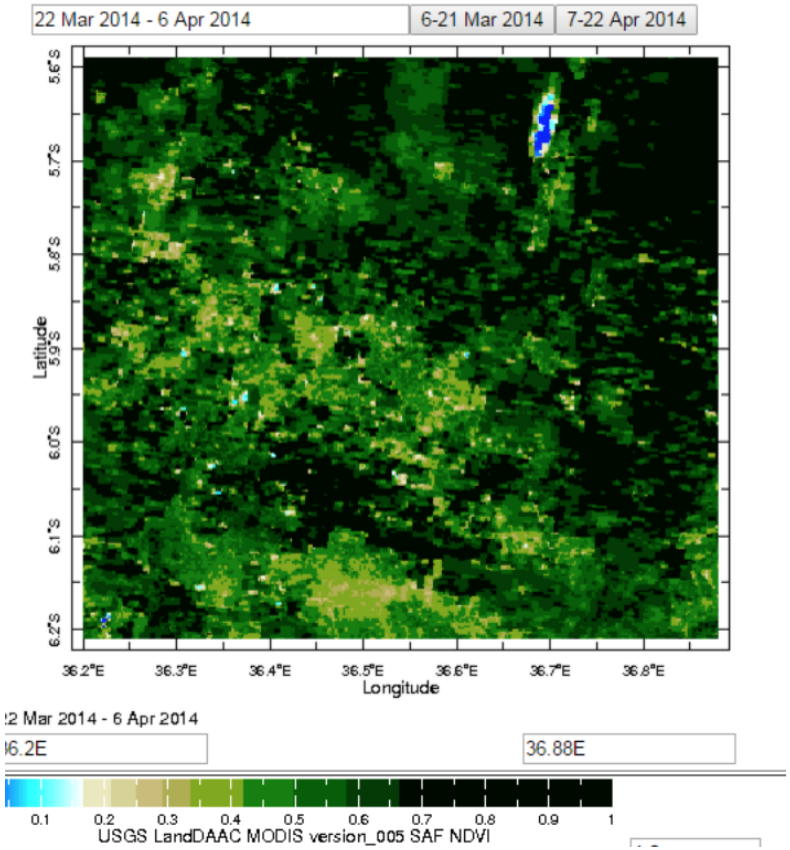
Using Satellite Data to Predict Yields

- For small scale farmers, too costly to visit and verify crop losses
- Need therefore to find an easy to measure index that is correlated with farmer losses
- But if index not well correlated, have a lottery ticket, not an insurance contract
- Our approach relies primarily on two satellite based indices, with payments occurring if:
  - Less than 80 mm of rain falls in the 40 days following maize planting (with both planting dates and rainfall estimated using radar-based rainfall estimates); or,
  - Local average yields predicted to be less than 70% of average by remotely sensed measure of vegetative growth (specifically the Normalized Difference Vegetation Index, or NDVI)

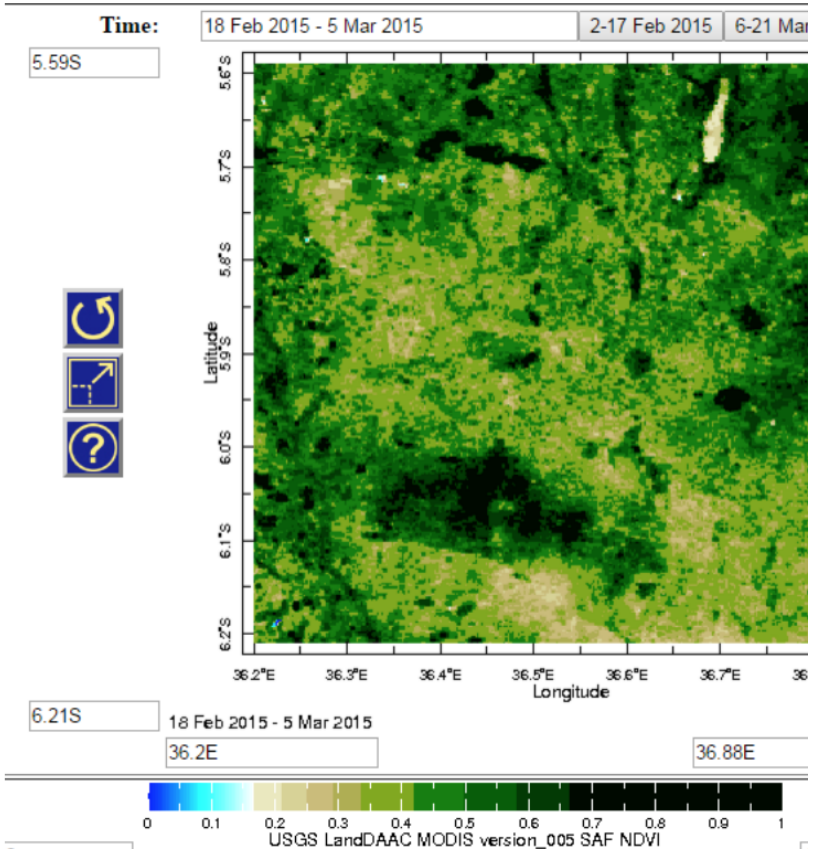
Index Design: "Triggers"

- Here is an example of NDVI pixels (250m x 250m) from the Dodomo region of Tanzania for a year of adequate moisture and a drought year:

2014 (Planting 11 Jan, 2013)

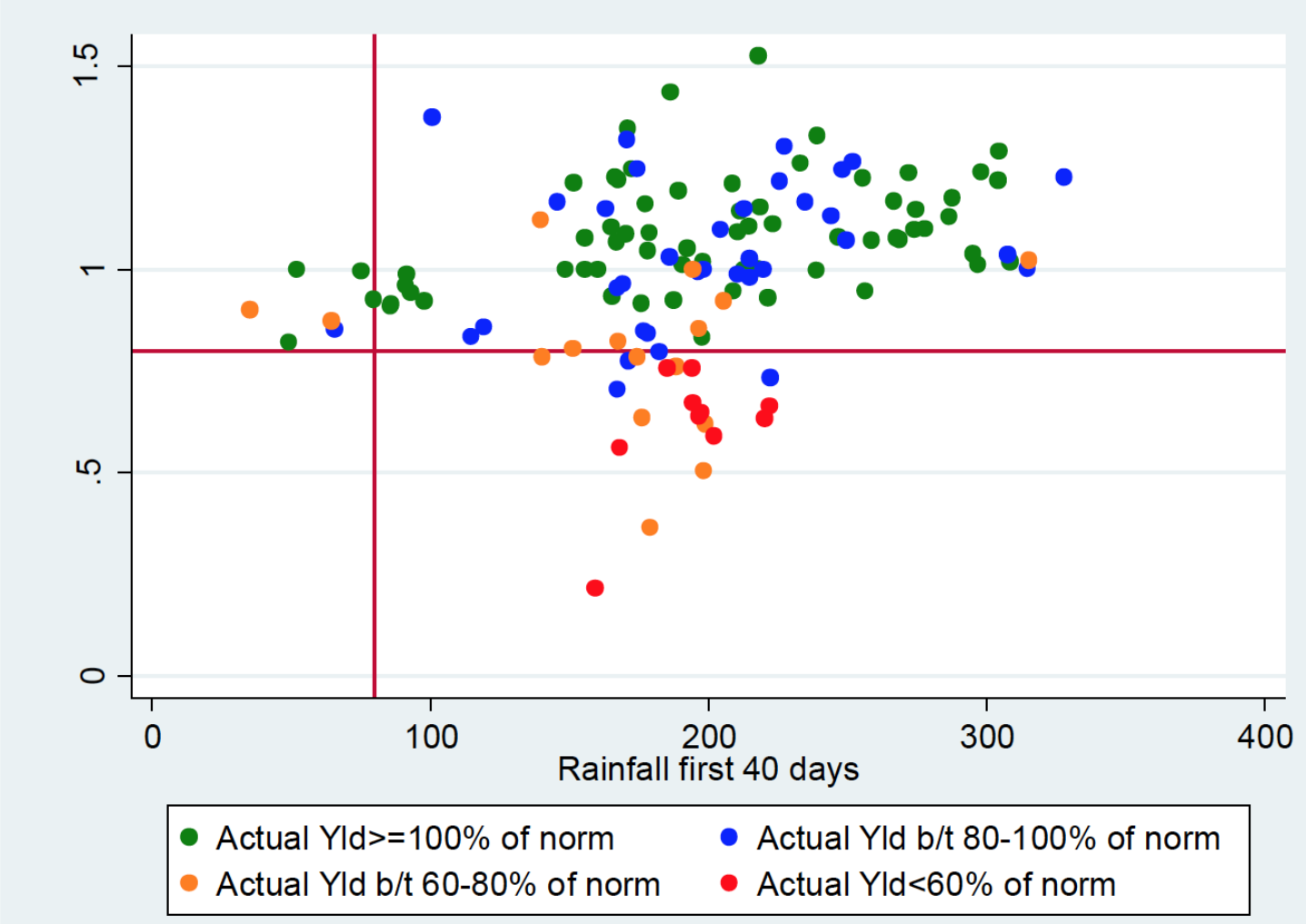


2015 (Planting 1 Dec, 2014)



- So, how well does this work?

Overall Contract Performance



Proposed Audit Rule

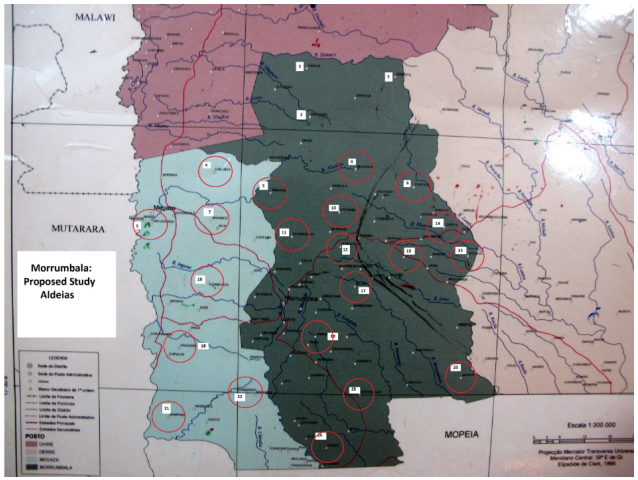
- Results above are for our easiest to predict area, but

- Pursuing various technological solutions: improved 'masking;' high resolution commercial satellites (3m x 3 m resolution) and drones
- In the meantime:

Fail-safe Audit Rule

- 100 days after planting, farmers are notified if there will be a payout on the basis of either trigger (early season rain or NDVI).
- If more than 50% of farmers call for an audit, An agronomist (either through CIMMYT or the Ministry of Agriculture) estimates yields for a sample of plots.
  - If yields are less than 80% of average, a payout will occur (Optional)
  - If no payout is recommended by agronomist, farmers are asked to defray part of the cost.

Randomized Controlled Trial



- So will all this work & help achieve SD2 & 3 goals?
- 3000 farmers in Tanzania and Mozambique currently participating in a randomized controlled trial to find out
- 5 seed companies that have propagated DT seed; 2 insurance companies have adopted the insurance model
- After a trial year (in which farmers given small bags of seed to try out), we are now in year 1 of the study, with insured and uninsured DT seeds going into the ground
- Next follow-up will be after the next harvest.

Conclusion

Ulinzi Maradufu Dhidi Ya Ukame:

Mbegu Zinazovumilia Ukame Na Zilizo na Bima

Tumia mbegu Bora ya Mahindi Yanayovulmulia Ukame na zilizo wekewa Bima

Mbegu ni Gharama, Bima hii Itakulinda Dhidi ya Hasara:

- Ikiwa mahindi katika eneo lenu yameathirika na upungufu wa mvua mwanzoni mwa msimu
- Ikiwa mazao ya mahindi katika eneo lenu yameathirika na ukame na kupelekea kupata mavuno chini ya matarajio
- Kupitia kampuni la UAP, utafidiwa mbegu msimu ujao bila malipo

- Evidence for years that risk makes and keep people poor
- Employing cutting edge technologies in an effort to craft a new ending to this age old story about risk, hunger & poverty
- Challenges are plenty, and caution is required if we are to find a durable solution

KLEIN KAROO K2 SEED MARKETING
MOZAMBIQUE

SUBA AGRO

Hollard.
seguros

IFFA Seed
Company Ltd

LINDA MBEGU ZAKO NA BIMA

MATC
Meru Agro-Tours and
Consulting Company

UAP
Better. Simple. Life.
UAP INSURANCE TANZANIA LIMITED

CIMMYT MR
International Maize and Wheat Improvement Center

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

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