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The Design of the Rainfall Index Annual Forage Pilot Program

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Problem Statement

- Pressure from agencies, constituents, and other interested parties create competition for federal and state funding.

- Rainfall Index Annual Forage Program (RIAFP) is a pilot program being tested in the states of Texas, Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota.
  - RIAFP offers catastrophic risk protection and buy up coverage to forage producers.

Problem Statement (continued)

- RIAFP utilizes rainfall indices constructed by the National Oceanic and Atmospheric Administration.
  - Previous findings of Maples, Brorsen, and Biermacher (2016) suggest that rainfall is not highly correlated with forage yields thus providing little risk protection to forage producers.
  - Previous research limited to one location in southern Oklahoma. Examination rainfall correlations across multiple locations and other factors influencing forage growth could provide better risk protection for producers.

Research Objectives

- Determine relationship between:
  - Local rainfall and RMA indices
  - RMA indices and forage yields
  - Temperature and forage yields
  - Rainfall frequency and forage yields

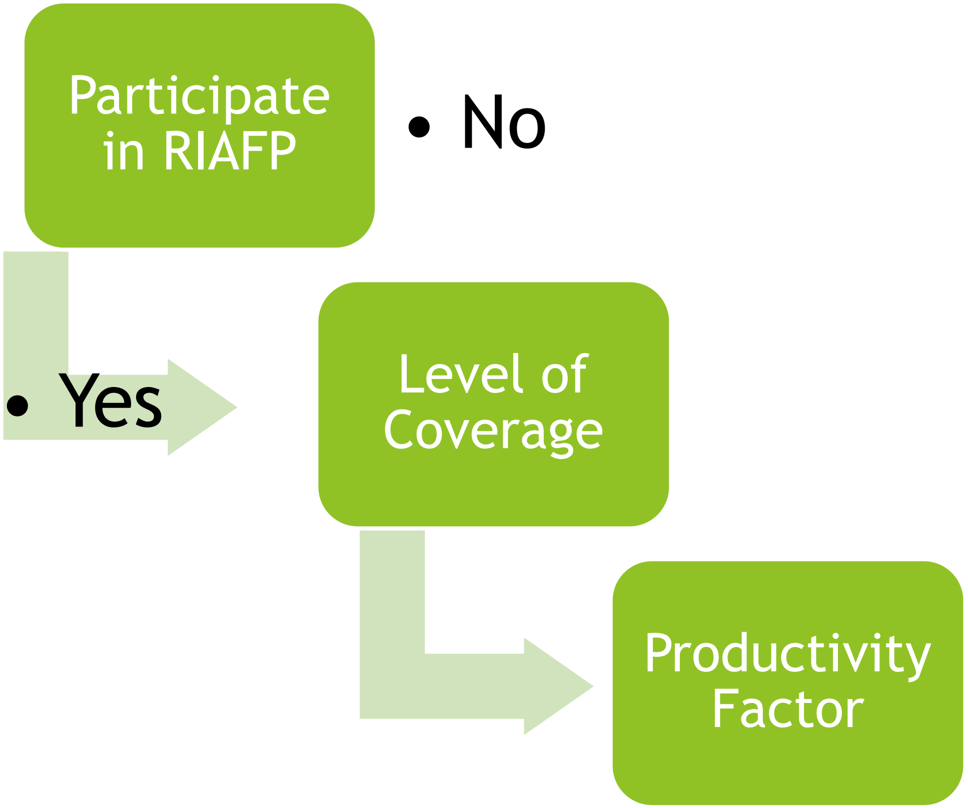
- Determine if an index composed of frequency of rainfall events better protects producers against basis risk.

Review of the Literature

- Index insurance pays indemnities not on verified loss by on a variable correlated with actual loss (Barnett and Mahul 2007).

- Prevents:
  - Moral Hazard: arises after purchasing insurance when a producer may behave in a manner consistent with increasing their chances of receiving an indemnity (Smith and Goodwin 1996)
  - Adverse selection: a producer has greater knowledge of his production practices than an insurer (Makki and Somwaru 2001).

Conceptual Framework: The producer decision



Conceptual Framework

- Assumption of Profit Maximization:
  - $\pi = Price * ForageYields + ParticipationChoice \; - InputCosts$
- Nested within utility function:
  - $\theta = (Rainfall\ Index\ Variable, Forage\ Yields)$

$$\max_{A \in \{0,1\}} EU(\pi) = \iint U(\pi) f(\theta)\, dI dY,$$

$$\text{s.t. } \pi = PY + A - \boldsymbol{r}'\boldsymbol{z}$$

$$\theta = (I, Y)$$

$$U'(\pi) > 0, \; U''(\pi) < 0,$$

Methods and Procedures

- The Noble Research Institute Data
  - Small grain variety trials from 1966 to present day from the Samuel Roberts Noble Foundation farms.
  - Farms located near Ardmore, Burneyville, and Gene Autry.
  - Over 4,000 plots and 600 varieties of oats, rye, ryegrass, triticale, and wheat.
  - Ardmore location - Wilson silt loam soil.
  - Burneyville location - Minco fine sandy loam soil.
  - Gene Autry location - has silty clay.
  - Fall planting and harvest throughout the month of May.

Methods and Procedures

- Oklahoma State University Forage Variety Trials
  - Forage variety trials from 1990 to 2003 for wheat varieties.
  - Plots located at the South Central Research Station (Chickasha, Oklahoma) and the Cimarron Valley Research Station (Perkins, Oklahoma).
  - Data was collected on 423 plots and 106 wheat varieties.
  - Fall planting and harvests done through May.

Methods and Procedures

- Local rainfall recorded onsite while temperature data collected from Mesonet and NOAA.

- Temperature index created by summing days where minimum temperature below 32 degrees F.

- Total precipitation, precipitation frequency, and temperature structured in six two month intervals beginning in September.

Empirical Model

Eq. (1) $Yields = \beta_0 + \beta_2 Days_t + \beta_3 RainfallInterval1_t + \beta_4 RainfallInterval3_t +$

$\beta_5 RainfallInterval3_t + \beta_6 Nitrogen_t + \beta_7 SeedingRate_t + \beta_7 Time +$

$d_1 Ardmore_{\ 1t} + d_2 GeneAutry_{2t} + v_t$

- Where $var(v_t) = \tau + \alpha(\frac{1}{N})$

Results

- As previously found by Maples, Brorsen, and Biermacher (2016), RMA indices are highly correlated with local rainfall.

Table 1. Pearson Correlations between Rainfall Index Intervals and Actual Rainfall Intervals for Noble Research Institute locations

Months (Cumulative Rainfall)	Burneyville (RMA)	Ardmore (RMA)	Gene Autry (RMA)
September-October	0.939***	0.964***	0.807***
October-November	0.985***	0.958***	0.853***
November-December	0.991***	0.948***	0.825***
December-January	0.966***	0.972***	0.915***
January-February	0.964***	0.974***	0.889***
February-March	0.850***	0.941***	0.988***

Asterisks (***, **, and *) denote significance at the 1%, 5%, and 10% levels, respectively.

Results

- Across all locations and species, we find no or little statistical significance for RMA index interval coefficients as well as rainfall frequency intervals coefficients.
- Temperature index interval coefficients across all locations for wheat varieties are more likely to be negative and significant.

Conclusions

- RMA index is well designed due to high positive correlations with actual rainfall.
- Insignificant coefficients for RMA and rainfall frequency indices suggest that neither index will protect producers against forage loss.
- The proposed temperature index seems to be more predicative of forage yields as more intervals are significant and negative.

Questions?