

# **BASIS RISK IN INDEX INSURANCE**



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# Outline



- ✓ **Why index insurance?**
- ✓ **Architecture of Indian crop insurance**
- ✓ **Coverage: The Numbers**
- ✓ **Basis Risk: Yield Vs Weather**
- ✓ **Weather Index: Product Basis Risk**
- ✓ **Weather Index: Spatial Basis Risk**

# Index Insurance

**Index (Parametric) insurance** is a type of insurance that does not indemnify the pure loss, but ex-ante agrees to make a payment upon the occurrence of a triggering event

**'Homogenous area'** approach based insurance envisages that in the absence of reliable data of individual farmers and in view of the moral hazard involved in the 'individual approach', a homogenous area comprising villages that are homogenous from the point of view of crop production and whose annual variability of crop production is similar, would form the basic unit, instead of an individual farmer

# Index Based Crop Insurance: Rationale

- ❑ **Non availability of past record of Yields, Land surveys, Ownership and Tenancy**
- ❑ **Large number of Small sized Farm-holdings (nearly 120 million / 1.2 hectare)**
- ❑ **Low value output per unit**
- ❑ **Difficulty in collection of small amount of premium from large number of farmers**
- ❑ **Prohibitive cost of Manpower and Infrastructure**
- ❑ **Asymmetric Information**
- ❑ **Systemic nature of Agriculture risks**

# Indian Crop Insurance – Architecture

- ❑ **Specialty Insurance**
- ❑ **Open-top enterprise with systemic risk**
- ❑ **Credit linkage (presently compulsory, but need not be in future)**
- ❑ **Credit institutions also finance the premium (in addition to crop loan)**
- ❑ **Insurance acts as collateral, and lending agencies have the first lien on claim**
- ❑ **Risk covered is based on production cost (safety-net)**
- ❑ **Being 'index', claims process is automated**
- ❑ **Multi-Agency Platform (administratively convenient, but insurer doesn't have full control)**
- ❑ **Government provides for about 2/3rd cost of the program**
- ❑ **Being a instrument with social dimension, the government has a larger say**
- ❑ **Private insurance providers are allowed for actuarially priced programs, and enjoy same level of support as public insurer**

# Index Based Crop Insurance

## Progress: 2011-12

Program	Farmers (Millions)	Hectares (Millions)	Sum Insured (US \$ Millions)	Premium (US \$ Millions)	Program Nature
NAIS	16.731	22.947	7415.29	219.22	Adminstered
WBCIS	11.63	15.648	4179.99	370.28	Actuarial
MNAIS	1.084	1.182	730.56	66.67	Actuarial
<b>TOTAL</b>	<b>29.445</b>	<b>39.777</b>	<b>12325.84</b>	<b>656.17</b>	
Source: Agriculture Insurance Company of India					

Total Market Size 2012-13: US \$ 785 million (provisional)

# Index Insurance: Basis Risk

***Difference** between the value of losses as measured by the **index** and the value of losses experienced on the **farm** (by the farmer)*

# Yield Index Insurance – Basis Risk

## **Challenges:**

**Units are administrative (rather than homogenous)**

**Cost of Yield estimation surveys**

## **Solution:**

**Lowering the insurance unit**

**Separate irrigated and rain-fed crop**

**Satellite imagery**



# Weather Index Insurance: Basis Risk

## **Challenges:**

**Product Basis Risk**

**Spatial Basis Risk**

**Weather Station Infrastructure & maintenance**

## **Solution:**

**Agronomic models**

**Low frequency & High Impact events (Catastrophe events)**

**Macro Product**

**Increased weather station density**

**New Technologies (TOPS etc.)**

# Indian Weather Insurance: Growth

<b>Agricultural year</b>	<b>Farmers insured</b>	<b>Crop insured (hectares)</b>	<b>Sum insured (INR millions)</b>	<b>Premium (INR millions)</b>	<b>Payouts (INR millions)</b>	<b>Claim ratios (%)</b>
<b>2003-04</b>	<b>1000</b>			<b>&lt;0.1</b>	<b>&lt;0.1</b>	
<b>2004-05</b>	<b>11300</b>			<b>9.00</b>	<b>4.50</b>	<b>50.00</b>
<b>2005-06</b>	<b>125975</b>	<b>98747</b>	<b>579.00</b>	<b>32.27</b>	<b>2.38</b>	<b>7.38</b>
<b>2006-07</b>	<b>181900</b>			<b>72.00</b>	<b>45.00</b>	<b>62.50</b>
<b>2007-08</b>	<b>711012</b>	<b>1135186</b>	<b>19910.00</b>	<b>1506.34</b>	<b>1168.02</b>	<b>77.54</b>
<b>2008-09</b>	<b>396870</b>	<b>538826</b>	<b>9661.00</b>	<b>879.33</b>	<b>709.21</b>	<b>80.65</b>
<b>2009-10</b>	<b>2438762</b>	<b>3513379</b>	<b>50161.00</b>	<b>4508.22</b>	<b>3508.02</b>	<b>77.81</b>
<b>2010-11</b>	<b>9391889</b>	<b>13351994</b>	<b>144848.00</b>	<b>13025.82</b>	<b>6381.47</b>	<b>48.99</b>
<b>2011-12</b>	<b>11630319</b>	<b>15648189</b>	<b>209165.00</b>	<b>18529.05</b>	<b>11507.85</b>	<b>62.11</b>

Source: Collation from various sources, including AIC



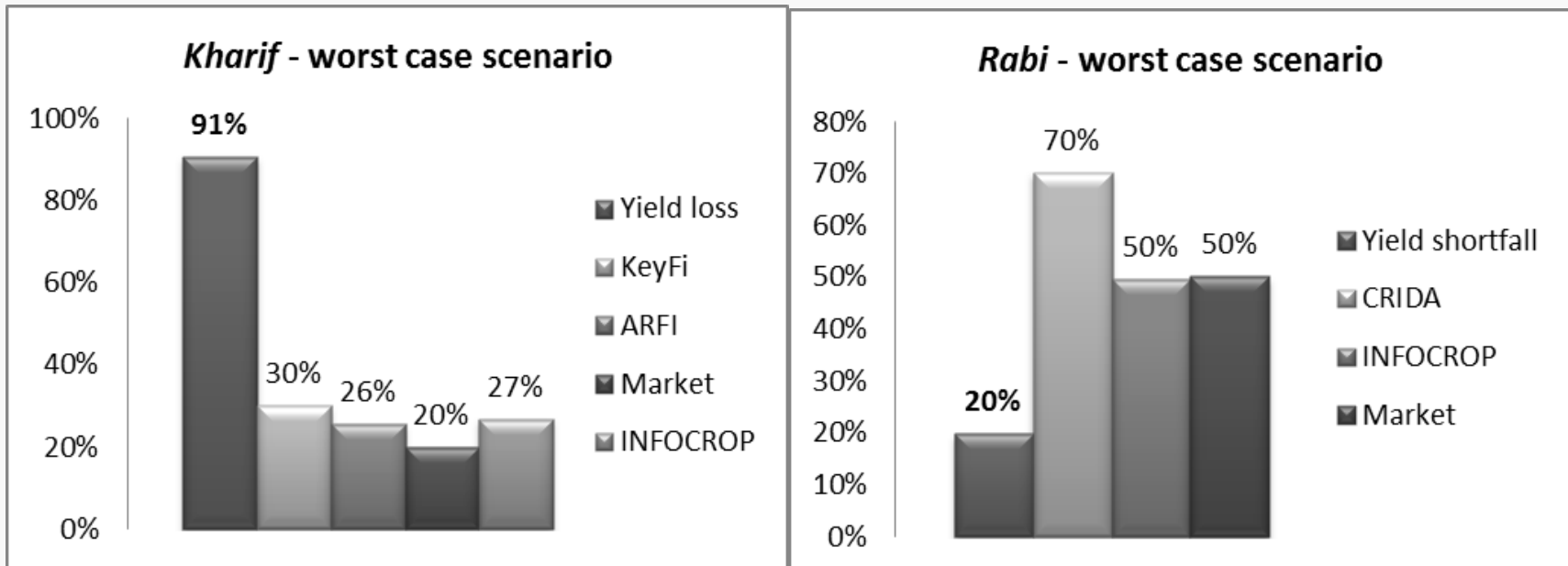
# **Product Basis Risk**

# Pearson's correlation coefficient between yield loss and Weather Payouts



Product Designs	Correlation (%)	t-value	P-value (%)
<i>KeyFI-Kharif</i>	49.68	3.754	0.56
<i>ARFI-Kharif</i>	47.38	3.528	0.78
<i>MARKET-Kharif</i>	30.31	2.086	7.05
<i>INFOCROP-Kharif</i>	16.91	1.125	29.31
<i>CRIDA-Rabi</i>	45.23	3.326	1.05
<i>INFOCROP-Rabi</i>	32.11	2.223	5.69
<i>MARKET-Rabi</i>	47.58	3.547	0.75

# Product Designs: Worst Loss Scenario



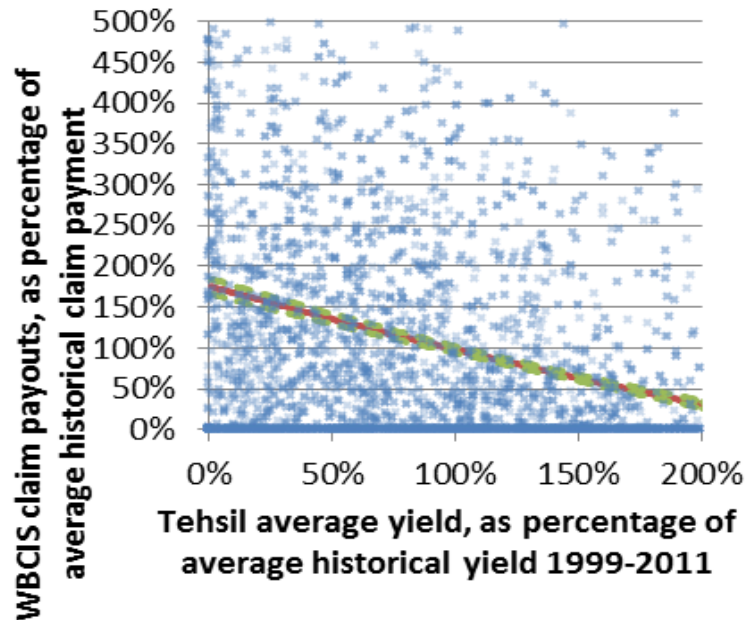
● Rainfall

Heat (Max. Temp)

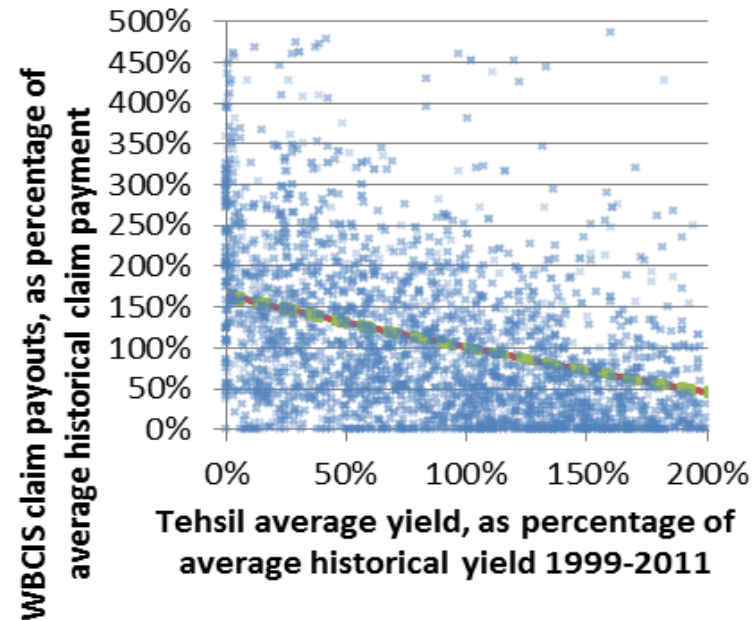
# Kharif: Scatter plots and Kernel regressions for different sets of products



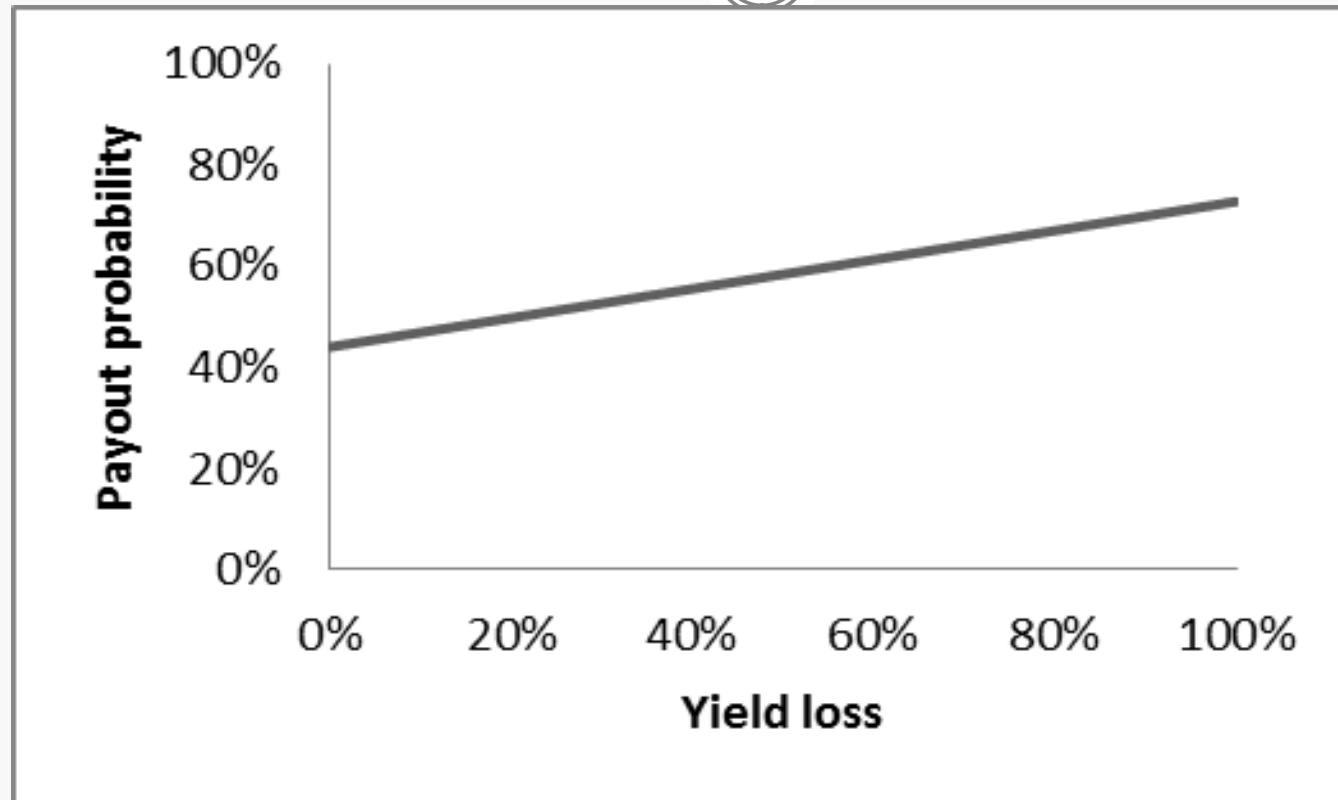
**Complete WBCIS cover 2011**



**Complete WBCIS cover 2012**



# Kharif: Linear payout of payout probabilities and yield loss

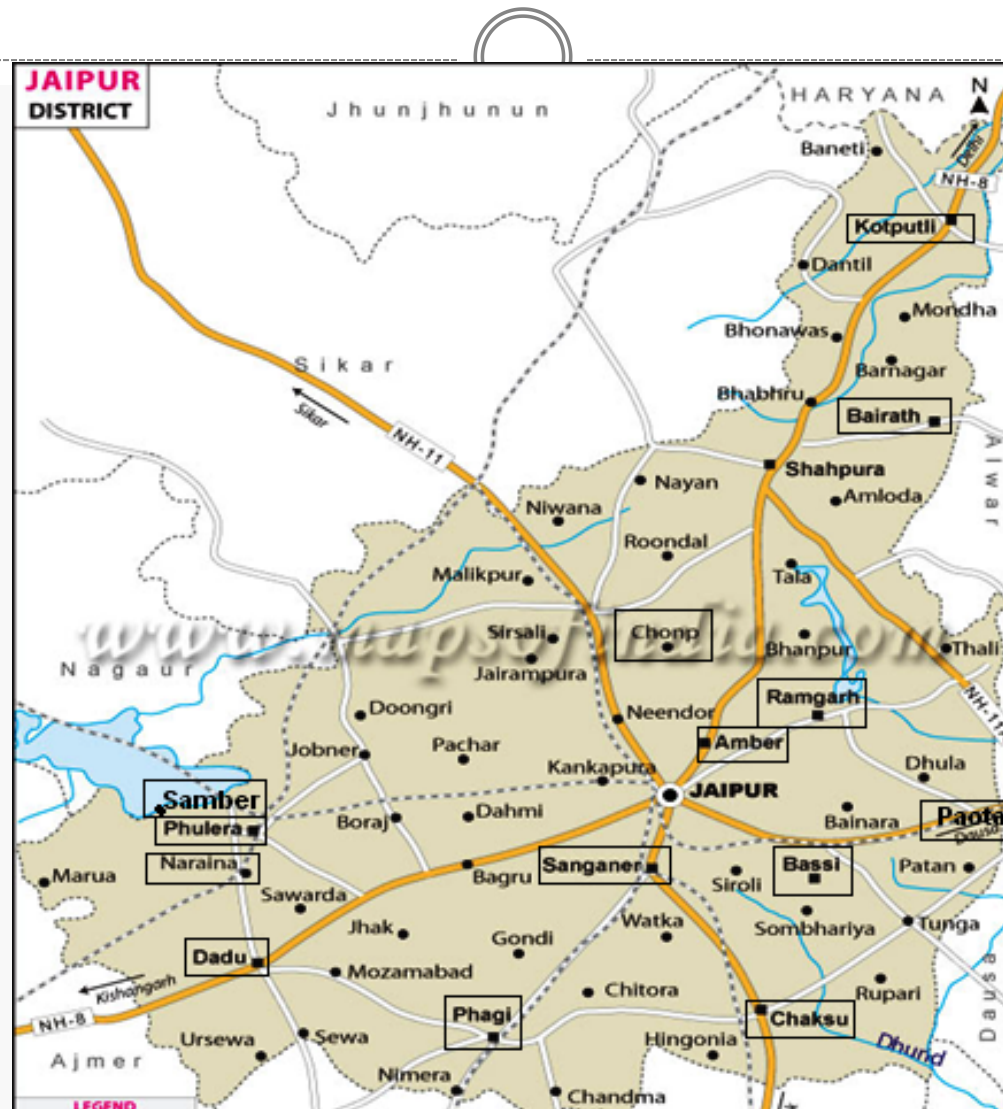




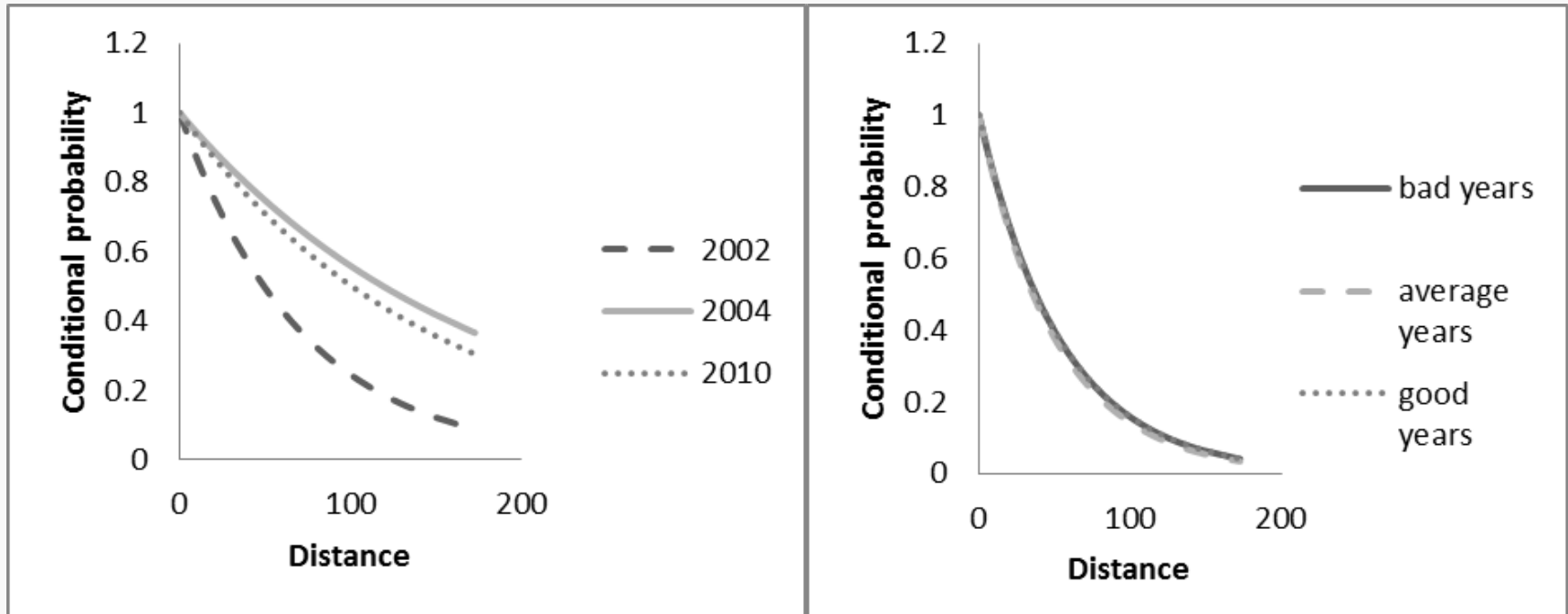
# **Spatial Basis Risk**



# Spatial Basis Risk



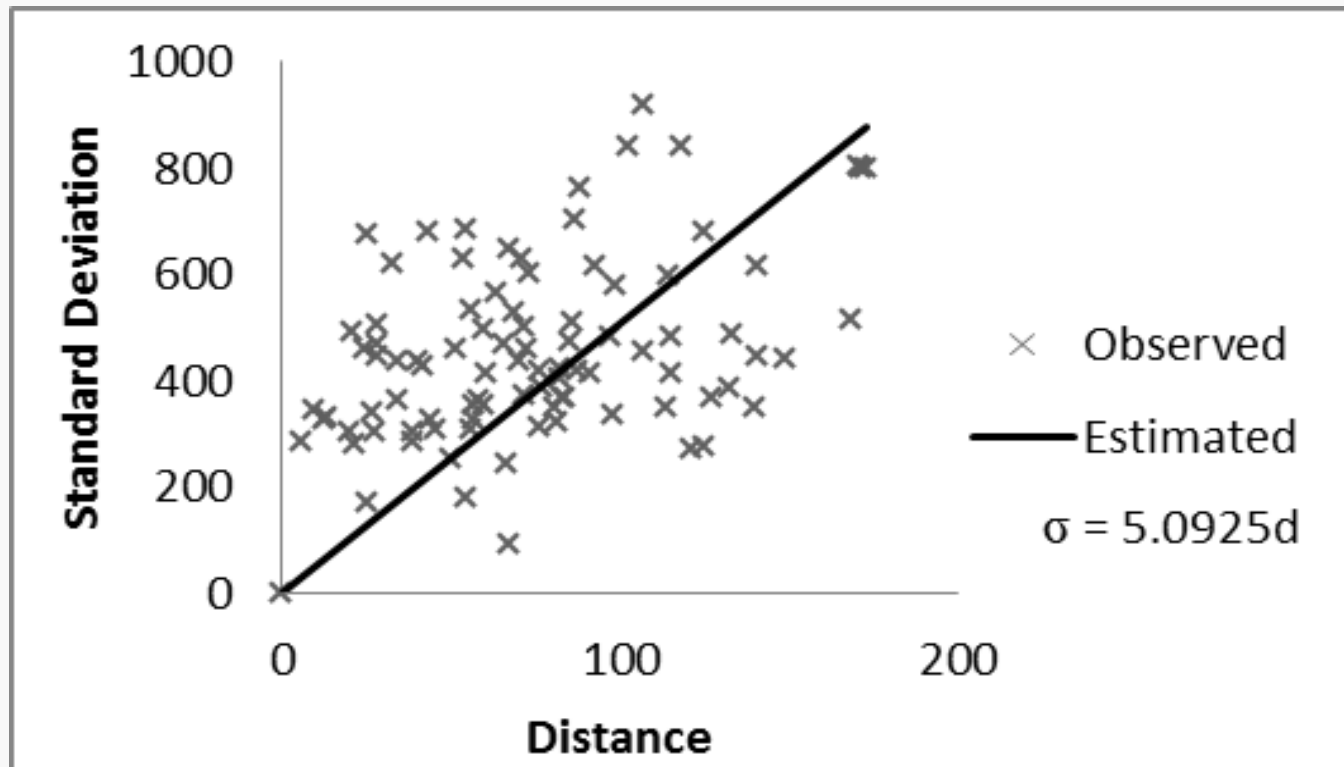
# Scatter plots for conditional probabilities and distances (spatial basis risk)



● Rainy Days

One-Day Max. Rainfall

# Scatter plots of standard deviations with distances



# Basis Risk (on Relative Terms)

	With Govt. Subsidies	W/o Govt. Subsidies
Product Basis Risk	HIGH	LESS
Spatial Basis Risk	LESS	HIGH

**Thanks!**