Market-based Risk Management and Insurance for Developing Countries

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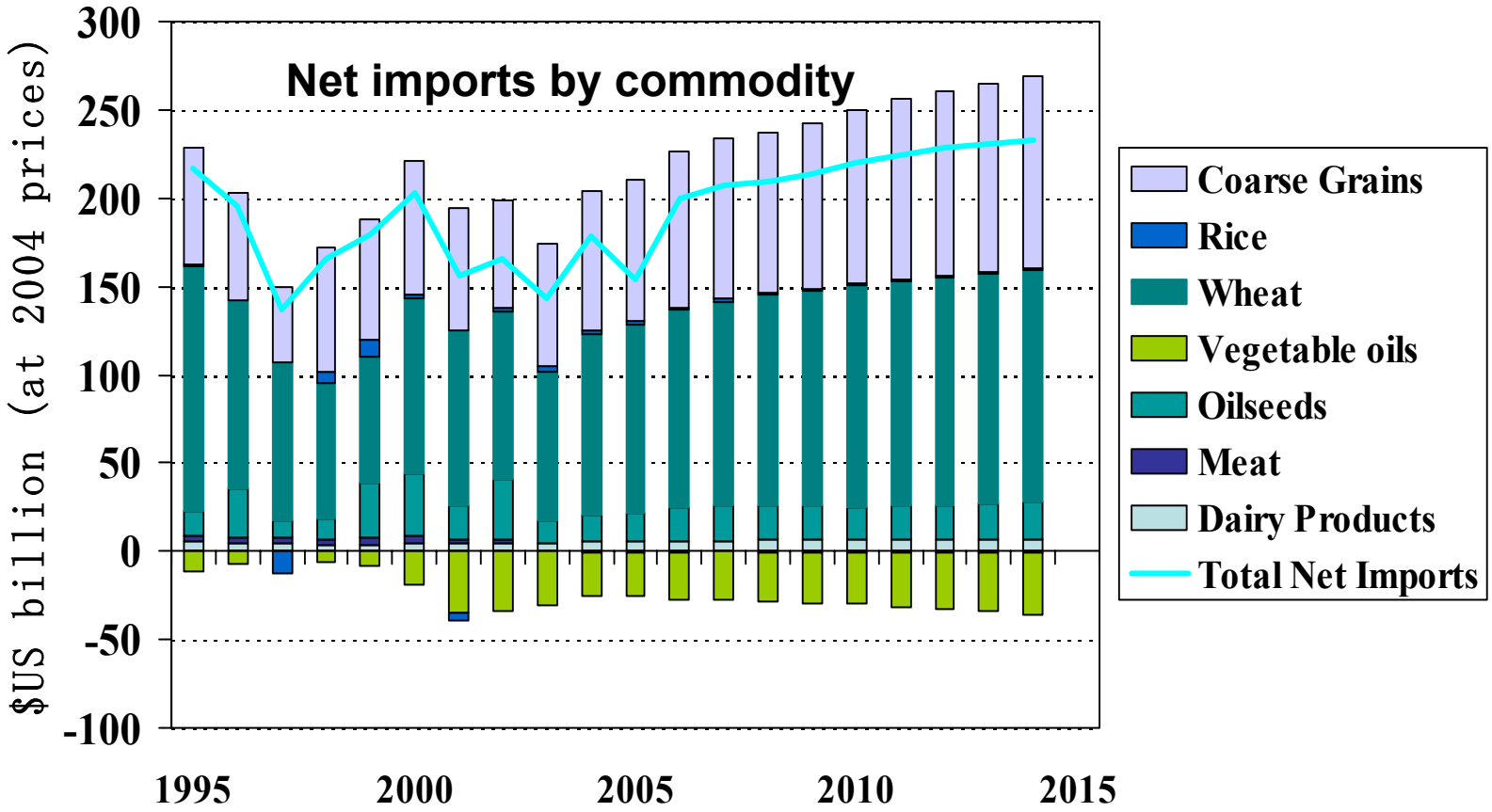
Plan of Presentation

- Food import risks of Net Food Importing Developing and Least Developed Countries and how they can be managed
- Conceptual formulation of possible relevant hedging strategies
- Simulation results of hedging wheat and maize imports with futures and options
- Risks faced by rural households in developing countries
- Index based risk management in developed and developing countries: issues and advantages
- The demand for commodity price insurance by developing country producers
- The demand for weather insurance by rural households
- Operationalizing the use of price and weather insurance in developing countries

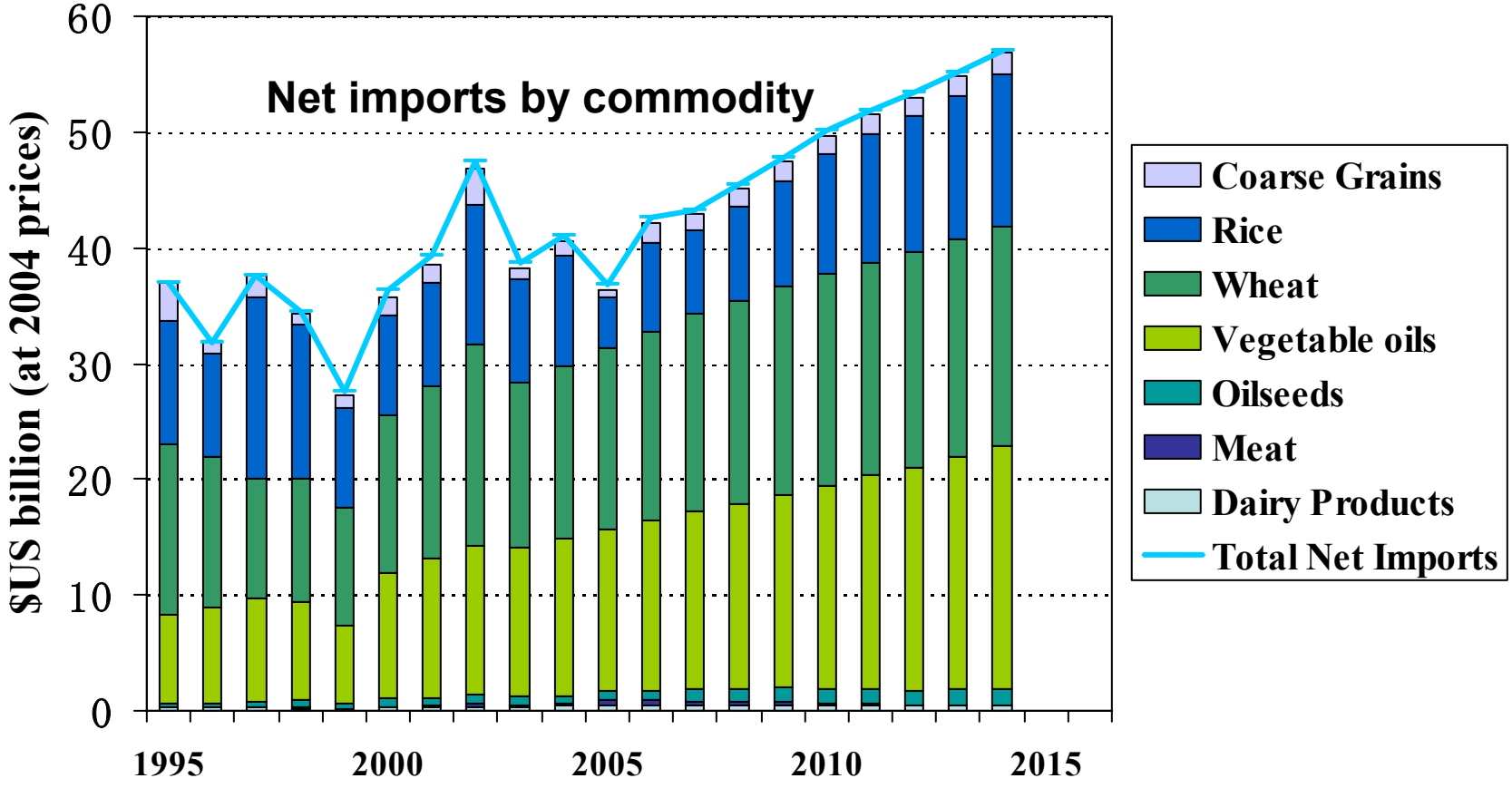
Are food import risks a problem for DCs and LDCs?

- Are becoming prominent again on international and national agenda recently because of high prices
- Secular increase if food import bills as share of export earnings in LDCs
- Secular export commodity prices have been declining making it more difficult to pay for increased commodity exports
- Growing dependence on food imports opens risk by commodity dependent LDCs that price spikes in food imports may coincide with low prices of commodity exports. Price main reason for variability of import bills
- Abolition of marketing boards may imply that domestic market instability due to both international and domestic shocks is larger
- Domestic market instability may induce irreversible effects on domestic investments, production, and population movements

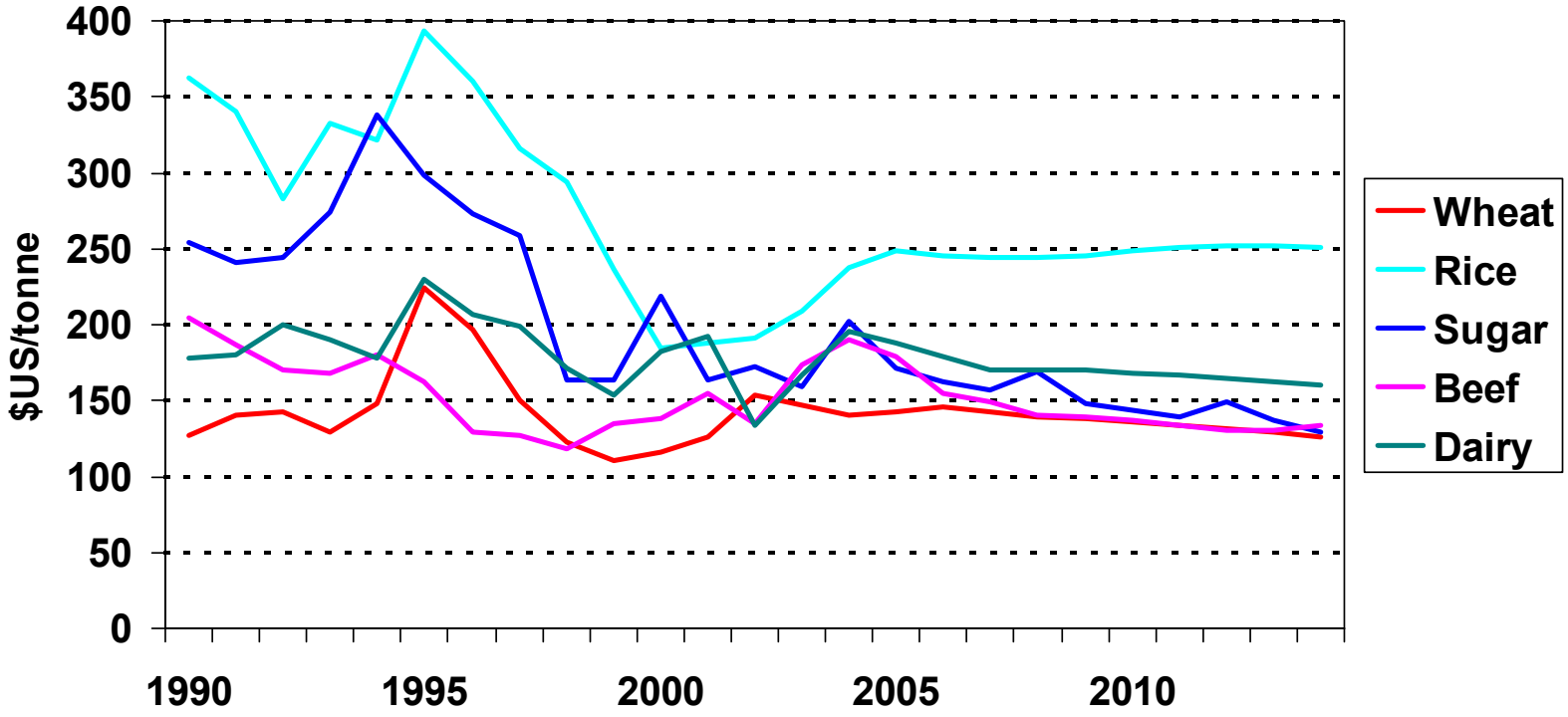
Developing countries increasing their dependence on food imports



Net imports of basic foods to grow over 6 % annually in LDCs in the medium term



Real international prices expected to decline slightly



Issues relevant to food imports by DCs and LDCs

- Food import trade now privatized in most DCs and LDCs
- Private traders do not always have adequate finance for food imports.
- Provision of Developed Country bank credit to DCs and especially LDCs is constrained by bank credit limits
- Developing country clients are considered risky counterparts by developed country bankers and traders
- Agents that could utilize RM strategies. Import traders (public or private), local banks, central bank
- Is hedging with futures and options a viable food import strategy?
- Simulate hedging rules with ex-post data to explore the issue

Conceptual formulation

- Assume that the objective of the “agent” (private trader, bank, government, etc.) is to minimize the unanticipated variability of food import bill (the agent is concerned about unpredictability of import bill).
- The agent will forecast the actual import needs, some periods in advance, and then hedge in an organized exchange.
- Issues
  - What is the hedge rule?
  - In what exchange to hedge?
  - Should the hedge include only futures or options or both?
  - Which future to buy if hedging with futures and which option to buy if hedging with options?

Empirical implementation

- Consider 11 major wheat and 6 major maize importing Low Income Food Deficit Countries (LIFDCs
- Assume agent knows need to import wheat and maize during each month of the marketing year (July-June). Use data for actual monthly imports and use prices from Gulf as import prices.
- Assume that known quantity of wheat and maize import needs is hedged in Chicago Board of Trade (CBOT) futures and call options.
- Assuming that imports are ordered one month before physical delivery, hedges are placed 3, and 9 months before the month of order or 4 and 10 months before the months of delivery (k=4 or 10)
- Day hedge is placed and lifted is midmonth of the month of futures or options purchase or order of physical quantities
- Quantity hedged is equal to the hedge ratio “beta” of amount actually imported. Beta is the coefficient of the regression between cash and near future prices. For wheat beta=0.92, for maize beta=0.27
- Strike price for call option is a fraction $\alpha=(0, 0.05, 0.1, 0.2)$ above price of the wheat or maize future that expires in month nearest after the date of actual physical contract.
- Costs for hedging with futures include 0.15 $ per ton brokerage fees. Costs of hedging with options are 4.5% of option price
- Simulate ex-post over 1987-2003

Countries selected for the wheat simulations

Wheat importers

	Average country wheat imports 1980-2003 (000mt)	Share in LIFDC Wheat Imports (%)	Share in world Wheat Imports (%)	Average country cereal imports 1980-2003 (000mt)	Share of wheat in country's Cereal Imports (%)
Bangladesh	1,543	3.6	1.5	2,115	72.9
China, Mainland	7,802	18	7.7	9,806	79.6
Egypt	6,589	15.2	6.5	9,156	72
India	974	2.2	1	1,233	79
Indonesia	2,712	6.3	2.7	4,491	60.4
Mozambique	173	0.4	0.2	521	33.2
Nicaragua	94	0.2	0.1	185	50.7
Pakistan	1,334	3.1	1.3	1,363	97.9
Philippines	1,796	4.1	1.8	2,532	70.9
Sudan	644	1.5	0.6	793	81.2
Tanzania	115	0.3	0.1	297	38.9
Total of above	**23,776**	**54.8**	**23.5**	**32,491**	**73.2**
Total LIFDC	**43,384**	**100**	**42.8**	**65,632**	**66.1**
World	**101,324**			**212,647**	**47.6**

Source: FAO

Countries selected for the maize simulations

Maize importers

	Average Maize Imports 1980-2003 (000mt)	Share in LIFDC Maize Imports (%)	Share in World Maize Imports (%)	Average Cereal Imports 1980-2003 (000mt)	Share of Maize in Cereal Imports (%)
Egypt	2,539	18.1	3.8	9,156	27.7
Indonesia	476	3.4	0.7	4,491	10.6
Kenya	366	2.6	0.5	760	48.1
Malawi	121	0.9	0.2	159	76.3
Mozambique	233	1.7	0.3	521	44.7
Tanzania	96	0.7	0	297	32.5
Total of above	**3831**	**27.4**	**5.5**	**15384**	**24.9**
LIFDC	**14,023**	**100**	**20.8**	**65,632**	**21.4**
World	**67,332**			**212,647**	**31.7**

Normalized standard deviations of wheat import bill changes over 4 months with and without hedging with futures and options (in percentage terms)

	Hedging only with futures			Hedging only with options		
	Unhedged	Hedged	Percent change	Unhedged	Hedged	Percent change
	k=4			k=4		
Bangladesh	15.8	8.6	-45.6	15.7	13.1	-16.6
China, Mainland	17.8	10.1	-43.3	18.2	14.6	-19.8
Egypt	12.1	6.2	-48.8	11.9	9.7	-18.5
India	19.9	15.7	-21.1	20.2	18.3	-9.4
Indonesia	19.5	11.9	-39.0	19.4	15.3	-21.1
Mozambique	22.1	14.8	-33.0	21.8	18.5	-15.1
Nicaragua	26.9	10.8	-59.9	26.5	21.4	-19.2
Pakistan	17.6	10.5	-40.3	17.9	15	-16.2
Philippines	15.0	9.4	-37.3	14.6	12.2	-16.4
Sudan	19.0	11.9	-37.4	19.1	15.3	-19.9
Tanzania	35.1	27.3	-22.2	35.7	29.8	-16.5

Normalized standard deviations of maize import bill changes over 4 months with and without hedging with futures and options (in percentage terms)

	Hedging with futures only			Hedging with options only		
	Unhedged	Hedged	Percent change	Unhedged	Hedged	Percent change
	k=4			k=4		
Egypt	15.2	9.9	-34.9	14.9	11.5	-22.8
Indonesia	23.2	11.7	-49.6	23.1	11.7	-49.4
Kenya	32.0	17.5	-45.3	29.4	22.1	-24.8
Malawi	32.4	24.3	-25.0	31.1	26.1	-16.1
Mozambique	15.0	10.3	-31.3	14.9	12.6	-15.4
Tanzania	23.3	15.4	-33.9	23.6	22.3	-5.5

Conclusions:

- Hedging basic food imports in the CBOT (or perhaps other suitable exchanges with smaller basis risk) by developing countries appears to be a viable strategy to reduce unpredictability of food import bills.
- While unpredictability of prices is always reduced by hedging in futures or options, reduction in unpredictability of food import bills over a long period of time is a function of the import pattern.
- Reductions in unpredictability appear to be larger when hedging is done nearer to the time of order than when done long time before.
- Dynamic and more complex hedging strategies may offer more benefits
- Externality possible in terms of gains from better predictability, and reduction in uncertainly.

Agricultural household risks: Background and motivation

- Small agricultural commodity producers face many income and non-income risks
- Individual risk management and risk coping strategies are detrimental to income growth
- Considerable residual income risk and vulnerability
- Is there a demand for additional price and weather related income insurance in light of individual existing risk management strategies?
- What is the welfare benefit of price and weather based insurance?
- Is there a rationale for market based or publicly supported price and weather based safety nets?

Ways to deal with idiosyncratic and covariate market shocks affecting poor rural households

- Idiosyncratic shocks can be dealt with by pooling or risks across many households (standard health, accident, etc. insurance).
- Covariate risks affect many households simultaneously, and hence must be insured across time. Possibilities:
- Alter probability distribution of production of prices, by technology, or by manipulating markets
- Adjust exposure to risk (diversification)
- Design time dependent insurance strategies (depends on available risk management instruments)

Current agricultural price abd disaster risk management practices in developing coutnries

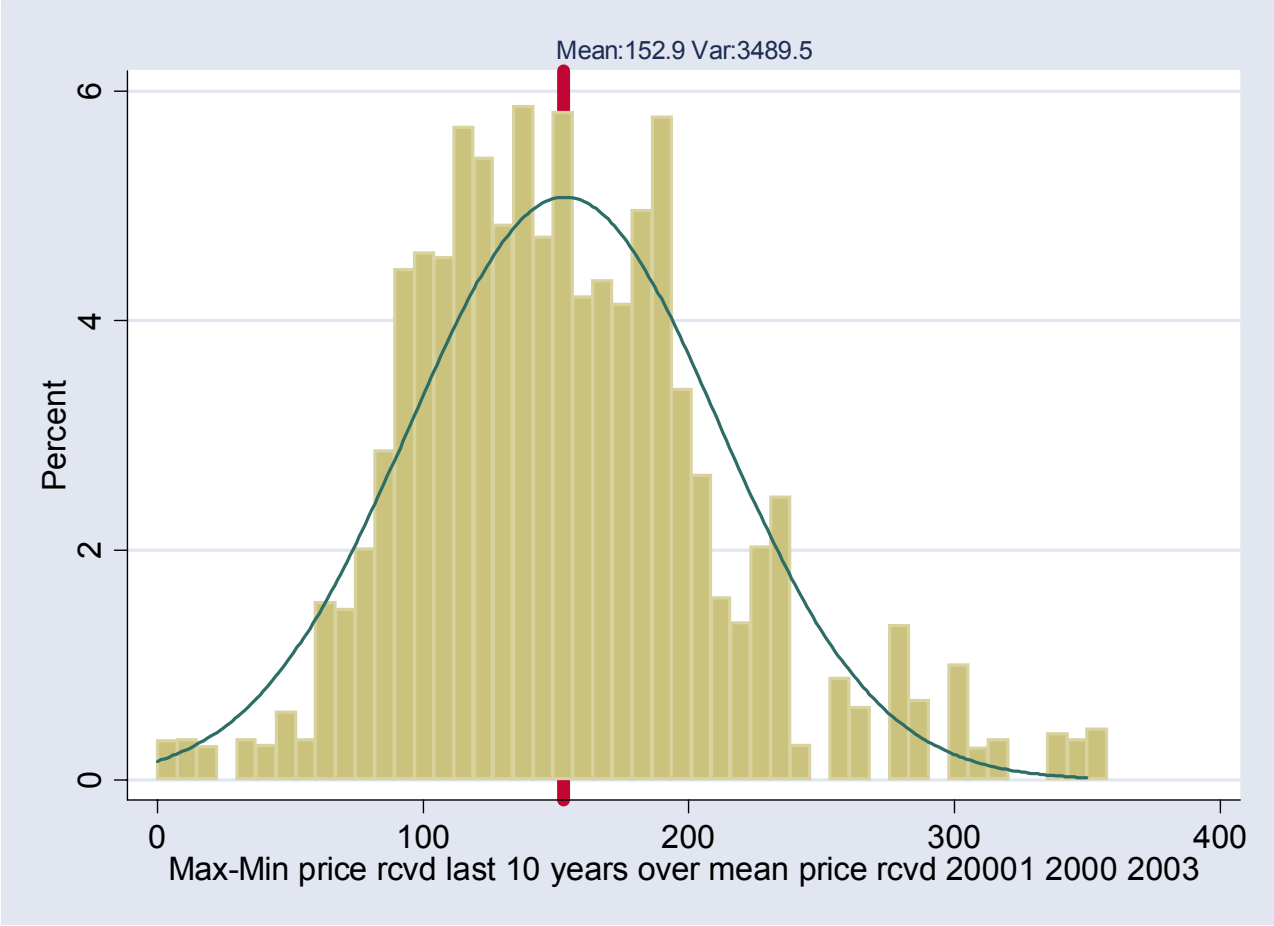
- Little ex-ante planning, mostly ex-post
- Donor resources provided for ex-post relief operations to cope with shocks rather than making dedicated resources available ex-ante (emergency mentality rather than risk management and insurance mentality)
- Relief for weather disasters takes time (to declare and to organize), is unreliable in terms of resources provided, and usually arrives after the major negative impact has been incurred.
- Safety nets need to be backed up by contingent insurance financing

Tanzania: Percentage of households affected by various shocks between 1999 and 2003, by region and status as cash crop grower or not

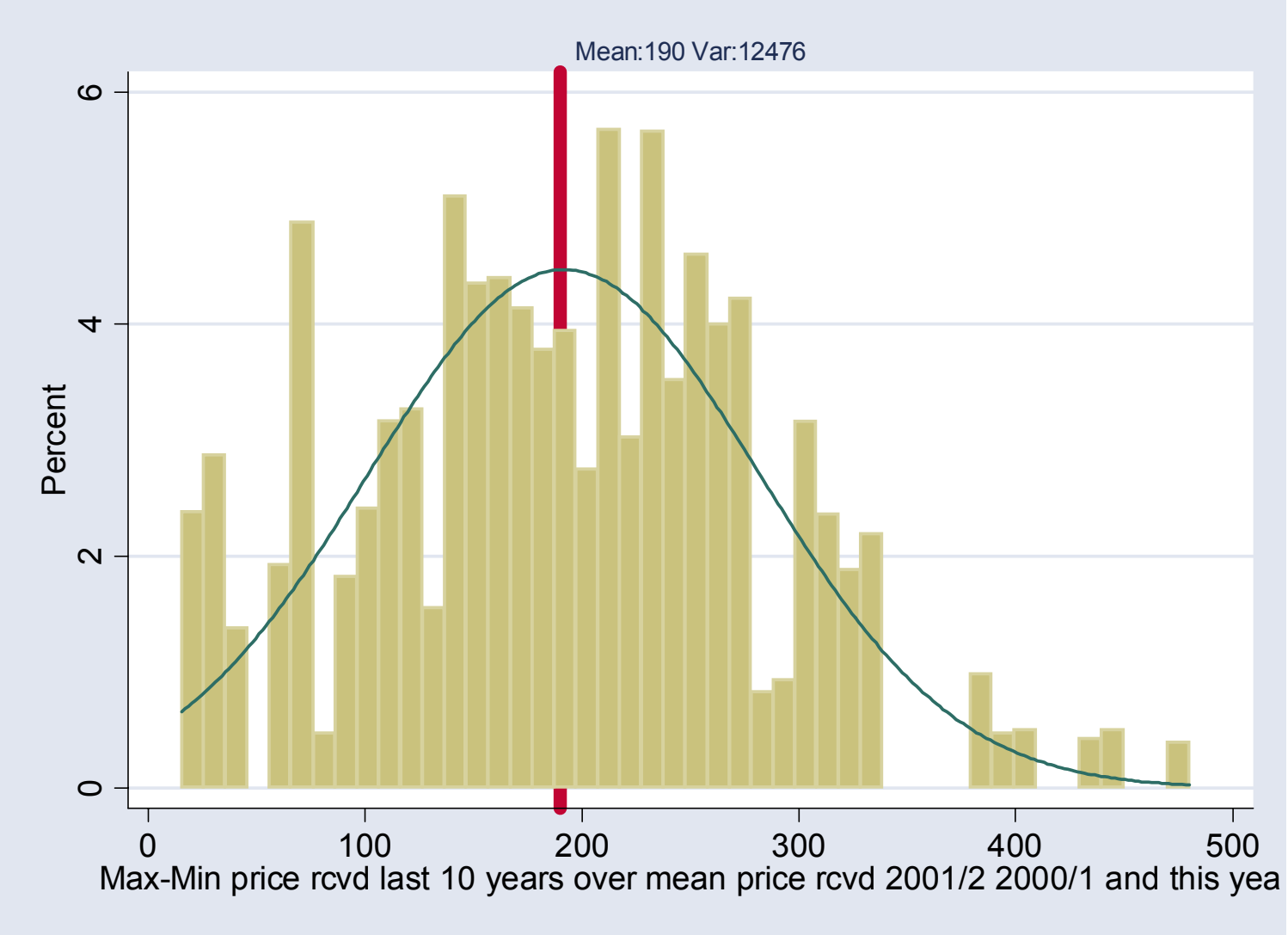
	Kilimanjaro			Ruvuma		
	All	Cash crop	no cash crop	All	Cash crop	no cash crop
Health						
Death	25.9	23.1	30.2	16.3	15.0	18.3
Illness	23.1	23.1	23.0	18.2	17.7	19.2
Climatic						
Drought	32.7	27.9	40.2	4.4	2.8	7.1
Excessive rains	7.2	4.2	11.9	2.7	3.3	1.7
Agricultural production						
Harvest loss	6.5	5.2	8.6	5.3	6.1	4.0
Livestock loss	6.4	5.1	8.5	4.0	3.1	5.4
Post harvest cereal loss	-	-	-	1.7	0.9	2.9
Economic						
Cash crop price shock	-	-	-	4.4	5.8	2.1
Cereal price shock	-	-	-	2.5	0.8	5.1
Unemployment	0.9	0.3	1.8	0.1	0.2	0.0
Property						
Theft	5.4	4.3	7.2	4.9	3.7	6.9
Fire/house destroyed	0.7	0.2	1.5	2.9	2.7	3.3
Land loss	0.5	0.2	0.8	0.1	0.2	0.0

Variability of nominal prices received for coffee in Kilimanjaro over the previous 10 years.

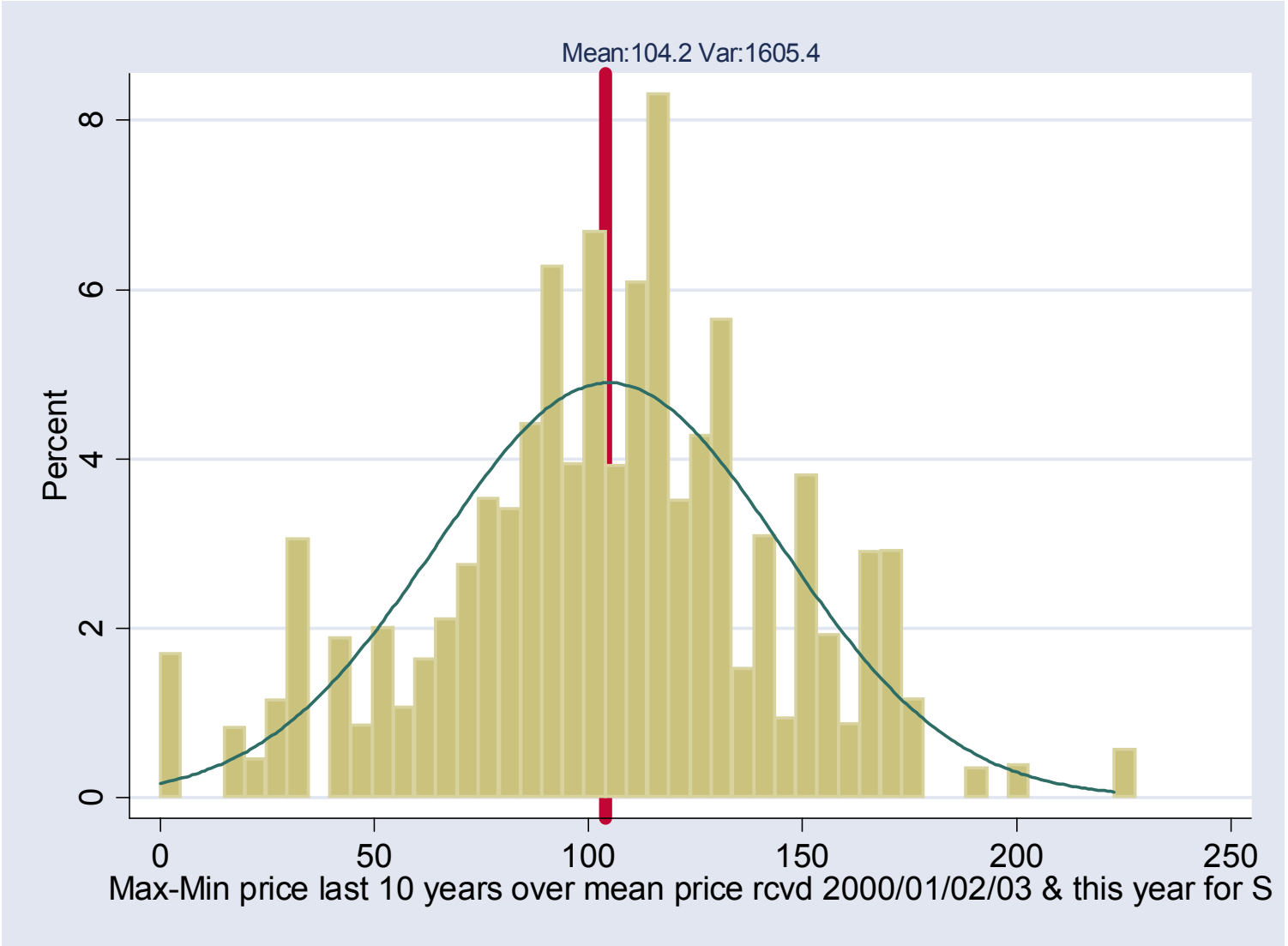
4A. Kilimanjaro



Variability of nominal prices received for coffee in Ruvuma over the previous 10 years.



Variability of nominal prices received for cashew nuts in Ruvuma over the previous 10 years.



Vulnerability among rural smallholders is high and a significant part of it due to covariate shocks

Vulnerability of rural households by economic status in Kilimanjaro 2003

	Number of hhlds	Mean vulnerability	Proportion of consumption variance due to covariate factors
ALL	191,585	0.31	0.11
Non Poor	115,903	0.15	0.12
Poor	75,682	0.55	0.11
Coffee producers	117,299	0.31	0.13
Non Coffee producers	74,287	0.29	0.09
Net Food Sellers	30,570	0.13	0.12
Net Food Buyers	161,015	0.34	0.11

Vulnerability among rural smallholders is high and a significant part of it due to covariate shocks

Vulnerability of rural households by economic status in Ruvuma in 2004.

	Number of hhs	Mean vulnerability	Proportion of consumption variance due to covariate factors
ALL	173,932	0.60	0.30
Non Poor	63,801	0.34	0.33
Poor	110,131	0.75	0.28
Coffee producers	57,213	0.50	0.37
Cashew nuts producers	44,057	0.74	0.18
Tobacco producers	7,091	0.69	0.14
Non cash crop producers	66.847	0.58	0.33
Net Food Sellers	59,047	0.57	0.30
Net Food Buyers	114,885	0.62	0.30

Risk management mechanisms available to farmers in developed countries

- Forward contracts (backed by futures and options markets)
- Publicly supported price stabilization schemes (have tended to become price support schemes in light of declining prices)
- Agricultural insurance (private and public)
- Index based yield insurance schemes (public and private)

Problems with traditional agricultural production and revenue insurance

- Agricultural production risks are spatially correlated, hence limits pooling of risks
- Asymmetric information between insured and insurer (adverse selection and moral hazard problems)
- High administrative costs (implies that it works better for large farmers, and hence very expensive for smaller farmers)
- Difficult to predict low probability events, and underestimates of exposure, hence private insurance markets for these events unlikely to emerge (or very expensive)
- Most agricultural income insurance schemes in developed countries heavily subsidized

Alternatives to traditional insurance systems: Index insurance

Criteria for successful index

- Observable and easily measured
- Objective
- Transparent
- Independently verifiable
- Reportable in timely manner
- Stable and sustainable over time

Advantages of index insurance

- Low administrative cost
- Less moral hazard
- Less adverse selection
- Standardized and transparent structure
- Availability and negotiability
- Possibilities for reinsurance
- Versatility (bundling with other financial services)

Challenges to index insurance

- Basis risk (dealt with by supplemental products, such as self insurance, blending with rural finance, offering coverage only for extreme events)
- Precise actuarial modeling (needed by insurers)
- Weather cycles (this could change the underlying probabilities)
- Micro-climates (makes weather index insurance difficult for micro-climates)
- Market size (still small in developing countries

Types of risk that could be addressed by public sector

Risk layers. Three layers of risk

1. Risks that occur frequently and have small negative consequences (dealt with by producers through own resources
2. Risks that are less frequent, but have larger negative impact (commercial layer, private sector could provide without or with minimal subsidies, but public sector could provide regulatory environment, education, etc.)
3. Risks that are infrequent and have catastrophic consequences (market failure, public sector to provide, and also perhaps subsidize)

Advantages of ex-ante index based risk management

- Predictability of fiscal cost (for affected country governments and donors)
- Immediate access to funds for early reaction to emergencies (lessens overall cost of emergency response)
- Lower overall cost of aid
- Releases other resources for developmental purposes

Is there an interest and demand for minimum price insurance by smallholders in developing countries? Coffee producers in Tanzania

4a. Kilimanjaro

		Round 2		
		No	Yes	Total
Round 1	No	22,454	22,772	45,226
	Yes	19,976	38,843	58,819
	Total	42,430	61,615	104,045

4b. Ruvuma

		Round 2		
		No	Yes	Total
Round 1	No	3,959	3,198	7,157
	Yes	12,962	31,183	44,145
	Total	16,921	34,381	51,302

Summary statistics of the predicted value of WTP for coffee minimum price insurance in Kilimanjaro in 2003.

	400 Tsh minimum price contract		
	No of hh's	Average WTP	St. Dev.
WTP (Tsh)	63,803	67.93	26.98
WTP (Share of 400Tsh min. price)	63,803	16.98	6.75
	600 Tsh minimum price contract		
	No of hh's	Average WTP	St. Dev.
WTP (Tsh)	58,619	74.32	28.29
WTP (Share of 600Tsh min. price)	58,619	12.39	4.71
	800 Tsh minimum price contract		
	No of hh's	Average WTP	St. Dev.
WTP (Tsh)	60,116	113.85	40.62
WTP (Share of 800Tsh min. price)	60,116	14.23	5.08

Summary statistics of the predicted value of WTP for coffee minimum price insurance in Ruvuma from round 1.

	400 Tsh minimum price contract		
	No of hh's	Average WTP	St. Dev.
WTP (Tsh)	46,002	23.01	11.61
WTP (Share of 400Tsh min. price)	46,002	5.75	2.90
	600 Tsh minimum price contract		
	No of hh's	Average WTP	
WTP (Tsh)	45,759	44.70	16.19
WTP (Share of 600Tsh min. price)	45,759	7.45	2.69
	800 Tsh minimum price contract		
	No of hh's	Average WTP	St. Dev.
WTP (Tsh)	45,563	74.05	21.53
WTP (Share of 800Tsh min. price)	45,563	9.25	2.69

Kilimanjaro coffee: Welfare benefit and cost for minimum price insurance.

Premium rule	Premium value (Tsh/kg)	Quantity insured (tons)	Number of households	Total premium (million Tsh)	Premium as share of coffee sales (percent)	Consumer surplus (million Tsh)	Consumer surplus as share of coffee sales (percent)
400 Tsh minimum price							
Mean WTP	67.9	3367	34,362	228.7	15.5	29.5	2.0
Mean WTP + 1 SD	84.9	2247	12,104	190.8	19.5	2.7	0.3
Mean WTP - 1 SD	51.0	4414	51,878	224.9	11.3	85.4	4.3
Mean WTP - 2 SD	34.0	5352	62,394	181.8	7.5	168.6	7.0
600 Tsh minimum price							
Mean WTP	74.3	2787	59,963	207.1	17.6	52.0	4.4
Mean WTP + 1 SD	86.7	1375	23,986	119.2	20.1	4.5	0.8
Mean WTP - 1 SD	61.9	4328	85,033	268.1	13.7	147.4	7.5
Mean WTP - 2 SD	49.5	5203	99,566	257.7	11.0	261.6	11.1
800 Tsh minimum price							
Mean WTP	113.9	4080	64,138	464.6	25.5	68.7	3.8
Mean WTP + 1 SD	128.1	3042	17,903	389.6	29.2	1.2	0.1
Mean WTP - 1 SD	99.6	4830	85,043	481.1	22.1	188.6	8.7
Mean WTP - 2 SD	85.4	5099	98,058	435.4	18.9	352.1	15.3

Ruvuma coffee: Welfare benefit and cost for minimum price insurance.

Premium rule	Premium value (Tsh/kg)	Quantity insured (tons)	Number of households	Total premium (million Tsh)	Premium as share of coffee sales (percent)	Consumer surplus (million Tsh)	Consumer surplus as share of coffee sales (percent)
400 Tsh minimum price							
Mean WTP	23.0	8118	26,579	186.8	6.2	75.3	2.5
Mean WTP + 1 SD	28.8	3625	11,535	104.3	8.5	5.0	0.4
Mean WTP - 1 SD	17.3	10400	35,455	179.5	4.5	180.0	4.5
Mean WTP - 2 SD	11.5	12900	43,014	148.5	3.0	298.3	6.0
600 Tsh minimum price							
Mean WTP	44.7	8866	28,272	396.3	12.0	109.9	3.3
Mean WTP + 1 SD	52.2	2670	6,381	139.2	15.6	0.9	0.1
Mean WTP - 1 SD	37.3	11600	38,539	432.1	9.9	273.4	6.3
Mean WTP - 2 SD	29.8	11800	39,994	351.6	8.0	345.2	7.8
800 Tsh minimum price							
Mean WTP	74.1	9352	33,044	692.5	19.3	113.6	3.2
Mean WTP + 1 SD	83.3	0	0	0	0	0.0	0.0
Mean WTP - 1 SD	64.8	11200	38,808	725.8	17.0	317.2	7.4
Mean WTP - 2 SD	55.6	12400	42,534	688.8	14.6	549.6	11.7

Demand for price insurance. Conclusions and policy implications from study of Tanzania

- There seems to be considerable variability in prices received for the main cash crops and incomes.
- This induces considerable interest in minimum price insurance.
- Large estimated values of individual WTP for cash crop producers.
- Considerable welfare benefits (net of costs) of minimum price insurance.
- Market based index price insurance viable (premiums comparable to option prices in organized exchanges)

Kilimanjaro. Welfare benefits and cost of rainfall insurance (10% rainfall reduction)

	Premium value (000Tsh/acre)	Acres insured	Number of households	Total premium (million sh)	Premium as shareof crop sales	Consumer surplus (million sh)	Consumer surplus as share of crop sales	Acres cultivated
				22000tsh contact				
At mean WTP	5.0	118,434.6	77,061.4	591.9	3.3	829.8	4.7	241,611
At +1 Sdev WTP	10.5	66,715.2	32,504.1	699.8	7.6	320.5	3.5	117,800
				38000sh contract				
At mean WTP	5.1	86,208.6	61,570.6	438.1	2.8	1,017.8	6.5	204,385
At +1 Sdev WTP	12.8	45,581.9	27,589.5	584.8	6.8	481.2	5.6	108,665
				61000sh contract				
At mean WTP	7.6	86,180.1	61,098.4	654.2	4.1	1,633.0	10.1	202,950
At +1 Sdev WTP	20.1	47,389.1	27,018.2	953.8	10.9	765.9	8.7	100,551
Total number of households/acres			182,834					504,152

Kilimanjaro. Welfare benefits and cost of rainfall insurance (1/3 rainfall reduction)

	Premium value (000Tsh/acre)	Acres insured	Number of households	Total premium (million sh)	Premium as share of crop sales	Consumer surplus (million sh)	Consumer surplus as share of crop sales	Acres cultivated
				24000tsh contact				
At mean WTP	3.4	109,298.2	64,430.4	373.5	2.3	794.2	4.9	211,256
At +1 Sdev WTP	8.4	61,629.1	28,708.7	518.5	6.3	340.6	4.2	102,873
				41000sh contract				
At mean WTP	4.4	94,289.6	59,689.5	415.3	2.6	1,033.2	6.5	208,050
At +1 Sdev WTP	11.5	50,843.9	28,165.2	587.0	6.6	492.0	5.5	106,507
				66000sh contract				
At mean WTP	6.4	88,234.4	57,586.1	565.4	3.6	1,477.6	9.3	197,650
At +1 Sdev WTP	17.3	51,161.1	27,323.6	884.7	8.9	723.4	7.3	105,086
Total number of households			182,834					504,152

Ruvuma. Welfare benefits and cost of rainfall insurance (10% rainfall reduction)

	Premium value (000Tsh/acre)	Acres insured	Number of households	Total premium (million sh)	Premium as shareof crop sales	Consumer surplus (million sh)	Consumer surplus as share of crop sales	Acres cultivated
				12000tsh contact				
At mean WTP	0.7	51,380.0	21,671.6	38.1	0.4	336.4	3.9	194,069
At +1 Sdev WTP	3.1	37,567.7	13,979.2	117.8	1.9	224.1	3.7	130,920
				21000sh contract				
At mean WTP	0.6	38,848.3	16,219.2	24.1	0.3	271.4	3.6	164,927
At +1 Sdev WTP	3.0	32,408.6	11,608.0	98.6	1.7	186.9	3.3	115,648
				35000sh contract				
At mean WTP	1.0	39,085.6	21,761.9	38.7	0.4	285.4	3.0	211,464
At +1 Sdev WTP	4.2	20,199.1	13,295.0	85.6	1.3	188.8	2.8	138,996
Total number of households			162,722					1,216,465

Ruvuma. Welfare benefits and cost of rainfall insurance (1/3 rainfall reduction)

	Premium value (000Tsh/acre)	Acres insured	Number of households	Total premium (million sh)	Premium as shareof crop sales	Consumer surplus (million sh)	Consumer surplus as share of crop sales	Acres cultivated
				20000tsh contact				
At mean WTP	0.2	22,599.0	9,845.8	5.0	0.1	85.0	1.8	99,095
At +1 Sdev WTP	1.4	16,967.0	7,013.9	23.1	0.6	65.8	1.6	65,343
				35000sh contract				
At mean WTP	0.4	23,506.3	9,934.5	9.6	0.2	133.0	2.5	80,088
At +1 Sdev WTP	2.4	15,461.9	7,772.3	36.9	0.9	101.0	2.4	53,928
				58000sh contract				
At mean WTP	0.4	24,918.8	9,571.2	10.3	0.2	168.1	3.6	77,978
At +1 Sdev WTP	2.7	14,421.9	6,277.4	38.4	1.0	130.2	3.5	44,749
Total number of households			162,722					1,216,465

Demand for weather insurance. Conclusions and policy implications from study of Tanzania

- In Kilimanjaro for 10 percent rainfall shortfall, about 30-40 percent of households would purchase the insurance at the average WTP, insuring 40-45 percent of their total acres cultivated. The insured land would constitute 15-20 percent of total cultivated land.
- In Kilimanjaro, for insurance against a 1/3 rainfall shortfall, participation at average WTP would be around 25-35 percent of households, and they would insure 40-45 percent of their cultivated acres. Total area insured would be around 15-20 percent of total cultivated land.
- For Ruvuma and for the 10 percent rainfall shortfall, the participation at average WTP would be of only 10-15 percent of households, insuring about 20-30 percent of their total area cultivated. At actuarially fair prices, however, participation would fall to less than 10 percent of households, insuring about 30 percent of their cultivated land.
- At the actuarially fair value, about 10-18 percent of all rural households in Kilimanjaro would insure about 28000-87000 acres (about 6-17 percent of total land cultivated) resulting in a consumer surplus or benefit to society of more than 300 million Tsh or 300 thousand US dollars.
- Market based weather insurance partially viable. Must be supplemented by some subsidies
- Provision of subsidised weather insurance could reduce considerably the vulnerability of poor households

Practical instruments. Commercial risk layer

- Smallholders are willing to pay for insurance, but how?
- Could be implicitly included in the cost of formal loans from banks
- Banks could provide the price insurance, so as to recover the loans, and reinsure the risk with market based instruments
- Index based weather insurance could also be provided through banks, as part of their lending programs.

Roles for FAO and other International Organizations

- Help governments quantify rural risks
- Help governments and donors quantify the impact of rural risks on household livelihoods
- Design appropriate weather and price indices
- Help governments design rural risk management frameworks and incorporate them into countries' rural development strategies (collaborate with World Bank and IFAD)
- Collaborate with WFP and IFAD on emergency response (FAO the focus of analysis and quantification as well as index design, IFAD focus of financing, WFP focus of implementation)

Roles for government

- Understand country's rural risk profile
- Quantify country's impact of this risk on the economy and farmers livelihoods
- Design rural risk management framework
- Implement risk reduction and risk transfer mechanisms
- Understand the types of organized exchanges in which hedging can be performed
- Enhance environment permitting international hedging operations by banks, cooperatives, and other private agents (foreign exchange regulations, etc.)