Risk Belief, Producer Demand, and Valuation of Improved Irrigations: Results from Field Experiments in Mt. Kilimanjaro Selected Poster 11914

Francis Muamba and David Kraybill PhD
Ohio State University
muamba.2@osu.edu

Poster prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA,CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

Risk Belief, Producer Demand, and Valuation of Improved Irrigations: Results from Field Experiments in Mt. Kilimanjaro

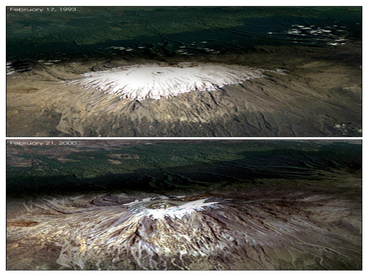
Francis M. Muamba and David S. Kraybill Ph.D. — Department of Agricultural, Environmental, and Development Economics, Ohio State University, Columbus, Ohio

Abstract

This paper systematically estimates the potential benefit of introducing improved irrigation schemes in Mt. Kilimanjaro to help rain dependent farmers cope with the risks of climate change. The study uses Contingent Valuation Method (CVM) to elicit farmers' Willingness to Pay (WTP) for eliminating the risks of crop loss by accessing improved irrigation schemes. Data for the analysis were gathered using a double bounded survey from over 200 randomly-sampled farmers in 15 villages. The study makes a contribution to the applied welfare literature and should also be useful for policymakers in Africa. The policy contribution consists of valuation of improved irrigation in the presence of climate change risks. The applied welfare contribution consists of empirical evidence about the impact of farmer's risk aversion on welfare valuation. The results show that farmers with lower expectations about future rainfall are willing to pay more for accessing the improved irrigation scheme. In addition, Mt. Kilimanjaro farmers are willing to pay up to 10% of their income to have access to improved irrigation canals

Background

Over the past 90 years, the glaciers of Mt. Kilimanjaro have shrunk by 82% (Thompson et al, 2002). These melting glaciers are accompanied with delayed rainfall onset, which in turn extends the dry season and creates agricultural yield uncertainties and food insecurity in the region (Aggrawala et al., 2003).



To help local farmers cope with the risks of Climate Change, policy makers have become interested in introducing improved irrigation scheme. The present study uses Contingent Valuation Method (CVM) to elicit Mt. Kilimanjaro farmers' Willingness to Pay (WTP) for improved irrigation schemes while accounting for the effects of farmer's prior risk aversion.

Conceptual Framework

Let $\tilde{z}_i$ *be risks that farmer i faces when no irrigation*

$\tilde{z}_i \sim (\bar{z}, \sigma^2)$ *and* $\theta \tilde{z}_i$ *is the pdf of* $\tilde{z}_i$.

Let w_i *be farmer wealth level and* $u(.)$ *be the utility s.t.*

$u(.)' > 0$ *and* $u(.)'' < 0$.

$$Eu(w + \tilde{z}_i) = u(w - \varphi_i(w, \theta \tilde{z}_i))$$

$$Eu(w + \tilde{z}_i) = E\{u(w) + u(w)'\tilde{z}_i + \frac{1}{2}u(w)''\tilde{z}^2_i + ...\} \approx u(w) + \frac{1}{2}u(w)''\tilde{z}^2_i$$

$$u(w - \varphi_i(w, \theta \tilde{z}_i)) = u(w) - u(w)'\varphi_i(w, \theta \tilde{z}_i)$$

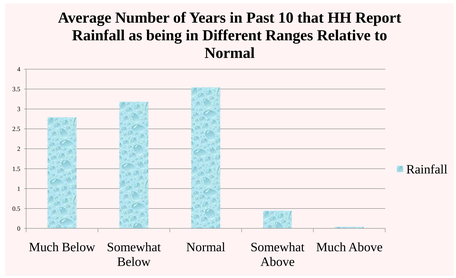
$$WTP = \varphi_i(w, \theta \tilde{z}_i) = \frac{\sigma^2}{2}[-\frac{u(w)''}{u(w)'}]$$

Fieldwork and Data Collection


A village reservoir would collect water day and night from an irrigation furrow sourced from a spring up the mountain.


The water would be conveyed by an underground pipe to your farm.

Results



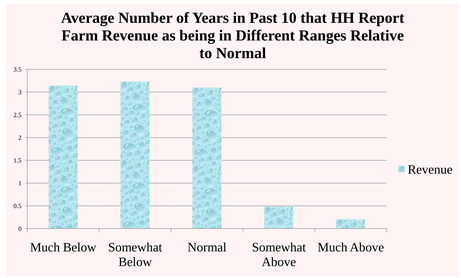


Table 6: Multivariate Probit Using Simulated Maximum Likelihood (SML)

	First Bid		Second Bid		Protection	
Variable	Coeff	t-val	Coeff	t-val	Coeff	t-val
bid1	-1.13***	-2.76				
education	0.04	0.87	-0.01	-0.28		
Age	0.004	0.05	-0.01	-0.18	-0.10*	-1.94
Age Sq	-0.0001	-0.37	-0.000	-0.14	0.01**	1.99
hhsize	0.04	0.78	0.03	0.67		
Income	0.003	0.73	-0.010**	-2.31		
land size	0.12	1.25	0.15*	1.71	0.02	0.36
livestock	-0.30	-0.67	-0.29	-0.53	0.67*	1.75
irrigation	0.075	0.31	0.65**	2.03		
maize	0.30	0.97	0.43	1.41	0.60**	2.18
banana	-0.04	-0.11	0.57	1.27	0.66**	2.30
coffee	-0.36	-1.27	-0.52*	-1.71	-0.42*	-1.71
fertilizer	0.41	1.16	0.59	1.52		
Expected Rain	-0.0009*	-1.75	-0.000	-0.26	-0.00	-0.63
altitude	-0.00	-0.14	0.000	0.03	0.001	1.48
mulch	0.82*	1.66	-0.54	-0.69		
bid2			-1.77***	-5.45		
Dummy1			2.31*	1.72		
extension			0.21	0.82		
gender			0.51	1.28		
Beans					-0.48*	-1.70
Constant	12.34***	2.77	16.66***	4.59	0.64	0.46
Fixed Effect	Yes		Yes		Yes	

*significant at 10%, **significant at 5%, ***significant at 1%.

Measuring WTP

Table 7: Mean WTP for Improved Irrigation (in US $)

	Mean WTP	Lower Bound	Upper Bound	p-value
First Bid	28.71***	21.62	62.62	0.000
Second Bid	33.14***	27.15	40.08	0.000

Conclusions

The results show that farmers with lower expectations about future rainfall are willing to pay more for accessing the improved irrigation scheme. In addition, Mt. Kilimanjaro farmers are willing to pay up to 10% of their income to have access to improved irrigation canals. Assuming a 5% discount rate, the study found that farmers will reimburse the cost of building the irrigation scheme after 7 to 9 years.

Selected References

Agrawala S, Möhner A, Hemp A, van Aalst M, Hitz S, Smith J, Meena H, Mwakifwamba SM, Hyera T, Mwaipopo OU. 2003. "Development and Climate Change in Tanzania: Focus on Mount Kilimanjaro". COM/ENV/EPOC/DCD/DAC (2003)5/FINAL. Organization for Economic Cooperation and Development Paris, France (72 pp)

Haab, TC., McConnell, K., 2002. Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation. Northampton, MA: Edward Elgar Publishing.

Konishi, Y., and J.S. Coggins 2008. "Environmental risk and welfare valuation under imperfect information." *Resource and Energy Economics* 30:150-69.

Pratt J and Zeckhauser R. (1996). "Willingness to Pay and the Distribution of Risk and Wealth" Journal of Political Economy, Vol 104 n 4.

Young R.A., 2005. Determining the Economic Value of Water: Concepts and Methods. RFF Press. Washington

Acknowledgments

I am thankful to Dr. David Kraybill for his wise insights and guidance from the inception to the culmination of this paper. I also thank The Ohio State Climate, Water, and Carbon (CWC) program for the generous financial support. I am grateful for the excellent fieldwork done by the enumerators and the positive participation of Kilimanjaro farmers to the survey without which these results would not have been possible.

For further information

Please contact the author at muamba.2@osu.edu. More information on this and related projects can be obtained at http://digitalunion.osu.edu/R2/summer09/yoon/.