Developing a Participatory Socio-Economic Model for Food Security, Improved Rural Livelihoods, Watershed Management and Biodiversity Conservation in Southern Africa

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August 31, 2009


Zambia
Malawi
Mozambique
Zimbabwe
Botswana

COMACO

Community Markets for Conservation

Lessons for Global Development

(Luangwa Valley not unique, lessons can be used in buffer zones where people & wildlife share resources)

1. local ownership/pride
2. **help develop analytical business skills**
3. **value-added products, stable contracts**
4. **food safety/hygiene training essential**
5. shelf life and packaging
6. cropping practices/ soil amendments vary tremendously--farmer education
7. sustainable ag methods can improve yields and also lead to new opportunities for profit
8. **traditional practices off-farm can impact environmental benefits of on-farm changes**

Lessons for Global Development

9. **introduced livestock disease can mimic impacts of climate change**
10. **farmers often adapt poorly when they need to rely on a new livestock species**
11. utilize existing veterinary services (e.g. poultry)
12. food processing waste can be utilized for additional products such as animal feed or biochar
13. **farming strategies still are in need of great improvement and site-specific development (e.g. Faidherbia)**
14. **assessments of impacts on food security can be difficult (move toward biometric markers)**

Lessons for Global Development

15. truly holistic approaches to biodiversity conservation can be successful but require time
16. long-term presence of WCS allowed development of COMACO over decades, beyond time-frame for standard grants/programs
17. iterative process requires constant monitoring and evaluation
18. **importance of communications (V-sat connectivity) and transportation**
19. scaling up is required to become economically self-sustaining
20. **traditional business models promote scale and product diversity (in contrast to eco-tourism models or forest crop models that rely on provision of small # of crops, but don't contribute back the value-add)**

Lessons for Global Development

21. risks can arise from influence of neighboring nations/conflicts
22. **climate variability can have tremendous impacts on agricultural businesses, need to have multiple income streams and build toward an operating reserve**
23. **crop diversification can be a critical adaptation to climate change and increased variability (e.g. cassava)**
24. long-term relations with local government essential
25. **benefits of strategic partnerships (e.g General Mills)**

Lessons for Global Development

26. **efforts to improve economy can have wide-ranging, unintended impacts** (e.g. shift toward a cash crop monoculture can leave a community ill-prepared to cope with climate or market variability, leading to unsustainable natural resource utilization, long-term loss of economic opportunities, and food insecurity)
27. **holistic approaches to biodiversity conservation can provide diverse economic and social benefits**
28. **rural development and biodiversity conservation efforts can and should be integrated--each impacts the other**

Specific Aims

1. To determine the extent to which the COMACO model can be economically self-sustaining and the effectiveness of the different COMACO model components.

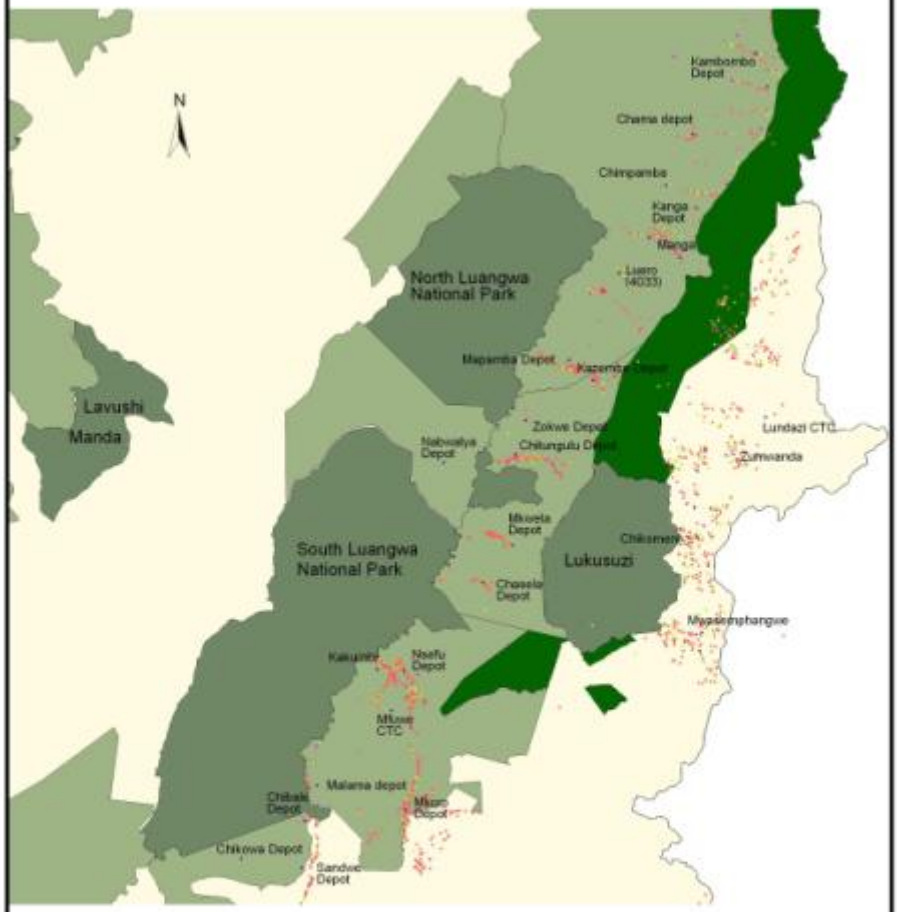
    - business economic analysis
        - historical analysis
        - profit and cost centers
    - natural resource economic valuation--What are the costs and benefits of biodiversity conservation by this model? (more on this near the end of this presentation)

COMACO Economic Sustainability Model_July 2 09.xls

	A	B	C	D	E	F	G	H	I
1	COMACO Phase Two Budget Summary								
2	Budget item description	unit cost	units	Year 1	Year 2	Year 3	Year 4	Year 5	Total
3	**4) COMACO Expansion on East**								
4	**Back-stopping existing CTCs : Lundazi**			**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
5	**Capital expenditures**								
6	a) processing/packaging equipment								
7	vaccuum packaging/sealing machine	$12,000	1	$12,000					$12,000
8	packaging support	$2,500	2	$2,500	$2,500				$5,000
9	product bio-safety support (reagents)	$1,000	5	$2,000	$1,000	$1,000	$1,000		$5,000
10	food safety equipment (enzyme tester)	$5,000	1	$5,000					$5,000
11	electric honey press	$1,200	1	$1,200					$1,200
12	purchase and installation of new extruder	$16,000	1	$16,000					$16,000
13	hot guns and shrink sleeve ribbons	$600	1	$600					$600
14	Filler	$2,600	1	$2,600					$2,600
15	processing equipment not yet identified	$18,000	1		$18,000				$18,000
16	b) building and construction								
17	New Storage Shed for Lundazi CTC	$18,000	1		$18,000				$18,000
18	New Storage Shed for Lundazi CTC	$15,000	1		$15,000				$15,000
19	Fit air-vents for all existing storage sheds	$1,000	1	$1,000					$1,000
20	Extend peanut butter making room in Lundazi	$7,500	1	$10,000					$10,000
21	Rennovate depots	$5,000	1	$7,000	$3,000				$10,000
22	c) other equipment								
23	computers	$1,200	2	$2,400		$2,400			$4,800
24	photocopier	$600	1		$600				$600
25	portable generator	$800	1	$800					$800
26	vehicle workshop tools	$1,200	1	$1,200			$1,200		$2,400
27	printer	$400	2	$400			$400		$800
28	d) transport equipment								
29	motorbike	$6,000	3	$6,000	$12,000	$6,000	$6,000	$6,000	$36,000
30	e) inputs								
31	Procurement and distribution of bee-hives			15,000	$10,000	$10,000	$10,000	$10,000	$55,000
32	Distribution of key farmer inputs			20,000	$20,000	$20,000	$20,000	$20,000	$100,000
33	Production of producer group ID cards			5,000	$5,000	$5,000	$5,000	$5,000	$25,000
34	**Subtotals:**	$115,600		$110,700	$105,100	$44,400	$43,600	$41,000	$344,800
37	**Recurrent Costs**								
38	a) salary support								
39	Salary for Machine Engineer	$500	12	$6,000	$6,180	$6,365	$5,000	$2,500	$26,045
40	CTC salary support			$22,000	$15,000	$10,000			$47,000
41	Extension staff salary support			$25,000	$20,000	$20,000	$10,000	$10,000	$85,000
42									
43	b) Field activities								
44	Compliance survey			$3,000	$3,000	$3,000	$3,000	$3,000	$15,000
45	Field Day events			$4,000	$4,000	$3,000	$3,000	$2,000	$16,000
46	Poultry vaccination			$2,500	$2,500				$5,000
47	Printing/distribution of training manuals/posters			$4,000		$4,000			$8,000
48									
49	d) Internal audit inspections (fuel, per diem)			$2,500	2,500	2,500	2,500	2,500	$12,500
50	e) Transport/travel								$0
51	fuel	variable		$8,000	$6,000	$4,000	$4,000	$4,000	$26,000
52	per diem	variable		$4,000	$4,000	$4,000	$3,000	$3,000	$18,000
53	vehicle maintenance	variable		$5,000	$5,000	$5,000	$3,000	$3,000	$21,000
54	i) Communications								
55	telephone	variable		$2,400	2,400	2,400	2,400	2,400	$12,000
56	broadband	variable		$4,500	$4,500	$4,500	$4,500	$4,500	$22,500
57	j) Meetings								
58	Extension staff meetings			$3,000	3,000	3,000	3,000	3,000	$15,000
59	Local CTC advisory board meetings	$1,500	3	$3,000	$4,500	$4,635	$4,774	$4,917	$21,826
60	Joint meetings & exercises with Dept Agri. Staff			$1,500	1,500	1,500	1,500	1,500	$7,500

Assumptions | Sales | Purchasing | Cost_HQ | Costs_Nyimba | Model_Nyimba | Costs_Chama | Model_Chama | Costs_Lundazi | Mod

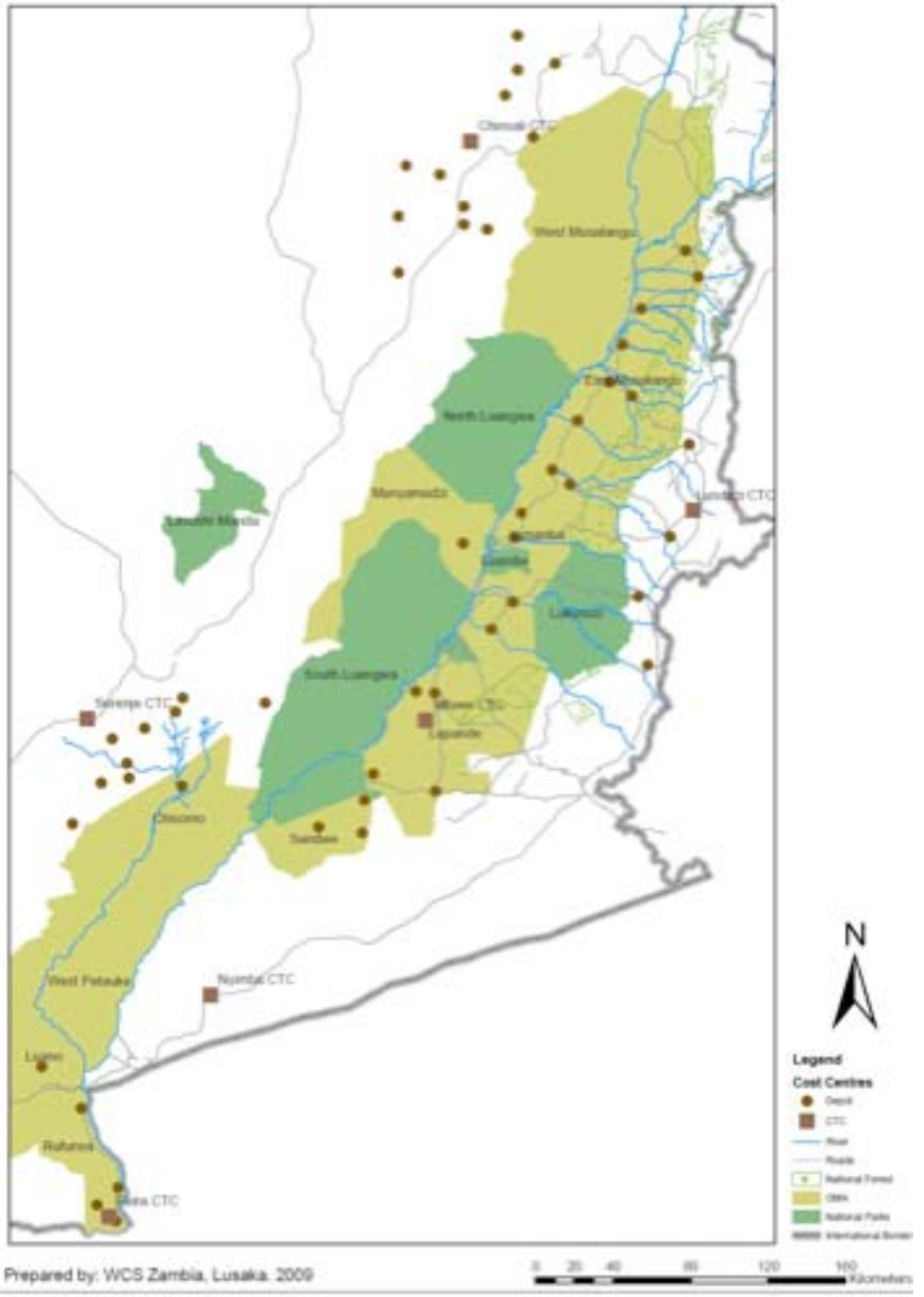
Distribution of Comaco Villages



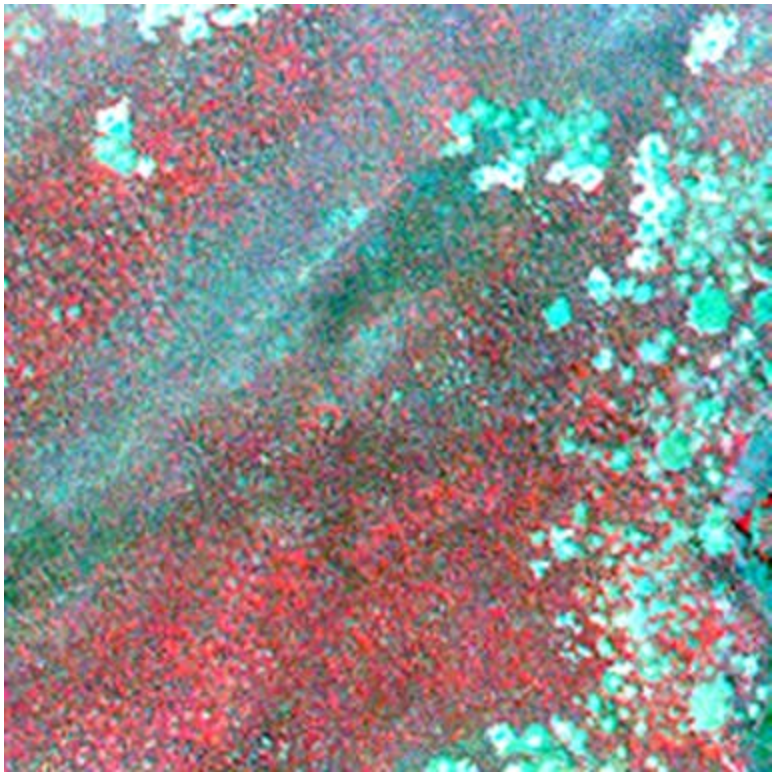
Comaco Members
- 0
- 1 - 10
- 11 - 30
- 31 - 60
- 61 - 133

- Comaco Depot
- National Forests
- G.M.A
- National Parks
- Zambia

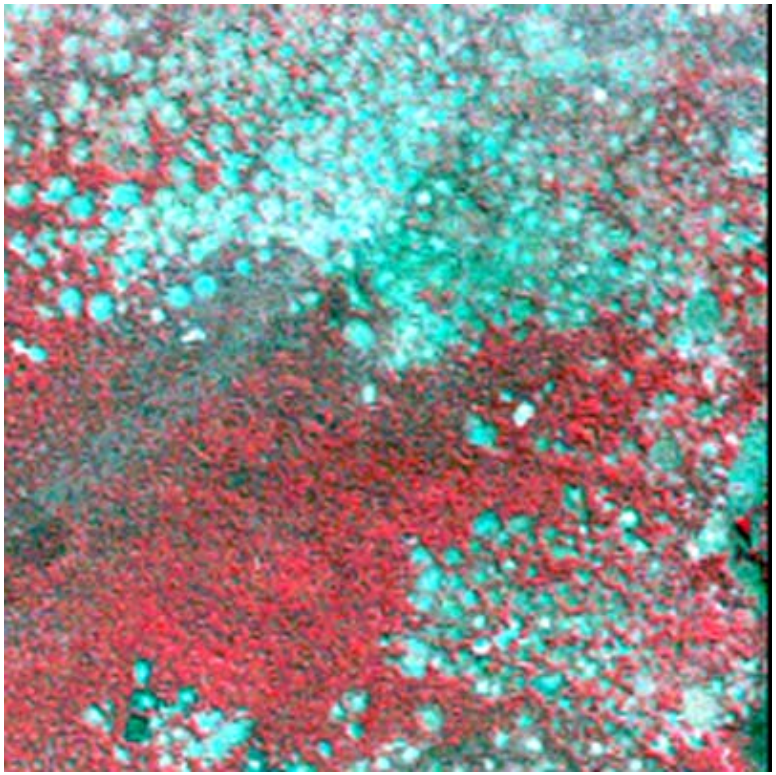
0 50 Kilometers



What are the threats on the western plateau?



2001



2009

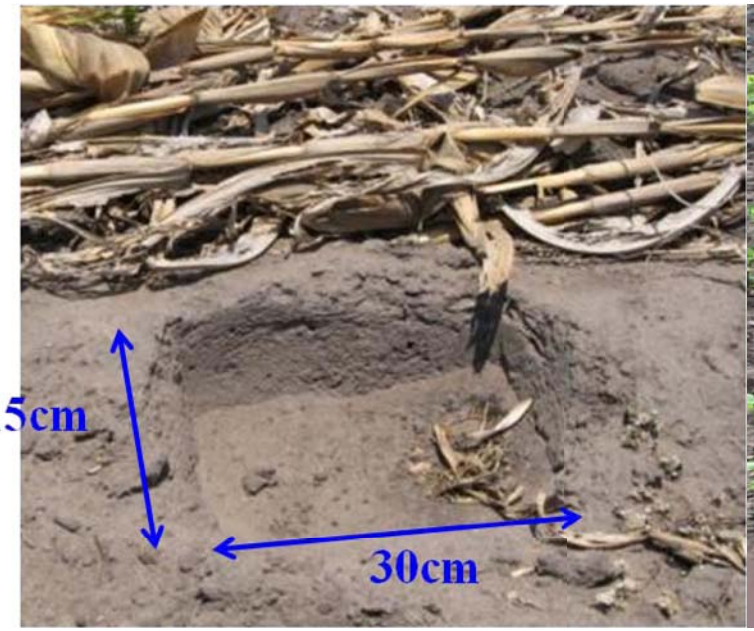
Specific Aims

2. To identify and integrate new technologies into the COMACO model to improve its profitability, food security, and rural incomes.

    - food sciences
    - crop and soil sciences
    - veterinary sciences (poultry and goats)

Effects of environmental variables along a soil and climatic gradient in Zambia

Conservation Farming



Dry season land preparation using **restricted minimum tillage** methods (hand-hoe) laid out in precise grid of 15,850 basins per hectare

Quality of compost used by farmers

What are the other options soil amendments?

Field days

Goals

To investigate the maximum yields attainable along the wide gradient of soil and climatic conditions; and what types of organic amendments are best (quality) for improving production potential under conservation farming.

1. *Does conservation farming improve crop yields under a wide gradient of environmental variables?*

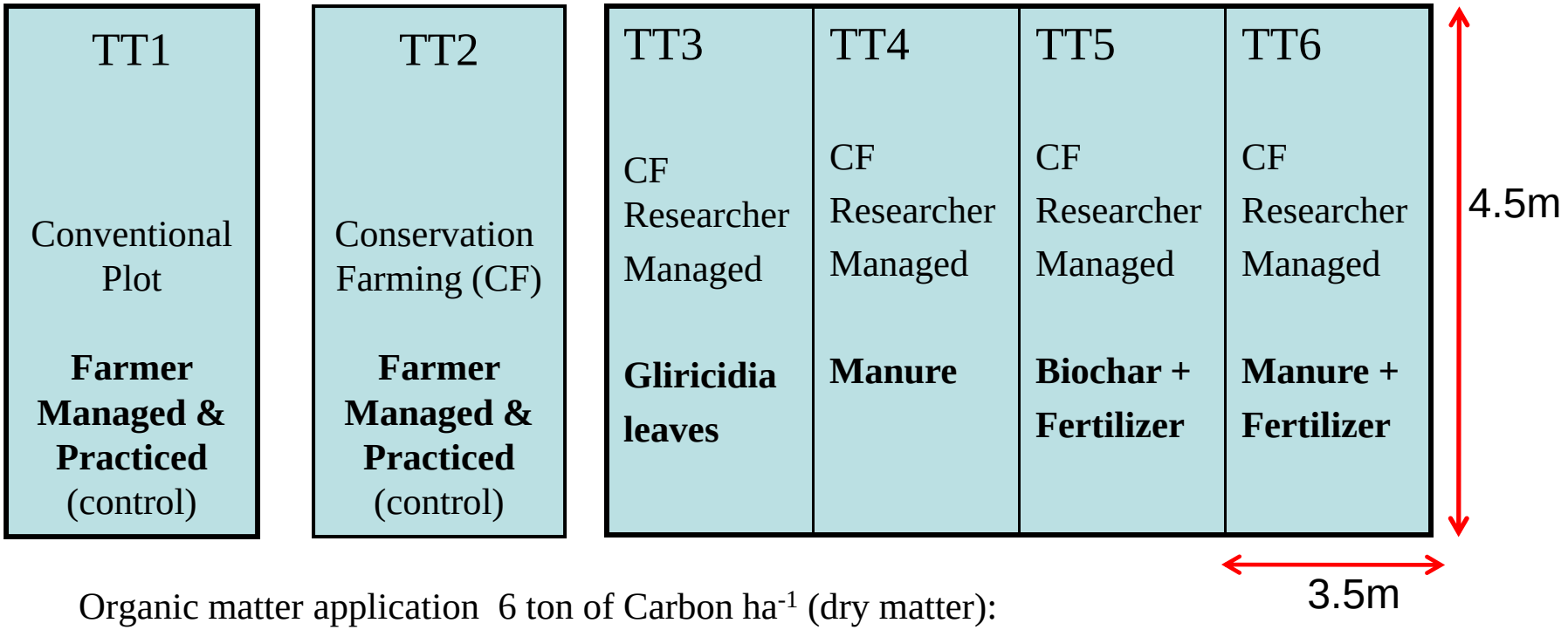
2. *Does conservation farming improve plant nutrition and water availability through soil amendments?*

280 farmers across the 3 major physiological agro-ecological zones

Training of trainers and lead farmers

Farmers recorded daily rainfall

Farm-Plot Layout... 5 x 5 basins per each plot (6 plots per farmer)



Organic matter application 6 ton of Carbon ha^{-1} (dry matter):

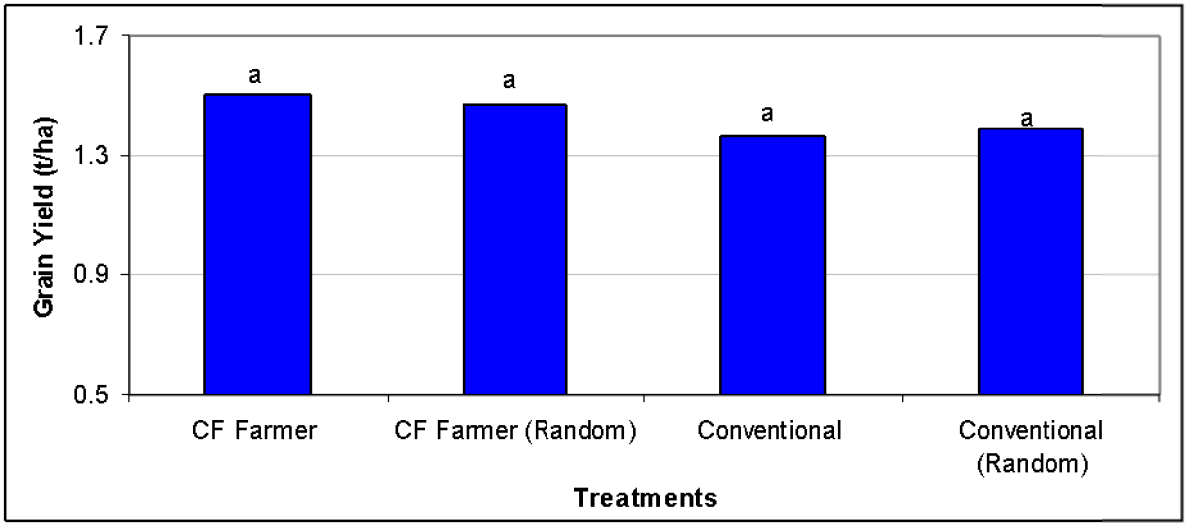
- Gliricidia leaves from ICRAF and MACO plantations
- Manure from farmers in Lundazi
- Biochar made from rice husks (by-product) in Lundazi and Mfuwe

Inorganic fertilizer- Compound D (10:20:10 NPK + S, B, Cu)

Nitrogen = 200kg ha^{-1}

Potassium & Phosphorus = 100 kg ha^{-1} and micronutrients

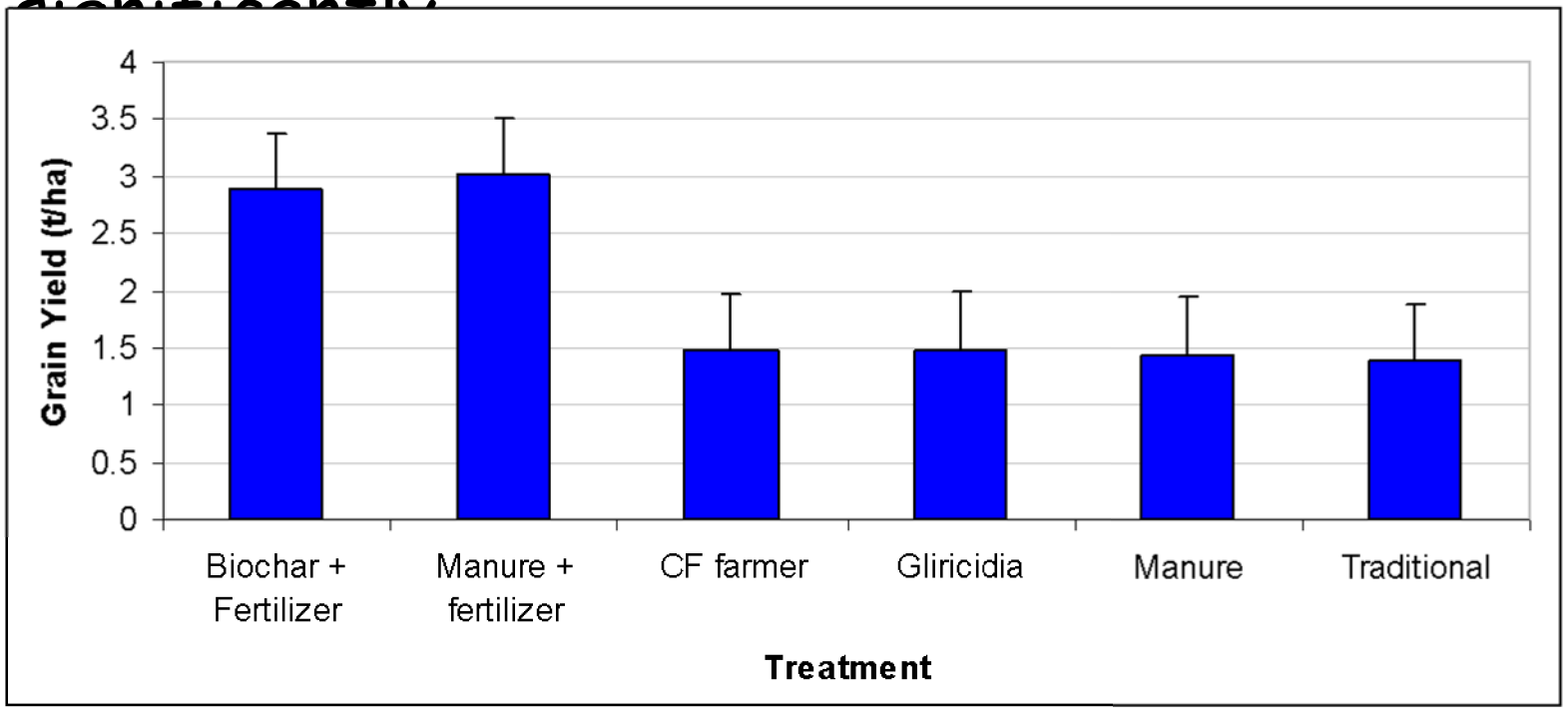
Effect of environmental variables on conservation farming along soil and climatic gradient.



Grain yield under conservation and conventional farming practices in Eastern Zambia (n=280);

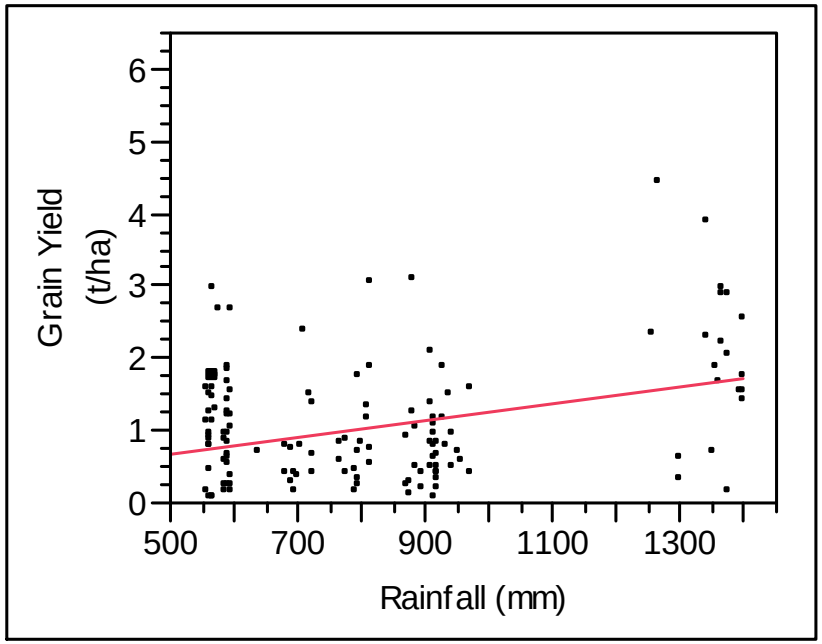
Random indicates that plots were randomly chosen at harvest to avoid any bias by farmers to attend differently to experimental plots

Introducing improved practices, in particular mineral fertilizers, crop yields increased significantly

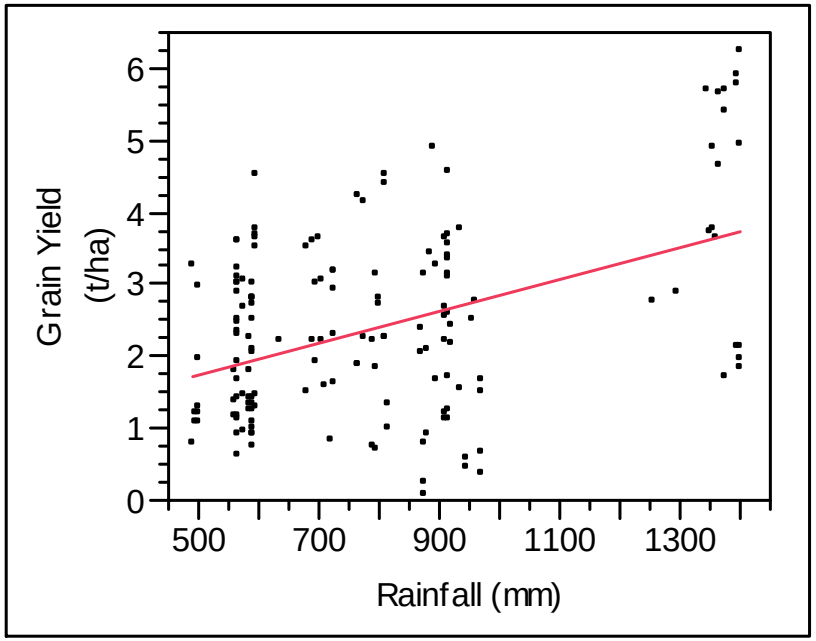


Grain yield under conservation farming with improvement in comparison to conventional farming using researcher managed on-farm trials in eastern and Northern Zambia

Grain yield along the climatic gradient



Traditional plot



Biochar + fertilizer yields

Addition of biochar as an organic soil amendment along the environmental gradient increased with increase in rainfall. The location and agroecological zone significantly affected crop yield, with greater yields at wetter regions. This is confirmed by a slightly positive relationship between yields and rainfall. Very interesting is the proportionally greater increase in crop yields through conservation farming at higher rainfall.

Biochar – soil amendment

- Manure and Gliricidia leaves had no significant effect on yield. This is from low soil N supply from organic amendments which depends on both the initial availability of inorganic N in the amendments and also the longer-term rate of mineralization and subsequent immobilization of N.

- Biochar additions to the soil improves nutrient retention by increasing CEC upto 50% due to increased surface area, decreased nutrient leaching, direct addition of minerals e.g. K^+

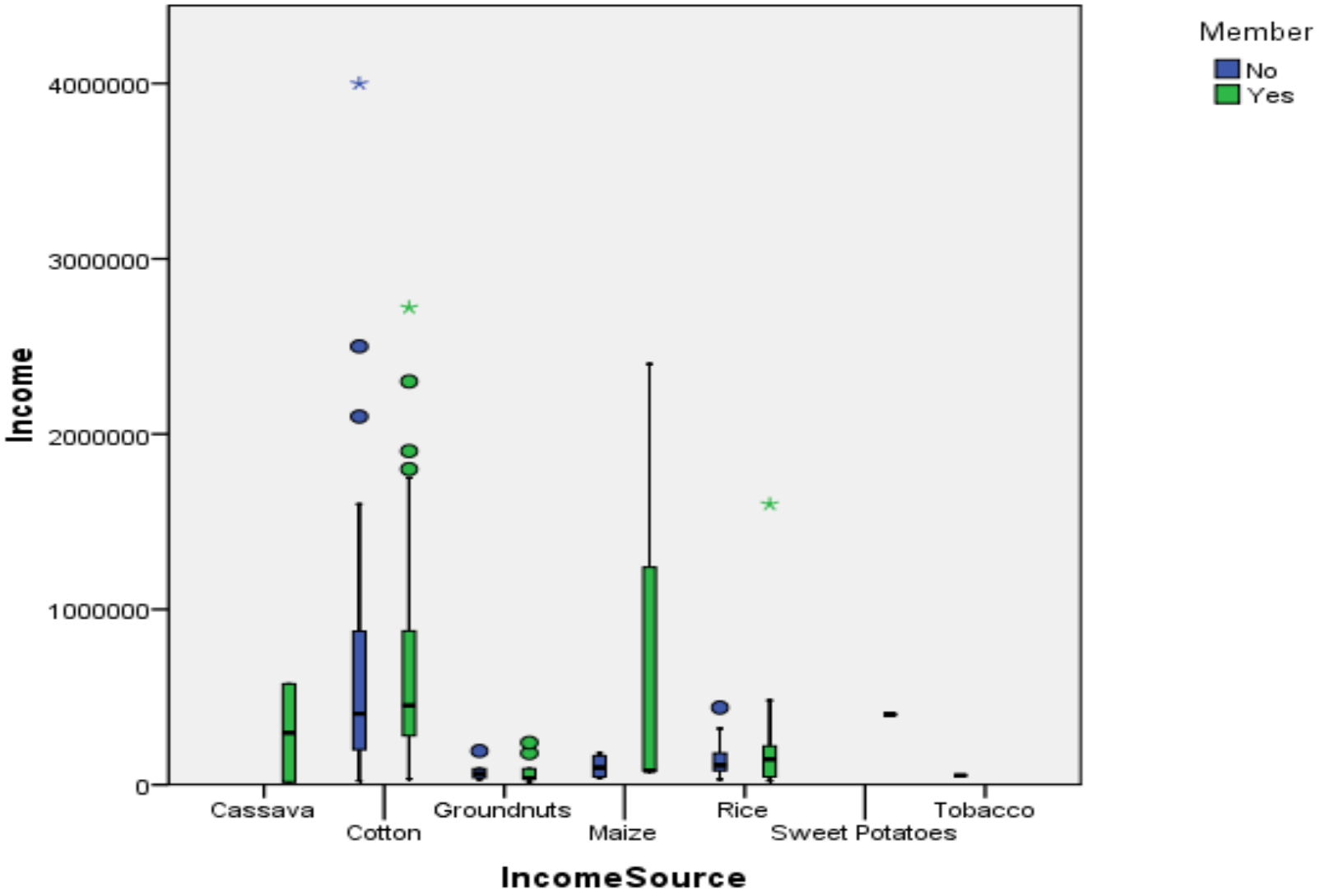
- Biochar is the oldest Carbon in soil and hence sequester C in soil.

Specific Aims

3. To determine the extent to which the COMACO model provides self-sustaining social institutions and meaningful roles for COMACO participants.

    - COMACO baseline surveys

social acceptance of new crops



Specific Aims

4. To determine the extent to which the COMACO model improves biodiversity and watershed conservation.

   - aerial wildlife surveys (COMACO core and control areas, hippos)
   - watershed, canopy and bushfire analysis

Economic Evaluation of the impact of Community Markets for Conservation on Natural Resources, Human Health and Social Welfare

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Dr. William Schulze
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COMACO
COMMUNITY MARKETS FOR CONSERVATION

WILDLIFE CONSERVATION SOCIETY

Cornell University

Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Program

SANREM CRSP
Office of International Research, Education, and Development
Virginia Tech (0378)
840 University City Blvd., Suite 5&7
Blacksburg, Virginia 24061
Phone: (540) 231-1230
Fax: (540) 231-1402
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www.oired.vt.edu/sanremcrsp

USAID
FROM THE AMERICAN PEOPLE

Food Security, Malnutrition, Child Mortality and the Value of Statistical Life

- Over 30,000 member households of COMACO, mostly in the Eastern Province of Zambia. COMACO targets households that are most food insecure

- Average HH size 5.5 (Lewis, Tembo, Nyirenda 2001), proportion of children under five years old (U5's) per rural household 20.6% (ZDHS 2007)

  - **Over 30,000 U5's are part of COMACO member families.**

- Only 18.6% households in the Eastern Province usually/always had enough food to eat – second lowest rate in Zambia (ZDHS 2001/2002)

- Under 5 Mortality 152 (per 1000) Eastern Province, 119 nationally and ranked 13th highest rate of child mortality in the world (UNICEF 2009)

- 12.7% of under five's are moderately to severely malnourished in Eastern province (ZDHS 2007)

Food Security, Malnutrition, Child Mortality and the Value of Statistical Life (cont.)

- District health center figures indicate 15% of those U5's admitted from 2004 to 2008 were underweight
- Malnutrition in children compounds the effects of other diseases, and the 'probability attributed risk factor' has been estimated to be 51% for under five in-patients in rural Kenya (Bejon, 2008).
  - Preventing malnutrition in U5's reduces in-patient deaths by 51%
- 24,578 children admitted to health centers in COMACO areas were underweight in 2004, down to 8,363 in 2008
  - Double counting likely, assume U5's attend clinics twice/year on average (**4,181** in 2008)
- Assuming a 15% mortality rate (likely to be higher) of those admitted underweight, 627 children lost their lives in these areas in 2008 alone, from a probabilistic perspective

… but what is the "Value of Statistical Life"?
(VSL)

- Simply put, it is the amount individuals would be willing to pay to *avoid* additional mortality risk (WTP), or the amount of compensation individuals would be willing to accept for additional mortality risk (WTA)
- WTA versus WTP at the boundary (*certainty* of death) are not equivalent: WTA=infinity and WTP=lifetime income, however…
- WTP = WTA for lower risk levels and for marginal changes
- Represents the economic value of life, including *non-market values*
- EPA: USD 7million value for reduced premature mortality - VSL (2006)
- No VSL estimates for Africa, but studies from India, Bangladesh, Thailand show that VSL is substantial even in developing countries
  - Safety is a normal good with relatively inelastic response to changes in income
- VSL in Zambia is conservatively in the order of USD 100,000

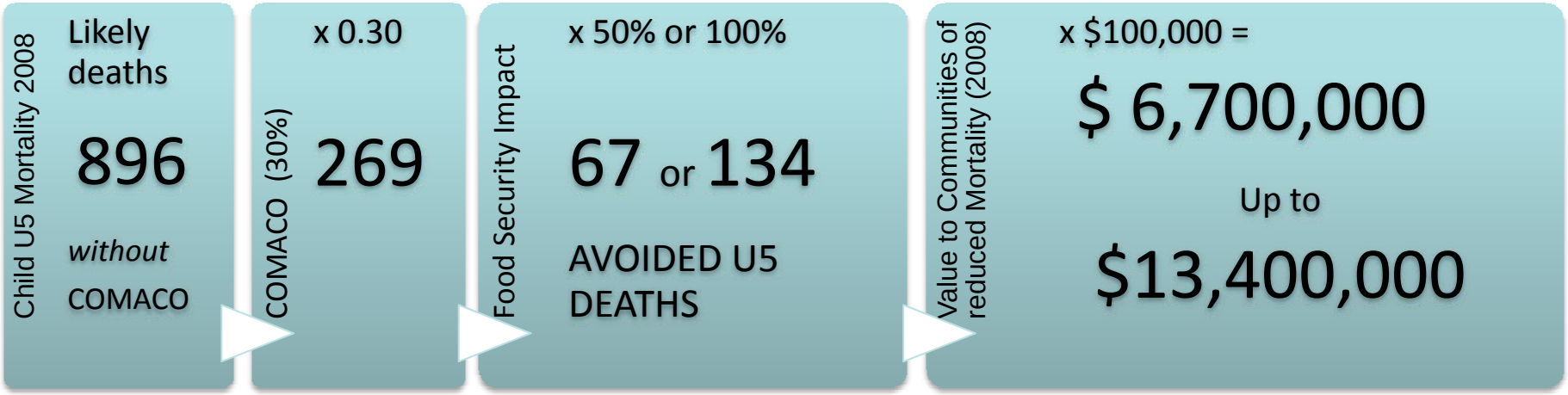
How does COMACO affect this?

(Malnutrition, Child Mortality, and the Value of Statistical Life)

- COMACO members ~30% of the population accessing these health centers, and targets those most food insecure.
- Consider a range of impact levels: proportion of members (and their families) who attain a state of food security either partial (50%) or complete (100%) and assume food security results in proper nutrition

⇒ Based on the these assumptions – the number of U5 deaths would have been 134 to 269 *greater* without COMACO (2008)

- The approximate Value of a Statistical Life in rural Africa is $100,000

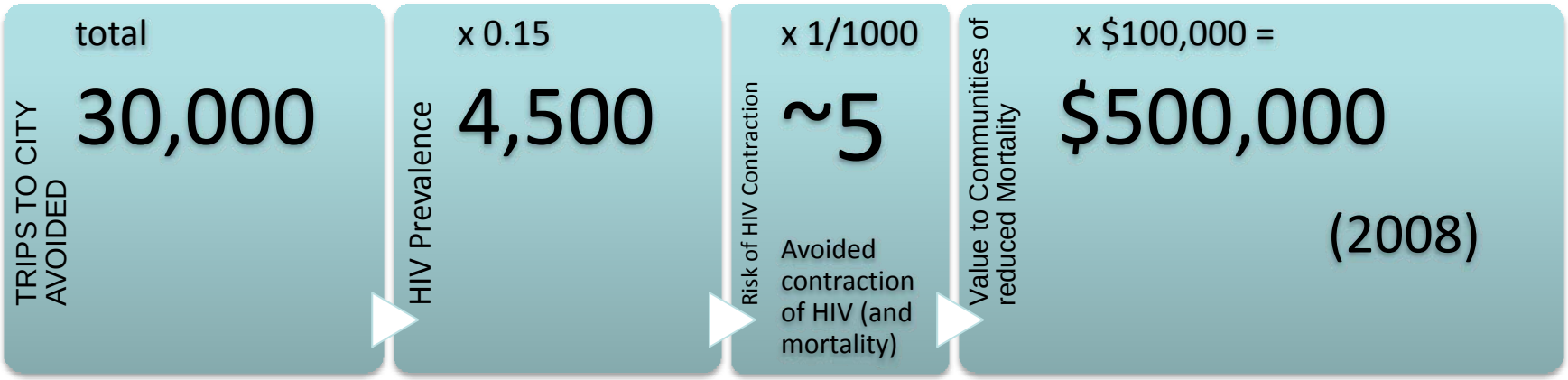


- Value from 2004 – 2008 is between $39,000,000, $78,000,000

(Assuming COMACO coverage expands linearly from 10% in 2004 to 30% in 2008)

Possible Effect of COMACO on HIV

- COMACO farmers need to visit town/city centers less frequently as products are bought and sold locally at depots and CTC's
- Assume one trip to the city avoided for each household, and one sexual encounter per trip (some many, some none) ~30,000 households
- Average risk of contracting HIV from female to male is 1/1000 per encounter (Royce, 1997), while the HIV prevalence in Zambia is around 15%, while 65.4% in sex workers in Lusaka 2004 (UNAIDS 2008)
- The direct effect of COMACO may be around 5 fewer HIV cases per year
- The indirect effect from transmission of infected husbands to wives is 1/500 per encounter or near certainty after 5 years - indirect effects may be much higher.



Value from 2004 – 2008 is over $1,100,000

(Assuming COMACO coverage expands linearly from 10,000 in 2004 to 30,000 in 2008)

Poacher Transformation Program (PTP)

- Overall economic benefits of the PTP exceed costs by $10,135 to $16,178 per poacher - to ZAWA, Zambian Government, Communities, Safari Operators etc (Saudubray, 2007)
- There are a total of 661 transformed poachers since the program began
- Total economic gains from PTP of between $6,700,000 and $10,700,000 for the years 2001-2008 combined
- Potential lives saved not accounted for in Saudubray's analysis Poachers (and fishermen) are at significant risk of being killed by wild animals – hippopotamus, crocodile, elephant. 56 people were killed by wild animals in GMA's across Zambia in 2005

CONSERVATION FARMING
Impact on Poaching

- Food insecurity is a significant driver of poaching, as households turn to game meat when maize supplies are exhausted
- Conservation farming and alternative livelihoods lead to improved food security and higher income
- Evidence suggests incidence of poaching is going down, wildlife populations are generally stable or have increased in some cases
- Benefits to local and international communities accrue through tourism, and non-use values
- Possible costs include an increase in human/wildlife conflict

South Luangwa National Park Visitors Survey (SLNP)

- Investigate the impact of increased wildlife populations on tourists' willingness to pay higher entrance fees in the SLNP
- Stated choice contingent valuation experiment using an attribute-based model
- Respondents are offered three options with varying levels of these attributes
- Wildlife levels are indexed with the current population taken as 100

Attribute	Possible Levels
Daily Park Entrance Fee (USD for foreign citizens)	**$25, $35, $45, $60**
Small to Medium Animals (current pop. indexed at 100)	**100, 140, 180**
Large Mammals (current pop. indexed at 100)	**100, 130, 160**
Prominent Species (current pop. indexed at 100)	**100, 130, 160**
Rhinoceros Program (breeding pairs)	**0, 10**

			OPTIONS:		
		CONDITION NOW	OPTION A *no new initiatives*	OPTION B	OPTION C
ATTRIBUTES	Example				
HOW MUCH EACH PERSON IN MY HOUSEHOLD PAYS:	Daily Park Fee Per Person (USD)	$25	**$25**	**$60**	**$45**
SMALL TO MEDIUM ANIMALS:	Duiker, Gennet, Hyrax, Steinbok Porcupine, Puku Jackal, Impala, Grysbok etc (indexed at 100)	100	**100**	**140**	**180**
LARGE MAMMALS:	Greater Kudu, Eland, Roan Antelope Hartebeest etc (indexed at 100)	100	**100**	**100**	**130**
PROMINENT SPECIES:	Elephant, Lion Buffalo, Giraffe, Leopard, Zebra, Hippopotamus, (indexed at 100)	100	**100**	**100**	**160**
RHINOCEROS:	Rhinoceros Repopulation (breeding pairs)	0	**0**	**0**	**10**
		MY CHOICE: √ *check **one** only*	☐	☐	☐

Use-Value of wildlife to South Luangwa National Park visitors

Attribute	WTP Range (Entrance fee *increase* from the current USD 25 per day per person)
Small to Medium Animals (per 10% increase in population)	**$0.50-0.90**
Large Mammals (per 10% increase in population)	**$1.60 - 2.00**
Prominent Species (per 10% increase in population)	**$2.10 - 2.80**
Rhinoceros Re-population (10 breeding pair program)	**$1.30 - 5.50**

- Willingness to Pay (WTP) values for change in a single attribute
- WTP increase linearly with population increase
- Highly Statistically Significant Results
- An increase of 10% in large mammal populations alone represents a potential $50,000 value to tourists each year
- An increases of 10% in all wildlife groups represent a value of around $142,000/year
- Non-use values are in addition to this, and likely to be much larger

CONSERVATION FARMING
Impact on Natural Resources

- Potential benefits are wide ranging, but include:
- Sustainable use of agricultural plots
  - Reduced deforestation as soil fertility of current plots protected
    - Habitat protected, wildlife benefits
  - Carbon sequestration and contribution to climate change mitigation
  - Reduced flooding and erosion
  - Reduced siltation of rivers
- Costs may include:
  - Additional labor inputs, but this is spread across the dry season when opportunity costs are low
  - The alternative to CF is continued degradation of soils and further deforestation, so the labor costs of land clearing and travel costs of distant plots will tend to offset the above

Potential Impact on Carbon Stocks and Sequestration

- 40-60 tons/ha soil lost due to farming on hilly areas (COMACO 2007)
- 200-300,000 Ha forest lost to agriculture annually (FAO 2001), highest deforestation rate of SADC nations -2.4% per annum
- 21.6% loss of woodland on the Plateau and 9.4% loss in the valley from 1989-2002 (canopy analysis)
- Miombo forest soils in Malawi lose 37 tons carbon in the top 1.5m after conversion to agriculture – around 40% reduction (Walker 2004)
- COMACO activities cover wide range of AFOLU carbon sequestration strategies (Conservation Farming/soils, Agroforestry, REDD)
- Benefits could be large even at $5/ton carbon, and fungible with the advent of voluntary carbon markets. Carbon markets represent a significant opportunity for COMACO to enhance premium prices for improved practices and provide short term incentives to overcome the lag time of benefits from agroforestry – but technical assistance required to access markets

Comments/discussion

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Alice Pell
William Schulze

International Rural Poultry Centre

Robyn Alders
Brigitte Bagnol

Wildlife Conservation Society

Dale Lewis
Steve Osofsky
David Moyer*

Virginia Tech University

Conrad Heatwole
Keith Moore
Theo Dillaha

Tropical Soil Biology & Fertility

Robert Delve