LP rescues the White Rhino

Bill Tromans
Haverly Systems Europe
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An investigation into the financial feasibility of intensive commercial white rhino farming in South Africa

A Strategic Approach

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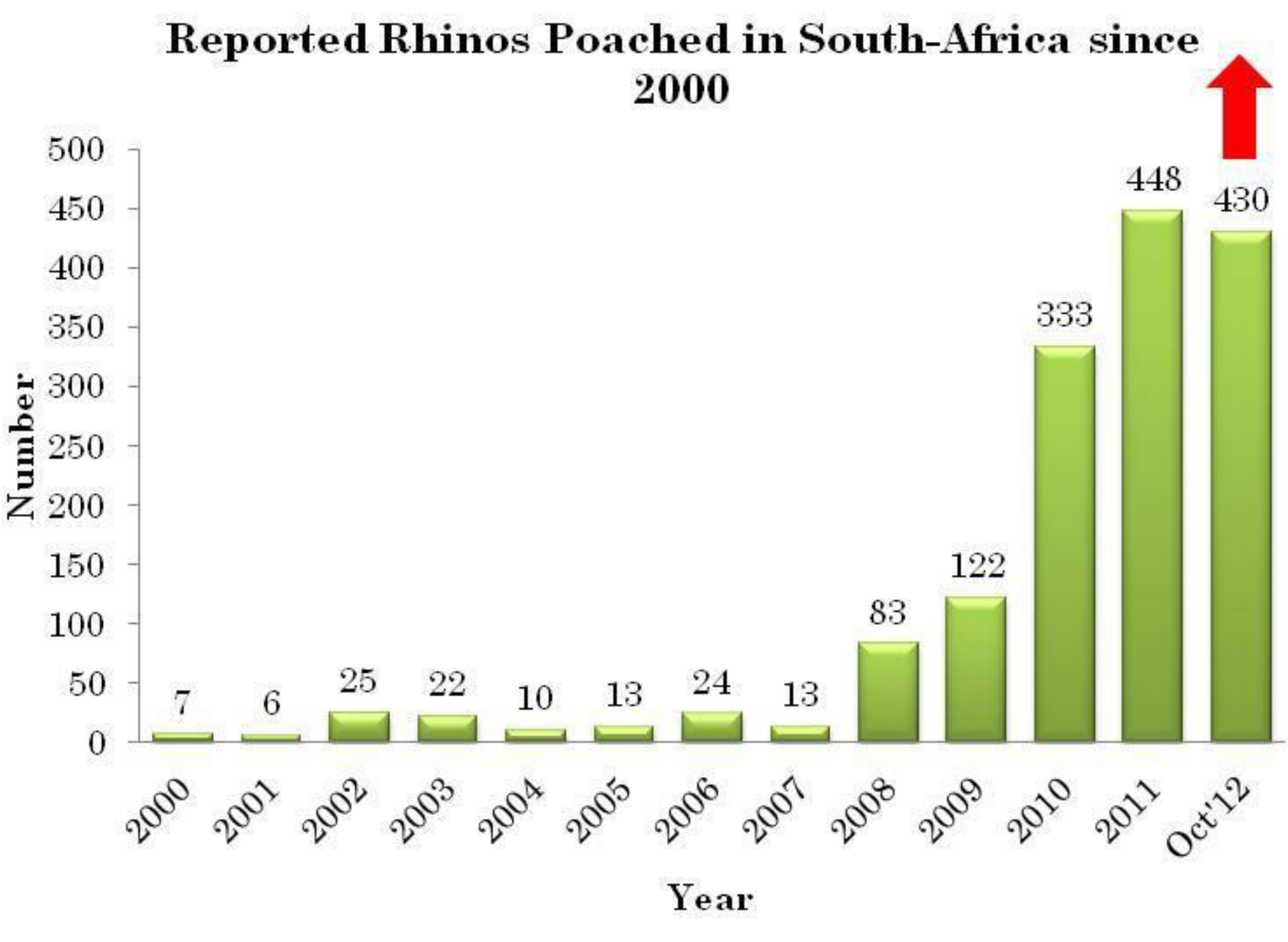
The Problem

- White Rhino are hunted and poached for their horn, which commands a high value on the black market
- Restricted supply of horn leads to illegal trading becoming more profitable
- The ban on the trade of rhino horn no longer makes economic or conservation sense, since rhino horn is a renewable resource, which can be harvested without harming the rhino
- South Africa conserves 93% of the white rhino population
- South Africa is home to more than 90% of the world's 20,000 white rhino. Yet, poaching in South Africa has, on average, more than doubled each year over the past 5 years


Reported Rhinos Poached in South-Africa since 2000
Number
500
450
400
350
300
250
200
150
100
50
0
7
6
25
22
10
13
24
13
83
122
333
448
430
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Oct'12
Year

BBC report 1 March 2013

- A group of environmental researchers says that legalising the trade in rhinoceros horn is necessary to save the animals.
- Writing in Science journal, they argue that a global ban has failed to stem an "insatiable international demand".
- The authors say the market could be met by humanely shaving the horns of live rhinos.
- At present in South Africa, poachers are on average killing around two rhinos every day.
- According to the lead author of the research Dr Duan Biggs from the University of Queensland, poaching is now out of control: "The current situation is failing, the longer we wait to put in place a legal trade the more rhinos we lose. It is an urgent issue, we must start the process of getting a legal trade evaluated and put in place soon."

BBC report 1 March 2013 – Part 2

- At present it is estimated that there are around 20,000 white rhinos left with the majority in South Africa and Namibia. There are also an estimated 5,000 black rhinos still alive, but the western black rhino was declared extinct in 2011.
- Any trade in rhino horn is prohibited under the Convention on the International Trade in Endangered Species (CITES). Delegates from 178 countries will meet in Bangkok next week to update the 40 year old treaty.
- But according to the Science paper, the ban is actually boosting illegal poaching by constricting the supply of rhino horn and driving up the price. In 1993 a kilogramme sold for around $4,700 - In 2012 it was selling for $65,000 for the equivalent weight.
- Attempts to restrict the trade by persuading consumers of Chinese medicine that rhino horn has no therapeutic effect have also failed.

Prince William, CITES, 4 Mar 2013

“As we enter 2013, the world's natural resources are under threat as never before. We know from the data and analysis presented to this meeting that the illegal killing of the African elephant and rhino, and the related illegal trade in their ivory and horn, has reached shocking levels in the past few years.”

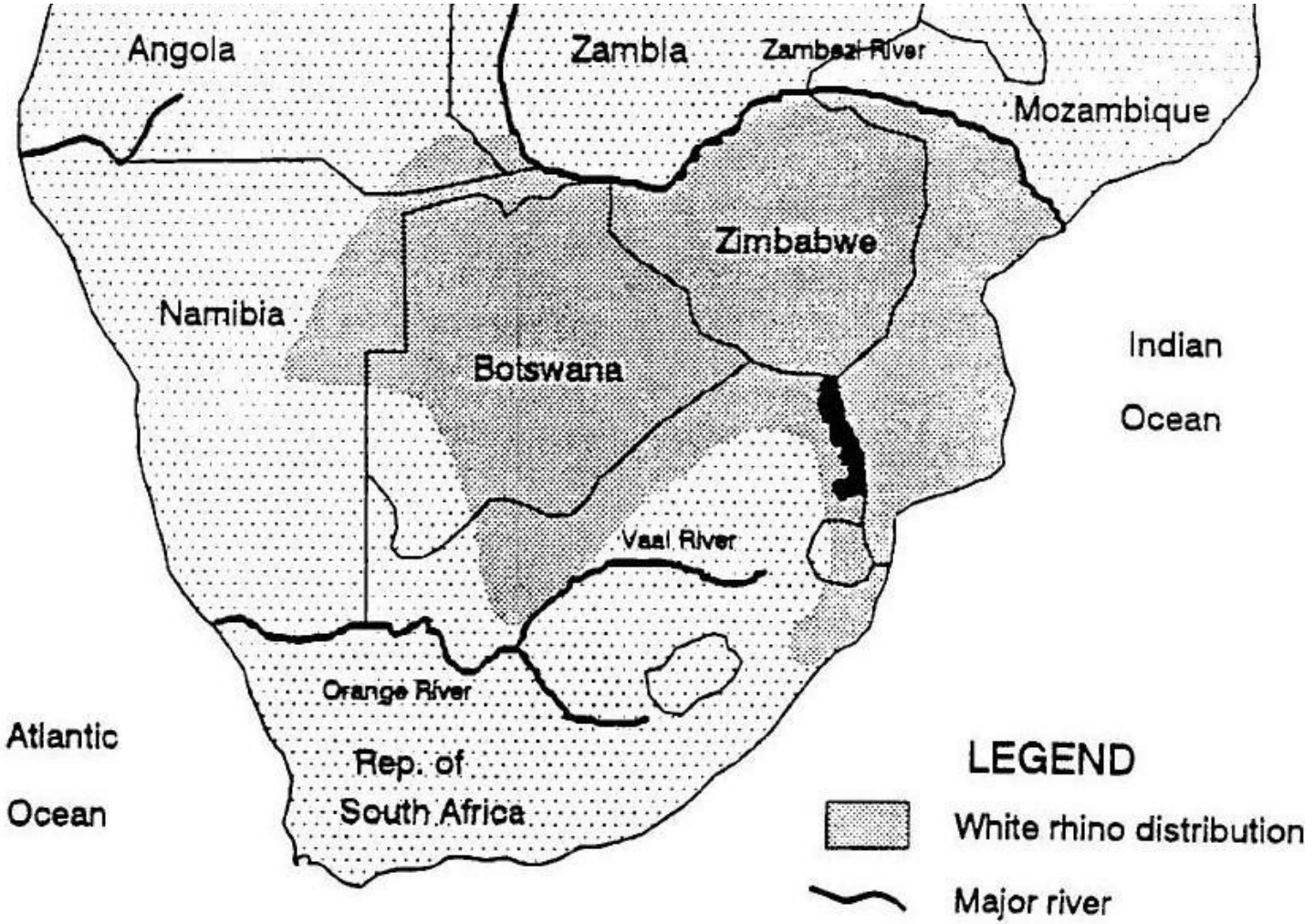
“We must do more to combat this serious crime if we are to reverse the current alarming trends. If not, we could soon see some populations of these creatures, or even an entire species, disappear from the wild. We simply must not let this catastrophe unfold. Our children should have the same opportunity that we have to experience wildlife in its many beautiful and varied forms.”

CITES Conference, Bangkok, March 2013

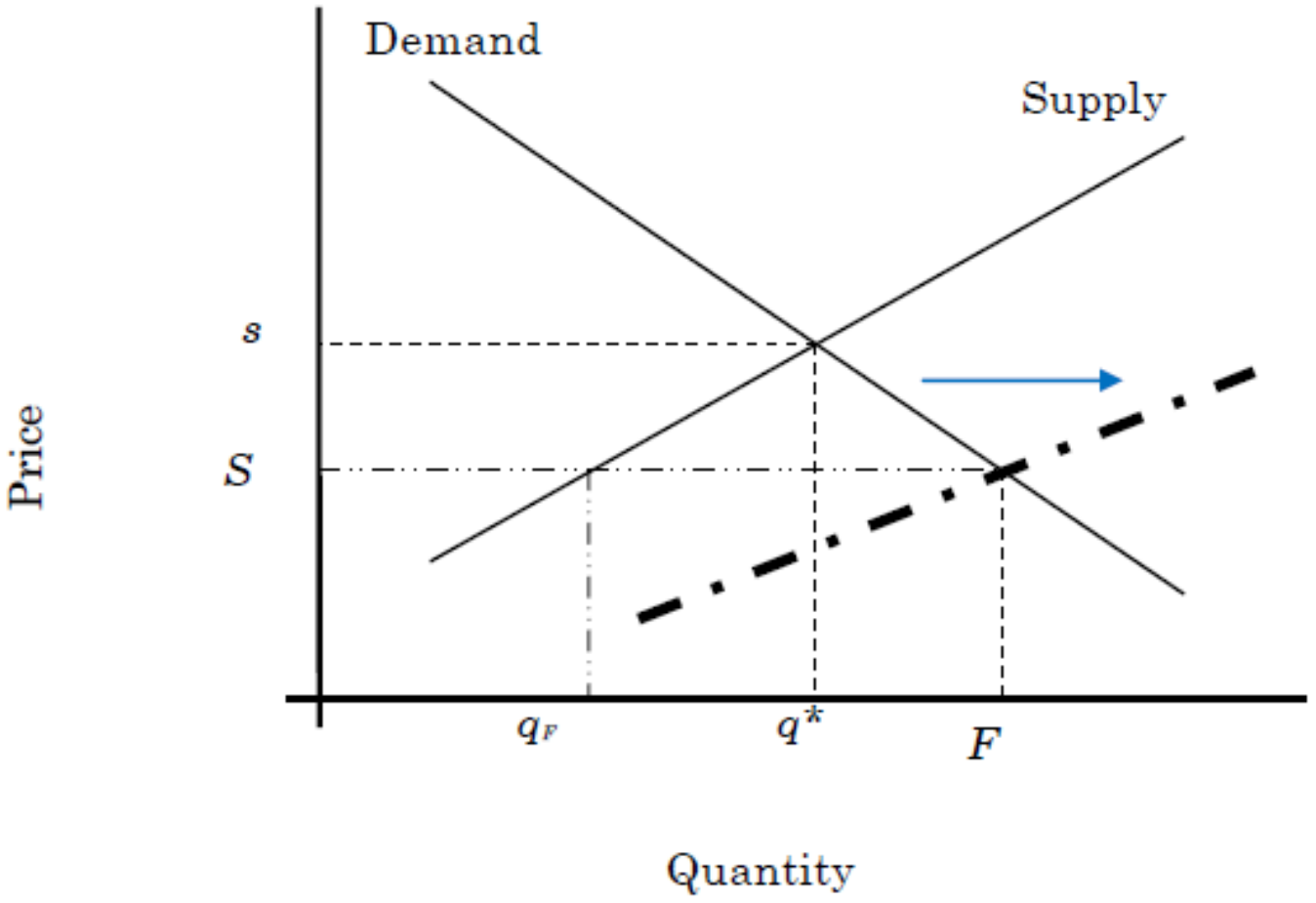
- Fundisile Mketeni from South Africa's environment ministry said that 146 rhino had been killed so far this year, with 107 of them in Kruger National Park.
- The South African delegate explained that while his country had not yet made a decision about calling for a lifting of the ban on selling rhino horns, the nation believed it was time for the dialogue to begin.
- According to the charity Care for the Wild: "The danger is that legalising horn will feed the growth of the market rather than reduce the demand on poaching."

Dehorning a Rhino

Distribution of White Rhino in Southern Africa



Supply/Demand curve for Wildlife Commodities



Commercial Rhino Farming

- Several rhino are kept in a large enclosure, as part of a captive breeding operation
- They are supplementary fed every day
- If the harvesting of rhino horn is legalised then commercial farming may make economic sense
- The study was to formulate a strategic production plan that investigates the financial viability of intensive commercial white rhino farming in South Africa

Cost Factors

- Agricultural land cost
- Infrastructure cost – fencing the enclosure
- Current white rhino trade data
- Insurance cost
- Horn harvesting cost
- Veterinary services cost
- Habitat requirements cost
- Labour cost
- Inflation

Biological Characteristics

- Life expectancy of the animal
- Intensive area required for breeding
- Number of bulls needed to stimulate breeding
- Number of cows per bull recommended for wildlife production
- Fruitful breeding years for a rhino cow
- Age of cow at birth of first calf
- Gestation period
- Weaning age of calf
- Mean time between successive calves
- Habitat requirements
- Labourers per rhino
- Horn growth and re-growth rate

LP Formulation

- Consider a 400Ha enclosure, which can support up to 20 white rhino
- Called Dynamic Recursive LP model
- Means a multi-time period model, of 10 periods (years)
- The closing population of one year forms the starting population of the following year
- Simple model, using the breeding assumptions made
- Matrix has 242 rows, 243 columns
- Solution shows how many rhino bulls and cows to buy and sell each year, and how much horn is harvested

HSSLP Spreadsheet Interface

- Developed 15 years ago by a client in South Africa, as an interface to HS/LP
- VBA macro code to run HS/LP and display simple forms for user to choose options
- Matrix (MPS format) can be imported, or exported
- Matrix is displayed in the spreadsheet
- Options available on the optimisation
- Solution also displayed in the spreadsheet

HSSLP showing part of this model

HAVERLY SYSTEMS INC.
SPREADSHEET LP (H/SSLP) Version 3
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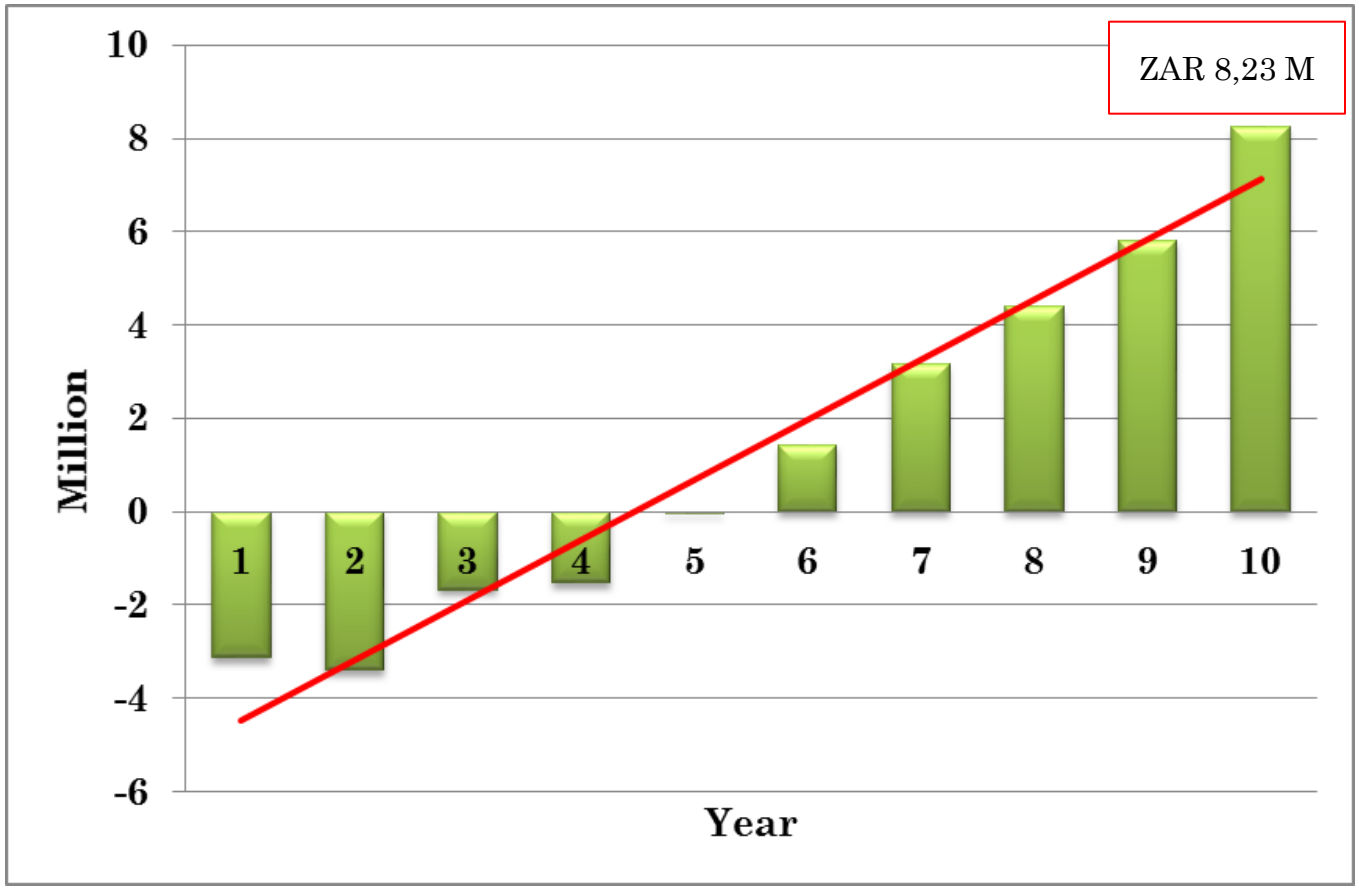
Options | OPTIMAL

Row Name	Sign	RHS	Activity	Slack	PI	BegW11	BegW12	BegCW11	BegCW12	BuyCW11	BuyCW12	BuyW21	BuyW22	EndWM2	EndWV2	EndTOT2	TOTKg2	TkgBW21	TkgBW22	TOTC2	TOTW22	TOTW21	SW21	SW22
Column Name						BegW11	BegW12	BegCW11	BegCW12	BuyCW11	BuyCW12	BuyW21	BuyW22	EndWM2	EndWV2	EndTOT2	TOTKg2	TkgBW21	TkgBW22	TOTC2	TOTW22	TOTW21	SW21	SW22
Upper Bound						2										20				10				
Lower Bound						2																		
Activity																								
DJ																								
Profit						-319690	-319690					-199794	-199794				210000						185808	185808
TOTSW2	<=																						1	1
BALWM2	=					1		0.9		0.9		1		-1									-1	
BALWV2	=						1		0.9		0.9		1		-1									-1
BALWT2	=					1	1	0.9	0.9	0.9	0.9	1	1			-1								
BegCW11	=						1	-4																
BegCW12	=						1		-4															
BuyCW21	=									-4			1											
BuyCW22	=										-4		1											
TOTC2	=							0.9	0.9	0.9	0.9									-1				
BWVtWM2	=					-4	1																	
AWWtWM2	=											-4	1											
lEndWM2	>=					-1																1		
lEndWV2	>=						-1														1			
TOTKg2	=																-1	0.4	0.24					
TkgBW21	=					1						1						-1						
TkgBW22	=						1						1						-1					
SW21	=													-0.6									1	
SW22	=														-0.6									1
Ha2	=					20	20	20	20	20	20	20	20										-20	-20
Feed21	=													1										
Feed22	=														1									
Labour2	=													1	1									
Insur2	=													1	1									
Dehorn2	=					1	1					1	1											
Vet2	=													1	1									

HSSLP – Model and Solution (part)

HAVERLY SYSTEMS INC. SPREADSHEET LP (H/SSLP) Version 3 Copyright @ 1997 - 2013					Column Name	BegW11	BegW12	BegCW11	BegCW12	BuyCW11	BuyCW12	BuyW21	BuyW22	EndWM2	EndWV2	EndTOT2	TOTKg2	TkgBW21	TkgBW22	TOTC2	TOTW22	TOTW21	SW21	SW22
					Upper Bound	2										20				10				
					Lower Bound	2																		
Options			OPTIMAL		Activity	2.00	8.00	2.00	2.00	2.49	2.49	2.49	9.98	5.34	13.76	19.10	6.11	4.49	17.98	8.09	8.00	2.00	3.20	8.26
					DJ	-599480																		
Row Name	Sign	RHS	Activity	Slack	PI																			
Profit			8237736.899	-823773.59	1	-319690	-319690					-199794	-199794				210000						185808	185808
TOTSW2	<=																						1	1
BALWM2	=				158686.7	1		0.9		0.9		1		-1									-1	
BALWV2	=				193744.8		1		0.9		0.9		1		-1									-1
BALWT2	=					1	1	0.9	0.9	0.9	0.9	1	1			-1								
BegCW11	=				17008.64		1	-4																
BegCW12	=				24896.71		1		-4															
BuyCW21	=				17008.64					-4			1											
BuyCW22	=				24896.71						-4		1											
TOTC2	=							0.9	0.9	0.9	0.9									-1				
BWVtWM2	=				111223.3	-4	1																	
AWWtWM2	=				-8672.69							-4	1											
lEndWM2	>=					-1																1		
lEndWV2	>=						-1														1			
TOTKg2	=				210000												-1	0.4	0.24					
TkgBW21	=				84000	1						1						-1						
TkgBW22	=				50400		1						1						-1					
SW21	=				-101905									-0.6									1	
SW22	=				-66847.1										-0.6									1
Ha2	=				-3739.18	20	20	20	20	20	20	20	20										-20	-20
Feed21	=				-50370									1										
Feed22	=				-35040										1									
Labour2	=				-9900									1	1									
Insur2	=				-9070									1	1									
Dehorn2	=				-2800	1	1					1	1											
Vet2	=				-300									1	1									

Potential NPV before Inflation



Conclusions

- The project analysed a single 400Ha enclosure with a maximum capacity of 20 white rhino
- Commercial rhino farming is economically feasible over a 10 year period
- Compared to a capital investment option, the farming option gave a higher net present value
- This is all dependent on legislation of the white rhino horn trade
- The model signifies the definite probability of farming the white rhino successfully and possibly halting the poaching of this beautiful creature