Magombera Wildlife Corridor and Development Plan

Kilosa Disrict, Magombera Region, Tanzania

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Background and Introduction of Issues

Background

Situated in the South Central portion of the East African country of Tanzania, our area of focus is located in the Kilombero Valley and bordered by the Eastern Arc Mountains to the west. Udzungwa Mountains National Park represents the southern portion of the Eastern Arc Mountains, famous for its high concentrations of biodiversity and species endemism. The large number of species found solely in the mountains is largely a result of the Eastern Arc's ancient geology and unique, as well as relatively stable, climate. Consequently, the mountain range as a whole presents a prime focus for biodiversity conservation. On the other hand, the Kilombero Valley also offers fertile agricultural soils which have been rapidly capitalized on in recent years for shambas, pastoral purposes, and subsistence and commercial agriculture. As a result, a once viable forest connection between the national park and the remaining Magombera Forest has been almost entirely depleted. The remaining forest patch encompasses merely nine square kilometers, down from 11 in 1979, yet retains a high degree of biodiversity despite its isolation.

Habitat Loss and Endemic Species

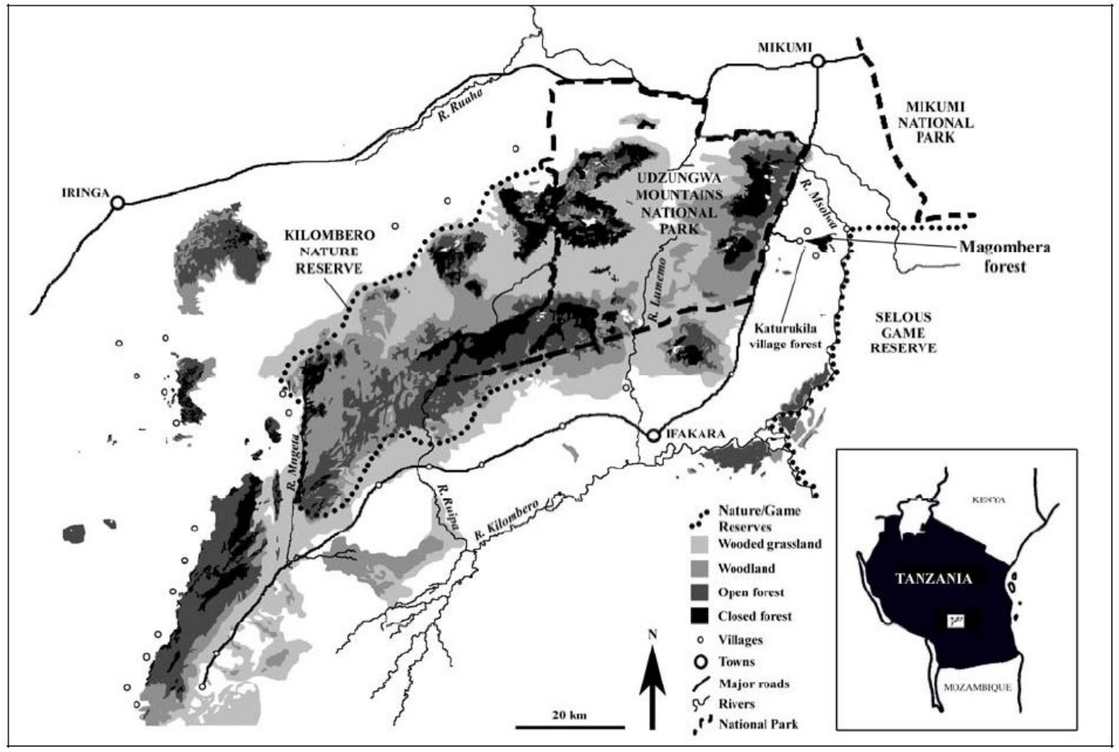
The Magombera Forest Patch has decreased by over five km in the past 30 years, losing its link to the Udzungwa Mountains. Wildlife habitats are diminishing in size, and are no longer able to connect with other portions of their population. This is causing large numbers of endemic species, wildlife that only occurs in a certain area, to the Kilombero Region. If a reconnection to other habitats is not seen, these endemic species will die off due to an increase in competition of resources, and a lack of genetic variation.

Community Need for Resources

There is a great need for community resources, such as fuel woods, medicinal plants, and building materials. Most locals would use the adjacent Udzungwa Mountains National Park, but a law passed in 2011 made it illegal for collection of resources within the park boundary. Incomes are very low in this region, and a solution needs to be found to increase resource collection areas that are accessible to all community members.

Elephant Crop Raiding

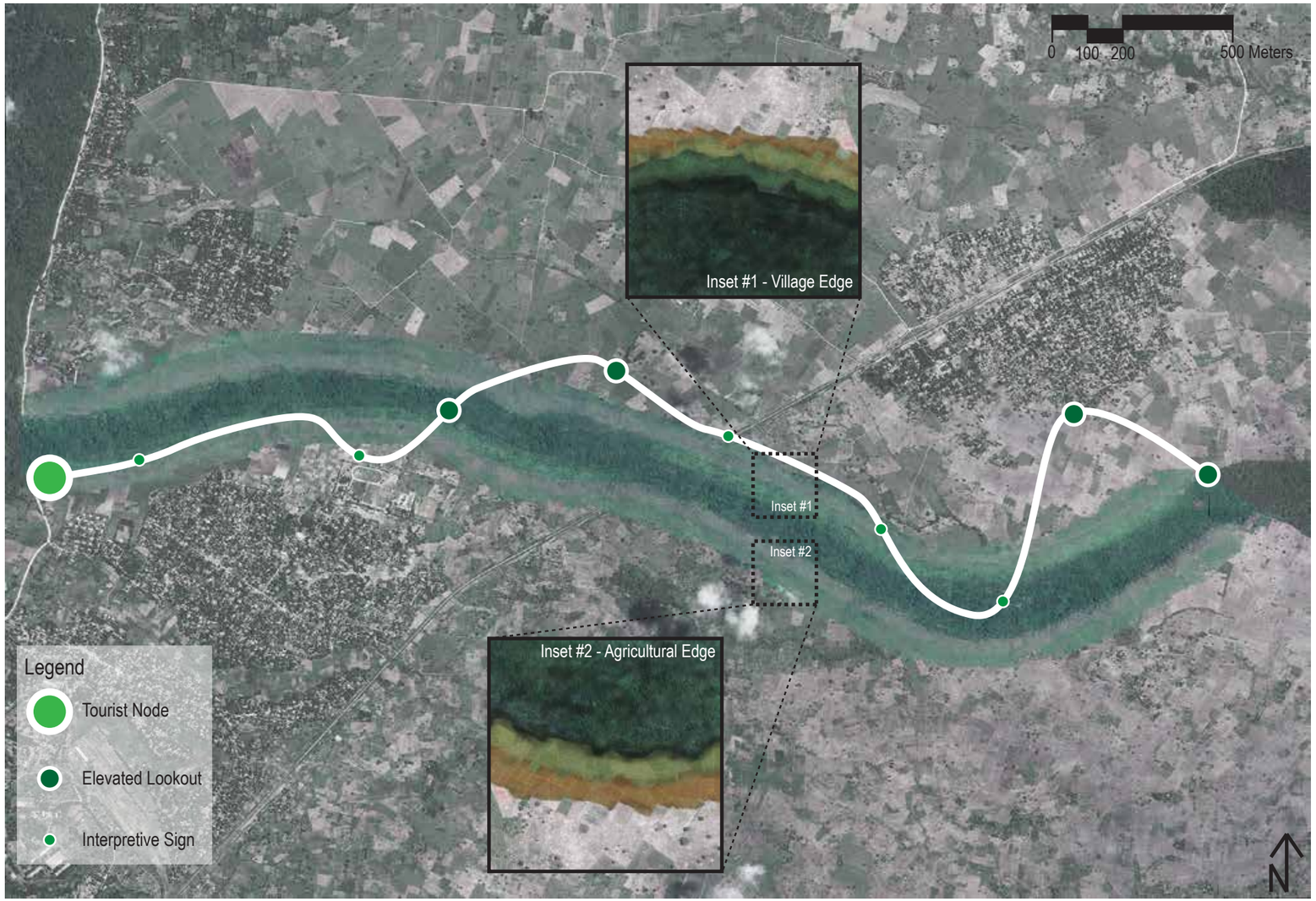
Elephants are a beautiful animal species that can also cause grave harm to the local farmers. On average, over 40% of all crops are lost each year because of elephant crop raiding. However, elephants need to migrate from the Magombera Forest Patch to the Udzungwa Mountains to continue their population, but currently it is all agricultural fields. If they try to cross the Kilombero Valley now, crops will be lost, or elephants could be harmed due to the infuriated farmer that lost their yield.



Context map showing the relationship between UMNP and the Magombera Forest

Decreasing forest from 1979 (left image) to 2004 (right image)

Project Concept and Phasing



Overall Master Plan

Our project will be split into three sequential phases. Phase One will include the implementation of a wildlife corridor to create habitat connection for local endemic fauna and flora, Phase Two will include the design of the interpretive trail to showcase the fluidity of environment and community, and Phase Three will include the construction of tourist nodes for the benefit of the village economy and increased environmental awareness and education. These three phases will also include a management plan for the proper care and maintenance of the design opportunities created by our project.

Phase One: Wildlife Corridor

The Phase One wildlife corridor will be created mainly by expanding pre-existing woodlots of the area to connect Udzungwa Mountains National Park with the Magombera Forest Patch.

Phase Two: Interpretive Trail

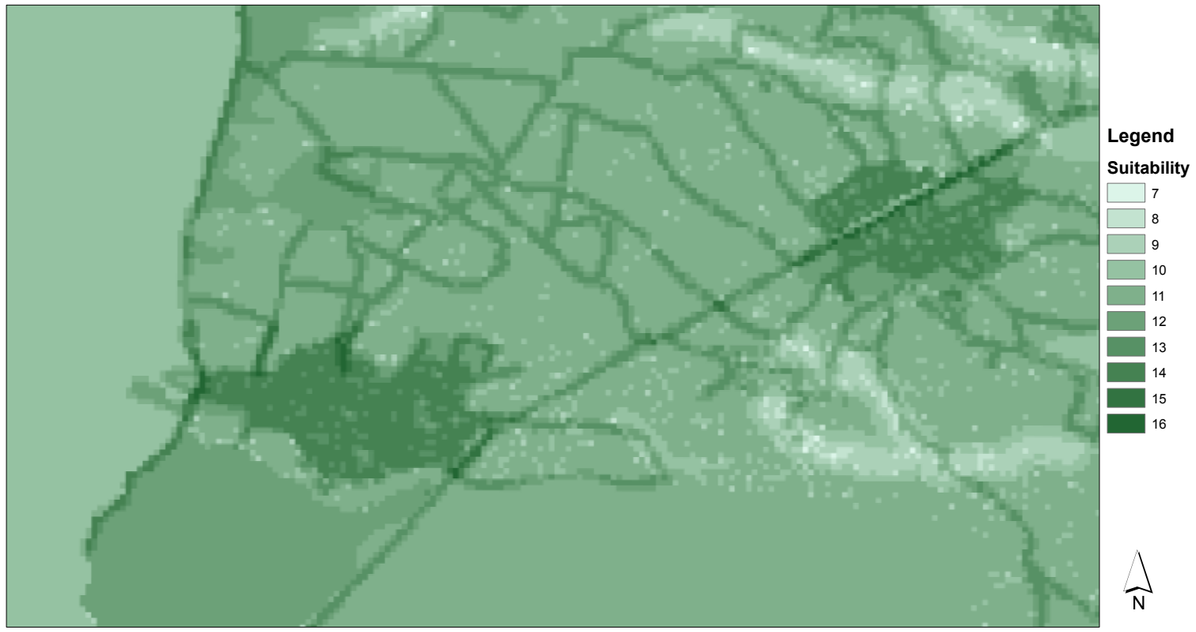
The Phase Two Interpretive Trail will stretch the length of the wildlife corridor and move the visitor through a variety of human and ecological land uses. This experiential path will expand their knowledge of the cultural and natural aspects of the Kilombero Valley.

Phase Three: Tourist Node

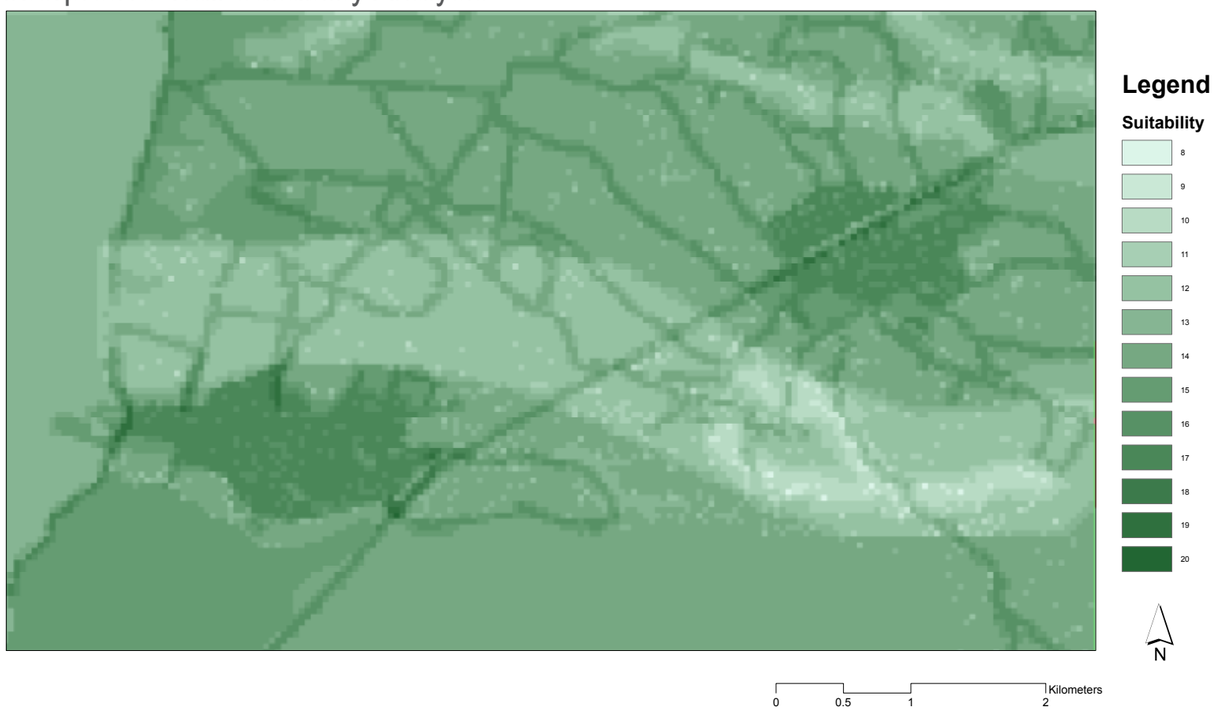
The Phase Three Tourist Node will be located at the trail head of the interpretive path well within easy access of tourists. Construction of a visitor area will boost the local economy and provide sustainable jobs for villagers.

Suitability Analysis

Wildlife Corridor Suitability Analysis



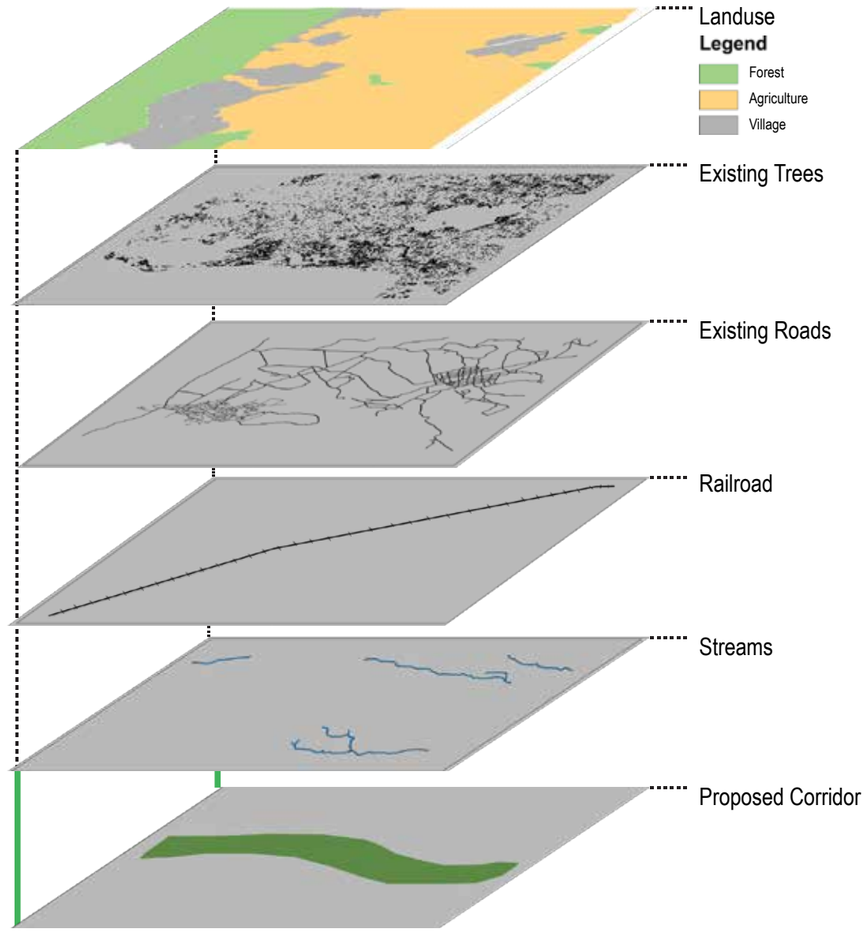
Interpretive Trail Suitability Analysis



Site Inventory

Based on the site elements shown below, two suitability analyses were created to pinpoint the most appropriate locations for the wildlife corridor and interpretive trail. The study showed that the area located between Mang'ula A and Katurukila/Magombera provided the best location for implementation.

Site Inventory Analysis

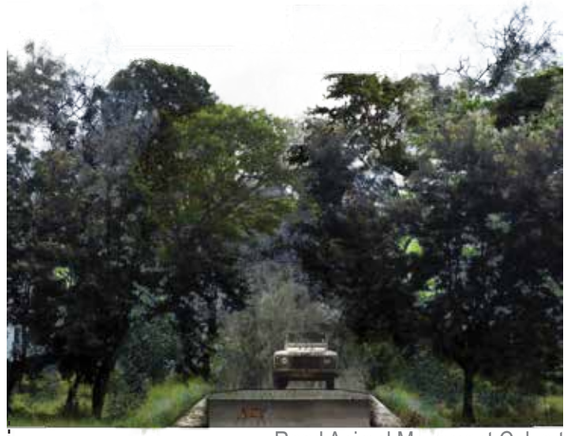


Phase 1: Magombera Wildlife Corridor

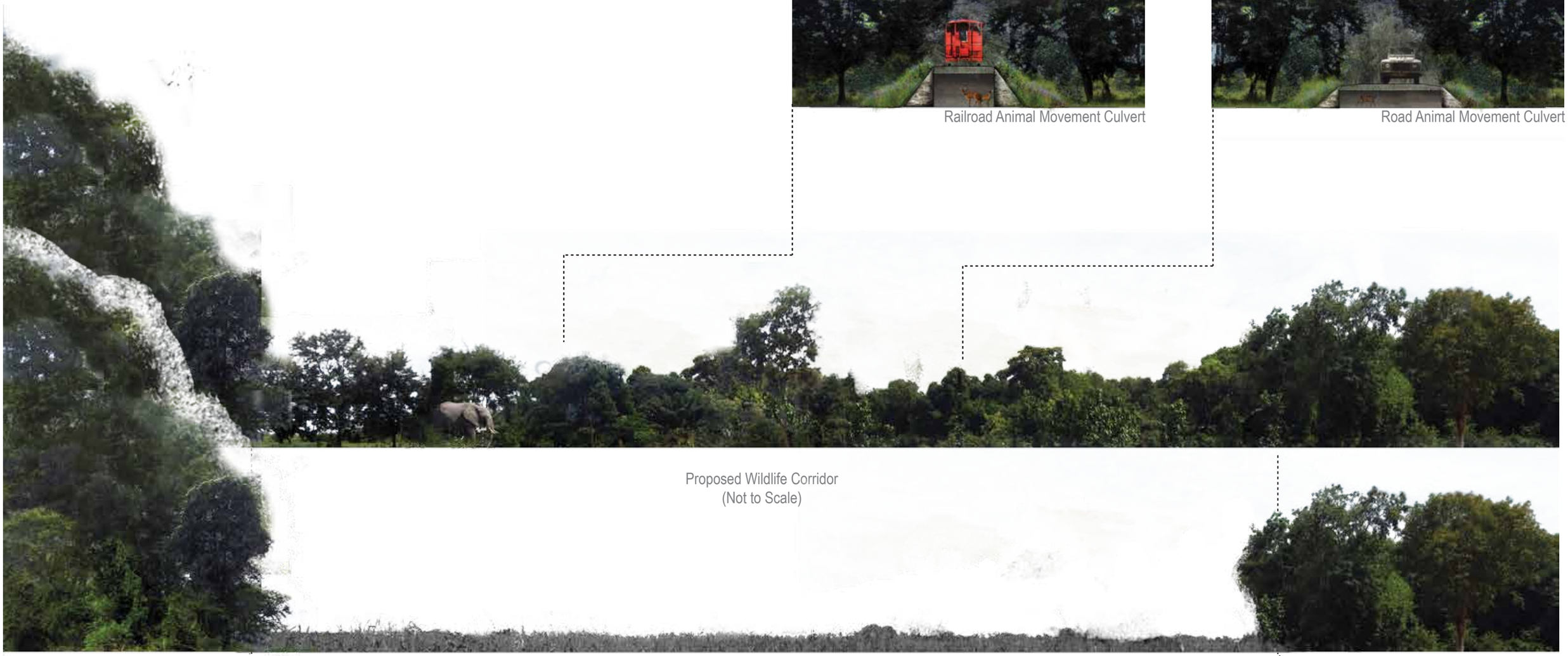
Biodiversity Connection

Today the land between Udzungwa Mountains National Park and the Magombera Forest Patch is mainly used for sugar cane cultivation. This project reimagines that agricultural land as viable wildlife habitat, connecting the two pools of forest biodiversity. The created corridor restablishes an environment that facilitates animal movement while not hindering the existing human circulation network.

Railroad Animal Movement Culvert



Road Animal Movement Culvert



Proposed Wildlife Corridor
(Not to Scale)

Udzungwa Mountains
National Park

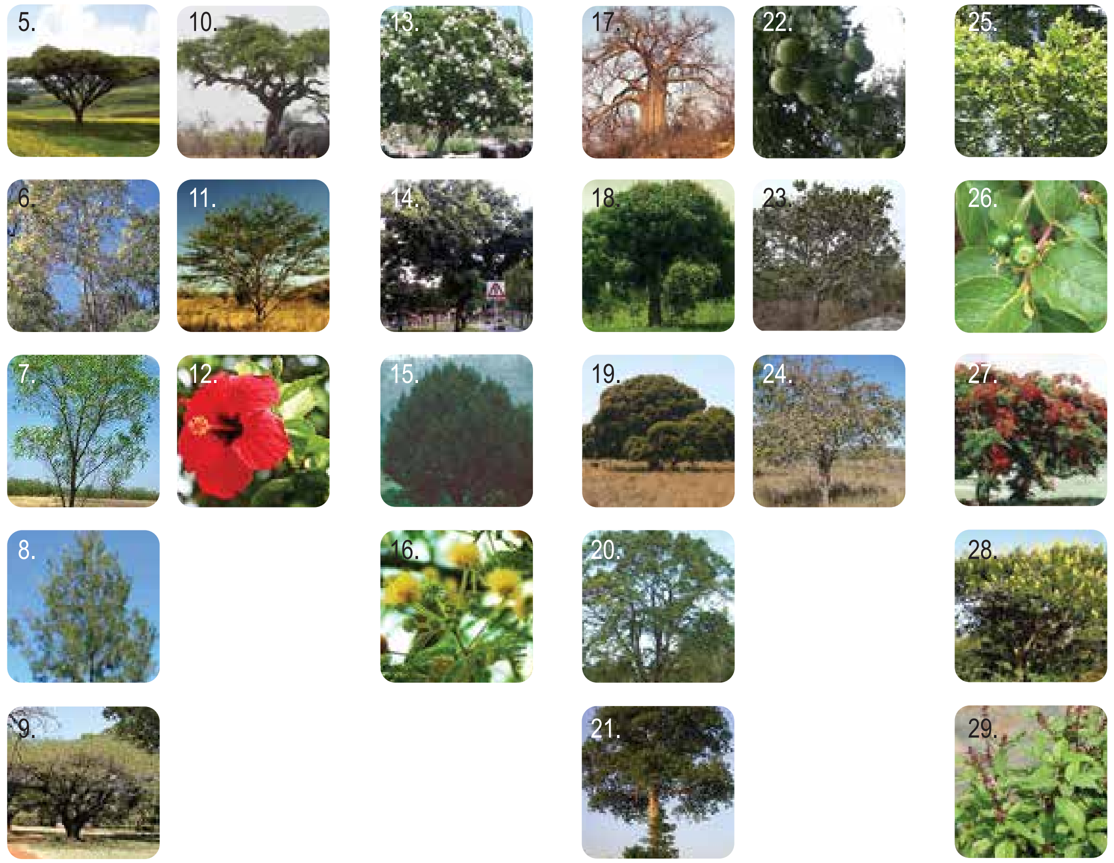
Existing Agricultural Fields
(Not to Scale)

Magombera Forest
Patch

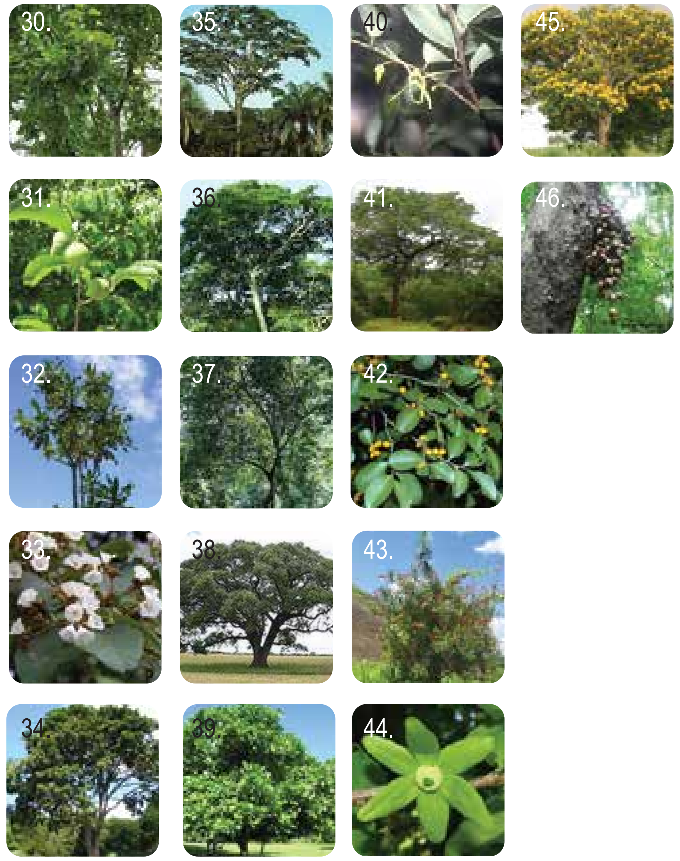
Phase 1: Corridor Land Use Divison

Cash Crops/ Elephant Barrier

Woodlot



Wildlife Habitat



Elephant Barriers

Elephants, while beloved by many, are responsible for more than 40% of crop loss in the Udzungwa area. In order to protect the village fields, crop barriers planted with produce repulsive to elephants line both sides of the wildlife corridor.

Cash Crops/Elephant Barrier

1. *Apus mellifera scutellata* - “African Honey Bee”
2. *Nicotiana tabacum* - “Tobacco”
3. *Capsicum annuum* - “Pilli pilli”
4. *Solanum lycopersicum* - “Tomato”

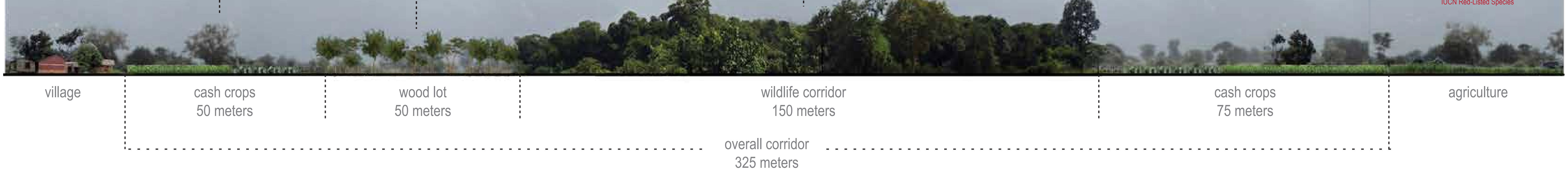
Woodlot

5. *Acacia abyssinica* - ”Njora rahisi”
6. *Acacia crassicarpa* - “Red Wattle”
7. *Acacia leptocarpa*
8. *Casuarina cunninghamiana* - “Mvinje”
9. *Erythrina burtii* - “Mboosi”
10. *Acacia drepanolobium* - “Eluai”
11. *Acacia senegal* - “Kikwata”
12. *Camellia sidensis* - “Mchai”
13. *Calodendrum capense* - “Murarachi”
14. *Erythrophleum suaveolens*
15. *Juniperos procera* - “Mutarakwa”
16. *Albizia amara* - “Mwowa”
17. *Adansonia digitata* - “Mbuyu
18. *Mangiferia indica* - “Mwembe”
19. *Parinari curatellifolia*
20. *Tamarindus indica* - “Mkwaju”
21. *Sterculia appendiculata*
22. *Strychnos occuloides*
23. *Uapaca kirkiana*
24. *Ziziphus mauritania* - “Mkunazi”
25. *Ocotea usambarensis*
26. *Vabgueria infausta*
27. *Abrus precatorius*
28. *Senna petersiana*
29. *Ocimum suave*

Wildlife Habitat

30. *Albizia gummerifera* - “Mcani mbao”
31. *Antiaris toxicaria*
32. *Aoranthe penduliflora*
33. *Cordia peteri* - “Makobokobo”
34. *Khaya anthotheca*
35. *Milicia excelsa*
36. *Parinari excels*
37. *Polyathia verdcourtii*
38. *Pterpcarapus mildebraedii*
39. *Tabernaemontana pachysiphon* - “Mwerere”
40. *Xylopia longipetala*
41. *Brachystegia spiciformis*
42. *Diospyros var.*
43. *Dracaena manni*
44. *Lettowianthus stellatus*
45. *Markhamia lutea*
46. *Sorindeia madagascariensis*

IUCN Red-Listed Species



Animal Habitat

The wildlife corridor itself will be at minimum 150 meters to provide adequate habitat functions for our focal species. The plant palette of the corridor will be primarily rare native trees chosen to provide the endemic animals with adequate shelter and food sources, with a variety of canopy and understory trees to provide a range of habitats.

Number	Name (Swahili)	Name (English)	*Scientific Name*
1	Ng'uluva	Udzungwa red colobus	*Procolobus gordonorum*
2	Mbega	Angola black and white colobus	*Colobus angolensis palliatus*
3	Nduumbili	Sykes's monkey	*Cercopithecus mitis*
4	Kirogoto misitu	Fischer's Greenbul	*Phyllastrephus fischeri*
5	Kwale wa Udzungwa	Udzungwa Partridge	*xenoperdix udzungwensis*
6	Tai-miraba kusi	Southern banded snake eagle	*Circaetus fasciolatus*
7	Tai kumbakima	African crowned eagle	*Stephanoaetus coronatus*
8	Bundi	Pel's fishing owl	*Scotopelia peli*
9	Chozi-macheo	Uluguru violet-backed sunbird	*Anthreptes neglectus*
10	chozi bawa-jekundu	Rufous Winged Songbird	*Nectarinia rufipennis*
11	Vipepeo	Butterfly	*Rhopalacera*
12	Chura miti	Ornate tree frog	*Leptopelis flavomaculatus*
13	Chura bwawa	Painted Reed Frog	*Hyperolius viridoflavus reesei*
14	Kinyonga ya Magombera	Magombera chameleon	*Kinyongia magomberae*
15	Kurumbiza	Red-capped robin-chat	*Cossypha natalensis*
16	Kihindi	Tanganyika mountain squirrel	*Paraxerus lucifer*
17	Duma	Leopard	*Panthera pardus*
18	Ndebo	African elephant	*Loxodonta africana*
19	Mbawala	Bushbuck	*Tragelaphus scriptus*
20	Mbogo	Cape buffalo	*Syncerus caffer*
21	Funo	Harvey's red duiker	*Cephalophus harveyi*
22	Dudu mavi	dung beetle	*Scarabaeoidea*
23	Kisaangi	Chequered elephant shrew	*Rhynchocyon cirnei*
24	Djongoo	red-legged millipede	*Ephibolus pulchripes*

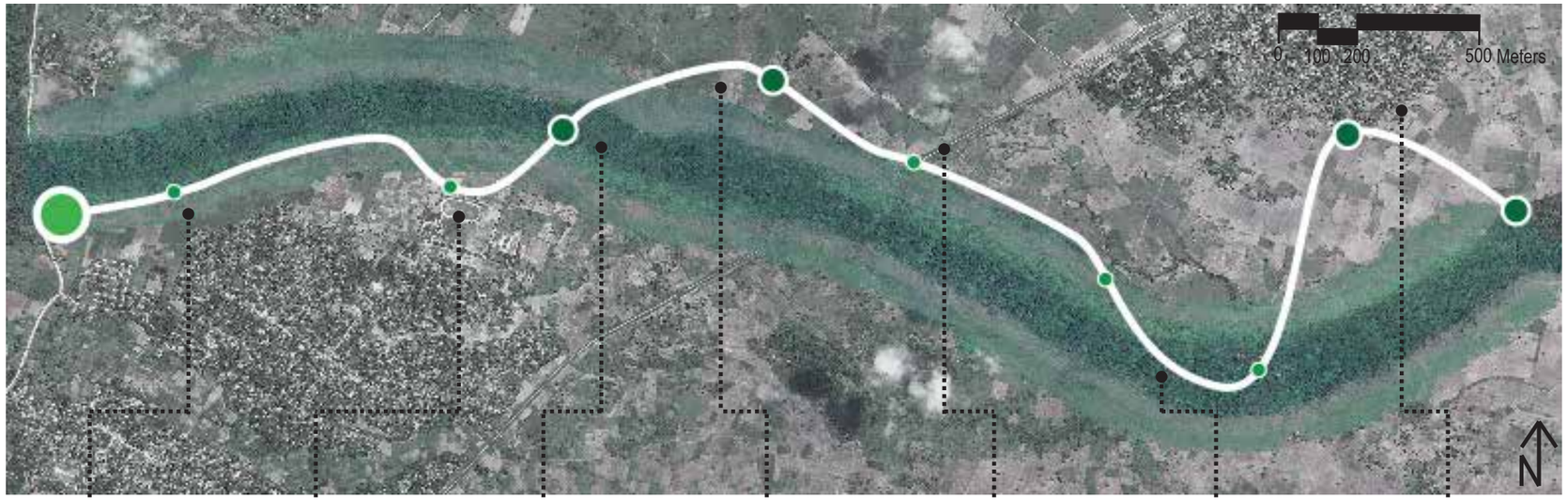
Canopy Cover

The animal species that constitute the main focus of this corridor are more attracted to dense interior forests than sparse edge forest; therefore trees will be planted with the eventual aim of creating a 90-100% canopy cover.

Phase 2: Interpretive Trail

Local Knowledge

The interpretive trail highlights different cultural and environmental locations important to life in the Kilombero Valley Region while respecting the community boundaries. By tying together both human and natural features, the trail will strengthen the bond between villager, visitor and wildlife.



Interpretive Signage

Signs placed along the trail at key points of interest will provide the user with educational information.

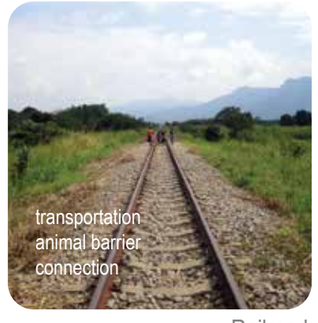
Football Field

Agricultural Fields

Wetlands

Woodlot

Forest



Railroad

Market

Phase 2: Interpretive Trail Experiences

Elevated Canopy Lookout

In areas of dense vegetation within the wildlife corridor, tree-encircling platforms will be raised seven meters above the forest floor. These elevated lookouts will showcase the high canopy, similar to a canopy walk. Users will be able to view the forest from above and rest on wooden benches while enjoying the monkeys and songbirds that constitute two of the corridor's main foci.

Agricultural Fields

Leaving the shade of the forest corridor, the user will emerge into the sugarcane fields and rice paddies that provide the backbone for the village economy. Visitors will experience a range of enclosures along the winding trail, from towering grasses to seemingly endless rows of low produce. The trail's gravel will differentiate it from the many village paths that criss-cross the fields.

Forest Floor

Walking along the forest floor will provide users with a sense of the scale of the tropical rainforest ecosystem and the biodiversity of the Udzungwa/Magombera forest, without the steep uphill climbs of the national park. Colorful signs will highlight the way to keep those unfamiliar with the area oriented and on-track while they make their way through the thick understory.

Wetland Boardwalk

A boardwalk made of Mkongo, a sustainable local wood known for its durability, will provide users with increased access to wetlands. Through this portion of the trail, visitors will be exposed to the tumultuous water level changes experienced by the villagers throughout the seasons. The brightly colored aquatic plants and butterflies will delight both adults and children alike.

Phase 3: Tourist Node

Overall Tourist Node Plan

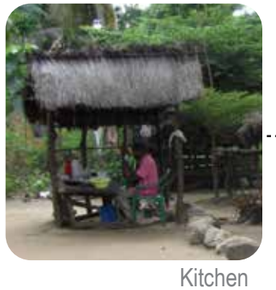
The tourist node will be placed at the head of the interpretive trail on the main road to allow easy access for visitors. The design of the node is inspired by the village gathering spaces so important to Tanzanian culture and social interaction.

Thatched Pavilion

Visitor Center

Handicrafts

Market Shops



Kitchen

Phase A

Phase A of the tourist node will construct a visitor center complete with bathrooms and demonstration area. The visitor center will provide information about the area, the wildlife corridor and the interpretive trail. A multi-purpose thatched roof pavilion surrounded by mango trees will offer tourists a picnic area, outdoor classroom and demonstration space to showcase new technologies and village craftsmanship. In addition, a parking area for four cars will accomodate toruists arriving from out of town.

Phase B

Phase B will be an expansion of the existing buildings to include a small market, food stands and a kitchen for employees. The shops will sell crafts emblematic of the area's rich indigenous culture, made by Kilombero Valley natives out of sustainable materials. The food stands will serve authentic Tanzanian cuisine with locally-sourced ingredients bought from village farmers. Permeable paved sidewalks will provide visitors with a dry surface to walk on, even in the midst of the rainy season.

Project Implications

Positives and Negatives

Just as each element of the Corridor plan builds on the success of the previous phase each consecutive element has broader positive and negative implications. The impact categories such as plant and wildlife habitat, economic inputs and outputs, ecosystem services, and education and cultural implications coincide with many of the projects overall goals. Each element is then assessed in each of these categories based on the positive, negative or neutral implications it has on the projects goals. In summary, the matrix reveals that each standalone phase has positive impacts in some areas and negative impacts in many others. In order to get the best results from the implementation the corridor, the application of all of the phases combined provides the most balanced and in turn, positive, overall implications.

		Plant + Wildlife Habitat			Economic Impacts						Ecosystem Services							Eucation + Culture	
					Inputs			*Outputs*											
Phase	**Element**	Connectivity	Food/ Water Supply	Cover	Compensation	Start Up Cost Construction/	Maintenance	Tourist Fees	Products	Revenue	Air Quality	Water Quality	Pollinators	Carbon Storage	Human Health	Forest Products (Non- Timber)	Human/ Elephant Conflict	Locals	Tourists
1	Wildlife Corridor	+	+	+	−	−	+	o	o	o	+	+	+	+	+	+	o	+	+
2	Mixed Use Zone																		
	Woodlots	+	o	+	o	−	−	o	+	+	+	+	+	+	+	−	+	+	+
	Cash Crops	−	o	−	o	−	−	o	+	+	o	−	+	o	o	o	+	+	o
	Beekeeping	−	+	o	o	−	−	o	+	+	+	+	+	+	+	+	+	+	+
	Interpretative Trail	o	o	o	−	−	−	+	o	+	o	o	o	o	+	o	o	+	+
3	Tourist Node																		
	Visitor's Center	o	o	o	−	−	−	+	o	+	o	o	o	o	o	o	o	+	+
	Craft/ Food Vendors	o	o	o	o	−	−	+	+	+	o	o	o	o	o	o	o	o	+

+ Positive Implications

− Negative Implication

o Nuetral/ No Implication

Revenue

Tourism

Biodiversity

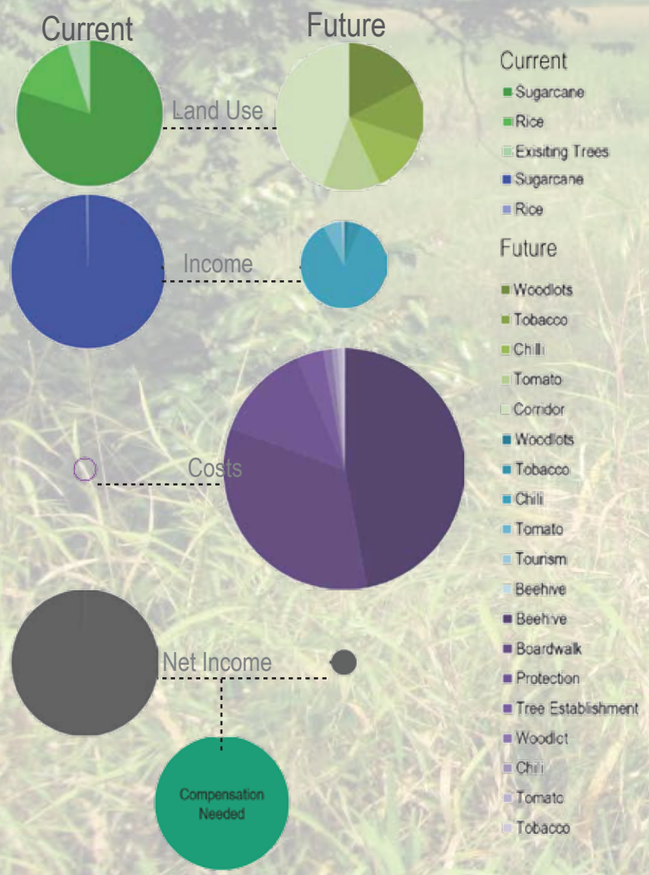
Education

Cash Crops

Costs and Benefits

Economics

The revenue generated in the Kilombero Valley relies heavily on the production of rice and sugarcane. The implementation of the wildlife corridor would decrease crop yields by over 250 hectares and be expensive to construct. However, the production of cash crops, wood-lots, and increase in tourism, as incorporated in the proposed project, would help decrease this financial deficit. The remaining net loss of income would be distributed out to villagers as compensation for their economic burden. The wildlife corridor would also improve the quality of ecological services which cannot be measured in monetary amounts, such as clean air and water.



	Crop	Area (Hectare)	Yield in Tons Per Ha	Total Yield in Tons	Price Per Ton (TZS)	Total Revenue (TZS)
Vegetative Revenue	Rice	98.10	2.50	245.25	42,000.00	10,300,500.00
	Sugarcane	523.20	69.80	36,520.12	73,125.00	2,670,533,775.00
					Total Revenue Lost:	2,680,834,275.00
	Wildlife Corridor	117.75	x	x	x	x
	Wood lots	39.25	x	x	price per Ha 97941.18	3,844,191.32
	Tobacco	32.71	1.54	50.37	272,199.69	13,711,623.86
	Chili Pepper	32.71	11.02	360.46	621,600.00	224,064,546.72
	Tomato	32.71	6.00	196.26	99,000.00	19,429,740.00
					Total Crop Gain:	261,050,101.90

		2012 Revenue (TZS)	Tourism Multiplier	Yearly TZS Increase	Total Yearly Revenue
Other Revenue	Tourism	600,000.00	0.01	7,020.00	607,020.00
		Number of Beehives	Yield of Honey Tons/ Hive	Price Per Ton (TZS)	Total Revenue (TZS)
	Beehives	1,200.00	0.01	907,184.00	15,567,277.44
				Total Revenue Gain:	277,224,399.34

		Cost Per Hive	Number of Hives	Total Cost (TZS)
Cost of Materials	Beehive	52,500.00	1,200.00	63,000,000.00
		Cost Per Seedling (TZS)	Number of Seedlings	Total Cost (TZS)
	Woodlot Seedlings	100.00	15,700.00	1,570,000.00
		Cost Seeds/Hectares (TZS)	Number of Hectares	Total Cost (TZS)
	Tobacco	14,700.00	32.71	480,837.00
	Chili Pepper	34,194.00	32.71	1,118,485.74
	Tomato	22,500.00	32.71	735,975.00
Cost of Corridor		Cost Per Seedling (TZS)	Number of Seedlings	Total Cost (TZS)
	Tree establishment	100.00	47,100.00	4,710,000.00
		Number of Employees	Avg. Yearly Salary (TZS)	Total Cost (TZS)
	Protection Costs	5.00	3,486,000.00	17,430,000.00
		Cost per Cubic Meter (TZS)	Area of Wood (m^3)	Total Cost (TZS)
	Boardwalk Costs	60,000.00	747.90	44,874,000.00
			Total Cost of Implementation:	133,919,297.74
			Net Gain:	277,224,399.34
			Net Lost:	2,814,753,572.74
			Remainder	-2537529173.4

Management Plan

Management and Protection Status

The management plan aims to help answer two pressing questions for the Magombera Wildlife Corridor: Who will manage and enforce protection for the corridor, trail, and tourist node and how can protection be guaranteed for the Magombera forest and corridor in the future. The Forest protection status chart considers annexation to the Selous Game Reserve and Wildlife Management area designations. Meanwhile, the Management chart compares Joint forest management and community based forest management for the corridor as a whole. These comparisons allow local communities to weigh individual benefits and challenges to find their best balance.

Forest Protection Options

Protected Status	Who Controls the Land?	Benefits	Challenges
Annexation to Selous	Selous Game Reserve Tanzania Goverment Wildlife Division	Higher level of protection and enforcement offered for wildlife More Revenue generated through fees and well known Selous name	Higher Entry Fees ($65) for tourists Less tourists will visit Money does'nt trickle down into community as easially
Wildlife Managment Area	Village Environment Council	Allows for more village control under village forest reserve management Gives locals a chance to share indigenous knowledge Cheaper access for tourists More tourism brings more money into the community	Success depends on the existing skill and knowledge level of the village council. Offers less of a guarentee of wildlife protection

Participatory Forest Management Options

Joint Forest Management			Community Based Forest Management		
Stakeholders	Benefits	Challenges	Stakeholders	Benefits	Challenges
Department of Forest and Beekeeping Division of Wildlife TANAPA Illovo Sugar Company Village Council (Environmental Committee) Kikundi Cha Beekeeping Association	Higher power of enforecement for protection Existing pool of start up funds -Access to professionals in conservation Economic costs shared between government and community.	Less profits going directly back into the community limited community access to resources No increase in leadership or educational opportunities for the community	Village Council (Environmental Committee, Tourism Committee, Trail Committee) Illovo Sugar Company Udzungwa Forest Project Kinkundi Cha Beekeeping Association Hondo Hondo Udzungwa Ecological Monitoring Center	Community has direct control over resrouce access Community can utilizes indigenous knowledge to make lthe best decisions for their area Direct control over profits from mixed border, trail, and tourist node Opportunites for leadership and conservation learning sense of pride and ownership local forest Greater motivation to conserve	Potential for community to deplete resources and conserved area. Less access to professionals in conservation Lack of resrouces and funds for managment Success dependant upon interest of current council members, who are not in permanent positions

Bee Keeping Association

Community Council

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