

Food and fuel security adjacent to Udzungwa Mountains National Park, Tanzania: Student learning and research outcomes

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Penn State Landscape Architecture
and numerous students who will be
identified as their work shows up...

Presentation Overview

- Origin of study-research program
- Udzungwa Mountains National Park
 - Location, brief history and conservation issues
 - Key challenges for park and neighboring villages
- Socioeconomic conditions near the park
 - Economic systems and resource demands
 - Addressing human challenges near the park
- Design and development options
- Learning and research synergies
- Discussion

Origin of program

- Desire to conduct study abroad in immersive developing world setting
- Strong research interest in the benefits that community design may offer for conservation
- Issues:
 - Identify a research focus able to sustain long-term faculty attention
 - Identify educational issues of broad interest
 - Identify locations where safety and logistical issues would not consume all our energy

Contacts, support network

- Conservation International/TEAM-Tropical Ecology Assessment and Monitoring Network
- Udzungwa Ecological Monitoring Centre/Trento Museum of Natural Science
- TANAPA-Tanzania National Parks
- University of Dar es Salaam, Department of Wildlife Conservation
- Sokoine Agricultural University
- WWF—World Wide Fund for Nature

Location of UMNP in Africa

- Tanzania in Africa
- Udzungwa Mountains National Park in TZ



UMNP background information

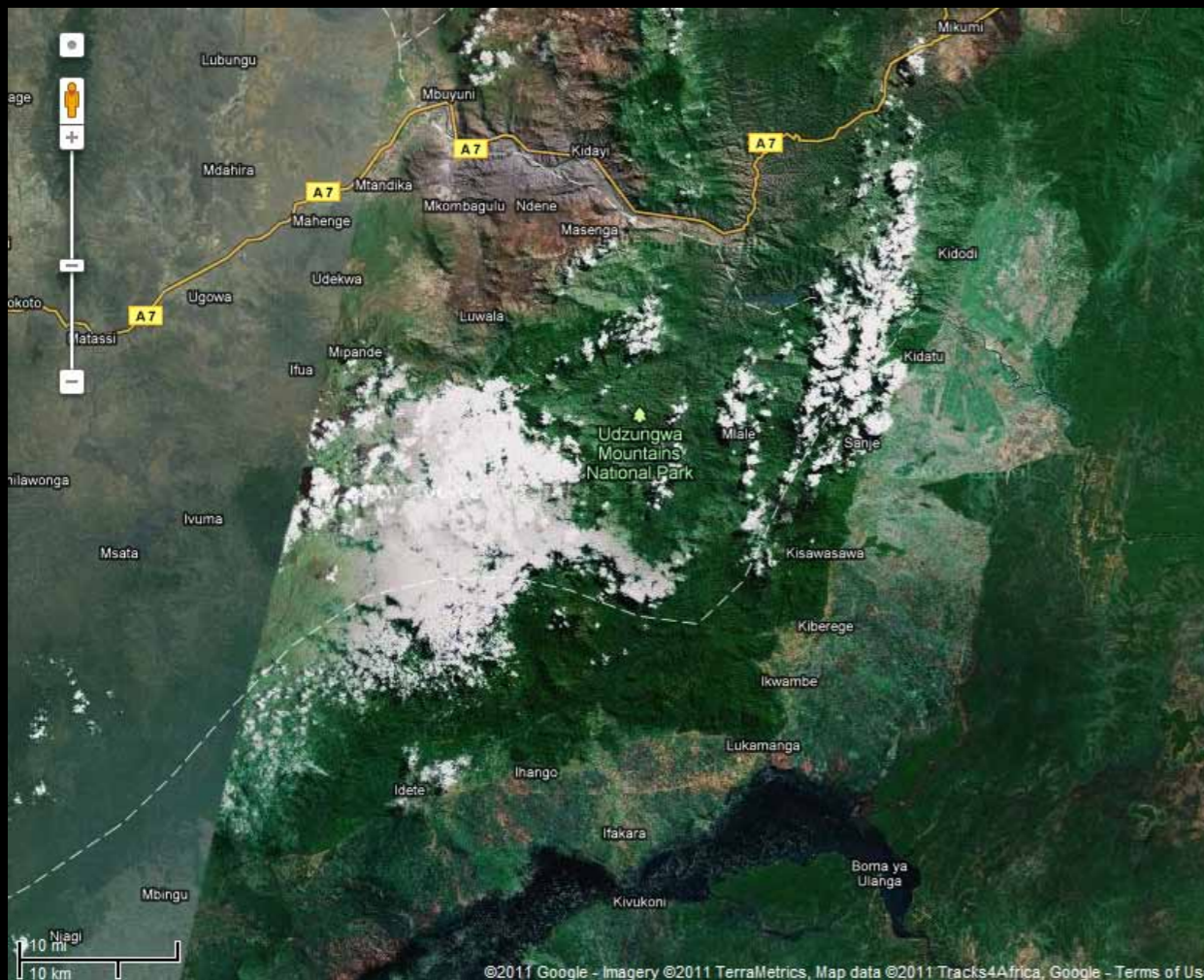
- **UMNP Gazetted in 1992**
 - Proposed and backed by World Wide Fund for Nature for value to biodiversity conservation
 - Formed from five 1950s forest reserves
 - Only national park in Eastern Arc Mountains
- **Remarkable levels of biodiversity**
 - Thirteen species of primates, several endemic
 - 2,500 plant species; 250 species of birds; 250 species of butterflies; high endemism
 - Unknown, but likely very high, fresh water biodiversity; others?
 - Most of the charismatic megafauna

Udzungwa Mountains National Park

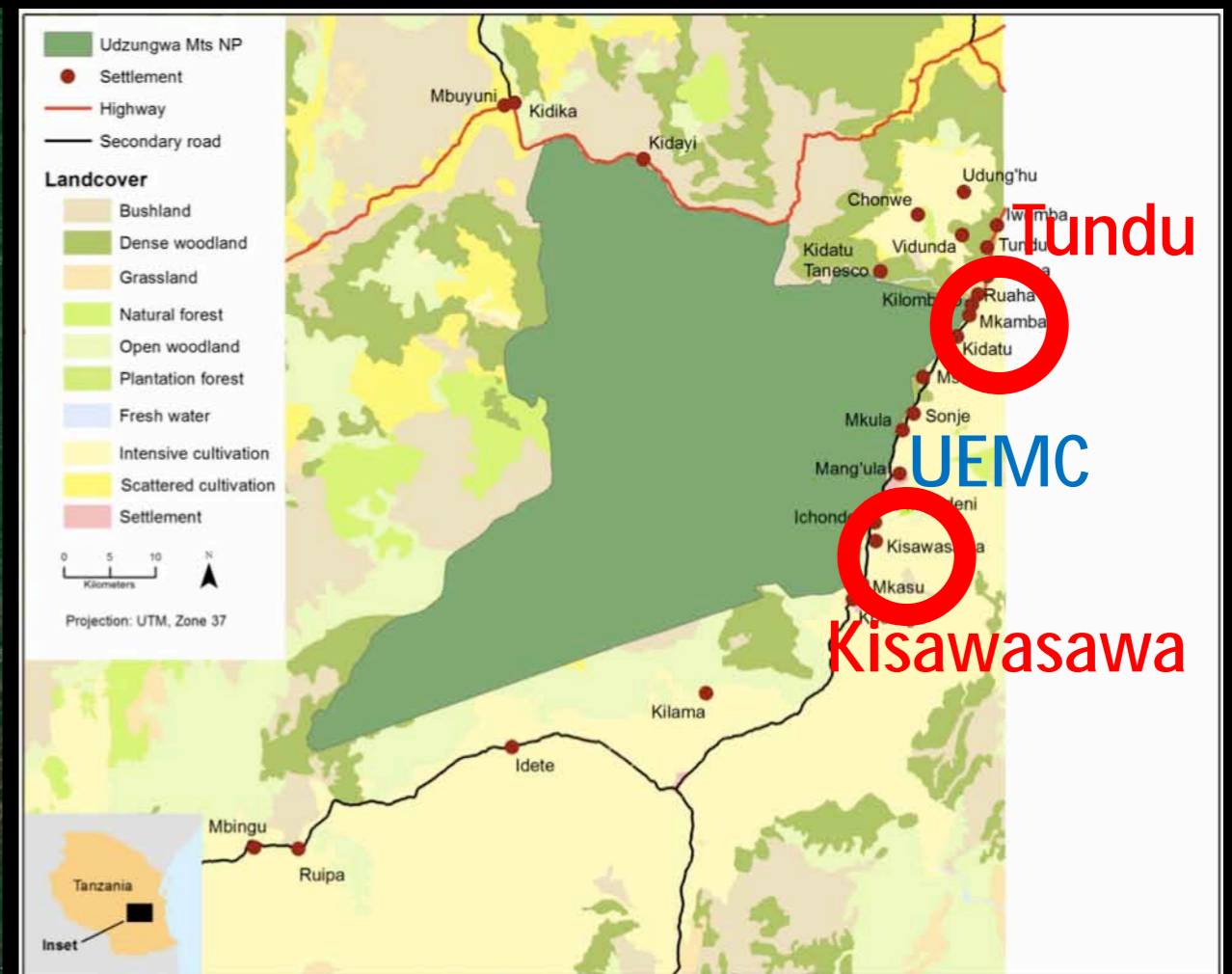


The Park in its context

- The mountainous park adjoins the Kilombero Valley—rich in resources—good soils, reliable rain and rivers, forests and woodlands



Google imagery, 2011



Base map by Larry Gorenflo

Water, food and fuel security

- Water catchment is vital to commercial agriculture and domestic water, but north of the park and Ruaha River is badly degraded
- To maximize sugar mill capacity, outgrower production must increase by 100%, diverting more village land from subsistence gardens
- Set-aside areas for fuel-wood growing have not been effective as long as gathering of fuel in UMNP and forest preserves has persisted
- Fuel-wood gathering ban in UMNP July 1, 2011

Park, road, fields, village, firewood



Modest villages, scarce resources



2010 season—Tundu village

- North of UMNP, +/- 4,000 population
- Bounded on East by sugar plantation of multinational Illovo sugar company
- Once-forested steep hillsides to West comprise Vidunda water catchment, now heavily impacted by deforestation.
- WWF land use plan designates broad areas for watershed protection, village fuelwood harvesting and for forest preserves

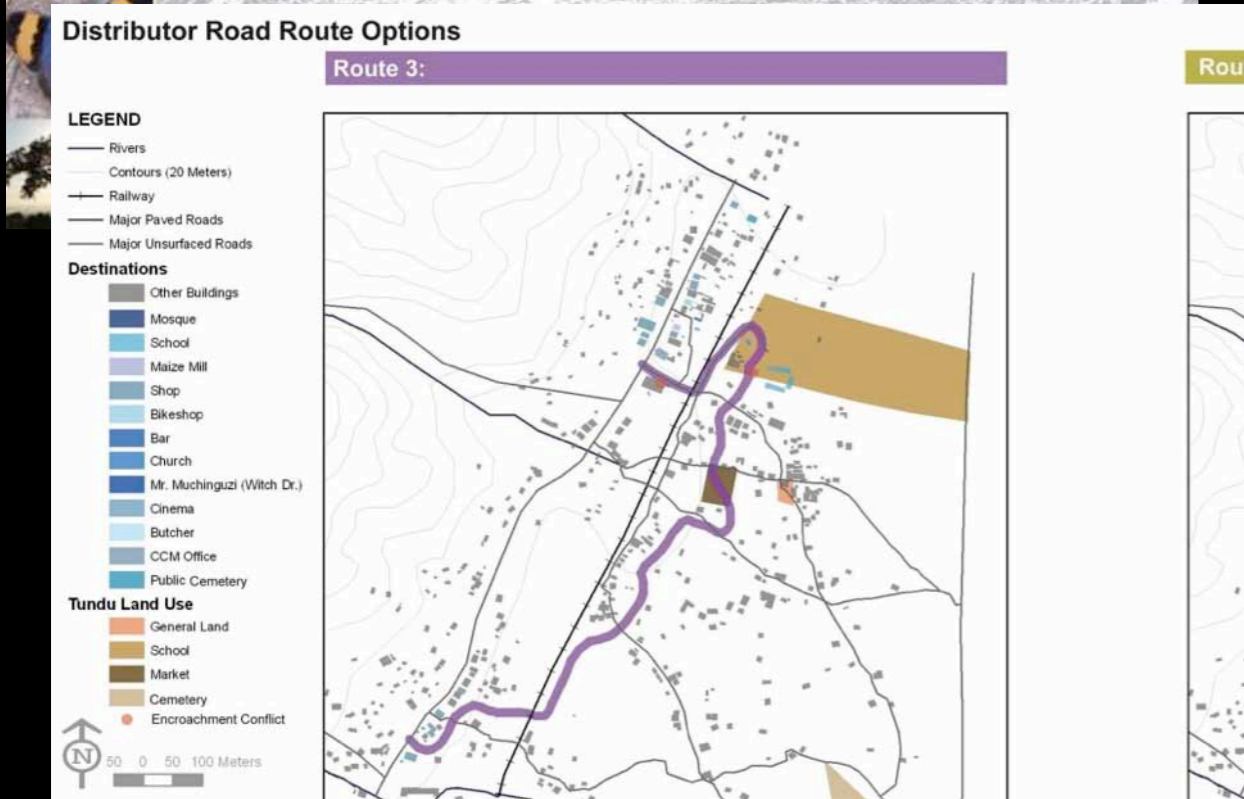
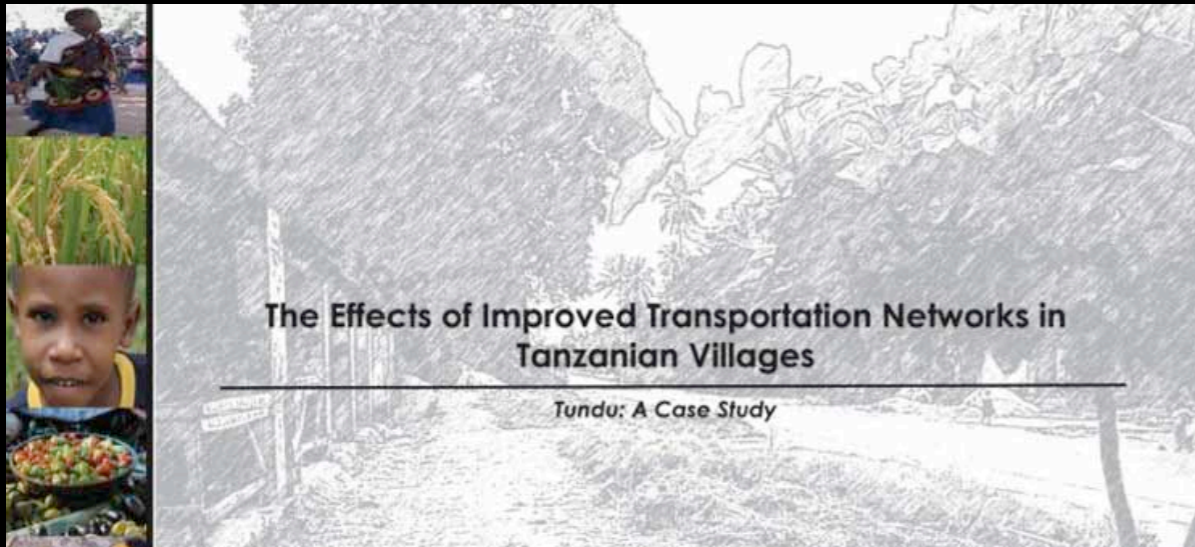
Mapping precedes village plans

- With increasing population and growing needs, efficient use of land will be critical
- Land must be reserved for fuel and food production vs. conversion to cash crops
- Location of homes relative to water, woodlots and agricultural fields central to villagers' energy and time budgets
- Standing water, seasonal flooding, location of latrines—represent potential health hazards
- No suitable plans, maps or imaging available

Tundu survey—GPS, tape, compass



2010 Student projects



How do you insert new roads into an informal village plan?

Adrienne Angelucci+ Abigail Thomas, Landscape Architecture students

Udzungwa Ecological Monitoring Centre as a showcase for innovation

TABLE OF CONTENTS	HISTORICAL CONTEXT	CONCEPTUAL MASTER PLAN	DEMONSTRATION PLOTS OVERVIEW	SUSTAINABLE WOODLOT DESIGNS	IRRIGATION DEMONSTRATION	ALTERNATIVE BIOFUEL / ENERGY SOLUTIONS	NATURE BASED BUSINESS OPTIONS	UEMC FOR OUTREACH / RESEARCH / TOURISTS	CONCLUSIONS & DISCUSSIONS
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ALTERNATIVE BIOFUEL / ENERGY SOLUTIONS

With the continual loss of viable land and the ever increasing demand for fuel wood, alternative energy solutions are needed to sustain rural villages within the region. The UEMC's newest protection plan will further hinder the energy crisis occurring within many of the local villages. As we already know, 98% of the population uses firewood and charcoal for energy uses, but this strategy cannot persist at the same level for much longer. At the UEMC visitors will learn of new energy efficient appliances in addition to accessible alternatives for fuel, specifically biofuel (biogas) options. With new technological advancements, and the UEMC's demonstration plots, many villagers will soon have the capabilities and knowledge needed to implement such strategies thus alleviating the need for firewood.

Villagers and tourists will learn of such alternatives in the hope that these cost effective products could potentially help themselves and their local ecosystems. New energy strategies could be implemented within villages if the knowledge for them were present. Biofuel systems, for example, could provide individual families or two neighbors enough energy to sustain all their energy needs on a daily basis. Finding other viable options is necessary especially with the high dependency on a resource that is becoming very limited. Other options developed within the demonstration area will be: rice husk uses, and solar energy, in addition to the biofuel and new oven appliance plots. According to a recent 2006 socioeconomic study, completed by the WFP and Paul Harrison, "The general feeling towards the potential introduction of such stoves once they have been explained to people is that they will save time collecting firewood, energy in cooking and reduce the degradation of forests. If there is education in how to use them, they would be welcomed" (Harrison 2006, 27). The problem within many of the surrounding villages is not that people do not want the new solutions, but that they have limited knowledge on how to build and use them properly. If the UEMC were advanced, many local village members could learn for the area, thus aiding to their needs as well as the environments.

ENERGY EFFICIENT APPLIANCES

The alternative energy solutions demonstration plot will provide visitors with educational teachings of such options including clay and metal energy efficient stoves (1 + 2), and rice husk fuel options (3). It is the hope that with exposure to new solutions, villagers will realize the possibilities and advantages of using such products, thus diminishing the need for firewood. Photographs From: Harrison 2006, Smith 2010.

CONTEXT MAP **ACTUAL BIOFUEL SYSTEM**

At the UEMC, the addition of a biofuel system can provide the needed electricity and energy required to run the kitchen and dining room areas. Because the system will be fully functional, visitors will have the opportunity to learn from it, seeing its potential first hand.

Photographs From: Smith 2010.

to the Monitoring Center and the research facilities (3) following the introduction, facility members shall direct guests through the newly designed, open-air pathway (4). The path will lead tourists and local village members to their new forest being arrangements (5) and proceed to the dining room and kitchen area (6) for either breakfast or lunch. After the meal is complete visitors will have the opportunity to inspect their belongings and prepare for the educational workshops to follow.

Educational demonstrations will take place in four different locations within the UEMC and consist of a one to two hour lecture / workshop period. Initially, visitors will meet within the second outdoor class room (2) located just outside of their living quarters. An additional introduction focusing on the educational experience to come will take place, followed by the first of the four learning demonstrations. Visitors will move towards the "Nature Based Business" plot (8) where they will learn of alternative business options which can bring in monetary gains for local families. Next, guests will move towards the "Alternative Biofuel / Energy Solutions" plot (9) where they will become educated on varying efficient energy strategies and waste management techniques all happening within the UEMC campus. After which, visitors will have an additional meal and the remainder of the day to explore the region or local towns (10). Dinner and sleep will complete the evening, and the educational experience will continue again the following morning.

The morning will begin after breakfast in the dining hall, followed by a quick meeting with the outdoor class room (2), provided by a walk to the remaining demonstration areas, near UEMC Office (1). The first workshop of the day will be the "Irrigation Demonstration Plot" (11), which will explore the beneficial aspects of crop irrigation for residential farmers. Visitors will then move to the last demonstration plot which is divided into two areas. This demonstration focuses on "Sustainable Woodlot Design" (12), but also incorporates nurseries (13) which help reach the process of how to begin a viable woodlot. After lunch, the seminar assistant consults with a final lecture on the importance of these alternatives as well as to research and conservation as a whole and again guests are encouraged to explore the area, specifically the Udzungwa Mountains National Park (14).

Overall the UEMC can be explored within one day, but the campus is designed for a multi-day, one night stay. Implementation of such demonstration plots will provide an amazing feature within the region for both visitors and tourists to learn, witness and value the conservation and sustainable efforts taking place within the Udzungwa Region.

THE VISUAL DIFFERENCE TO THE UEMC CAMPUS
The UEMC campus is designed to be a showcase for innovation and sustainable efforts taking place within the Udzungwa Region. The UEMC campus is designed to be a showcase for innovation and sustainable efforts taking place within the Udzungwa Region.

1. UEMC Office / Seminar Room
2. Outdoor Class Room
3. Dining and Kitchen Facility
4. Pathway
5. Forest Being Arrangements
6. Dining Room / Kitchen Area
7. Living Quarters
8. Nature Based Business Plot
9. Alternative Biofuel / Energy Solutions Plot
10. Towards Local Villages
11. Irrigation Demonstration Plot
12. Sustainable Woodlot Design Plot
13. Nurseries
14. Towards Udzungwa Mountains National Park

UDZUNGWA ECOLOGICAL MONITORING CENTER
IRINGA, TANZANIA

Alex Smith, Landscape Architecture student

2010 Student projects

Poverty Alleviation and Conservation Advocacy with Butterfly Farming as an Economic Incentive

Village of Tundu, Kilosa District, Morogoro Region, Tanzania



Matt Weir

LArch 499F

21 June 2010



Butterfly farming for poverty alleviation

Matthew Weir, Landscape Architecture student

How can the Park website connect with adventure-oriented tourists?

UDZUNGWA MOUNTAINS NATIONAL PARK
LEAVE ONLY FOOTPRINTS · TAKE ONLY PHOTOGRAPHS

- HOME
- ABOUT THE PARK
- PARK ATTRACTIONS AND FEES
- HISTORICAL SITES
- BIODIVERSITY
- HUMAN-WILDLIFE CONFLICT
- EVERETT COLLECTION

EXPERIENCE THE VILLAGE

FOOD - The villages surrounding the UMNP host a number of markets that offer a diverse array of foods native to the area. The outdoor markets are typically set up in a semi-enclosed area out in the streets of the village. Some of the most common food items sold at the local markets include bananas, oranges, papaya, eggplant, albino eggplant, okra, potatoes, cabbage, kale, peppers, beans, lentils and dried fish. Purchase some of these raw ingredients if you're interested in trying your own cooking. There are also a number of ready-to-eat foods such as fried bananas, sugar cane and deep-fried catfish.

You'll also want to try some of the local bars and restaurants in Mang'ula and Mwaya. We highly recommend a meal at the Mountain Peak Inn in Mwaya for traditional fare and a Tanzanian beer such as Serengeti or Safari Lager. Other local drinks sold in the bars and made right in the villages include a banana beer referred to as mbege among the villagers, raha; a banana based wine, pombe; a maize brew carbonated drink made in barrels in the villages over an open flame for three days, ulanzi; wine filtered through the stalk of a bamboo plant and mnazi; coconut water left to ferment overnight. A short walk down the streets of these villages will reveal many of the best kept roadside secrets of home cooking by welcoming villagers - just follow your nose.

AGRICULTURE - Mang'ula sits in the heart of the Kilombero Valley, an area of Tanzania that is highly dependent on agriculture because of its rich soil and close access to the Ruaha River. This industry drives the local economy with nearly 80% of Tanzanians in the Eastern Arc Mountains involved in some type of agricultural activity. Some of the most commonly grown crops are maize, rice, beans, cassava, and a variety of tropical fruits. To gain a well rounded understanding of the area, we recommend visiting agricultural sites from personal subsistence gardens known as shambas in Swahili to large scale commercial sugar cane fields owned by the ILOVO Kilombero Sugar Company. You may also want to stop by the corn mill in Mang'ula to witness flour production first hand or the Milimani Primary School to catch a glimpse of bee keeping and see how honey is harvested.

Visiting a commercial sugar cane field

BACK TO HOME

Rachel Tsupros, Marketing + Gichuhi Kamau, Communications

Key issues

- Agriculture supports food needs for all, some income for 97%; 77% gain income from small businesses; 48% from animal husbandry
- Heavy reliance on deadwood from the park
 - Cooking; trading; brewing; brick-making
 - Alternatives have not caught on—resisted by tradition + poverty
 - Tree planting has not been successful—as long as park has been available as a free resource
- Lack of clarity on land tenure issues and no community-based land use planning

Key resources

- Nyundo, Mtui, Kissaka, 2006
“Assessment of Ecological and Social-Economic Impacts Caused by Collection of Deadwood, Medicinal Plants and Cutting of Grass for Thatching” for Tanzania National Parks
- Harrison/Kilimanyika, 2006
“Socio-Economic Baseline Survey of Villages Adjacent to the Vidunda Catchment Area”

2011: Goals for study

- Refine work at Tundu using more concrete base data
- Add a village immediately adjacent to UMNP and closer to Monitoring Centre base
- Critical issues demanding responses:
 - Proposed ban on firewood collecting in UMNP to take effect July 1, 2011.
 - Increasing demand for outgrower sugar production in the Kilombero Valley.
 - Population growth driven by continuing in-migration to work in sugar cane etc.

Our role...

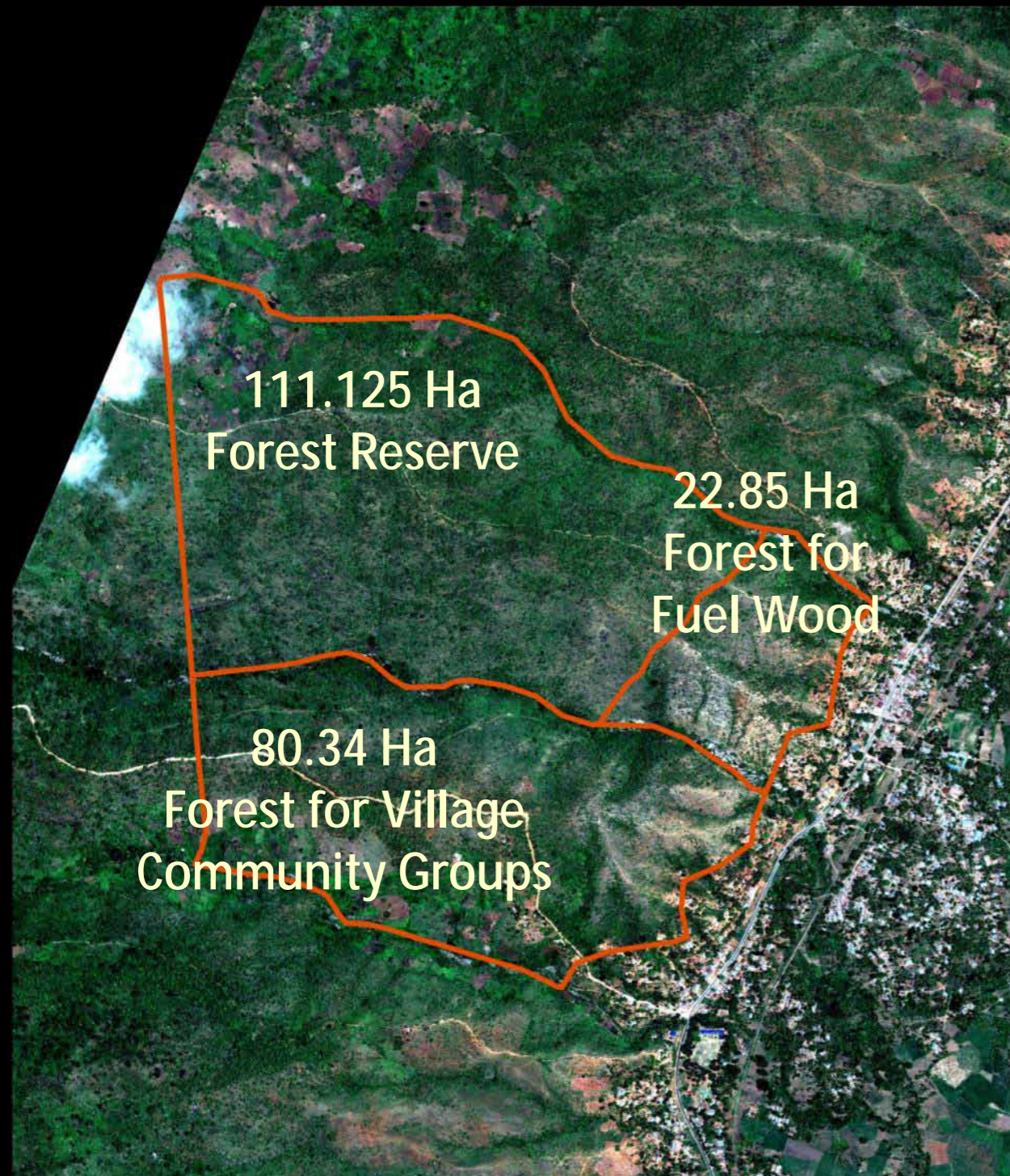
- Past reports highlight resource utilization needs and identify potential short-falls
- But few of them ask whether or how the existing village lands can sustain current or future demands
- Simple questions:
 - Is there enough land to sustain fuelwood needs?
 - Can rice husks, other fuels and energy-saving stoves off-set fuelwood needs?
 - Is there enough land to accommodate new people and still grow food, fuel and cash crops?

Collecting map data

- Year 2: Georeferenced satellite imagery
 - GeoEye sub-meter satellite imagery indicates majority of village infrastructure and properties
 - Using printouts, visually ID and classify structures—residential, shop, store, latrine, etc.



Tundu – WWF land use plan



- Fuel wood reserve
 - Estimate fuelwood volume per hectare from stem counts



Tundu – WWF land use plan



- Energy usage
 - Estimate wood used for domestic fuel, brewing, brick-making



Tundu – WWF land use plan



- Existing rice paddy
 - Estimate rice husk energy potential available for fuel

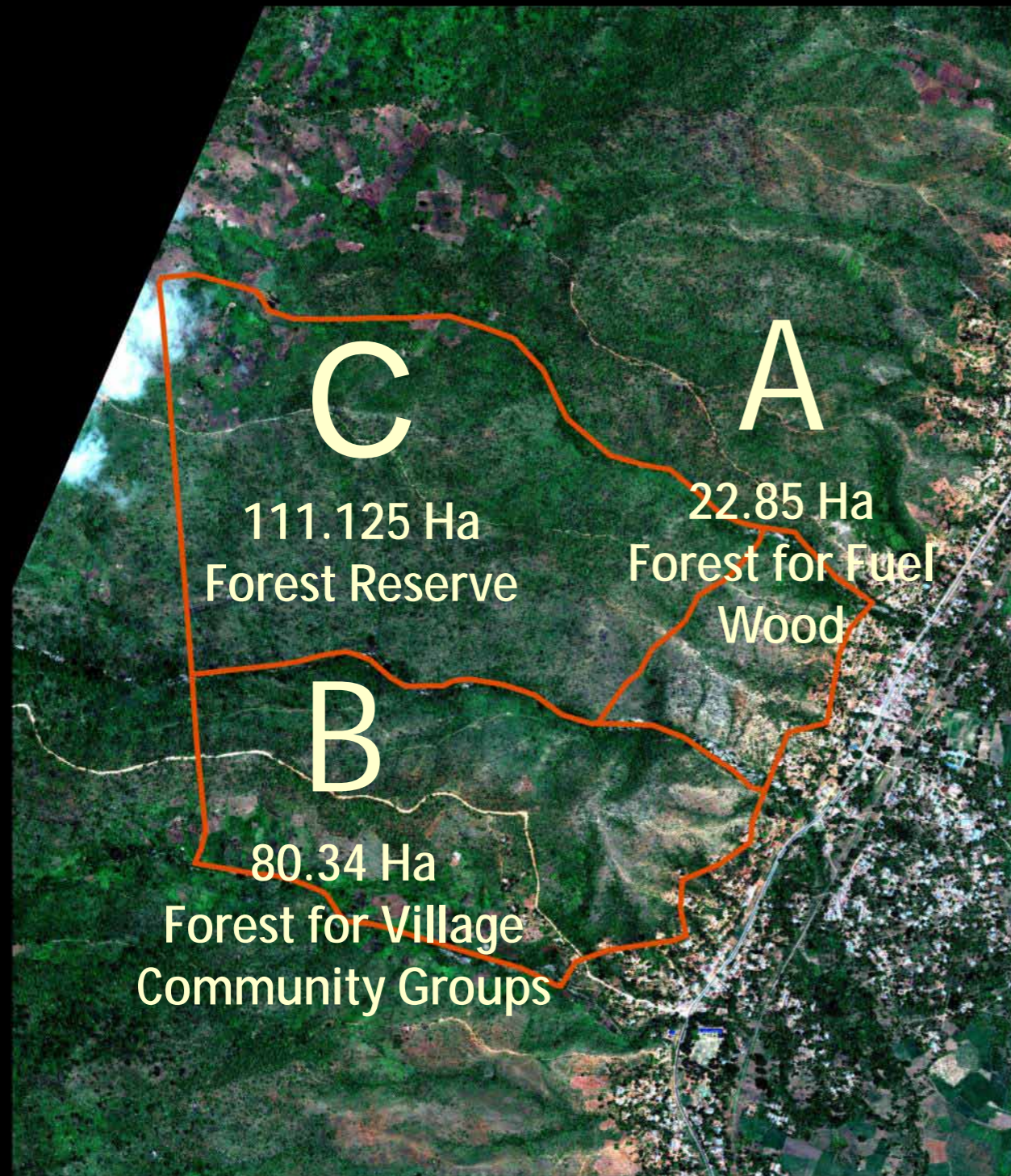


Tundu – WWF land use plan

- Efficiency and alternatives
 - Factor-in fuel-efficient stoves, biogas, charcoal



Tundu – Sustainability



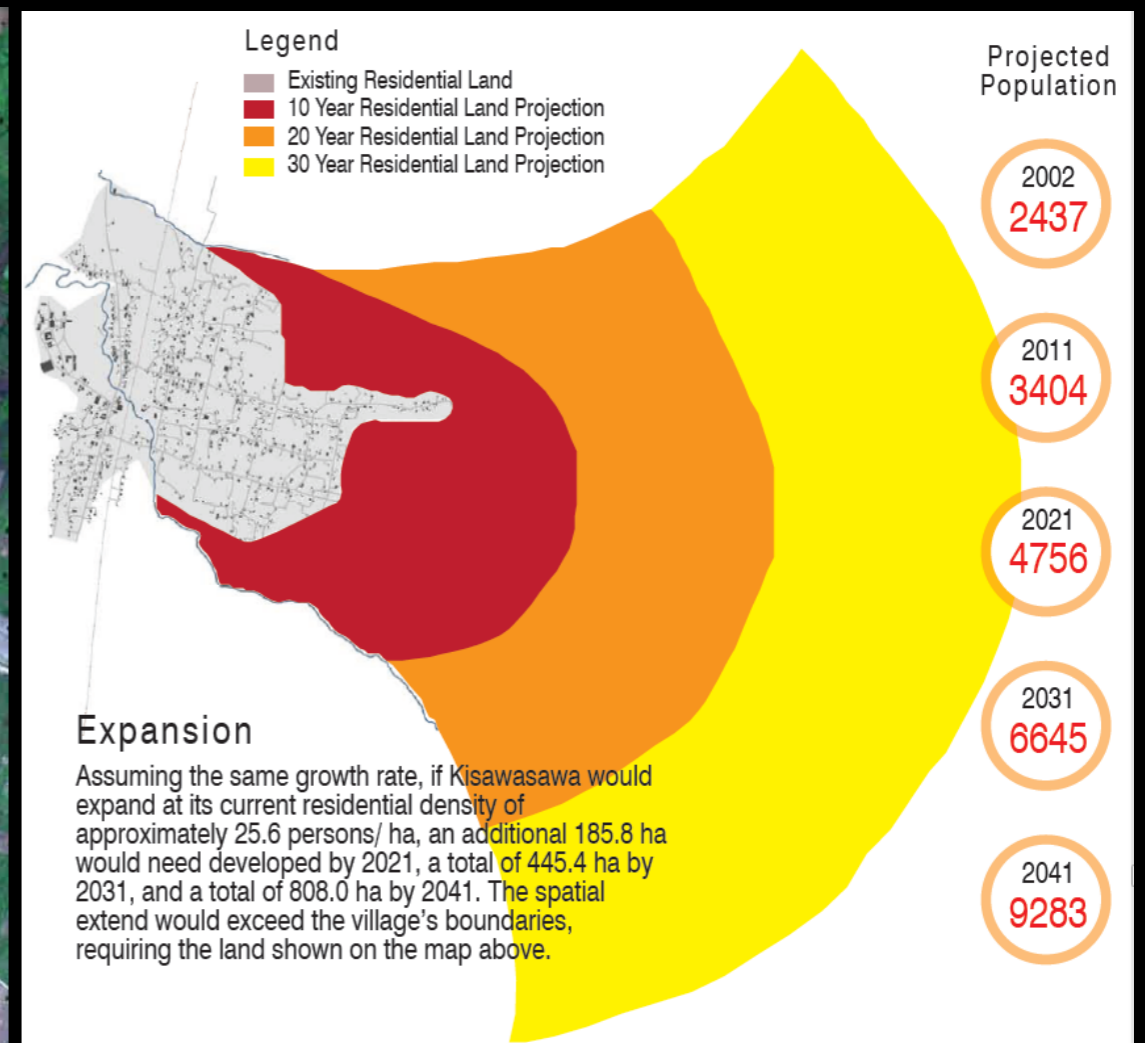
- 20-year projection
 - Fuelwood reserve A supports current use < 2 years
 - Only a mixed fuel scenario, with efficient stoves, using all forest areas, A+B+C, has a hope of sustaining anticipated growth

Kisawasawa village—land use

- 35km South of Tundu, +/- 9,000 population.
 - Bounded on East by extensive village-owned rice paddy.
 - Immediately bounded by UMNP to west.
- No plans for watershed protection, nor fuelwood harvesting, nor for protection of village gardens and paddy in face of growth.
 - No WWF land use plan prepared for this location
- Vigorous population growth, finite land resources, loss of UMNP as fuel resource

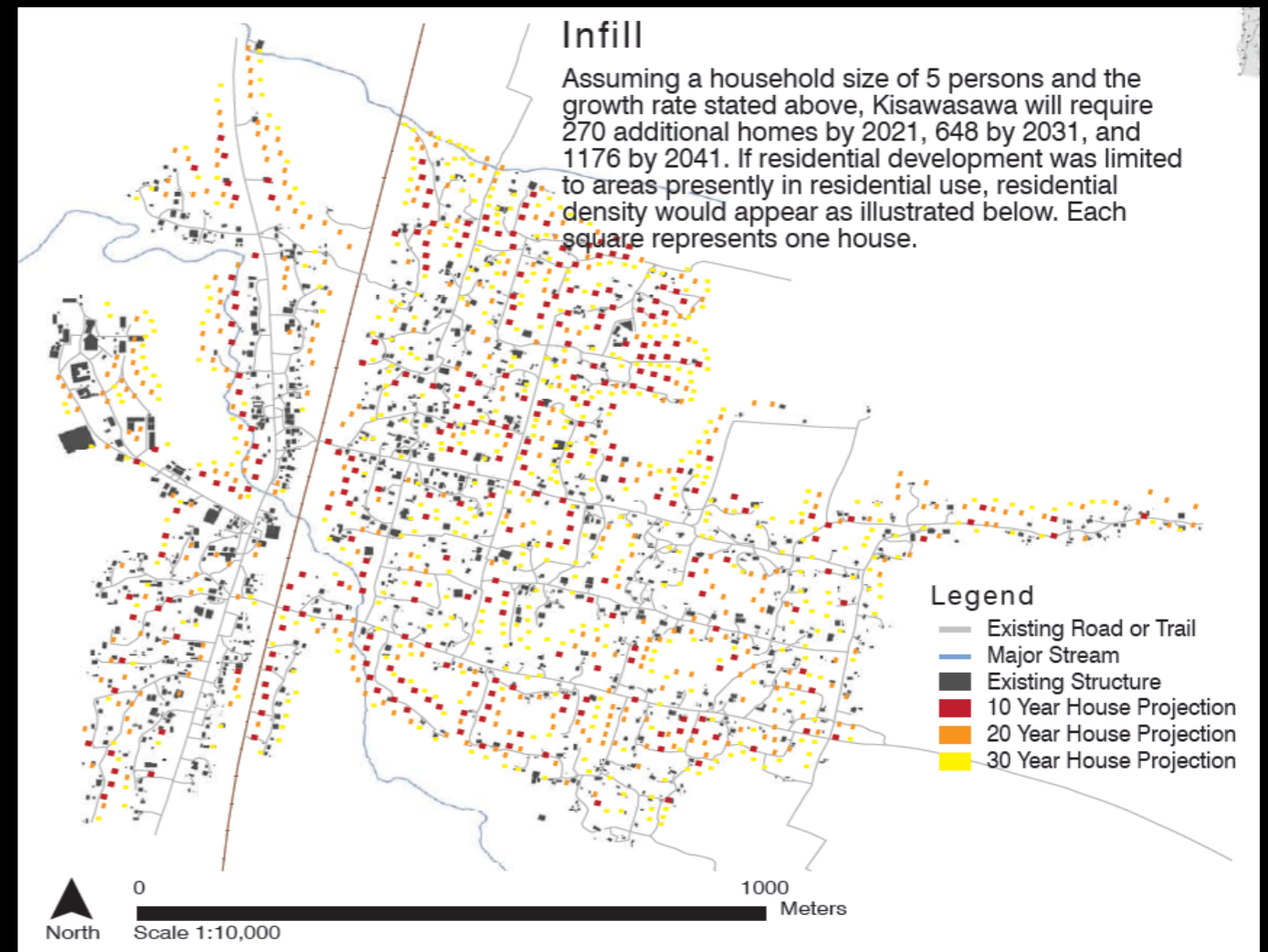
Kisawasawa

- Effects of population growth
 - Kisawasawa growing at 3.4% annually—10, 20 and 30 year projections at current density
 - Land (fuel and food) resource quickly depleted



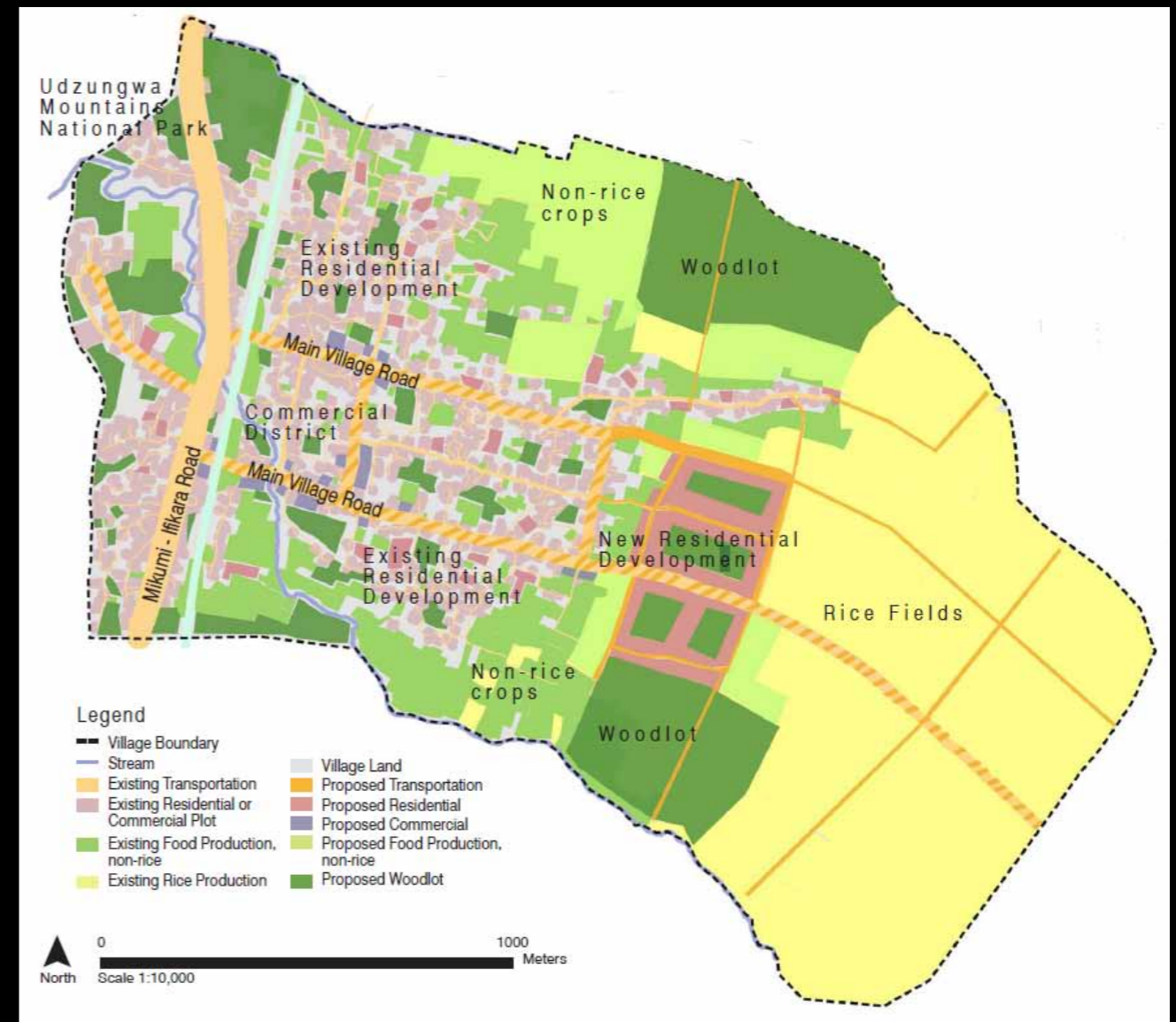
Kisawasawa

- Sprawl is the current pattern of growth
 - Organizing around grid layout enables infill without sacrificing space for shambas (gardens)



Kisawasawa

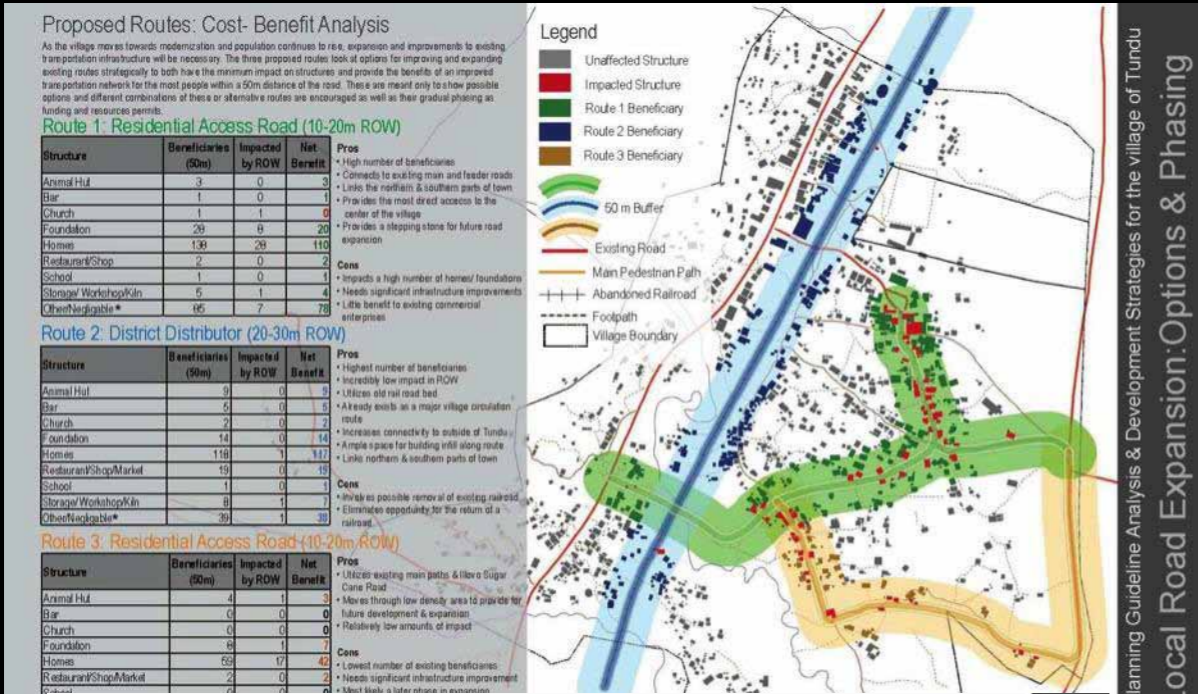
- Development plan
 - Maximizes infill to retain space for growing food
 - Balances cash crops against need for subsistence gardens and woodlots
 - Needs new sources of income to remain viable



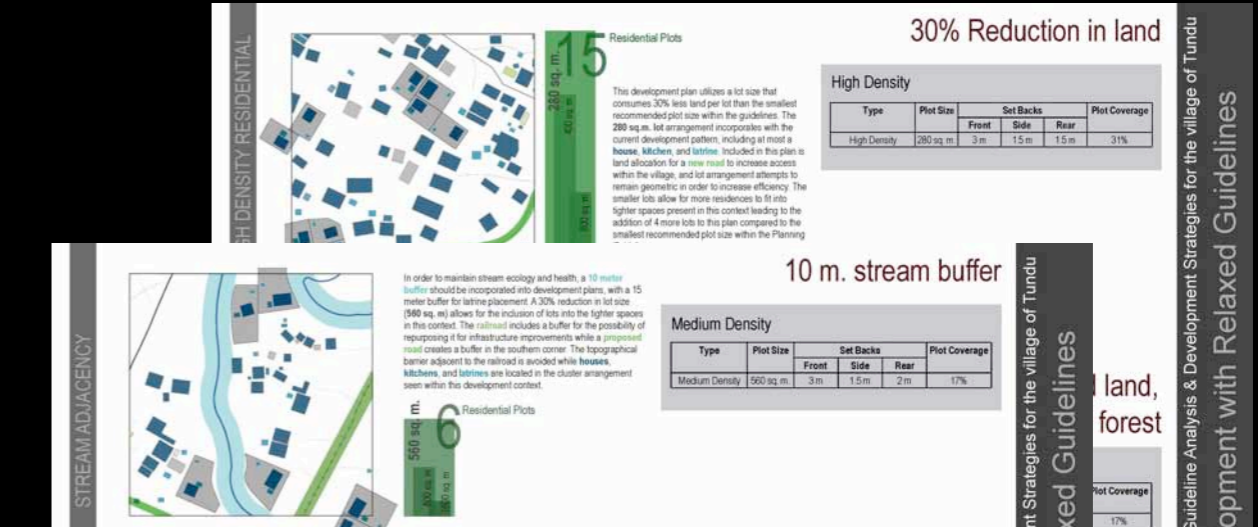
Plans and Data, Ariel Ries, Sarah Rumbaugh, Kellie Waksmunski, Landscape Architecture Students

More 2011 Student projects

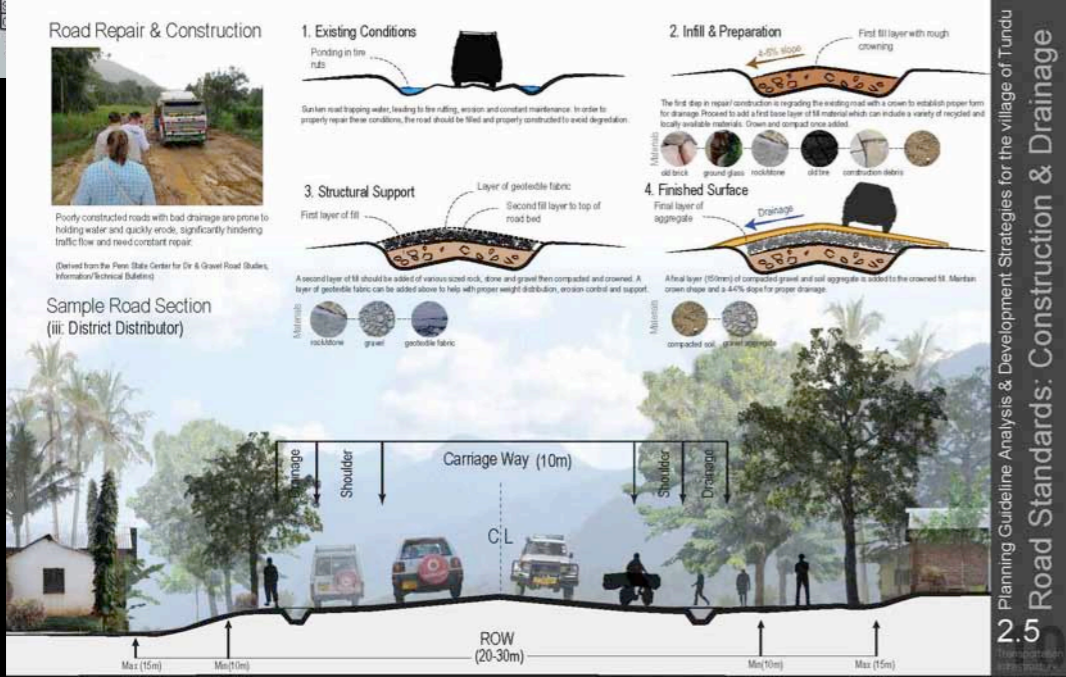
How can Tundu accommodate growth and protect water and land resources?



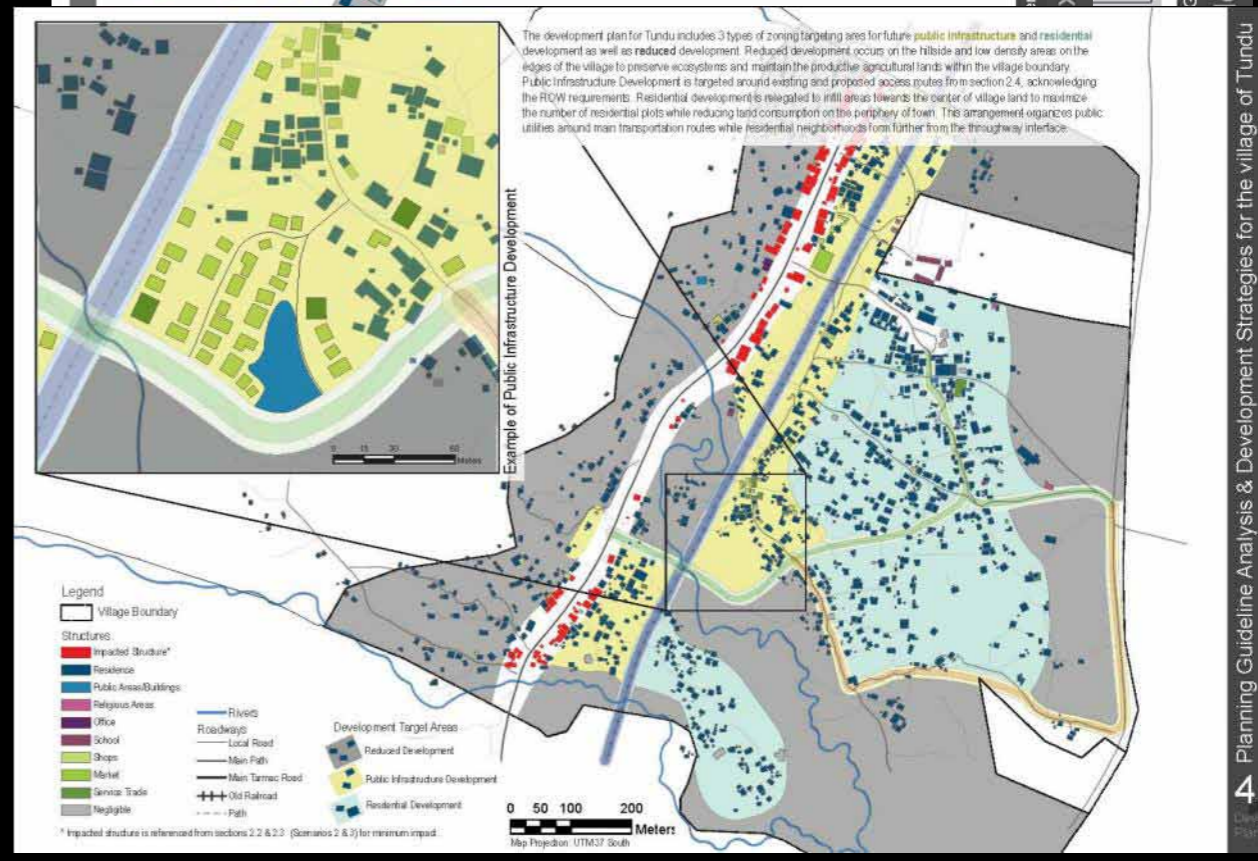
2.4 Local Road Expansion: Options & Phasing



2.5 Target Areas for Development: Options and Phasing



2.5 Road Standards: Construction & Drainage



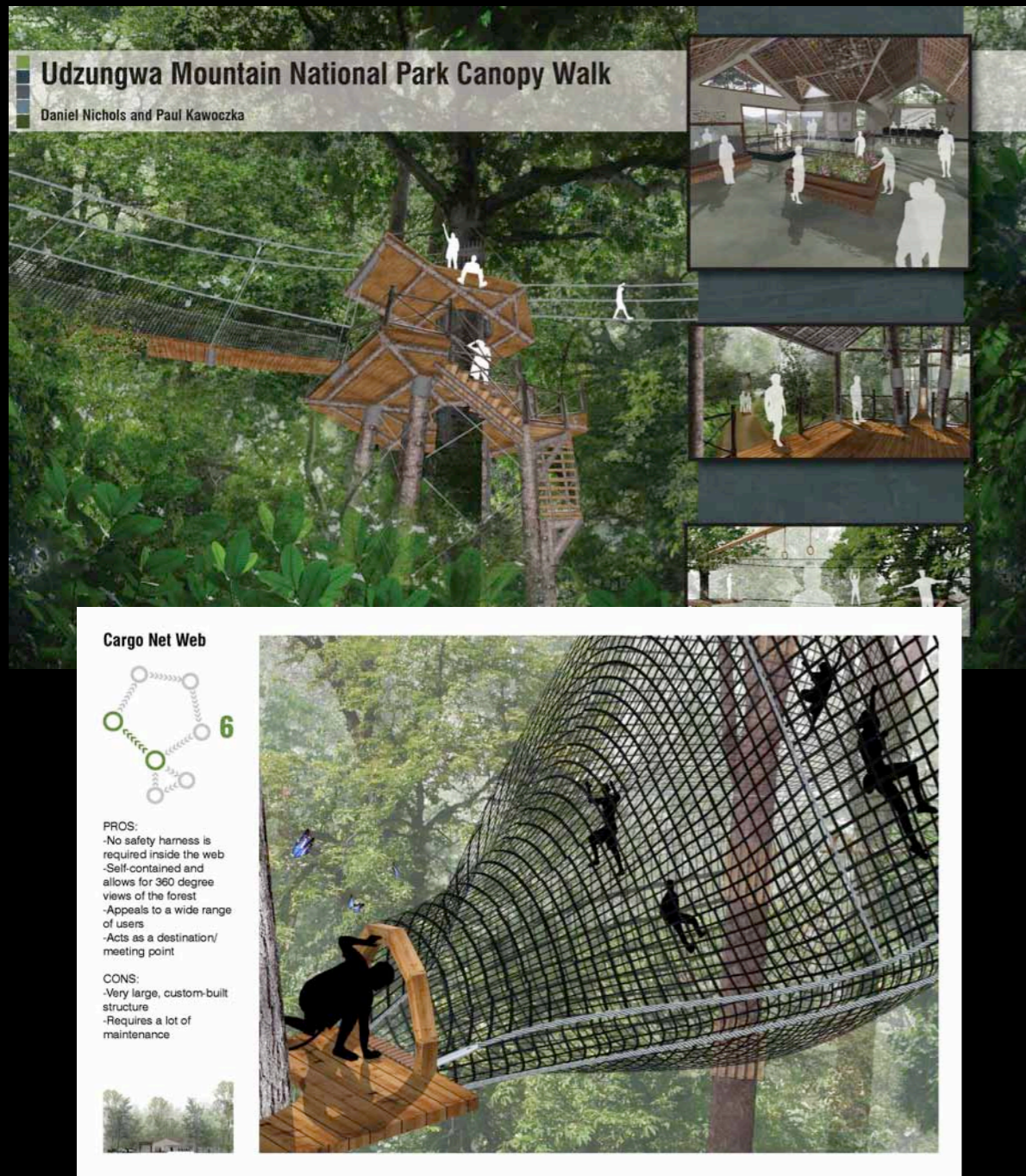
4.1 Target Areas for Development: Options and Phasing

Infrastructure alternatives for Tundu

Daniel Sepsy, Landscape Architecture student

Gabbi Salvemini, Landscape Architecture student

More 2011 Student projects



Educational support materials for schools in the Udzungwa area



Canopy walk for Udzungwa Mountains National Park

Paul Kawoczka + Dan Nichols, Landscape Architecture student

Jessica DiMarzio, AgExt Education + Nicole Murray, Public Relations

Parks and People Study Abroad

- Six-week program, mid-May—end June, nine credits, limited to twelve students
 - 3-credit seminar: People and Protected Areas
 - 5-credit studio: Community Design in the Vicinity of UMNP
 - 1-credit colloquium: Service-Learning for Students and Community
- Orientation at University of Dar es Salaam, Sokoine University of Agriculture; four weeks in field; three day safari in Mikumi National Park; three days in Zanzibar

Formal educational experiences



Informal educational experiences



Student reflections

- *“Culture is a dynamic, complex, living entity. It doesn't pause to be captured in a picture or to be explained to a friend. Before it can be explained it has already moved on. I knew I was going to see and experience new and different cultures while in Tanzania, but I had no idea the effect they would have on me.”* (2011 participant)
- *“Now I realize that the size of my contribution isn't the sole indicator of its success. It is more about doing something, because without trying there will never be any growth or progress.”* (2011 participant)

Future

- Continue land-use surveys that communities can use to locate boundaries, establish land tenure, and think about land use zoning
- Continue to assist Tundu and Kisawasawa in developing their alternate future scenarios
- Deploy household income and expenditure survey to fill gaps in socio-economic picture
- Collect field data to refine fuel production and utilization models
- Work with program students to explore new questions, new solutions



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Harrison (2006) – III

- Recommendations and Monitoring steps:
 - Build capacity of village natural resource committees
 - Implement land use planning
 - Broaden environmental education/awareness
 - *Initiate village environmental scouts*
 - Develop village forest reserves.
 - Initiate village and local area tree planting
 - Develop alternative energy sources
 - Develop alternative income generating activities
 - Support community-initiated projects
 - Formulate and enforce land use bylaws

Nyundo et al. (2006) for TANAPA

- “Assessment of Ecological and Social-Economic Impacts Caused by Collection of Deadwood, Medicinal Plants and Cutting of Grass for Thatching” for TANAPA
 - Biological diversity declines with intensive exploitation
 - Heavy reliance on deadwood from the park
 - Cooking and heating; trading; brewing
 - Alternatives have not caught on—tradition + poverty
 - Tree planting not successful—as long as park available
 - Minor impacts from thatch and medicinal plant collecting

Harrison (2006) for WWF

- “Socio-Economic Baseline Survey of Villages Adjacent to the Vidunda Catchment Area”
 - Agriculture supports food needs for all, some income for 97%; 77% gain income from small businesses; 48% from animal husbandry
 - In times of stress—drought, harvest failure—the natural environment, e.g., the Park, is seen as a “safety net” of abundant resources
 - Clarity of land tenure and ownership issues and consistent community-based land use planning have potential to bring improvements in economic and social well-being