

NAIS CHALLENGE 20/20 PROJECT ON DEFORESTATION: A JOINT PROJECT OF GREEN HILLS ACADEMY, KIGALI, RWANDA, IN COLLABORATION WITH BELMONT HILL SCHOOL, BOSTON, MA, USA.

What is deforestation?

The clearing of forests across the Earth has been occurring on a large-scale for many centuries. This process, which we know as deforestation, involves the cutting down, burning, and destruction of forests. Slash and burn itinerant farming (which means cutting and burning forest for crop growing, then moving on) as well as clear-cut logging and road building are major causes of deforestation worldwide. The needs of mankind for wood are varied: paper, building, furniture, poles, railways, firewood, charcoal, etc. These needs are difficult to satisfy in a sustainable way, and generally lead to deforestation. Forests are cleared for farmland and grazing land. Road building through forests is a source of damage and facilitates human encroachment.

What is the problem?

Mankind has been burning forests ever since he began mastering fire, hundreds of thousands of years ago, long before the appearance of settled agriculture. It was used as a hunting method, to chase the prey out of the forest. However, human population was very small so man's impact on his environment was probably negligible, during his hundreds of thousands of years as a hunter-gatherer.

Settled agriculture began about 10'000 years ago, according to archeological record. This means that for over 90% of his existence, Homo Sapiens was a hunter-gatherer. However, he may have practiced shifting agriculture well before he adopted a settled agricultural lifestyle.

Slash-and-burn itinerant agriculture was routinely accused by agricultural experts of being destructive, but increasingly it is recognized as being a sustainable form of coexistence of agriculture and forests, if practiced with care and knowledge, on a small enough scale to allow regeneration. (the Yekuana Indians in Venezuela practice it today)[\[1\]](#)

So what? Forests are cleared for good reasons, aren't they? Since deforestation has been going on for such a long time, it must be all right. What's all the fuss?

The first step towards an answer to that question is to meditate on the following graph showing world population growth.

What was sustainable in the not too distant past is no longer sustainable now.

If the current rate of deforestation continues, the world's forests will vanish within 100 years.

The second step is to understand that the loss of tropical rain forest is more profound than merely the destruction of beautiful areas. More than 50% of the plant and animal species live in tropical forests.

This biodiversity is a treasure that mankind cannot afford to lose.

Why?

First: loss of forests leads to increased greenhouse effect, with global warming and climate chaos, according to the prevailing scientific consensus. It also leads to [acidification of the oceans](#).

Deforestation greatly increases the level of carbon dioxide (CO₂) in the Earth's atmosphere. The plants and soil of tropical forests hold 460-575 billion metric tons of carbon worldwide, with each acre of tropical forest storing about 180 metric tons of carbon. When forests and vegetation areas are cut and burned, all the carbon stored in the tree trunks (wood is about 50% carbon) joins with oxygen and is released into the atmosphere as CO₂. This has a huge effect on the global carbon cycle and the greenhouse effect, because CO₂ is a greenhouse gas. From 1850 to 1990, deforestation worldwide has released 122 billion metric tons of carbon. The current rate is around 1.6 billion tons per year. In comparison, fossil fuel burning (coal, oil and gas) releases around 6 billion metric tons per year, so it does actually make a highly significant difference. The greenhouse effect is seen as the main cause for global warming and therefore a huge environment hazard.

Acidification of the oceans, as they absorb excess CO₂ from the atmosphere may be an equally formidable danger to ocean life. In particular, it dissolves the shells of shellfish which reduces the capacity of the oceans to absorb excess CO₂. Greenhouse gas levels today are highest in the last 650'000 years.[\[2\]](#)

Computer models of the regional impacts of global climate change predict drier and hotter weather, with extension of deserts throughout central Africa, including Rwanda. This could be both a cause and an effect of deforestation. Climate change in Africa is the main threat to the survival of many species. These species are confined and protected today in parks. In earlier eras, before human encroachment became predominant, they could have opted for migration in order to adapt to regional climate change- but this option has been eliminated by human development.

Tropical deforestation also affects the local climate of an area by reducing the evaporative cooling that takes place from both soil and plant life. As trees and plants are cleared away, the moisture kept above the ground by the tree canopy of the tropical rain forest quickly diminishes, leaving hot dry air which kills most young plants. Recent research suggests that about half of the precipitation that falls in a tropical rain forest is a result of its moist, green canopy. Evaporation and evapotranspiration processes from the trees and plants return large quantities of water to the local atmosphere, promoting the formation of clouds and

precipitation. Less evaporation means that more of the sun's energy is able to warm the surface and, consequently, the air above, leading to a rise in temperatures. In Rwanda, where 90% of the population depends on agriculture as its direct source of food or income, deforestation and especially the disruption of the hydrologic cycle can have devastating effects. Most farmers already now agree that there was more rain in Rwanda only a dozen years ago.

Second: because biodiversity is necessary for life on Earth. Only 7% of the earth is covered by tropical rain forest, but over HALF of the estimated species on our planet live in this environment. The biosphere depends on the complexity of "web of life" for its stability. Biodiversity = stability.

Third: on a simply economic level, tropical forests have great value. The "secondary" products of forests (particularly medicinal plants and essential oil plants) are more valuable and irreplaceable than the tradeoff wood or farmland.

What about Rwanda?

All sources show that the decade 1990-2000 was calamitous for the forests of Rwanda. These were years of turmoil, culminating in the 1994 genocide, and characterized by huge population movements during which large forest areas were annihilated, mainly for firewood. The total forest cover dropped by 33% and the natural forest cover by 78%. But for many decades, deforestation for grazing and agriculture has cumulatively reduced the region's forest cover. In 2000 it was about 12%. (Figures from <http://earthtrends.wri.org> : World Resources Institute, and FAO). Surprisingly, FAO gives 19.5% forest cover in Rwanda in 2005. If this figure is accurate, they would be a great source of hope, not only for Rwanda, but potentially for the whole world, as it goes to show that it is possible to combat deforestation.

General facts and figures (<http://www.cia.gov/cia/publications/factbook/geos/rw.html>)

Total population: 8.4 million.(CIA, 2005. However, [rwandagateway.org](http://www.rwandagateway.org) says 8.1 million, 2005 http://www.rwandagateway.org/article.php3?id_article=137)

Population density: 338 pop/km². Rwanda is the most densely populated country in Africa.

Population growth: 2.43% (CIA, 2005 estimate)

Population 0-14 years old: 42%

about 90%of the population is rural ([rwandagateway](http://www.rwandagateway.org) gives 83%)

GDP per capita: \$ 1300 (CIA, 2004 estimate)

Per capita income (yearly) : \$ 220.

Most of the people survive on less than \$2 per day.

Infantile mortality: 10%.

Death during childbirth 1%

Death rate under 5 years of age: 18.7%.

AIDS infection 3%-9% (esimates vary, 3% is the most recent estimate by a Rwandan census, *TNT*, 2005/11/27)

Forest figure highlights for Rwanda

- 19.5% of Rwanda's land area, or about 480,000 hectares (4,800 square kilometers) is covered with forest according to FAO figures from 2005.
- About 10.8% Rwanda's forest is classified as "protected"
- About 76.2% Rwanda's forests are classified as "production forest."
- Between 2000-2005, Rwanda gained about 136,000 ha of forest. Rwanda's 2000-2005 total reforestation rate was about 6.9% per year meaning it gained an average of 27,000 ha of forest annually.

What is Rwanda doing about it?

Rwanda has signed:

- o Convention on Biological Diversity
 - o United Nations Framework Convention on Climate Change
 - o Kyoto Protocol
 - o Convention to Combat Desertification
 - o CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna)
 - o Ramsar Convention on Wetlands
- All figures are derived from THE FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS' State of the World's Forests 2005.

The government of Rwanda, several years ago, aware of the environmental problems facing the country, adopted a **policy of reforestation**. There is an annual national tree-planting day. The tree-planting campaign which is operational all year round, is supported by tree nurseries supplying free saplings. These nurseries are run by schools and government-promoted local community groups.

Here is, *in extenso*, the editorial of [The New Times](#), 2005/11/16-17. *The New Times* is a governmentally backed newspaper.

Environmental conservation a must

On Monday morning, the nation went out to plant trees, fulfilling the government policy of environmental preservation. However, beyond implementing the governmental policy, tree planting should be embraced wholeheartedly for its obvious benefits to Rwanda and her citizens. Soil erosion is currently the number one cause of environmental degradation, occurring mainly because farmers have cleared forests for agriculture. The result has been that runoff from rainfall has carried away tonnes of soil into streams and rivers causing silting in addition to decreased soil fertility and lowered harvests for the very farmers who cleared the land. To reverse this paradoxical situation, tree planting has to be carried out if nothing else, to prevent increasingly infertile soils from causing famine. In light of the current power shortage nationwide, increased tree cover becomes more imperative. Trees, as any child in primary school will tell you, are second only to large water bodies in the creation of rainfall.

The years of unbridled deforestation have taken a toll, causing longer dry spells and even drought in areas like Bugesera and Umutara. Reduced rainfall has also led to water levels going down at the power generating plant at Ntaruka, Ruhengeri leading to widespread black-outs and the purchase of diesel generators at a time when fuel has become unbearably expensive. All these are only some of the reasons for planting trees and the importance of this activity cannot be overstated. Next time round, let's go and plant trees with enthusiasm and not only because we are fulfilling some abstract government policy.

Here are some extracts from a front-page article from the same issue of *The New Times* (*TNT*) that highlight the intent and scope of the governmental tree-planting campaign.

“You must monitor and protect the trees that have been planted today so that within the next five to ten years we realise the benefits”, the President implored, adding: “It would be absurd for a country like Rwanda that is endowed with water, fertile soils and forests to suddenly change into a desert due to deforestation.”

He also called for concerted efforts to protect the trees. “As we join hands in planting these, we should also join efforts to find out solutions to rampant tree cutting,” he said, citing examples of coffee and timber husks that are now used as a substitute to firewood and brick-baking.

...The Minister of Lands and Environment, Drocella Mugorewera...:

“It is only if we do it that in the next two years the tree planting exercise will have covered all identified places”, the minister promised and disclosed that the March-April tree-planting programme will focus on hilly areas and communal settlements.

The Governor of Kigali-Ngali, Epimague Nsanzwanda disclosed that eleven million out of the fifty million nursery trees have been planted around the province.

And from *TNT*, 2005/04/20-21:

Over a hundred million trees are to be planted in Kigali-Ngali province, with emphasis on Buliza district, where eleven million trees will be planted. [...]. “Residents must decide where and when to plant trees, rather than wait for directives from the district. The more efforts residents put into tree planting, the more benefits in terms of environmental conservation”, the mayor said.

A closer look at conservation in Rwanda

Nyungwe Forest national park currently havens 250 species of trees and shrubs, 275 species of birds, 25 of which are endemic, 13 types of primates, 100 varieties of orchids and several species of large mammals, including leopards, golden cats, bush pigs, the black-fronted duiker, chimpanzees, black-and-white colobus monkeys, mangabeys and blue monkeys. Its rich biodiversity is unparalleled in Africa. (Rwanda Office of Tourism).

Akagera national park shelters lions, leopards, elephants, giraffes, buffaloes, zebras, hippopotami, crocodiles warthogs, antelopes and several varieties of gazelles, snakes, and fish, more than 525 species of birds, including the shoebill, the papyrus gonolek, and various indigenous species: the ibis, the jacana, the heron, the plover, the sandpiper, and many others. The Volcanoes national park is the habitat of Dian Fossey's beloved mountain gorillas.

Obviously, illegal felling and poaching and arson are persisting threats that could destroy this

diversity, but Rwanda understands the value of these havens, in ecological terms and in economical terms (tourist attractions) and is very serious about conservation. Unfortunately, global climate change, over which Rwanda has no control, remains a serious threat.

A closer look at the tree planting campaign

The following information was provided by the director of the World Agro-forestry Center in Kigali, (alias ICRAF) in an interview conducted by our team member Joshua Cyitaitire, complemented with information drawn from an article in *TNT*, 2005/07/18-19. WAC and ISAR (Institute for Agricultural and Scientific Research) have collaborated in on-farm applied research and extension activities on progressive terracing in the central plateau and the northern highlands of Rwanda.

According to World Agroforestry Center, the most important trees planted for reforestation, are as follows:

In high altitude regions, such as Ruhengeri, Gisenyi (a part), Byumba, Kibuye (a part), Gikongoro, the recommended trees are *Alnus acuminata*, *Mimosa seabrela*, *Mimosa seabrela* and *Polysia fulva*.

In moderate altitude regions, such as Butare, Gitarama, Kigali-Ngali the recommended trees are *Grevillea robusta*, *Cedrela serrata*, *Podocarpus*, *Casuarina equisetifolia*, *Calliandra*, *Leucaena*, *Moringa oleifera*, *Mimosa seabrela*, *Maesopsis eminii* and *Markhamia lutea*.

In low altitude regions, the recommended trees are *Calliandra*, *Leucaena*, *Cassia spectabilis*, *Cedrela serrata* and *Markhamia lutea*.

The wood is used for firewood, building, carpentry, furniture, poles for beans and other crops, posts, fodder, soil improvement, reinforcement of anti-erosion embankments. Some trees thrive in the warmer low-altitude conditions. They grow faster than the trees in the other regions.

As an example, let us consider *Calliandra Calothyrsus*. It is a small thornless often multi-stemmed shrub. Its leaves and pods are rich in protein and do not contain any toxic substances. The leaf fodder can be given to all types of ruminants. The flowers contain nectar and because flowering lasts throughout the year, they are valuable for beekeepers. It is a good firewood species: fast growing, easy to regenerate. The rootstock is very vigorous and will sprout readily. The wood can also be used for staking. It is particularly suitable for erosion control as it dominates weeds, fixes atmospheric nitrogen on its roots, is compatible with crops, and makes excellent green manure with its abundant high-protein leaf biomass.

Tree planting at Green Hills Academy

Here at Green Hills Academy, we recently had our own tree planting day, as a part of a major government programme covering schools throughout the whole country. Our school was supplied with about 6-700 saplings, and another 500 donated by a parent. The saplings were deposited temporarily in our new tree nursery (built with the help of the school rotarian

Interact Club) before they were planted. Currently we are working on extending our nurseries and growing more saplings, and we will turn into a distribution center in our district, giving out free saplings.

Our headmistress, Jill Fenton, with the Environment minister, Drocella Mugorewera.



The minister planting a tree.



Environmental initiatives by various organisations and institutions



Human wastes power Rwandan prisons. The Kigali Institute of Science and Technology (KIST) Center for Innovations and Technology Transfer designed and built a 150 cubic meter fixed dome digester in Cyanguu prison. It produces 50% of the energy needed to cook for the 6000 to 10,000 inmates. This cuts in half the firewood bill (\$44,000 a year). The Rwandan prison biogas facilities received an Asden Award for sustainable energy. (*TNT* 2005/07/13-14)

KIST has made itself an international reputation in the field of renewable energy and other "appropriate technologies": solar cookers, solar electricity, solar hot water, solar dryers, biogas for cooking...

There is a dynamic interplay of high-level and grassroots initiatives, in Rwanda.

Here is an information taken from *TNT* 2005/11/19, about a new type of cooker, the Genius cooker, that burns an ethanol gel that does not emit soot. It is produced by a company called TEKA2020. The company has been operating for over a year, throughout the country, and in other African countries (Botswana, Malawi, Uganda, Kenya, Burundi, DR Congo). Although the cooker is environmentally friendly, the packaging contravenes the environment ministry's law which bans polythene bags in Rwanda. Matione said that he had met the environment minister and discussed the issue at length. "We soon hope to [...] start to supply Gel fuel in 5litre buckets, where clients use the same buckets for refilling". The cooker costs Frw12'000 and the litre of Gel fuel Frw1' 000 (about \$2, wholesale). It can last for 3 hours 20 minutes of continued cooking, and if used sparingly, up to 4 hours 30minutes. It cooks faster than ordinary furnaces, at a maximum temperature of 440°C. The price is still relatively high, for poor people. This problem is being looked into.

This picture was taken yesterday (November 29, 2005) at Kigali international trade fair. It

shows the Genius cooker and a bag of ethanol fuel, imported from Zimbabwe. The price of the cooker was actually Frw 15'000, and of the fuel bag: Frw 750. The bags are sold "in any supermarket", according to the vendor.

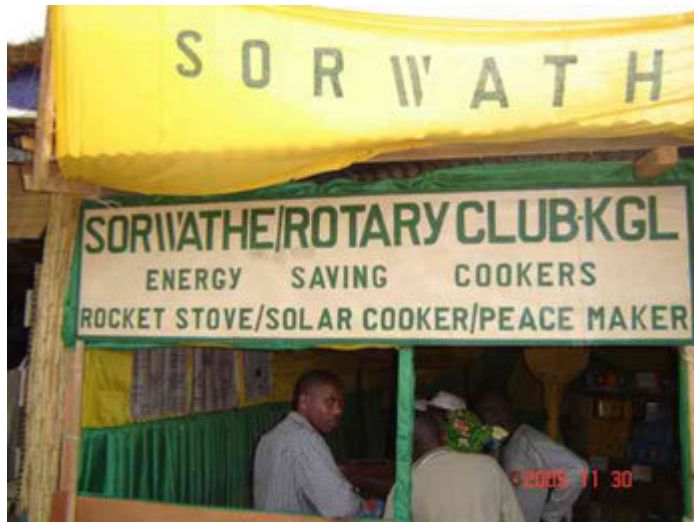
An outfit run by a group of women in Kigali produces fuel from collected and selected garbage.

A company called Solar Cookers Rwanda is producing and popularizing cheap solar cardboard box-cookers.

A company called Sorwathe, supported by Kigali Rotary Club, manufactures and sells efficient wood-burning cookers (the "rocket stove") and solar panel cookers.



These pictures were take yesterday at the trade fair. During the school science fair, the students of Green Hills Academy made a rocket stove (Tarusila) and a funnel cooker (Joshua) and experimented with solar panel cookers similar to this one.



Difficulties facing environmental campaigns in Rwanda

- Population pressure. Rwanda is the most densely populated country in Africa [\[CIA\]](#)
- Rwanda's population is 90% rural. This factor weighs heavily on the others: availability of land, education of the population, popularizing alternative cooking methods, etc.
- Poverty and health.
- Awareness and motivation.

"The final solution".

The solution, in Rwanda, from our point of view, is to encourage and support all the ongoing attempts described above to preserve forests and plant trees.

Our role in this solution, as students at Green Hills Academy, is to create awareness and enthusiasm for the momentous task that this solution implies. Here are some things we can do.

- Help to create emulation and collaboration between schools in Rwanda and rewards for the best contribution toward conservation and restoration of the environment.
- Continue our experiments in environmentally friendly agriculture and gardening.
- Experiment with the making and use of seed balls for reforestation as well as gardening.
- Continue experimenting with alternative energy saving cooking methods: improved wood cookers, ethanol cookers, solar cookers. Make various models of solar cookers and actually use them. This leads to co-operation with small-scale industries like Sorwathe, as well as with other schools and institutions.

- Explore the possibility of producing biogas in our school, and helping other schools and institutions in this field.
- Create an environment page on our school website and create links with other websites here in Rwanda and abroad.

Conclusion.

Working on this project taught us a lot and has been an inspiration to us. It has given us an insight into the potential contribution of young people towards solving global problems.

Jill Fenton, our headmistress, in her graduation day speech, said "If there is one country that can make dreams come true, it is Rwanda". To make a significant difference in bringing about this solution in Rwanda is our dream. Let us make it come true!