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### **Rwanda: Attaining Food Security - Value Chain Empowerment through Bananas**

Rwanda the “Land of Eternal Spring” and “Land of a Thousand Hills” is a sub-Saharan African country with a tropical temperate climate and high altitude throughout. This land of eternal spring has unfortunately been riven with colossal strife of unimaginable magnitude. While there were wars and mismanagement coursing through Rwandan history, the Genocide of 1994 has left a deep gash in the country. The country is trying to democratize, and reduce poverty while improving nutrition and attempting to eradicate hunger. The recent political stability is an opportunity to improve Rwanda’s food security and enhance its citizen’s prosperity to prevent further violence and bloodshed. Given that 90% of the population are farmers involved in agriculture (Zeller 21), Roger Thurow at the Chicago Council on Global affairs summarizes the problems facing Rwanda today by saying, “Hungry farmers. That is ridiculous, and shameful, oxymoron.”

The diet for average Rwandans consists mainly of sweet potatoes, peas, corn, beans, millet and fresh fruit, including bananas, mangos and papayas. Food insecurity in Rwanda is multifactorial, 30% of sub-Saharan Africa’s population is under nourished; earning the spot for the largest proportion of under nourished people in the world (Africa: Rwanda 2). Acute malnutrition in children decreased from 25% in 2000 to 23% in 2006. However, chronic malnutrition increased from 43% in 2000 to 52% in 2009, according to the Central Intelligence Agency (1).

In 2008, 47% of sub-Saharan Africans lived on \$1.25 a day or less (Zeller 12). Hunger directly impacts poverty, with poverty rates rising by 20% when repeated cycles of violence occur, Rwanda is no exception. Over the years aid has poured into Africa but most of that aid has been “Dead Aid”. Dambisa Moyo an international economist summarizes “Dead Aid” when she says, “In the past 50 years, one trillion dollars in aid has been transferred from rich countries to Africa.” Aid can easily turn into dead aid, so providing empowerment to the individual farmer can prevent aid from dying (Moyo 1). This demands new and innovative sources of nourishment in the poorest countries in the world. It is incumbent on America and the rest of the developed world to provide original, innovative solutions to the people whom the world has turned its backs on. As noble laureate Norman E. Borlaug once said, “... the world has the technology-either available or well advanced in the research pipeline-to feed on a sustainable basis a population of 10 billion people. The more pertinent question today is whether farmers and ranchers will be permitted to use this technology?”

Rwanda’s population has boomed in the last 60 years. The population was over eight million in 2006; this is an increase from two million in 1950 and five million in 1980. It is expected to reach 13 million in 2020. A skyrocketing population with country-wide density of 321 people/sq. km and 1500 people/sq.km in its capitol city Kigali is a significant limiting issue in Rwanda (“Africa: Rwanda” 3). The average family size is 5.5 people consisting of 2-3 children (“Africa: Rwanda” 5). Rwanda also has a high Gini co-efficient, (a statistical figure representing income inequality) increasing from 0.43 in 1990 to 0.54 in 2000. According to the World Food Program, 28% of the population was food insecure with an additional 24% being classified as vulnerable to food insecurity. Only 22% of the population was considered food secure. Food availability remains challenging for Rwanda. Between 2000 and 2008, food production was below the recommended minimum level of 2,100 Kcal/capita per day in all years except 2008 (Switzerland 182). One of the main barriers affecting employment and wage is population density. The high population density reduces the percentage of land used for farming leading to small farms and lowered income for rural families.

Another key factor in Rwanda's plight is education. The literacy rate is 70% which is higher than the 58% in 1991. The average amount of schooling each adult receives is 2.6 years and only 2.8% of the GDP is spent on education ("Africa: Rwanda" 2). It is imperative that people learn about new, innovative farming practices to compensate for limited education. Education can ensure that the land is put to proper and effective use.

According to the Food and Agriculture Organization (FAO), 73% of the land was used for agriculture in 2007 after declining to 56% in 1994. The remainder is lakes, forest, marshlands and mountains. Agriculture is on the rise with a shift to cash crop production from 2000 to 2005 at the expense of food crops, also the agriculture sector as a whole grew 9.5% from 1996-2000. The main drawback facing Rwandan agriculture is its high population density alongside limited natural resources; this has led to major reduction in farm sizes hurting the agricultural economy. While the country is small with a land area of 10,169 sq. miles, the average farm size ranges from .34 ha -1.34 ha with an average plot size of 0.81 ha. In 2002 11.5% of population was landless, 28.9% had access to less than 0.2 ha, and in 2006 more than 60% of population cultivated less than 0.7 ha. Fewer than 5% cultivate more than 5 ha. Farming predominantly remains subsistence agriculture (FAO 2). The small farm sizes mean that rural population cannot produce enough food and are struggling with the limited crops they can harvest.

The main cultivated crops are bananas, cereals, roots and tubers, legumes, fruits, vegetables and coffee for export. In 2008, 21% of the land was devoted to bananas followed by 20% for beans and 9% for cassava. There is no artificial irrigation; almost all water dependence is on rain and groundwater. Over 80% of Rwanda has more than 750 mm of rainfall annually accompanying two rainy seasons and two dry seasons. Most of the soil erosion occurs during the second rainy season which is longer and more intense than the first. Heavy rains with steep slopes, tillage and a lack of anti-erosion planting increases land erosion and degradation. The soil loss from the hillsides is approximately 100 mm per year. Unless the farmers adopt more terrace farming or other innovative techniques, their food sources will be unsustainable ("Rwanda State of Environment Outlook Report" 2). Terrace farming is used for many crops but has recently been used for bananas. Bananas are the 2nd most exported crop for Rwanda and are utilized in many aspects of daily life. One of the main struggles is the processing and handling of the crop and marketing the traditional uses of the fruit (Mukantwali 2). Unless modern methods are utilized for Rwanda's main crops, such as bananas, malnutrition will continue to rise and poverty will persist.

Most of Africa is malnourished, but there is a solution through bananas. Scientists at the National Agricultural Research Organization have developed a nutritionally enhanced, disease resistant banana. The new banana has up to 600% more vitamin A than normal bananas and scientists are working on ways to boost the iron content ("Better Bananas" 2). These new enhanced bananas could prevent malnutrition and stop iron deficiency in the region. A major problem for consumption of food is its storage and limited processing facilities. This leads to circumstances where farmers sell their produce while harvesting at low prices and a season later they buy it at a higher price when they are running low. The peak hunger seasons for Rwanda are March and April and to a lesser extent in September and October. Rwanda is a net importer of food and this appears to be rising. It is a net exporter of tea, coffee and bananas to a lesser extent. Unfortunately for Rwanda it is at a competitive disadvantage vis-à-vis its neighbors Kenya and Uganda. This is increasing its current account deficit, further threatening food availability and national stability.

The fourth largest food crop in the world is the banana and grows all across Rwanda. Every hill in Rwanda is dotted with the large herb. Though Rwanda is the 149<sup>th</sup> largest country it is the 10<sup>th</sup> largest producer of bananas. The banana has a multitude of benefits for the farmer. When utilized properly, it produces yield for many years, while producing a bunch of bananas every four months. Even a modest banana plantation can help the farmer with a perennial food supply and regular income. Banana leaf

foliage can reduce soil erosion and is good source of mulch and organic matter for the fields. Researchers across the globe are finding new uses for the plant, most importantly for replacing wood and thereby reducing deforestation. Although bananas are an important staple crop in Rwanda the yield has decreased by 45% in some locales due to lower soil fertility, erosion, and spread of diseases and pests. This is cause for concern and needs to be addressed on multiple fronts.

Toby Hemenway, a leading author on earth's ecological issues, talks of the potentials of bananas when he says, "The plants we have chosen will collect and cycle earth's minerals, water and air; shade the soil and renew it with leafy mulch; and yield fruits and greens for people and wildlife". The plant that meets all of these criteria is the large herb growing about 30 degrees on either side of the equator for centuries—namely the banana plant. Bananas are used to cook, make desserts and beer or wine. The ancient traditional process while effective is not always efficient or hygienic because the juicing process consists of a plastic funnel and grass. If new filtering and juicing technologies are implemented, the increased sanitary productivity rate could help the Rwandan economy greatly. Another bountiful use of a banana lies in developing its dried stem. The stem is very fibrous and can be used for clothing and other handicrafts (Mukantwali 1). The U.S. Government gave a \$50 million dollar grant to Rwanda that is helping farmers adapt crops and develop terrace farming which reduces erosion, improves the quality of the soil and increases crop yield, this is all occurring across 30,000 hectares of land (Government of the United States 16). Despite this help Rwanda still struggles to generate employment and wages.

While crop yields are going down in Rwanda, fertilizer use is liberating the average farmer. An USAID study carried out by International Institute of Tropical Agriculture (IITA) showed that modest fertilizer use can increase banana yield from 10 to 20 tons/ ha/ year. Fertilizer is used by less than 5% of farmers. Minimal fertilizer use increases the yield and reduces the crop turn over time. Increasing use of tissue culture bananas would increase the yield substantially, allowing for financial and nutritional benefits. As One Acre Fund has shown a banana loan package (a plantlet with fertilizer, transportation and training) costs US \$1.60 and the stem of the bananas produced sells for US \$3.93 with a higher return of investments in the following years (Government of the United States 6).

All of these solutions will be annulled if disease destroys banana crops, but recent breakthroughs have found a solution to this. Scientists have tested a spray-on coating called "hydrogel" made from chitosan, a derivative of shrimp and crab shells. "We found by spraying green bananas with a chitosan aerogel, we can keep bananas fresh for up to 12 days", said Xihong Li, professor at the Tianjin University, China. Li's team concluded that the hydrogel can kill the bacteria that causes the bananas to rot and slows down respiration in the fruit prolonging shelf-life (Steinberg 1). A recent study discovered a strain of bananas resistant to a common fungal disease that is currently rampaging through East Africa. A new breed of genetically modified bananas has shown signs of being resistant to a Black Sigatoka disease which has been killing bananas throughout Africa resulting in losses of up to 50%. Chemical control can be expensive and not viable for the poor farmers in Africa so these recent findings are imperative for managing the disease (Casozi 1). Plants are already programmed to fight infections in the wild, which includes wild bananas. The genome of the fruit has recently been sequenced so this could lead to future breakthroughs (Mestel 2).

Rwandans today have many uses for bananas; a main one involves juicing. A restriction in manufacturing banana puree is its tendency to brown rapidly. This can be overcome by heating the banana to 80 degrees for three minutes followed by peeling and pureeing. Foot pressing or hand mashing of bananas needs to change into mechanical hydraulic clean presses. The presses need to be provided to farm groups so that they can handle the banana in a safe manner. This puree where cold preservation is available can be converted to juice. If cold storage is unavailable then beer and wine can be made as end product. Opposed to traditional juicing methods, a student at the University of Johannesburg designed equipment and concluded that farmers could use pectinase enzymes to extract pure juice from the bananas (Segawa

14). An alternative is to provide the juicing machinery directly to the farmers, benefitting them and the economy (15). A hydraulic banana press runs from US\$ 2,000-10,000. This is fairly cheap, on scale of the billions of dollars in country aid. One press can manage the bananas produced by several farmers. Here, high population density becomes an asset. A kilogram of bananas costs US \$1.00 locally, when pureed and exported 100 grams costs \$1.00, a 1000% enhancement in value chain. This would greatly enhance the farmers' current daily income of \$1.25 a day. There are many new advances in the world of tropical fruit production; farmers can harness these breakthroughs to ultimately make Rwanda more stable. It is widely known that coffee grounds can be used as an organic fertilizer for fruits that prefer acidic soil. Bananas thrive in pH 5.5-6.5 using the grounds from coffee can provide a cheap organic way to boost crop yields. Organic produce sells considerably higher than regular produce in international markets yielding higher profit margins. The use of coffee grounds as fertilizers and the innovative juicing methods will empower the poor farmer.

The demand for energy in Rwanda continues to increase as in any country trying to find its way out of poverty. Fossil fuels are in short supply in Rwanda. When fossil fuels are supplied from outside they are subject to international price fluctuations and they contribute to increasing carbon emissions. Imported petroleum products consume 40% of foreign reserves. In Rwanda, wood is the major source of energy for 94% of the population. Rwanda Vision 2020 envisions that wood will only make up 50% of energy used by the population. With only 2% of the population having access to electricity, at the current rate of progress Vision 2020 is likely to fall substantially short (Rwanda, Rwanda Vision 2020 10).

The shortage of wood for energy needs is 3 million m<sup>3</sup>. Wood is already in short supply and is being transported great distances with cost escalations of 600% from 1995-2005, creating an unsustainable situation. To improve energy access in remote central areas like Rwanda, bio energy and biofuels other than wood should become the mainstay for long term energy security. Banana-based biofuel would be small scale, near the site of end user, economical and renewable. Unlike jatropha, the banana is not fuel only plant but is a dual purpose plant for both food and energy. For every one ton of bananas produced there is an estimated 10 tons of waste in the form of leaves, stems and skin. All which can be utilized for bio-fuel (Zeller 46). An Australian Company called Growcom created an anaerobic digester where mulched bananas are fed in, and methane gas is slowly extracted. These digesters are practical for on-farm use. The gas can be compressed and stored easily (Goldin 1). This is one way bioenergy adds to the dimension of enhancing food security.

A further use of the byproducts of the banana tree is the banana briquette. These work as an alternative to the traditional firewood that farmers gather. The transition from firewood to bananas will slow the ongoing deforestation. Many critics say firewood is easier to develop, but they are wrong. A single household needs 1.8 tons of wood a year for cooking (Rwanda 5). The way the briquettes are formed is very simple. First, a farmer mashes a pile of rotting leaves and skin then mixes the pulp with saw dust. The product is then compressed, and the mixture is allowed to dry into compact bricks. These briquettes have a very long burning life and are ideal for cooking. The mashing can be done by handheld implements. If extractors costing US\$500-1000 and briquette makers costing US \$1000 are supplied through an aid agency then the process can occur much more smoothly and efficiently. This shifting bioenergy modality will empower the farmers and stop the ongoing massive deforestation in Rwanda (McGrath 1). Reducing deforestation and preserving the mountain gorilla habitat would increase tourism as the country in the heart of Africa becomes more stable. These changes are the key to Rwanda's success.

Rwanda can change dramatically if rural farmers are taught the potential of banana. The use of biomass is projected to increase 2.3% by 2020. So if the growth can be attained, and briquettes are more widely utilized then not only incomes will increase, but Rwanda will become less energy dependent. The banana waste can also be used for methane production which will further assist rural farmers. The incomes of farmers will also rise as they sell cleanly processed puree, beer and juice from bananas. The USAID can

help with this process as NGOs like Heifer International and UNICEF have done in the past. Their model could be the basis for the new help that Rwanda need. Technology is incorruptible, it has proved that it can be implemented anywhere and in the time of need; it has proven useful, as it would in Rwanda.

For farmers to be taught these innovative methods, widespread education has to occur. Educational intervention needs to occur at every level of a bananas life cycle. The farmers need to be educated about tissue culture plants. The plants not only need to be high yielding, but they also have to be the disease resistant variety. The farmers need to be educated on the benefits of genetically modified bananas, so that they can enhance food and financial security. The higher yield of bananas needs better preservation with a longer shelf life. Every banana needs to be used either as food or drink or preserved and marketed. The plants should be used as mulch, fiber, bio-gas or briquettes. Nearly all of these changes can occur close to source, allowing farmers to be part of the decision in the value chain. Keeping the governmental bureaucracy out of day to day operations will help the farmer immensely. Kinyarwanda terms such as ubudehe (mutual assistance), imidugudu (villagization) and umuganda (community service) are traditional concepts in Rwanda encouraging collective citizen responsibility with government encouragement but not government interference.

If Rwanda is to remain the “Land of eternal spring” multiple factors need to change. Change from top or the “trickle-down effect”, as we have seen throughout history, seldom reaches those who need it most. In the long run, there is no better solution than empowering farmers. Land is in short supply and redistribution can make limited difference. There needs to be a heightened focus on increased productivity and better preservation of what is produced. Land use needs to include multiple crop rotations in the same field, and the same crop being put to multiple uses. Wastage has to be reduced and nothing can be discarded without serving a useful purpose. Education is empowerment, and to empower a country, one has to start with the farmer, after all 90% of the Rwandan population is agriculture based.

Rwanda needs aid that will help those who need it the most. Rwanda needs the kind of aid that will teach people how to live better for the long run. This will bring both food and financial security because one can seldom exist without the other. Empowerment, education and bananas are the answers to Rwanda’s success. While 60% of farmers have less than 0.70 ha it can still be a field of their dreams for food security and way out of poverty and hunger. As the US secretary of agriculture Mr. Thomas J Vilsack said in 2010, “Food insecurity is first and foremost a moral issue. We should all feel a humanitarian imperative to take on the challenge and ensure that children do not go to sleep hungry. Working to eliminate food insecurity across the globe will provide incredible economic benefits to developing and developed countries alike. It will increase political stability in conflict and poverty stricken regions, and put these countries on a path to future prosperity.” Nowhere in the world does his statement hold truer than in Rwanda as the history of brutality has shown. The time to act is now.

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