Margaret Baker  
Scottsbluff High School  
Scottsbluff, Nebraska

Making the Most of Costa Rica: Agriculture and Natural Resource Stewardship

Introduction

Throughout the world our food is the product of the soil. The loss of soil means the loss of food. The natural balance between soil, water, and the atmosphere never stays the same. So, the ability to adapt to, or control these changes requires planning. Factors that affect these most fundamental natural resources include industrial and residential development, modern agriculture and forestry practices. As the nations of the world strive to find ways to improve the lives of their people, the nations must, then in turn, discover ways to secure means to feed their people. The maximization of the natural resources and agricultural techniques must find a balance so that the basic right to sustain human life is maintained.

The topic of “securing” food, means finding ways to utilize natural resources, particularly land and soil, in harmony with nature. The Central American nation of Costa Rica may stand out in the world of nations as a beacon of hope to attain such a harmony, and by extension, provide food security. Because of its enormous natural resource assets, productive potential, and challenges, this country has become a positive example for the rest of the world to study.

This paper will describe Costa Rica’s natural resources, how they have been especially affected by agriculture, and the current status of those resources. Suggestions will also be offered for the future of Costa Rica’s agricultural practices.

To set the context for this discussion, let us briefly overview Costa Rica’s current agriculture status. Because of Costa Rica’s fertile land and frequent rainfall, Costa Rica’s economy has historically been based on agriculture, but this has been changing. Up through the 1960’s, agriculture employed over half of Costa Rica’s workforce. Currently, agriculture employs about one-tenth of the work force. Tourism has grown in importance because of the country’s extraordinary beauty, coastlines, and biodiversity. One-fourth of Costa Rica’s land is in national parks, some of which are adjacent to attractive coastal beaches, which are appealing to retirees, families, and eco-tourists. Costa Rica’s participation in Central America’s Free Trade Agreement (CAFTA) has encouraged industries such as Intel and Proctor and Gambel to expand in Costa Rica. Thus, in the last decade, electronics exports have replaced both agricultural and tourism as the top industry. Exports continue to become more diversified due to increasing growth of the high-tech manufacturing sector dominated by the microprocessor industry, and demands for medical equipment.

Most parts of the country are accessible through railroads and highways that link both coasts, and the Central American isthmus provides easy cross-oceanic access to foreign markets. For energy, Costa Rica has installed 12 hydro-electric plants on its fifteen rivers, making it nearly self-sufficient in energy needs, except in periods of extended dry seasons. However, Costa Rica has not developed its offshore oil reserves for environmental reasons, so Costa Rica is completely dependent on imports for liquid fuels.

In terms of “security” Costa Rica has chosen its citizenry’s living standard over external and internal threats which plague its neighbors on the Central American isthmus. In 1993 Costa Rica declared permanent neutrality; instead of supporting a military they provide social services such as healthcare, insurance, education, and a strategic infrastructure like roads, telecommunications, and energy. Costa Rica boasts a 96% literacy rate with most graduating twelfth grade. Immigration, primarily from
Nicaragua, has challenged the Costa Rican government’s ability to sponsor these social systems. Illegal immigrants that benefit from the system severely strain the system because they do not pay into it. Still, although up to 20% of the Costa Rican population (not including illegal immigrants) is below the poverty line, compared with its’ Central American neighbors, Costa Rica has a high standard of living.

**Biological Zones and Agriculture**

Topography, temperature, and rainfall determine the biological zones of Costa Rica. To understand the natural resources and the interplay of agricultural practices these “zones” must be appreciated in light of how food is produced and can be safely sustained. For example, biological zones less than 1000 ft. in elevation are mostly populated by native species common to South America. In zones above 1000 ft. the species resemble those of North America. This description will therefore serve to compare those zones with present ecological systems after centuries of agricultural production and development in Costa Rica.

**Tropical Dry Forests** are sparsely vegetated with two canopies: the tree level and the under story. The under story is a layer of small open crowned trees and thorny shrubs, and the taller trees have short stout trunks with large, flat topped crowns, which are rarely taller than 50 feet. This ecosystem developed under long periods of desiccating heat, and covered the Pacific coastal lowlands of Costa Rica and neighboring countries before the arrival of the Spanish in the 16th century. These tropical dry forests were disturbed by the Spanish and generations of Costa Rican farmers and ranchers in order to develop the land for cattle and forage production. Currently the tropical dry forests occupy only two percent of their former range, most of which has been replaced by savannahs colonized by imported perennial and annual species. The soils in this area consist of relatively rich alluvial matter and rich volcanic soils, which produce good crops and grassland. Irrigation during the dry season has increased the agricultural value of this land and further decreased the already diminished dry forest patches.

**Tropical Rain Forests** are remnants of the Cretaceous Period. These bands of thick, complex, evergreen forests now exist only near the equator. According to Philip Greenspun (Costa Rica, Ecosystems, 2009), “tropical rainforests contain over half of all living things known to man. Costa Rica alone has as many plant species as the whole of Europe, and the number of insect species in a hectare is so great that no successful count has been made. Entomologists have collected from just one species of tree over 950 species of beetles alone!” Tropical rainforests’ canopy is its richest strata in plant and animal diversity. It is so thick that only small beams of light hit the ground, and in a torrential downpour, it can take ten minutes for rain to make its way through to the floor. Because of the lack of light, the floor is relatively open compared to the canopy, and is the site of rapid breakdown and recycling of nutrients. A leaf on the rainforest floor will completely disintegrate and be taken up and recycled within a month, compared to over a year for a similar process in North America. The thick canopy protects the forest floor from erosion and varying weather conditions, much like a vaulted cathedral ceiling.

Costa Rica was once 99 percent forested, but forest cover has steadily diminished. During the 1940 about 80 percent was forested. Today estimates claim only 35 to 50 percent of the rainforest still exists, measured as amount of ground covered by canopy. The largest contributors to Costa Rica’s rainforest destruction have been expansion of farm ground for coffee, bananas, pineapples, and cattle pastures. During the 1970s and early 1980s, vast stretches of rainforest were burned and converted into cattle lands, mainly for export to the United States. These exports are no longer a driving factor; however farmers diversify their operations with cattle in order to withstand crop market variations. Cattle have also stabilized farm income from severe weather which has destroyed cash crops, but left cattle largely unharmed.
Removal of the forest canopy not only obliterated many species, but also exposed the underlying land to erosive forces. Grasses for grazing stabilize the ground to a certain degree, but not successfully when cattle trails on hillsides receive torrential downpours. Ironically, deforestation for cattle grazing has actually caused mudslides, causing crop losses. A cleared rainforest is also not best suited for grazing because grasses grown in warm climates, with great amounts of rainfall, lack nutrient value. Cattle ranchers in previous rainforest are therefore faced with purchasing and transporting expensive feed supplements.

Coffee plants provide more stability than grazing land if terraced well, however not near the protection provided by the rainforest canopy. Crops such as bananas and pineapples planted in large tracts on corporate farms lack natural protection against disease found in a more biologically diverse environment; therefore these crops require pesticide and herbicide applications, which can degrade soil and find their way into drinking water and streams. Pineapple plantations leave the greatest amount of soil exposed for erosion. Bananas are vulnerable to a fungus which requires using a fungicide if the fruit is to be stored and shipped. Farming and harvesting on steep rainforest hillsides makes machinery use more difficult, adding extra expenses in terms of time and real costs, and of course more wear and tear on the land.

*Mangrove Swamps* are groups of trees which grow on the land/sea interface and thrive in salty, aquatic conditions. The five existing species grow densely in estuarine and brackish waters and function to stabilize the land from the tides and violent fluctuations in river flow. Soil containing silt and nutrients which would otherwise wash out to sea are captured in the mangrove’s mat of roots which cover the fine grained, oxygen-less mud. This mat forms the fertile basis for the aquatic food chain, generating algae, microorganisms, oysters, sponges, and schools of young fish. Mangrove’s seeds germinate on trees and either drop in low tide and establish themselves, or float in high tide and colonize elsewhere. Eventually a colony of mangroves turns into a swampy forest, and enough sediment is captured to build up higher ground. In the course of about 10 year’s growth in such conditions, the mangroves die, high and dry, on reclaimed land from the oceans and rivers, while new mangroves have colonized. Although mangroves are protected by law today, they are still vulnerable. Mangroves have been harvested for boatbuilding, charcoal production; but erosion, coastal development and pollution have taken the greatest toll on mangroves. Soil erosion from upstream erosion prone farming practices, sewerage, oil spills and chemicals used in agricultural applications over stress and kill mangrove swamps, and are at the same time detrimental to much of the coexisting swamp life.

Through poor soil management, decreased productivity and profits, and increased expenses occur throughout watersheds and beyond the coastline. In both dry and tropical forests, destruction of the native flora for agricultural purposes has led to degradation of the soils, resulting in decreased productivity of the land. Cattle and machinery traffic compact the soil, and agrichemicals such as pesticides herbicides kill the micro flora and fauna in the soils. Between the degradation of this living aspect of the soil and physically compacted soil, heavy rainfall is less able to penetrate the soil, and washes away soil (and pollutants) with it. In areas of intermittent dry periods, less water is stored in the ground for later use. As farmers, ranchers, and foresters are left with less productive ground, there is a temptation to extend unsustainable practices into new territory, expanding the problem. Downstream, excessive silt deposits fill in reservoirs, reducing capacity behind hydro-electric plants. This ultimately increases energy costs and overhead expenses for farms. Even further downstream, mangrove swamps become overburdened with excess silt and are stressed by pollutants. As mangrove swamps loose their function, aquatic nurseries are lost. Silt, sediments and pollutants which are less likely to be trapped in estuaries are carried out further, threatening coral reefs. These damages to coastal areas result in both a decline in fisheries and a loss of land, which hurts food production, marine ecosystems, and tourism.
Large multinational corporations, such as Chiquita, Del Monte, and Dole produce large quantities of bananas and pineapples in Costa Rica. In order to produce large quantities they have deforested huge areas and relied heavily on agrichemicals.

Reversal of Natural Resource Degradation

Costa Ricans recognize that protecting the soils, which are the fundamental source of agronomic income, will directly protect their long term income. Additionally, the value of natural ecosystems has increased with Costa Rican’s and the world’s appreciation for the relationships between natural communities. A growing awareness and concern about the role of rainforests for global diversity of wildlife and the distribution of carbon for global climate is changing the value many Costa Ricans place on native ecosystems. A tremendous value also lies in medicinal organisms found in many species in the rainforests.

The model for land-based businesses from the family farm to corporate agribusinesses is changing as income is received for restoring and or preserving Costa Rica’s natural ecosystems. Currently, both ecotourism and markets for products which promote environmental stewardship make sustainable agricultural practices more economically feasible for farmers. On the Pacific side, ranchers and dairy farmers are implementing practices which protect and encourage expansion of tropical dry forests. Adoption of some new forage crops allows ranchers to stabilize the soil with legumes while adding necessary nutritional supplements for their cattle. Examples include the forbs *Arachis pintoi* which supplements native grasses during the wet season when grasses grow too quickly to provide needed protein content, and *Cratylia argente*, which is grown to supplement sugarcane during the dry seasons when forage is scarce. Research has shown that these practices have increased milk production in cows and the rate of gain in calves especially during the dry season. Additionally producers benefit from reduced costs of importing supplement. The greater initial input to the cattle operation reduces longer term pressure on the grazing lands. In an effort to protect remaining pockets of tropical dry forest, environmentally conscious ranchers and farmers burn firebreaks around the existing pockets so that trees and shrubs may germinate and take hold. In some cases ranchers have begun planting trees and shrubs in order to lure certain bird species that are responsible for seed distribution for more rapid dry forest restoration.

The Small Sustenance Family Farm

Coffee production was encouraged by the Costa Rican government during the 1800’s, and many small family landholdings from those policies still exist today in tropical rain forest zones. A typical Costa Rican “Tico” family farm now supports their immediate family as well as produces some extra food to be sold at the market. Most families have a plot of land, and when the children marry they build a home next door to their parents. Production animals include beef and dairy cattle, pigs, and chickens. One animal at a time is typically slaughtered, and is then shared amongst the entire family. Typically each farm has a few cows for milking and they produce their own butter, cream, and cheese from the milk. Fruits and vegetables grow plentifully, so each family harvests this weekly for sale at the market. Cooking at home is simple, with rice and beans being the staple ingredients. The farms are taken care of by all members of the family, although more office and industrial jobs are available now for some family members to travel into the city for work.

My sister, (a veterinary student at Iowa State University), recently travelled to northern Costa Rica and stayed with a Tico family on a typical farm. This family lived on approximately 25 acres in the mountainous rainforest. The farm included a small herd of five cows and numerous chickens. The cattle grazed on the mountainside pastures and were also fed mangos, yucca, molasses, and other left over fruits. A few of the fruits and vegetables that were grown there and sold at the market included: plantains,
mangos, lemons, limes, breadfruit, pineapple, yuca, peppers, beans, corn, and avocado. Each meal was
home cooked; including home-made tortillas, fresh milk, butter, ice cream, rice and beans, beef, pork,
chicken, or fish, fresh fruit and vegetables, plus a different type of fruit juice nearly every day. The farm
family she visited rarely purchased food. She also observed that practices of this family farm did not
significantly increase erosion, farm generated waste was recycled as manure, and diversity plus near
immediate consumption avoided the need for many agrochemicals.

A simple search on the Internet provides multiple websites for smaller family farms in Costa Rica
which have transitioned to practices such as shade grown coffee, and have reduced energy consumption,
diversified organic farming systems, and grow a kitchen garden to provide a variety of food for the
family. These farms take advantage of the niche market for eco-friendly, good quality food. An example
is the Brenes Farm in Monteverde. This family has converted its farm into a showcase for organic
farming and simplified living, and advertises coffee plantation tours and links to other tourist services.

Along the coasts, efforts are in place to restore mangrove swamps through government sponsored
pollution control efforts and plantings along disturbed coastal sites. Government organizations such as
the Department of Health and non-profit environmental groups are responsible for such efforts. The
benefits to these efforts are and will be realized by all people who directly or indirectly benefit from a
stabilized coastline and clean productive estuaries and marine systems.

Recommendations for Natural Resource Protection and Sustainable Agriculture

Norman Borlaug recently wrote: “Given the right tools, farmers have shown an uncanny ability to
feed themselves and others, and to ignite the economic engine that will reverse the cycle of chronic
poverty. And to escape from poverty offers a chance for greater political stability in their countries, as
well.” The smaller more eco-friendly farmer and academic research has an important role in helping us to
explore natural ecosystems as a model or tool to the future of agriculture, as opposed to the older notion
of subduing a wild wasteland. However, Costa Ricans must find a compromise between small family
“eco-friendly” sustenance and niche market farms, and larger farms which produce the bulk of exports.

The future challenge, beyond current efforts, is to safeguard the progress which has been made in
Costa Rica. Continuing on the same path of preserving and expanding these forests of great value and
potential future value is important so that degradation can be stopped in an area which is a critical part of
our global ecosystem. More study of tropical ecosystems must be a priority so that we better understand
and learn from them. The possibility of better and more efficient sustainable farming practices will likely
come from better understanding of native ecosystems’ complex productivity and the natural strategies
these systems have developed to produce and protect life. Agricultural practices will likely become more
productive in the long run by working within or simulating these natural systems.

Continued dynamic cooperation between the government of Costa Rica with organizations
supporting the conservation and sustainable agriculture trend which is developing there is crucial to Costa
Rica’s success. This well educated country is an ideal position to foster strong communication, higher
education, research, and implementation. Wise, long term investments and philanthropic projects from
private enterprises hold potential for Costa Rica as well. These combined efforts will move Costa Rican
farmers and ranchers beyond the current step of sustainable farming on reclaimed mountainsides with
highly productive but less sustainable corporate farms to sustainable and conservation oriented, very
productive farms balanced with pristine forests.

Several research topics of special interest look to canopy farming and canopy silviculture
supported by the Associated Circle of International Canopy Farmers. Another area of research with great
practical potential is fine-tuning density of shade-grown crops, such as coffee, for optimal benefits
production and diversity benefits. These agro-forestry ideas have potential especially as buffer zones around protected forest. Multidisciplinary approaches which change and give economic value to undisturbed native ecosystems on the basis of carbon or even toxin sequestration, and to wildlife migration patterns and diversity may help Costa Rica fund advances in conservation approached agriculture and land use, and costs associated with sharing and implementing the knowledge from these studies.

**Conclusion**

Costa Rica’s history shows that sometimes overusing and abusing natural resources makes the most sense economically—because short term profits may be most important to the people who control land use. It takes a different mindset, good workable ideas, and sometimes artificial economic incentives to care for natural resources in the long run. That is a tall order for any country, but an important one.

Turning again to Borlaug, “If we are to capitalize fully on the past biological accomplishments and realize the prospective accomplishments, as exemplified in my dream, there must be far greater investments in research and education than in the past.”

Costa Rica has chosen a direction within the past decade or two which is reversing the trend of natural resource degradation. Wisely, the country, groups inside the country, and help from organizations outside Costa Rica have chosen to preserve and encourage the expansion of the rich native ecosystems unique to Costa Rica. Sharing and applying the science of what we know about wise and appropriate uses of natural resources, and respecting and pursuing what we do not yet know, is important to the future of Costa Rica, its neighbours, and our world.
Bibliography


<http://www.nature.org/wherewework/centralamerica/costarica/>. 


Costa Rica was once one of the most deforested countries in the world. Today it is a pioneer in reforestation, forest management, and the Bank’s 1993 Forest Sector Review of Costa Rica probably have had the greatest impact. Costa Rica’s Influence Costa Rica is one of the few countries in Latin America to promote reforestation through incentives such as tax credits, direct payments, and subsidized loans that have benefited landowners, large and small. Among the important steps Costa Rica has taken are the following: The Natural Resources Administration has merged the administration of forest and protected area activities into one unified organization. Safeguarding natural resources has become a priority for policy-makers who have extended protection to include secondary rainforests, which regrow naturally after being cleared or degraded. More than half of Costa Rica’s tree canopy is now secondary rainforest. Have you read? These charts show just how much forest we’re losing every year. But Costa Rica’s success story is an exception to an otherwise negative rule. Globally, tropical tree canopy loss has almost doubled over the past decade. Image: World Resources Institute. As the above chart shows, 2017 saw the second highest global tree cover loss ever recorded. In that year, researchers at the University of Maryland found an area of tree loss equal to the size of Bangladesh. Costa Rica is then in the privileged list in which there is a net increase and stabilization in the forest cover. Consolidation of the protected areas system of the country. Secondary forest stops degradation of soils abandoned by agriculture and cattle farming, improves back the water cycle and recovers biodiversity, but being an important forest resources also for wood production, secondary forests are mostly devoted for preservation, because of the lack of legal definition about them. Long before 1990, Costa Rica was trying to be independent from food imports; small farmers produced for subsistence and sold the surpluses in the local and national markets of food.