Climate change adaptation in small-holder coffee plantations in Costa Rica

by
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Introduction

Coffee has played an important economic and political role in Costa Rica since 1830s, when it first began exporting the crop to South America and Europe. The government of Costa Rica has heavily promoted coffee throughout the country's history and to this date is highly involved in its regulation.

Approximately 181,000 hectares are dedicated to coffee in Costa Rica from which 40% are fully technified or sun-grown coffee; 10% is traditional or shade grown; and 50% consists of intermediate systems. Costa Rica produces the arabica species only. Various studies indicate that arabica coffee has the highest yields under 35 to 65% shade; nevertheless in the 70's with the help of United States Agency for International Development (USAID), Costa Rica converted many of its traditional shade grown plantations to sun grown in an effort to produce faster, higher yields and prevent the spread of coffee leaf rust (*Hemileia vastatrix*), many coffee plantations began to grow coffee under sunnier conditions. While this manner of cultivation produces substantially increased yields, these cannot be sustained for many years without intensive management (additions of chemical fertilizers and a range of insecticides, herbicides and fungicides); they are also subject to premature death in environments possessing a marked dry season, and they need to be renovated (plants replaced) much more frequently than the shade varieties.

There are about 70,000 coffee farms in Costa Rica and 85% of them are small farms (under 10 Hectares)(Rice,2003). Coffee production is dominated by small producers, which are responsible for more than half of the total coffee production. Large producers account for 25% of the national production.

The social impact of coffee plantations in Costa Rica

Small coffee holders predominate in supplying the bulk coffee harvest. Coffee currently accounts for 11% of export revenues and employs 5% of the nation's labor force, which represents 20% of the rural workforce. Costa Rica accounts for 2.6% of world production of coffee and 20% of Central American production. There are 72,942 coffee growers in Costa Rica, 45,000 of whom are members of

cooperatives (62%).

Although Costa Rica claims a stronger focus on small farmers than in other countries in Latin America, concentration of land in the hands of the few still disadvantages small producers. Most farmers (92%) produce with less than 5 hectares, which amounts to 44% of the total coffee production. In terms of medium-sized farmers, 6% of growers own between 5-20 hectares, accounting for 21% of the national production. However, while only 2% of coffee growers own more than 20 hectares, they produce an entire 35% of the national crop. In terms of processing, the concentration of mills reveals even more disparity; of the 94 coffee mills (beneficios), only 25 are owned by cooperatives. Additionally, there are only 35 roasters and 44 exporters in the country.

The past 3 years have seen a deepening crisis due to record low quality coffee production in Asia. Between 1961 and 2000, Asia increased its coffee exports by 657% in volume and 16 times in value (Rice, 2003). Vietnam which produced almost no coffee in the early 1990s has come out in the last 10 years to settle in as third largest produces in the world with about 12% of the world market (Oxfam, 2002).

International overproduction and low demand of coffee drove prices down to a record low in 2001. The crisis has extended for nine years and has depressed prices to such extent that the cost of production is almost twice the price received. This led to cost saving strategies such as cutting back on jobs that included fertilizing, pruning and weeding.

Since the crisis of 2001 farmers have already found ways to diversify and find alternatives to coffee production (Flores, 2002) such as turning former coffee

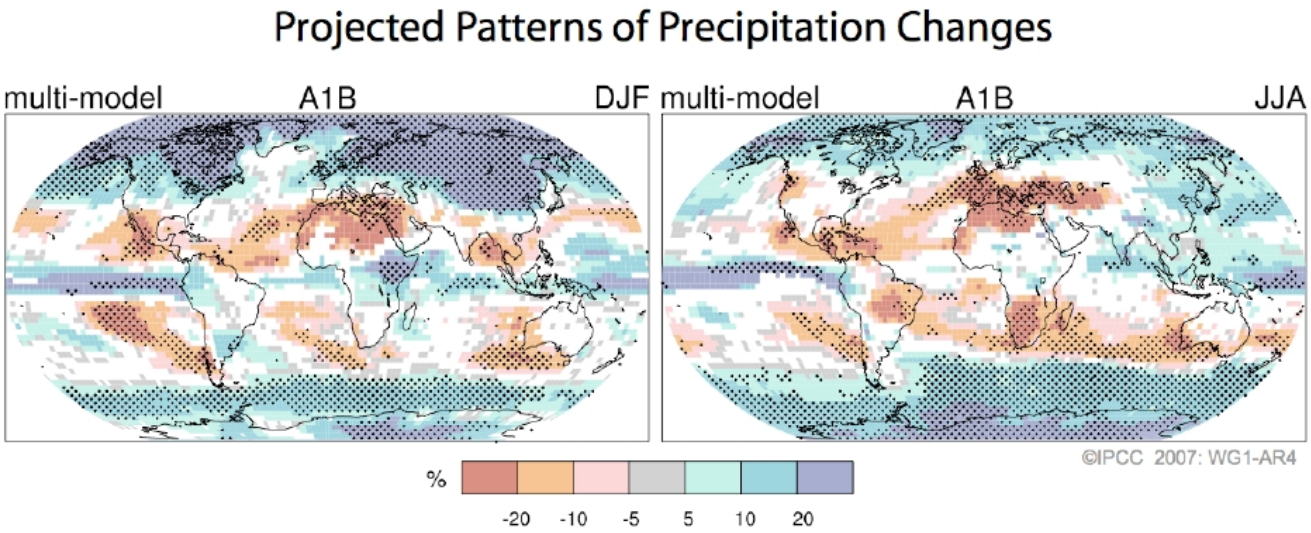
fields into cocoa plantations. Cocoa unlike coffee is less labor dependent and can produce three to four crops per year.

Climate change in Central America

Results of recent research suggest that Central America is one of the regions that is most likely to get both hotter and drier over the course of this century (IPCC 2007). Evidence from Central America suggests that this is already happening. Studies of climate change over the past 2-3 decades in coffee growing zones of Mexico, Guatemala and Honduras indicate that temperatures have risen by between 0.2°C and 1°C over this time period, and in some cases rainfall declined by up to 15% (Castellanos et al., 2003). In Costa Rica the precipitation pattern will change with heavy rain in the rainy months and longer drought periods in the dry months (CATIE, 2010).

Climate variation appears to be having significant impact on coffee production in Costa Rica. Over the past four years the El Niño/La Niña climate cycles have increased in frequency. Cycles having alternated from one year to the next; 2004 and 2006 were low rainfall year El Niño years, 2006 having historically low rainfall, while 2005 and 2007 were very high rainfall La Niña years. These fluctuations in rainfall have coincided with the normal biannual fluctuations in coffee production to create extreme highs and lows in coffee production with 2004 and 2006. Clearly this has significant impacts on farm economics and supplies of coffee to buyers.

Some of the drier coffee regions in Mesoamerica may cease producing coffee by the end of the century (Haggar, 2008). Lin et al., (2008) pointed to the mutually reinforcing stresses of climate change and market forces that together have led to the simplification of many coffee production systems in the region. They argue that farmers who depend largely on a single crop (such as coffee) have less ability to cope with periodic crop failure than farmers who use traditional, more diversified farming systems. Eakin et al., (2006) discuss how small-holder coffee farmers in Mesoamerica have been adapting to volatile and declining prices and institutional change especially since the collapse of the International Coffee Agreement in 1989, highlighting the important fact that climate change is only one among several stressors to which coffee farmers need to continuously adapt. Indeed, coffee farmers still tend to perceive climate risks as less urgent than those posed by market volatility (Gay et al. 2006).



Recent studies have demonstrated that development and climate change are closely related in developing countries. The impacts of climate change will be notable on developing countries since they heavily rely on natural resources for their development. Identifying potential risks from climate change has been a key step towards decision making. Nevertheless, all decisions made towards climate change adaptation are also considered steps towards development.

Most of Premium coffee comes from Central America, places like Antigua Guatemala, Marcala in Honduras, Segovia in Nicaragua and Tarrazu in Costa Rica amongst others. In 2008 tropical storm ALMA formed in the Pacific devastating most central American countries. In Costa Rica alone the losses mounted to 20 thousand million colones. In this present year, Agatha was the first devastating tropical storm and damages to coffee plantations are not yet quantified(Reuters, May 2010).

Climate change adaptation strategies in Costa Rica

In absence of targeted adaptation measures, changes in temperature, rainfall and extreme events would have negative effects on coffee production systems, the communities involved in it and their natural ecosystems. Some climate change adaptation strategies for coffee farm plantations have been studied in Mexico by Schroth et al., they have outlined elements of adaptation strategies that they believed would increase adaptability of communities, local institutions and ecosystems to extreme events. I will use these strategies and relate them to my personal perception of coffee plantations in Costa Rica.

Table 1. Adaptation activities that can help mitigate extreme climate events in small-holder coffee plantations in Costa Rica

Activity	Uncertainties/Cons
Promote crop diversification for small farmers	Changing practices is very costly (education, farming techniques etc.)
Promote structurally diverse coffee shade (agroforestry)	Complex relations between crops and trees under drought conditions
Promote diversification of land use (livesock, PES)	Requieres careful market analyses for new options,altesrnative jobs when PES is stablished
Reforest degraded and risk erosion prone lands	Government and institutional help to support projects
Increase water efficiency in coffee production and processing	Requieres low cost credit for small farmers
Strengthen community organization	Widespread negative perception of farmer organizations among farmers

Amongst the most important studied climate change adaptation strategies for farmers, crop diversification seems to be the choice that provides most beneficial short and long term outcomes.

According to studies conducted by Schroth (2009) on coffee communities and ecosystems some of the drier coffee regions in Mesoamerica may cease producing coffee by the end of the century (Haggar, 2008). Lin et al., (2008) pointed to the mutually reinforcing stresses of climate change and market forces that together have led to the simplification of many coffee production systems in the region. They argue that farmers who depend largely on a single crop (such as coffee) have less ability to cope with periodic crop failure than farmers who use traditional, more diversified farming systems. Eakin et al., (2006) discuss how smallholder coffee farmers in Mesoamerica have been adapting to volatile and declining prices and institutional change especially since the collapse of the International Coffee Agreement in 1989, highlighting the important fact that climate change is only one among several stressors to which coffee farmers need to continuously adapt. Indeed, coffee farmers still tend to perceive climate risks as less urgent than those posed by market volatility (Gay et al., 2006).

Agroforestry is also considered a successful climate change adaptation strategy. During the past three decades, agroforestry has become recognized as an integrated approach to sustainable land use because of its production and environmental benefits. Its recent recognition as a greenhouse gas-mitigation strategy under the Kyoto Protocol has earned it added attention as a strategy for

biological carbon (C) sequestration. The perceived potential is based on the premise that the greater efficiency of integrated systems in resource (nutrients, light, and water) capture and utilization than single-species systems will result in greater net C sequestration.

Amongst other benefits agroforestry can, under extreme events, reduce erosion, maintains relative humidity and increases hydric retention in the ground (Camori et al, 2004). Agroforestry also maintains soil fertility due to an increase of nutrient availability,water absorption and increases bush longevity under shadow conditions but decreases seed production (Beer et al., 1998).

Disadvantages attributed to agroforetry use in coffee plantations include an increase in labor costs due to uneven maturation at harvest(DaMatta, 2002); but requires less herbicides due to marginal weed growth decreasing operational costs.

It is important to note that inadequate tree selection could lead to specie competition and also an overproduction of shadow will decrease production and increase operative difficulties for harvesting.

In conclusion agroforestry and crop diversification should be considered as climate change adaptation strategies. Before decision making climate change local conditions and coffee species should be evaluated in order to favor sustainability and productive competitiveness in international markets.

Discussion

Communities have already perceived a change in climate and have began to diversify their crop selection (Personal communication, Reinhold 2010). Though no global review of data on diversification among coffee producers exists, fragmentary evidence suggests that smallholders coffee growers throughout Mesoamerica may in fact already be well diversified specially after the 2001 coffee crisis. Central America small mono-culture farmers have attempted diversification, the attempts have often had limited success. Many of the obstacles to further diversification involve sectorial, macro-level, or regional problems, including for example the size of the market for alternative crops or lack of sufficient transportation infrastructure. Once these constrains are removed, small farmers will diversify on their own (Godoy and Bennet, 1989)

There is a consensus that information on emergency response and the effects of climate change are limited, there is full understanding that yearly climate events will be stronger in the future. Local farmers have noticed heavier rain in the rainy season, it is concentrated and intense (less rain days per year). The heavy rain brings disease epidemics in coffee plants which leads to seed destruction. In Alajuelita the heavy rains lead to flood and increased erosion (Vignola et al., 2009).

Local knowledge is essential to predict future climate events, farmers have been able to identify certain patterns of climate change and are well informed of the consequences of extreme weather events in their localities.

Uncertainty and ambiguity are words often used in climate change adaptation strategies around the world. Understanding and predicting small farmers behavior in climate change scenarios is complicated. All farmers face and perceive risks in different ways depending on their vulnerability and risk aversion that they manage.

Naranjo et al., (2009) suggest that farmers react positively to information received under their own risk level, when information is well presented and choices are well elaborated to their level of understanding. On the other hand, they over invest and overreact when the information of their own risk is not presented and choices are not evaluated prior to their decision making.

Investment decision making in new technologies or crop growing to create crop diversification can be affected by group decision making and strategies adopted by other members of the community. Adaptation costs can be reduced amongst the community if farmers decide to adapt in economies of scale and the learning process id financed by multiple holders. Community adaptation is essential, according to Naranjo et al., decision making under group communication in small holder coffee farmers communities in Costa Rica are 70% more likely to adopt adaptation strategies because of reduced costs and problem understanding.

In conclusion, coffee communities of Mesoamerica will be impacted by more frequent and severe hurricanes. These events will be aggravated by a gradual increase in temperature and changes in rainfall pattern that will make some areas unsuitable for coffee and will force producers to adapt to a new environmental conditions. If given the necessary tools, depending on their specific circumstances and vulnerabilities they may continue to use or increase diverse tree shade in their coffee farms to reduce temperature extremes and hurricane damage. They may also protect their incomes through organized diversification of crop growing, but amongst all this scenario is more likely to occur with strong community organizations that favor group learning and information exchange and that facilitate the access to markets for a wider range of products and services.

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