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Ecuador, Agricultural
Sustainability

Ecuador: Preserving Today to Feed Tomorrow

Nestled in the northwestern corner of South America lies Ecuador; the country with the most biodiversity per square kilometer in the world, yet 64 percent of the population does not have sufficient access to food, and 23.9 percent of children under five suffer from chronic malnutrition. As erosion, desertification, and deforestation plague the country, the hunger rate only increases (Jayroe, 2017).

Ecuador has a population of 17.5 million people and is growing at a rate of 1.4%. The GDP per capita is $6,117.82 (World Population Review, 2019). The average family size in Ecuador is 3.8 people, with 56% of all households containing nuclear families (United Nations, Department of Economic and Social Affairs, Population Division, 2018). It is estimated that 63% of the population lives in urban areas (Ochoa, Rivas-Mariño, & Verstraeten, 2017). Twenty-five percent of the country's total population lives below the poverty line, and it is estimated that 40% of the rural population lives under the poverty line, while 62% of children under the age of one suffer from anemia. An estimated 400,000 people emigrate from the country yearly (World Food Programme, 2020). Ecuador consists of four distinct geological regions: el Oriente (the Amazon jungle); la Sierra (the Andes mountains); la Costa (the Pacific coastal lowlands); and the Galapagos Islands off the west coast (Ecuador, 2020). Small mountain farms provide most of the country's food (Mecham, 2001). Ecuador is the world's largest exporter of bananas. Its economy relies heavily on petroleum which makes up approximately half of the export earnings and approximately a quarter of public-sector revenues (The Heritage Foundation, 2019). Ecuador has more biodiversity per square kilometer than any other country, but with one of the highest deforestation rates in Latin America, it is losing 200,000 hectares of forest per year due to illegal logging and deforestation for agricultural expansion (New Agriculturist, 2012). The maximum size for land holdings in the highlands is 800 hectares of arable land plus 1,000 hectares for pasture (Encyclopedia of the Nations, n.d.).

In Ecuador, the land with better soil is being used for high-return export crops, and the steep lands are being used for stable food production. Due to socio-economic inequalities, farmers in these steep lands are left with little choice other than to exploit the land. These lands are extensively farmed for grain and vegetables with little attempt to preserve the soil (Phillips, 1984). Ecuador is currently facing erosion and desertification problems. The western side of the

country, which is home to its mountainous region as well as the majority of the country's farms, is the most prone to desertification, with 90,000 hectares already suffering from complete desertification (Soil Issues in Central and South America, 2010). Due to high deforestation rates in the country, in favor of plantations, pastures, and cities, only 1-2% of the original forest cover remains. In 1996, Ecuador attempted agrarian land reforms by creating the Ministry of Environment which is responsible for implementing the nation's environmental legislation and regulations (Mecham, 2001). However, the program is underfinanced and does not have the resources to properly implement reform (Mecham, 2001). Conflicting policies in Ecuador's government failed to regulate colonization, extractive industries, such as mining, timber, and oil; and export-crop monocultures, such as shrimp, bananas, African palm oil, and flowers (Mecham, 2001). A boom in oil prices between 2007 and 2014 led the country to experience a period of growth and poverty reduction. The boom hid structural problems such as an inefficient public sector and large macroeconomic imbalances, which became evident when the oil prices fell (The World Bank, 2019).

Conservation agriculture holds the potential to combat Ecuador's current situation. Three principles differentiate conservation agriculture from traditional practices, those being: (i) minimal soil disturbance through either reduced or no-tillage; (ii) permanent soil cover through cover crops, plant residue, or mulch; and (iii) predetermined crop rotations. There is evidence of these techniques being used as far back as the Mayans, who would use sticks to insert maize seeds into unprepared soil. Despite this evidence, the practices have yet to gain traction in Latin America's highlands. In Paraguay, no-tillage decreased soil erosion from 21.4 to 0.6 tons hectares (Barrowclough & Alwang, 2018). No-till farming also saves money by reducing the amount of diesel fuel needed to farm a plot of land. According to the U.S. Department of Agriculture, in the United States when no-till agriculture practices were implemented, farmers went from using six gallons of fuel per acre to only two gallons of fuel per acre. This led to a 306 gallon reduction in fuel use per year, saving the average American farmer $8,500 per 1,000 acres of land (Creech, 2018). Potatoes make up as much as 50% of the calories in the Andean diet. To plant potatoes, however, intense soil preparation is required. In Peru, farmers press seed potatoes into the ground, and groundcover is maintained by mulch or plastic. In Ecuador, bush beans are planted in established pastures, and the cover created by the bush beans reduces soil and nutrient loss. In more temperate regions that implement corn-bean-wheat systems, cover crops such as vetch or clover are grown after the wheat harvest and grow in the off-season, allowing them to not interfere with the farmers' cash crop harvests. In Ecuador, however, the optimum period of growth for the cover crops is the same as that of the cash crops. A proposed solution is intercropping the cover crop with the cash crop. Farmers are wary of this solution due to the fear of reduced harvests. In Brazil, no-till methods for a soybean-corn rotation increased soil carbon by 6.2% (Barrowclough & Alwang, 2018). Soybeans could present itself as the ideal crop for crop rotation in la Sierra. The crop itself grows well in the region, and soybeans act as a nitrogen

fixer through its symbiotic relationship with rhizobia bacteria. It also takes up residual and mineralized nitrogen from the soil (Schmidt, n.d.). In Brazil, 24-25 million hectares are devoted to growing the crop, with 80% of the harvest going towards animal feed, and the other 20% goes towards oil production and human consumption (Global Forest Atlas, 2020). Implementing these practices could also lead to water conservation, thus leading to a reduction in water costs by farmers. Fields using no-till farming methods for multiple years tend to have a high water-holding capacity than fields that are tilled regularly (Creech, 2018).

When farmers begin to practice conservation agriculture, there are a few extra steps that they can take to ensure that their fields remain bountiful. Following the harvest of the previous season's cash crops, the residue of the crops should be evenly spread across fields. This acts as a layer against erosion, and it will allow for a consistent breakdown of organic matter and nutrients. When the plant reside is applied during the fall, it can act as a good base cover throughout winter (Creech, 2018). This takes into account the no-tillage aspect of conservation agriculture by preparing the soil in ways besides plowing, as well as the cover crops which protect the soil from erosion. Crops can also be planted to break up the soil in place of tilling. In the winter, root crops such as the daikon radish can aerate the soil while not making it susceptible to erosion (Creech, 2018). Special equipment can also be used to reduce the amount of tillage required to cultivate land. A roller crimper with a no-till drill is just one option that has the potential to take the place of a plow (Creech, 2018).

The main obstacle for the adoption of conservation agriculture practices in the region is the absence of publicly funded agriculture extension programs. Ecuador's extension services were eliminated in the 1990s, making the diffusion of these practices very slow and difficult (Alwang, Norton, Barrera, & Botello, 2013). Ecuador's economy went in a downwards spiral following a drop in oil prices in the late 1980's, accompanied by rising inflation. When the country began making financial cuts, agriculture took a backseat to the country's other endeavors (Ecuador, 2020). It is currently estimated that only 10% of smallholder farmers in Latin America have access to finance. Changing this statistic could hold the key to unlocking agricultural sustainability in the region. Loan officers being trained in a variety of ways to seek collateral could combat the situation (Varangis, Kioko, Spahr, Hishigsuren, & Miller, 2014). The demand for land or other fixed assets for collateral loans exclude many smallholder farmers from gaining access to loans. The World Bank suggests collateral requirements correlate with the loan size, and be secured by both fixed assets secured with a legal title, and moveable assets backed by a valid pledge. Joint liability of a third party is also used (Varangis et al., 2014). The World Bank also suggests analyzing the cash flow of the entire family unit, not just agricultural activity, to establish loan amounts and payment terms (Varangis et al., 2014). This technique gives lower-income smallholder farmers better access to loans. It also provides a clearer picture of the payment capacity and risk of lending to the farmers (Varangis et al., 2014). Studies performed

demonstrated that microfinance institutions with 50 percent of their portfolio in agricultural lending can be profitable (Varangis et al., 2014). Risk management on the loans include client monitoring, where the loan officer can visit farms to ensure the farmers are abiding by proper conservation agriculture practices. Loan officers can also limit the farmer's ability to grow a certain crop (Varangis et al., 2014).

Ecuador's government also plays a vital role in making sure its population is fed for generations to come. The Ecuadorian government should support an agricultural insurance program to provide support to its citizens. A program was implemented in China and with support (and premium subsidies) from the Chinese government, its agricultural insurance market became the second largest in the world (Mahul & Stutley, 2018). India and Mexico have both implemented agriculture insurance programs which protects farmers against unexpected weather. The farmers' crops are insured against poor weather and natural disasters. Government support of this program in Ecuador could give the country new industries and improve agricultural productivity by financially supporting conservation agriculture practices (Mahul & Stutley, 2018). Ecuador's government should also implement an agricultural extension program. The World back has suggested a new model for agricultural extension programs focused on reducing poverty in rural areas, improving agricultural productivity, optimizing the use of available resources, and protecting the environment by generalizing the delivery of professional agricultural services to all levels of the farming community. The World Bank hopes to accomplish this by strengthening the support of agricultural extension services and provide support to organizations for farmers, provide training to agricultural workers on technical and management techniques by providing equipment, facilities, supplies, and transportation of the extension staff, rehabilitate at least two agricultural training colleges, and finally support financial management and supervision at all levels of the national agricultural extension program (The World Bank, n.d.).

In conclusion, if no action is taken to preserve the already feeble Ecuadorian highlands, hunger will continue to rise among the country's citizens, leading to malnutrition and emigration. By implementing conservation agriculture practices and giving loans to conservation-minded farmers, we will be able to feed Ecuador's population for generations to come.

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