**Introduction**

The effects of climate change threaten coffee production worldwide, increasing temperatures and precipitation variability cause reduced growth, flowering and fruiting in addition to enhancing disease and pest pressures, and suitable land for coffee growth is decreasing across the planet. 

Coffee was a top export for Ecuador from the time it was introduced in the early nineteenth century till the 1970s. It has been slowly rebuilding its status yet both domestic consumption and exports of coffee are expected to increase at a higher rate in the coming years. The Ecuadorian government mapped the most optimal and moderately-suitable growing locations in the country in 2014, using parameters demonstrated in Table 1. The associated map illustrates the concentration of optimal and moderate-condition growing areas in nine provinces; these provinces provide the environment of this analysis.

Intercropping bananas and coffee is one strategy to combat some of the effects of climate change. Banana production provides shade in increasingly warm conditions and helps to financially diversify rural livelihoods by producing another crop for sale. Bananas remain a top export for Ecuador, as illustrated by Table 2, having greatly surpassed coffee production in export value, as well as percent of total of exports. These elements provide an opportunity for coffee development aimed at empowering women in Ecuador; highlighting provinces that have the most hectares of optimal and moderate conditions for coffee growth, lower current coffee production, high banana production and low percentage of working females in agriculture and skilled labor sector.

**Methods**

To visualize the most suitable provinces for women-empowered coffee development projects, several layers of data were incorporated and ranked.

Estimates of the percentage of females working in agriculture or skilled work occupations by province were generated, drawing from estimates made in the 2010 Ecuador census. The provinces were ranked 1-9, with 1 as the lowest and 9 as the highest. This indicates preference for provinces with lowest amount of females in agriculture. Hectares harvested of coffee and bananas in 2012 were calculated as percentage of total hectares by province; following the same ranking system of 1-9, the province with the lowest amount coffee produced was ranked as 1—indicating site preference for lowest coffee production and thus biggest gap potential—while the highest amount of bananas produced was ranked as 9, preferred to encourage intercropping.

The square meters of optimal and moderate-conditions were calculated for province and ranked 1-9 where 1 was the province with the most square meters. Provinces that had no female workers were ranked as “0” to weight scores. Ranks were calculated by adding all rank per province and dividing by the amount of categories. The total rank illustrates ranks for provinces across all categories, combining moderate and optimal locations. Ranks closer to 1 indicated provinces that had low percent of females working in agriculture, low amount of 2012 coffee production, high potential for optimal and moderate condition growth and high amount of 2012 banana production.

Ranks were also calculated illustrating only moderate or optimal conditions, as well as only incorporating percentage of females in agriculture and land in moderate and optimal coffee growing conditions.

Final ranks calculated as 1 = most suitable and 9 = least suitable.

**Findings and Limitations**

The full ranking range spanned 1-9 but no province ranked number 1, indicating some limitation to any site for “perfect” suitability. Considering all variables, Guayas is shown to be the most suitable for women-empowering coffee development projects, a location that interestingly has very minimal optimal growing locations; it does, however, have a very low percentage low women in agriculture and high banana production. This holds true when distinguishing by optimal and moderate growing locations. Considering only percentage of females in agriculture and no 2012 crop production, Los Ríos is ranked at the top for both moderate and optimal.

Much of this data had to be estimated, due to limited data availability. The combination of “agriculture and skilled workers” by the Ecuadorian census means that it is unclear as to whether all of the females indicated actually work in agriculture. Also limited by data availability, the range of data spans the years 2011-2014, with 2012 population data all having been estimated from the 2010 Census.

**Rank by highest amount of moderate and optimal conditions for coffee growing: including percent of females in agriculture or skilled occupations**

**Total Rank of site suitability for women-empowering coffee development projects**

**Rank by highest amount of moderate and optimal conditions for coffee growing: including 2012 coffee and banana hectare production, percentage of females in agriculture or skilled occupations**