The Changing Demography of Indigenous Populations and the Environment in Amazonia

I. Introduction

It is well known that population growth and its components can significantly affect processes of social and economic development as well as the natural environment (refs,). Effects on the natural environment include deforestation due to forest clearing and land use, climate change, shifts in hydrological cycles, desertification, and loss in biodiversity in the Amazon region (refs.). Because indigenous populations have gained legal jurisdiction over much of the Amazon due to government policy changes especially in recent decades, and live in protected areas, and because they have lived harmoniously with nature in these places for centuries prior to the rapid population expansion over the past half century, and finally because there has been little systematic analysis of their changing demography due to limited data, our study will focus on these indigenous populations.

This work draws on earlier studies by the authors and colleagues on both migrant colonist and indigenous populations in the Ecuadorian Amazon (e.g., Bilsborrow et al. 2003; Pan & Bilsborrow 2005; Bremner et al. 2006; Davis et al. 2016), showing that around the turn of the century, indigenous fertility remained very high while colono fertility was already declining. Around this time, McSweeney (2005) published a stimulating paper on indigenous populations in Latin America (2005) based on 100 small ethnic groups, finding their populations growing rapidly, although studies on the Brazilian Amazon found declining fertility. Thus the limited evidence was mixed. But what has happened since the turn of the new millennium? And what does this have to do with ongoing changes in perhaps the most important ecosystem in the Hemisphere if not the world?

To contribute to this topic, we will summarize, to the extent possible, trends in *indigenous* fertility and population size and growth in the main Amazon basin countries based on publications using data from population censuses and household surveys (including DHS and smaller surveys focusing on the Amazon), first, followed by a case study country on one country, Ecuador.

II. Changes in demographic trends in Amazonia

A. At the regional level, for the main Amazon basin countries

This draws on censuses of population and published data from household surveys, including DHS. However, even though all censuses and some surveys may have sufficient numbers of indigenous women of child-bearing age (15-49) to estimate their fertility (viz., Total Fertility Rates, TFR), none have published these data, instead opting to publish results by area (urban rural), geographic region/province, education of woman, etc. Some distinguish indigenous and non-indigenous populations but none do this for the Amazon separately. A check of the DHS surveys (which ceased for the countries in the region after 2016 in Peru) again finds the same situation. Prior to around 2000, census data in Latin America undercounted indigenous populations even when they included questions on ethnicity, resulting from both coverage problems of remote populations and indigenous populations classifying themselves as mestizos or mixed. Nevertheless, these macro sources do provide some useful data to set the stage.

Thus the TFR in Brazil was 3.4 in 1986, already only 2.5 in 1996, and only 1.7 by 2020, lowest of the major countries in LA. Colombia with its series of DHS surveys and known to also have declining fertility early had a TFR of only 2.4 already in 2005, 2.1 in 2010, 2.0 in 2015, and 1.8 in 2020, with

significant urban-rural differentials (e.g., for 2015 urban TFR=1.8 vs. rural=2.6). The UN estimated the TFR for the Colombian Amazon to be 3.6 in 2001, while the 2010 DHS found for Colombia's Amazon provinces TFRs of 3.8 for Vaupés and Guainía 3.1, while in the 2015 Colombia DHS the values 4.6 and 2.9, respectively. In Peru, the national TFR declined from 4.3 in 1986 to 3.5 in 1996 to 2.6 in 2009 (Rural=3.6) to 2.5 in 2014 (R=3.3), based on data from its innovative continuous DHS survey, and to 2.3 in 2020. Estimates are also available from this survey for its Amazon region ("Selva") of 6.0 in 1986, 4.7 in 1996, 3.5 in 2009 and 3.3 for 2014. According to DHS, the TFR in 2003 for Bolivia was 3.8 and for its most representative Amazonian department, Pando, it was 4.2, while for 2008 for the total population it was 3.5 and for Pando it was 3.9.

Data from well-controlled household sample surveys usually are more reliable than censuses though accurate only for the survey households themselves or at most their study area, depending on the sample design. There have been many specialized household surveys in the Amazon basin countries both before and after 2000 which we will seek out for published estimates. For Peru a survey of 1126 households in 23 communities (8 indigenous and 15 mixed). In the native communities 227 women were estimated to have a TFR of 3.1, with 72% not desiring another birth and 23% overall (slight less in indigenous communities) using some modern form of contraception, 15% injectables (W.K Pan et al., 2016). [other studies being sought out]

B. For the Ecuador Amazon

Ecuador has a long history of data on fertility from household surveys, beginning with the very first fertility surveys conducted in Latin America by CELADE (UN) in 1965 in which two of the 11 cities were Quito and Guayaquil. Six DHS-type fertility surveys were undertaken by a demographic research center (CEPAR) between 1980 and 2004, estimated the national TFR to be 5.4 in 1975-79, 3.8 in 1984-89, and 3.3 in 1999-2004 (rural 3.9, urban 2.9), with the decline decelerating. No similar DHS survey has been undertaken since. As of 2004, every Amazon province had a TFR over 4.0, and overall indigenous (but mostly in the Sierra or highlands) fertility was TFR= 4.9. Data were never published from any of these surveys for specifically indigenous women in the Amazon, and likely would have not been very reliable due to the small number of such women in only a handful of rural PSUs.

Census and other data show declining overall fertility in Ecuador between 2001 and 2022, reflecting a clear demographic transition. In 2001, the Total Fertility Rate (TFR) was 3.61 children per woman (slightly higher than from ENDEMAIN), with Urban=2.9 and Rural=3.5, and overall Amazon region= 5.07 children per woman. By the 2010 census, the national TFR was estimated as 3.27, with a significant reduction in urban areas (2.25), while the rural TFR remained 3.5, showing persistent higher fertility. In the Amazon region, the TFR decreased to 4.41. Finally, from the most recent census of November 2022, preliminary estimates we have prepared suggest a sharp overall decline, to a TFR of 1.9, with the urban and rural levels being 1.75 and 2.67, and the overall Amazon 3.01.

For the indigenous population, our own estimates show substantial variation across ethnic groups. In the 2001 census, the indigenous population was still not identified well (for reasons mentioned above), but with increasing pride and political power since, more reliable estimates should be available for the two last censuses of 2010 and 2022. Indeed, from special tabulations we estimate the TFR for indigenous women in the Amazon in 2022 to be 4.03.

In the case of Ecuador, we carried out two household surveys on a panel of 500+ indigenous women of child-bearing age in both 2001 and 2012, providing data for five ethnic groups, in the northern 2/3 of the Ecuadorian Amazon, working with CEPAR and Ecociencia in Quito. Data from the 2022 census can also be disaggregated for these same groups. In 2001 the two largest ethnicities, Kichwa and Shuar, had an overall TFR of 7.9 (8.3 with Brass-Coale P/F ratio adjustment: Bremner et al. 2009), while the TFR was around 5 for the Waorani and under 3 for the two small populations of Cofan and Secoya (later Siekopai). Reasons for these differences are found in Lu & Bilsborrow (2011) and Lu et al. (2012). Marital fertility TFRs by ethnicity are available for temporal comparison for the five ethnicities: Kichwa 11.7 in 2001and 10.4 in 2012, hardly changing; Shuar 10.4 and 7.6; Wao 6.9 and 9.0 (unstable due to small number of women); and finally Cofan and Siekopai together, 7.6 and 4.9.

Marital fertility is 20-30% higher than TFR values, estimated from the 2022 census as follows: Kichwa 2.76, Shuar 2.80, Wao 2.27, Cofan 2.56, and Siekopai 1.74. It is illuminating that in our 2001 indigenous survey 55% of the women overall expressed a desire to have no more births, but few knew about methods to control their fertility and only 18 of 474 were using any modern method. The high percent not wanting more was indicative of the transition to come. By 2012 65% did not want another birth but now most women knew about some modern methods and around 20% were using some modern method, showing the transition underway. By 2022 most of the fertility transition has occurred, in even these "isolated" traditional societies, almost catching up with the larger Ecuadorian population whose transition has occurred over 50 years, vs. only 10 for the indigenous ethnicities. How could this have happened so quickly? First, there has been a vast increase in education of the indigenous population over time, already by 2012 most young women had a secondary education (Salinas et al. 2020). Second, the Correa government built new roads and improved others in the period from about 2008 to 2016, so that the vast majority of the communities had access to significant towns with health facilities and markets within an hour away by 2012 to 2016, vs. most being hours away and often only by river access in 2001. Roads are closely linked to forest clearing also, however, and are major "mediating factors" in the study of Salinas on the linkages between population change, changes in economic activities (increasing involvement in markets), and changes in land use and forest clearing, not unfavorable to the environment (Salinas, 2023).

During the years from 1980 to very recently, there was substantial population growth, as mortality declined substantially due to both vaccination campaigns and government pressures on indigenous groups to settle in fixed locations with legal communal land titles, and cease their traditional nomadic ways including fighting with other groups and ethnicities for land. This led to stage II of the demographic transition, with high and stable fertility and declining mortality. It is then only in the past decade or so that the indigenous populations have clearly entered stage III, and are now rapidly heading towards a nearly stable population in stage IV.

In Ecuador there has been extremely rapid demographic growth of the indigenous population in the Amazon in recent decades, from about 163,000 in 2001 to 245,000 in 2010, with an annual growth rate of 4.9%. By 2022 it rose to 376,000 at an intercensal mean rate still of 3.3% (double the 1.6% growth for Ecuador overall). The growth of the five ethnic groups studied most intensively in our panel survey of 32 communities was from 3050 in 2001 to 3713 in 2012, at a growth rate of 1.9%

(but with considerable out-migration). The growth rate of the Wao population was 2.8 % between 2010 and 2022 (Salinas, 2024).

The rapid population growth of Amazonian indigenous populations, resulting in the expansion of dwellings and the creation of new, now all sedentary communities, has led to a significant decrease in biodiversity. Drawing on various studies based on the 2001-2012 panel survey data, as hunting becomes less viable, the distance and time to find prey has increased, which has led to less hunting activity and greater reliance on salaried jobs in local towns or for oil companies. These changes have altered traditional livelihoods and threaten cultural customs (Gray et al., 2015; Bozigar et al. 2016; Gray & Bilsborrow 2020; Salinas et al. 2020; Salinas 2023, 2024).

C. Trends in land use and deforestation on indigenous lands in Amazonia

Data on land use and deforestation provide a crucial foundation for understanding environmental impacts in the Amazon, which are exacerbated by climate change. By obtaining precise information on deforested areas and their linkages with indigenous populations, the effects on biodiversity can be better analyzed. The importance of this is indicated by the extraordinarily high mega biodiversity of the lands of these indigenous populations, on the eastern edge of the Andes from southern Colombia through Ecuador and Peru to northern Bolivia: see Norman Myers (1987), Bass et al. (2010), and Finer et al. (2012), etc. These studies on biodiversity suggest how clearing and heavy hunting around indigenous communities in this part of Ecuador (including both the Cuyabeno Wildlife Reserve and Yasuni National Park) is likely leading to species extinction and ecosystem degradation. [more data to be added at the country level later on Brazil, Peru, Colombia, Bolivia]

Climate change and deforestation are also drastically altering hydrological patterns in the region, as revealed in hydrological models based on satellite and rainfall data (Zubieta et al. 2017). Changes in precipitation directly affect river flows, which are critical for water resource management (in 2024 the main rivers in Ecuador and Peru feeding the Amazon are at record lows due to drought). Marengo et al. (2018) adds that climate variability and intensive land use are causing more frequent extreme droughts, affecting moisture recycling, with profound implications for biodiversity.

Conclusions: The Good, the Bad and the Ugly

The Good, is that most of the indigenous populations in the Ecuadorian Amazon--due in part to the increased penetration of roads into their ancestral lands and land invasions by oil companies, farmers, and miners—have greater contacts with the outside world, including contacts with labor and product markets, health care, schools, and technology (having cell phones before refrigerators). So living standards have improved substantially as measured objectively by vaccinations and other health care, education, housing quality, use of electricity, and possession of material goods, although this is not be matched by subjective feelings (Salinas et al. 2020). There is also major success in achieving declines in unwanted births and therefore fertility in the 21st century.

The Bad, is that there has already been substantial loss of environmental services—deforestation evident in satellite imagery and also hidden (depletion in quality and diversity of standing forests from removal of valuable hardwoods, keystone species, with implications for plant and animal

diversity)—most due to widespread illegal land invasions, logging and mining, rather than indigenous populations. [Refs.]

The Ugly, refers to the fact that, despite strong and growing efforts of responsible persons and local indigenous leaders, environmental NGOs, scholars, and some governments and political leaders, the future is terribly compromised by selfish interests of the global political powers (competing governments), corporations aiming only for profits, corruption, and human greed.