COLLECTING SAMPLES FOR GLOBAL FOREST MAPPING

Fernando Yutaka Yamaguchi[1]

[1]Brazilian Institute of Geography and Statistics (IBGE), Avenida Presidente Castelo Branco, 750, Nazaré, Salvador BA, Brazil, fernando.yamaguchi@ibge.gov.br

ABSTRACT

Since 1946, the Food and Agriculture Organization of the United Nations (FAO) has published the Global Forest Assessment at intervals of 5 to 10 years. Since 1990, FAO has published consolidated data every 5 years as part of the FAO Global Forest Resources Assessments (FRA). In the beginning, since 1948, forest statistics were published using questionnaires provided by partner countries. From 1980 onwards, more robust techniques were introduced, based on local expertise, remote sensing data and statistical models. This article reports on my experience with the new FAO assessment of global forests for FRA 2020. The article describes the technology and methodology of the sample survey and highlights some interesting features of land use by indigenous peoples and rangelands in the savanna region.

Key words **—** forest, amazon, samples, landuse.

1. INTRODUCTION

The Food and Agriculture Organization of the United Nations (FAO) is an intergovernmental organization established in 1945 to fight world hunger. FAO currently operates in over 130 countries [1]. According to FAO, forests are "fundamental and improve livelihoods," regulate water flows, support sustainable agriculture, stabilize soils and climate, and provide many other services to the community [2]. Since 1946, FAO has assessed the world's forests at 5-to-10-year intervals and currently every 5 years as part of FAO's Global Forest Resource Assessment (FRA) [3] . All inventories can be found at http://www.fao.org/forest-resources-assessment/past-assessments/en [4], and the history of the last seventy years at FRA [5].

FRA collects forest data through a global network of national correspondents and combines it with remote sensing and other data so that FAO can provide information to governments, civil organizations, and the private sector. Apart from the fact that FRA has the world's forest resources, the most important thing is how they are changing [2] so that FRA can guide countries in their environmental policies. FRA 2020 aims to estimate the world's forests from country data using an independent methodology. This methodology uses hot spots distributed pseudo-randomly in ecological zones. Each spot was classified using a high-resolution image, land use changes were also plotted using Sentinel and Landsat imagery from 2000, 2010, and 2018, also Google Earth® imagery was also used to support the classification. Finally, a statistical model is applied to these forest cover data. Forest plays an important role in global climate change and the process of carbon change beyond country mapping [6].

2. MATERIAL AND METHODS

In May 2019, the first workshop in Brazil on the analysis of Amazonian data was held with the participation of 36 experts from federal institutions, universities, and non-governmental organizations in the city of Belem, Pará State. The training was designed to understand FAO's conceptual land use model and collection software; the entire workshop lasted five days. Sampling was carried out in seven states of the Brazilian Amazon, Acre, Amapá, Amazonas, Mato Grosso, Rondônia and Roraima, at a total of 11949 points. The observation points were distributed to the specialists. Figure 1 shows the geographical location of the states and the observation points.

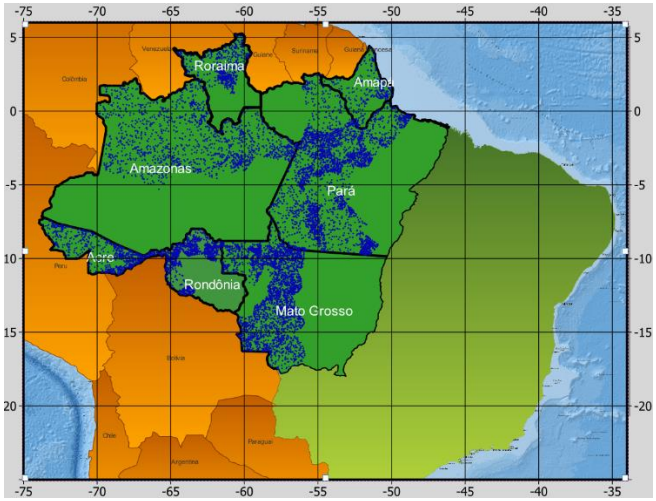


Figure 1. The seven Amazonian states from which the samples were extracted

Each point was customized and arranged in a 1-hectare square inscribed in a 20-ha hexagon, as shown in Figure 2, with both features to be studied and classified according to FAO rules. This procedure runs on the framework of Collect Earth Online (CEO), a free and open-source tool for viewing and interpreting imagery that "leverages the global coverage of MapBox and Bing Maps, a variety of satellite data sources from Google Earth Engine... All functionality is implemented

online" [7], recently adding Planet® imagery [8]. GeoDash is an application for CEO to customize an interface with widgets, time series charts, and an image collection to help identify a class [9].

FAO customized the interface at three different points in time to characterize both the current stage and the temporal evolution of the sample, using Landsat imagery (2000, 2010), Sentinel imagery, and Digital Globe imagery (2018) for this purpose. The FAO-defined classes are forest (5 m high or higher), other forested land (below 5 m), other land (pasture, bare ground, etc.), and water. Figure 2 shows the sorting interface with the high-resolution image and the control panel. Each numbered button is associated with a task as a percentage of change from one date to another, or with a class in a square or hexagon. Figure 3 shows the 2nd interface with imagery from three time points, Landsat (2000-2010) and Sentinel (2018), which allows assessment of change over time.

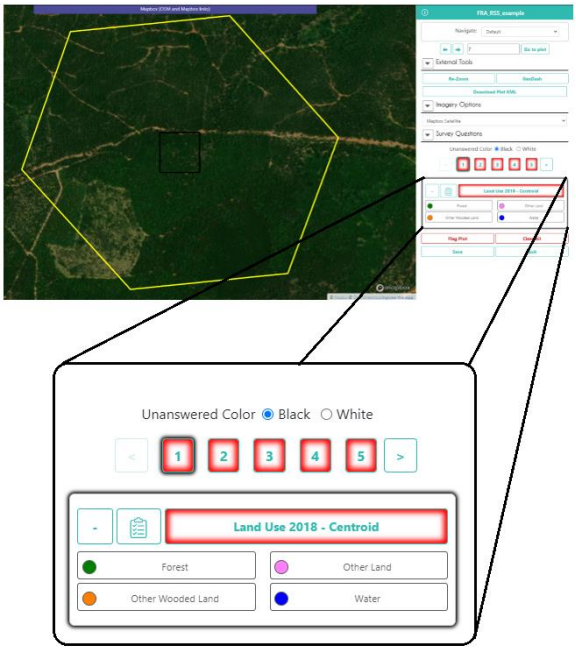


Figure 2. Sample classification interface.

(https://collect.earth/collection?projectId=4260)

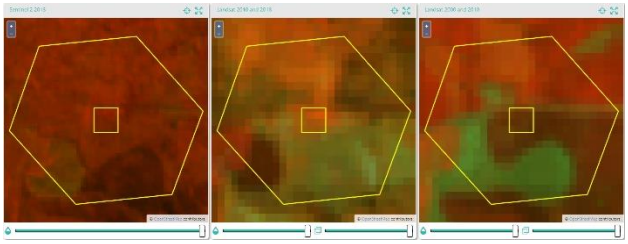


Figure 3. Three different date interface - Landsat (2000-Left, 2010-Middle) and Sentinel (2018-Right) (https://collect.earth/collection?projectId=4260)

This methodology was applied in 70 countries, 384 specialists were trained in the workshops and 134,700 samples were obtained.

3. REPORTS

I chose the state of Roraima as the work area because I assisted the team of the Brazilian Institute of Geography and Statistics in mapping the land use in this state [10]. Figure 4 shows the state of Roraima, the northernmost state of Brazil, bordering Venezuela and Guyana. Yellow polygons are indigenous territories such as the Yanomami and Raposa Terra do Sol, both of which are shown on the map. I counted over 300 points, most of them in preserved natural vegetation.

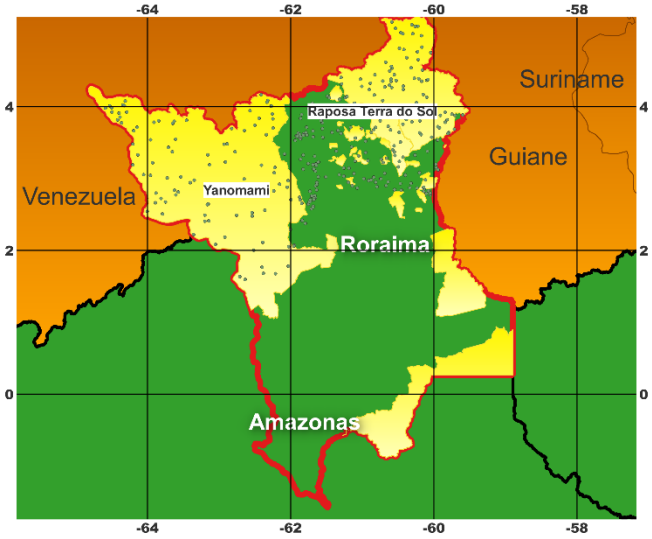


Figure 4. State of Roraima with Indigenous Territories in yellow and the sample points.

The FRA also classifies a standing forest as one that will remain a forest even in a deforested area, e.g., a freshly harvested eucalyptus plantation will remain a forest because there will be replanting. At one of my sample points, I noticed a type of land occupation by the Kulapoipu Tailla indigenous tribe that consists of occupying small areas that, once explored, belong to another so that the forest can regenerate. According to FRA, the deforested area remains forest. Figure 5 shows the settlement area (red), the regeneration areas (orange) and the regenerated areas (yellow).

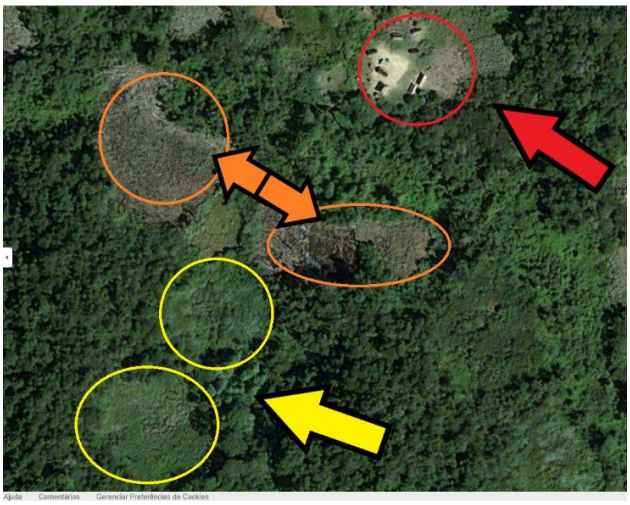


Figure 5. A space occupation model of Kulapoipu Tailla indigenous tribe (04º02'35''N,64º31'03''W). Bing® image.

Figure 6 shows several paths toward the lake. These are paths for cattle grazing in the savannah region.

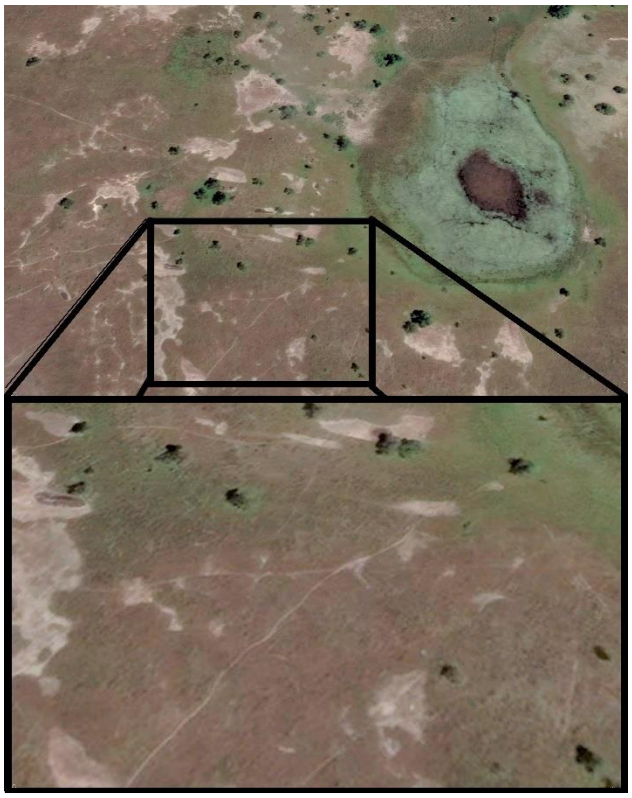


Figure 6. Pasture in savannah region (03º54'25''N,61º06'52''W). Google® image.

Figure 7 shows a typical fishbone settlement normally used by grazing.



Figure 7. typical fishbone settlement in the amazon(02º47'34N,60º05'56''). Google® image.

4. CONCLUSIONS

Global Collect Earth is a free, open source, and practical tool with satellite imagery for global sampling. The GeoDash tool allows easy customization of a human-machine interface. With the help of national experts, FAO was able to use this tool to produce a global report on the growth and loss of the world's forests. In a world concerned about global climate change and the increase in extreme events such as hurricanes, floods, and sea level rise, tools are needed to share all the data we have and mitigate the damage. So CEO is a serious candidate for this global tool.

8. REFERENCES

[1] FAO, "About FAO," 2019. http://www.fao.org/about/en/ (accessed Jul. 25, 2019).

[2] FAO, "Global Forest Resources Assessments," 2019. http://www.fao.org/forest-resources-assessment/en/ (accessed Jul. 28, 2019).

[3] FAO, "Proceedings of the FRA 2020 Launch: Technical Meeting of National Correspondents and CFRQ Partners," Rome, 2018. [Online]. Available: http://www.fao.org/3/BU648en/bu648en.pdf

[4] FAO, "Past assessments," 2019. http://www.fao.org/forest-resources-assessment/past-assessments/en/ (accessed Jul. 29, 2019).

[5] M. Garzuglia, *Seventy years of FAO's Global Forest Resources Assessment(1948-2018).* Rome, Italy: Food and Agriculture Organization of the United Nations, 2018.

[6] FAO, *Proceedings of FAO Expert Consultation on Global Forest Resources Assessment 2000*. Kotka, Finland: The Finnish Forest Research Institute, 1996.

[7] CEO, "Data Collection Manual," 2022. https://collect.earth/downloads/CEO_Manual_DataCollector_EN_20220421.pdf (accessed Sep. 25, 2022).

[8] "Collect Earth Online." https://collect.earth/support (accessed Sep. 27, 2022).

[9] D. Saah *et al.*, "Collect Earth: An online tool for systematic reference data collection in land cover and use applications," *Environmental Modelling & Software*, vol. 118, pp. 166–171, Aug. 2019, doi: 10.1016/j.envsoft.2019.05.004.

[10] IBGE, "Uso da Terra e a Gestão do Território no Estado de Roraima," 2009. Accessed: Sep. 25, 2022. [Online]. Available: https://biblioteca.ibge.gov.br/visualizacao/livros/liv95887.pdf