

Report for ForestQuery into GlobalDeforestation (1990 - 2016)

ForestQuery is on a mission to combat deforestation around the world and to raise awareness about this topic and its impact on the environment. The data analysis team at ForestQuery has obtained data from the World Bank that includes forest area and total land area by country and year from 1990 to 2016, as well as a table of countries and the regions to which they belong.

The data analysis team has used SQL to bring these tables together and to query them in an effort to find areas of concern as well as areas that present an opportunity to learn from successes.

1. GLOBAL SITUATION

According to the World Bank, the total forest area of the world was **41282694.90 km²** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.90 km²**, a loss of **1324449 km²** or **3.21%**.

The forest area lost over this time period is slightly more than the entire land area of **Peru** listed for the year 2016 (which is **1279999.99 km²**).

2. REGIONAL OUTLOOK

In 2016, the percent of the total land area of the world designated as forest was **31.38%**. The region with the highest relative forestation was **Latin America & Caribbean** with **46.16%** and the region with the lowest relative forestation was **Middle East & North Africa** with **2.07%** forestation.

In 1990, the percent of the total land area of the world designated as forest was **32.42%**. The region with the highest relative forestation was **Latin America & Caribbean** with **51.03%** and the region with the lowest relative forestation was **Middle East & North Africa** with **1.78%** forestation.

Table 2.1: Percent Forest Area by Region, 1990 & 2016

Region	1990 Forest Percentage	2016 Forest Percentage
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16
Middle East & North Africa	1.78	2.07
North America	35.65	36.04
South Asia	16.51	17.51
Sub-Saharan Africa	30.67	28.79
World	32.42	31.38

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Latin America & Caribbean** (dropped from **51.03%** to **46.16%**) and **Sub-Saharan Africa** (**30.67%** to **28.79%**). All other regions actually increased in forest area over this time period. However, the drop in forest area in the two aforementioned regions was so large, the percent forest area of the world decreased over this time period from **32.42%** to **31.38%**.

3. COUNTRY-LEVEL DETAIL

A. SUCCESS STORIES

There is one particularly bright spot in the data at the country level, **China**. This country actually increased in forest area from 1990 to 2016 by **527229.062 km²**. It would be interesting to study what has changed in this country over this time to drive this figure in the data higher. The country with the next largest increase in forest area from 1990 to 2016 was the **United States**, but it only saw an increase of **79200 km²**, much lower than the figure for **China**.

China and **United States** are of course very large countries in total land area, so when we look at the largest *percent* change in forest area from 1990 to 2016, we aren't surprised to find a much smaller country listed at the top. **Iceland** increased in forest area by **213.66%** from 1990 to 2016.

B. LARGEST CONCERNS

Which countries are seeing deforestation to the largest degree? We can answer this question in two ways. First, we can look at the absolute square kilometer decrease in forest area from 1990 to 2016. The following 3 countries had the largest decrease in forest area over the time period under consideration:

Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016

Country	Region	Absolute Forest Area Change
Brazil	Latin America & Caribbean	-541510
Indonesia	East Asia & Pacific	-282193.9844
Myanmar	East Asia & Pacific	-107234.0039
Nigeria	Sub-Saharan Africa	-106506.001
Tanzania	Sub-Saharan Africa	-102320

(NOTICE: Sign '-' (minus) in the last column means *decrease*)

The second way to consider which countries are of concern is to analyze the data by percent decrease.

Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016

Country	Region	Pct Forest Area Change
Togo	Sub-Saharan Africa	-75.44
Nigeria	Sub-Saharan Africa	-61.80
Uganda	Sub-Saharan Africa	-59.27
Mauritania	Sub-Saharan Africa	-46.75
Honduras	Latin America & Caribbean	-45.03

(NOTICE: Sign '-' (minus) in the last column means *decrease*)

When we consider countries that decreased in forest area the most between 1990 and 2016, we find that four of the top 5 countries on the list are in the region of **Sub-Saharan Africa**. The countries are **Togo, Nigeria, Uganda and Mauritania**. The 5th country on the list is **Honduras**, which is in the **Latin America & Caribbean** region.

From the above analysis, we see that **Nigeria** is the only country that ranks in the top 5 both in terms of absolute square kilometer decrease in forest as well as percent decrease in forest area from 1990 to 2016. Therefore, this country has a significant opportunity ahead to stop the decline and hopefully spearhead remedial efforts.

C. QUARTILES

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016

Quartiles	Number of Countries
0 - 25%	85
25% - 50%	73
50% - 75%	38
75% - 100%	9

The largest number of countries in 2016 were found in the **1st (or '0 – 25%')** quartile.

There were **9** countries in the top quartile in 2016. These are countries with a very high percentage of their land area designated as forest. The following is a list of countries and their respective forest land, denoted as a percentage.

Table 3.4: Top Quartile Countries, 2016

Country	Region	Pct Designated as Forest
American Samoa	East Asia & Pacific	87.50
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Palau	East Asia & Pacific	87.61
Seychelles	Sub-Saharan Africa	88.41
Solomon Islands	East Asia & Pacific	77.86
Suriname	Latin America & Caribbean	98.26

There are **94 countries** with their percent forestation higher than that of the United States.

4. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.

1. What have you learned from the World Bank data?

- The result of deforestation is astonishing. In just 26 years from 1990 to 2016, the world's total forest area has dropped by **3.208%** or **1324449 km²**, which is about the land size of **Peru**.
- Although there are only 2 out of 7 regions seeing dropping in forest coverage, the general trend for world's forestation area is decreasing. Especially **Latin America & Caribbean**, being the region with the largest forest coverage ever, has dropped nearly **5%** from **1990 (51.03%)** to **2016 (46.16%)**.
- **China** is on the top the increasing list in terms of forestation area from 1990 to 2016, over 6 times as large as that of the **United States**, which holds the 2nd place. There must be something interesting to explore and study.
- **4** out of the **top 5** countries whose forest area decreased the most from 1990 to 2016 are in the **Sub-Saharan Africa** region. Specifically, the country of **Nigeria** is both referred to in either absolute forest area decrease or percentage decrease.
- In the **218** countries being investigated, there are **85** countries whose forest coverage rate is less than **25%**, the largest number of countries when grouped in forestation percent quartile. Only **47** countries have their forest coverage percentage above **75%**.

2. Which countries should we focus on over others?

Togo, Nigeria, Uganda and Mauritania in the **Sub-Saharan Africa** and **Honduras** need more attention as they are the countries that decreased in percentage of forest area the most. We need further exploration and study on what caused these decreasing and what actions could be taken, such as in law, education, economic aid, resource allocation, population control etc.

In general speaking, deforestation is becoming more and more serious in our modern world. We should make deliberate plans and take instant action against it. If not, a sequence of chain events could happen such as climate change, air pollution, wildlife extinction and so on.

5. APPENDIX: SQL Queries Used

```
1  -- Create the VIEW
2  DROP VIEW IF EXISTS forestation;
3  CREATE VIEW forestation AS
4      SELECT f.country_code country_code,
5             f.country_name country_name,
6             f.year,
7             f.forest_area_sqkm,
8             l.total_area_sq_mi*2.59 total_area_sq_km,
9             100*f.forest_area_sqkm/(l.total_area_sq_mi*2.59)
10            pct_forestation,
11            r.region,
12            r.income_group
13      FROM forest_area f
14      JOIN land_area l
15        ON f.country_code=l.country_code and f.year=l.year
16      JOIN regions r
17        ON r.country_code=f.country_code;
18
19  SELECT count(*)
20  FROM forestation;
21
22  -- PART I. GLOBAL SITUATION
23  -- Difference and percentage drop in forestation area between 1990
24  -- and 2016
25  WITH t1 AS (
26      SELECT *
27      FROM forestation
28      WHERE country_code='WLD' and year in (1990, 2016)
29      ORDER BY year)
30
31  SELECT year,
32         forest_area_sqkm,
33         LEAD(forest_area_sqkm) OVER (order by year) AS lead,
```

```

32     LEAD(forest_area_sqkm) OVER (order by year)-forest_area_sqkm AS
abs_diff,
33     ROUND((100*(LEAD(forest_area_sqkm) OVER (order by year)-
forest_area_sqkm)/forest_area_sqkm)::NUMERIC, 3) AS pct_diff
34 FROM t1
35
36 -- Find the country with its land area in 2016 closest to the
deforestation area between 1990 and 2016
37 WITH t1 AS (
38     SELECT *
39     FROM forestation
40     WHERE country_code='WLD' and year in (1990, 2016)
41     ORDER BY year),
42     t2 AS (
43         SELECT year,
44             forest_area_sqkm,
45             LEAD(forest_area_sqkm) OVER (order by year) AS lead,
46             LEAD(forest_area_sqkm) OVER (order by year)-forest_area_sqkm AS
abs_diff,
47             ROUND((100*(LEAD(forest_area_sqkm) OVER (order by year)-
forest_area_sqkm)/forest_area_sqkm)::NUMERIC, 3) AS pct_diff
48         FROM t1)
49
50 SELECT DISTINCT country_name,
51                 total_area_sq_km,
52                 (SELECT ABS(t2.abs_diff) FROM t2 ORDER BY year LIMIT
1) AS abs_diff,
53                 ABS(total_area_sq_km-(SELECT ABS(t2.abs_diff) FROM t2
ORDER BY year LIMIT 1)) AS diff
54 FROM forestation
55 ORDER BY 4
56
57 -- Part II. Regional Outlook
58 -- Find the world's forestation area percentage in 2016
59 SELECT country_code,
60         country_name,
61         year,
62         forest_area_sqkm,
63         total_area_sq_km,
64         ROUND(pct_forestation::NUMERIC, 2) pct_forestation
65 FROM forestation
66 WHERE year=2016 AND country_code='WLD';
67
68 -- Find the region with the highest forestation percentage in 2016
69 SELECT year,
70         region,
71         SUM(forest_area_sqkm) total_forestation,

```

```

72         SUM(total_area_sq_km) total_land,
73
       ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
       forestation_pct
74 FROM forestation
75 GROUP BY 1,2
76 HAVING year=2016
77 ORDER BY forestation_pct DESC
78 LIMIT 1;
79
80 -- Find the region with the lowest forestation percentage in 2016
81 SELECT year,
82        region,
83        SUM(forest_area_sqkm) total_forestation,
84        SUM(total_area_sq_km) total_land,
85
       ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
       forestation_pct
86 FROM forestation
87 GROUP BY 1,2
88 HAVING year=2016
89 ORDER BY forestation_pct
90 LIMIT 1;
91
92 -- Find the world's forestation area percentage in 1990
93 SELECT country_code,
94        country_name,
95        year,
96        forest_area_sqkm,
97        total_area_sq_km,
98        ROUND(pct_forestation::NUMERIC, 2) pct_forestation
99 FROM forestation
100 WHERE year=1990 AND country_code='WLD';
101
102 -- Find the region with the highest forestation percentage in 1990
103 SELECT year,
104        region,
105        SUM(forest_area_sqkm) total_forestation,
106        SUM(total_area_sq_km) total_land,
107
       ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
       forestation_pct
108 FROM forestation
109 GROUP BY 1,2
110 HAVING year=1990
111 ORDER BY forestation_pct DESC
112 LIMIT 1;

```



```

113
114 -- Find the region with the lowest forestation percentage in 1990
115 SELECT year,
116         region,
117         SUM(forest_area_sqkm) total_forestation,
118         SUM(total_area_sq_km) total_land,
119
120         ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
         forestation_pct
120 FROM forestation
121 GROUP BY 1,2
122 HAVING year=1990
123 ORDER BY forestation_pct
124 LIMIT 1;
125
126 -- Calculate Table 2.1: Percent Forest Area by Region, 1990 & 2016
127 DROP VIEW IF EXISTS t1;
128 CREATE VIEW t1 AS (
129     SELECT year yr,
130            region,
131            SUM(forest_area_sqkm) total_forestation,
132            SUM(total_area_sq_km) total_land,
133
134            ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
            forestation_pct
134 FROM forestation
135 GROUP BY 1,2
136 HAVING year in (1990, 2016)
137 ORDER BY region, yr);
138
139 WITH tab1 AS (
140     SELECT region,
141            forestation_pct
142     FROM t1
143     where yr=1990),
144
145     tab2 AS (
146     SELECT region,
147            forestation_pct
148     FROM t1
149     where yr=2016)
150
151 SELECT tab1.region,
152        tab1.forestation_pct AS pct_1990,
153        tab2.forestation_pct AS pct_2019
154 FROM tab1
155 JOIN tab2 ON tab1.region=tab2.region

```

```

156
157 -- Part III. Country-level Detail
158 -- A. Success Stories
159 -- Largest change in terms of forest_area
160 WITH tab_1990 AS (
161     SELECT country_code,
162            country_name,
163            forest_area_sqkm,
164            total_area_sq_km,
165            pct_forestation
166 FROM forestation
167 WHERE year=1990
168 ORDER BY country_name),
169
170 tab_2016 AS (
171     SELECT country_code,
172            country_name,
173            forest_area_sqkm,
174            total_area_sq_km,
175            pct_forestation
176 FROM forestation
177 WHERE year=2016
178 ORDER BY country_name),
179
180 tab_join AS (
181     SELECT tab_1990.country_name,
182            tab_1990.forest_area_sqkm forest_1990,
183            tab_2016.forest_area_sqkm forest_2016,
184            tab_1990.total_area_sq_km land_1990,
185            tab_2016.total_area_sq_km land_2016,
186            tab_1990.pct_forestation pct_1990,
187            tab_2016.pct_forestation pct_2016
188 FROM tab_1990
189 JOIN tab_2016 ON tab_1990.country_code=tab_2016.country_code)
190
191 SELECT country_name,
192        forest_1990,
193        forest_2016,
194        (forest_2016-forest_1990) AS forest_area_change,
195        (100*(pct_2016-pct_1990)/pct_1990) AS pct_change,
196        land_1990,
197        land_2016
198 FROM tab_join
199 WHERE forest_1990 IS NOT NULL AND forest_2016 IS NOT NULL AND
200        country_name!='World'
201 ORDER BY forest_area_change DESC

```

```

202 -- Largest change in terms of forest_area percentage
203 WITH tab_1990 AS (
204     SELECT country_code,
205            country_name,
206            forest_area_sqkm,
207            total_area_sq_km,
208            pct_forestation
209 FROM forestation
210 WHERE year=1990
211 ORDER BY country_name),
212
213 tab_2016 AS (
214     SELECT country_code,
215            country_name,
216            forest_area_sqkm,
217            total_area_sq_km,
218            pct_forestation
219 FROM forestation
220 WHERE year=2016
221 ORDER BY country_name),
222
223 tab_join AS (
224     SELECT tab_1990.country_name,
225            tab_1990.forest_area_sqkm forest_1990,
226            tab_2016.forest_area_sqkm forest_2016,
227            tab_1990.total_area_sq_km land_1990,
228            tab_2016.total_area_sq_km land_2016,
229            tab_1990.pct_forestation pct_1990,
230            tab_2016.pct_forestation pct_2016
231 FROM tab_1990
232 JOIN tab_2016 ON tab_1990.country_code=tab_2016.country_code)
233
234 SELECT country_name,
235        forest_1990,
236        forest_2016,
237        (forest_2016-forest_1990) AS forest_area_change,
238        (100*(pct_2016-pct_1990)/pct_1990) AS pct_change,
239        land_1990,
240        land_2016
241 FROM tab_join
242 WHERE forest_1990 IS NOT NULL AND forest_2016 IS NOT NULL AND
243        country_name!='World'
244 ORDER BY pct_change DESC
245
246 -- B. Largest Concerns
247 -- Calculate Table 3.1 Top 5 Amount Decrease in Forest Area by
248 Country, 1990 & 2016

```

```

247 WITH tab_1990 AS (
248     SELECT country_code,
249            country_name,
250            region,
251            forest_area_sqkm,
252            total_area_sq_km,
253            pct_forestation
254 FROM forestation
255 WHERE year=1990
256 ORDER BY country_name),
257
258 tab_2016 AS (
259     SELECT country_code,
260            country_name,
261            region,
262            forest_area_sqkm,
263            total_area_sq_km,
264            pct_forestation
265 FROM forestation
266 WHERE year=2016
267 ORDER BY country_name),
268
269 tab_join AS (
270     SELECT tab_1990.country_name,
271            tab_1990.region,
272            tab_1990.forest_area_sqkm forest_1990,
273            tab_2016.forest_area_sqkm forest_2016,
274            tab_1990.total_area_sq_km land_1990,
275            tab_2016.total_area_sq_km land_2016,
276            tab_1990.pct_forestation pct_1990,
277            tab_2016.pct_forestation pct_2016
278 FROM tab_1990
279 JOIN tab_2016 ON tab_1990.country_code=tab_2016.country_code)
280
281 SELECT country_name,
282        region,
283        forest_1990,
284        forest_2016,
285        (forest_2016-forest_1990) AS forest_area_change,
286        (100*(pct_2016-pct_1990)/pct_1990) AS pct_change,
287        land_1990,
288        land_2016
289 FROM tab_join
290 WHERE forest_1990 IS NOT NULL AND forest_2016 IS NOT NULL AND
291        country_name!='World'
292 ORDER BY forest_area_change

```

```

293 -- Calculate Table 3.2 Top 5 Percent Decrease in Forest Area by
    Country, 1990 & 2016
294 WITH tab_1990 AS (
295     SELECT country_code,
296            country_name,
297            region,
298            forest_area_sqkm,
299            total_area_sq_km,
300            pct_forestation
301 FROM forestation
302 WHERE year=1990
303 ORDER BY country_name),
304
305 tab_2016 AS (
306     SELECT country_code,
307            country_name,
308            region,
309            forest_area_sqkm,
310            total_area_sq_km,
311            pct_forestation
312 FROM forestation
313 WHERE year=2016
314 ORDER BY country_name),
315
316 tab_join AS (
317     SELECT tab_1990.country_name,
318            tab_1990.region,
319            tab_1990.forest_area_sqkm forest_1990,
320            tab_2016.forest_area_sqkm forest_2016,
321            tab_1990.total_area_sq_km land_1990,
322            tab_2016.total_area_sq_km land_2016,
323            tab_1990.pct_forestation pct_1990,
324            tab_2016.pct_forestation pct_2016
325 FROM tab_1990
326 JOIN tab_2016 ON tab_1990.country_code=tab_2016.country_code)
327
328 SELECT country_name,
329        region,
330        forest_1990,
331        forest_2016,
332        (forest_2016-forest_1990) AS forest_area_change,
333        ROUND((100*(pct_2016-pct_1990)/pct_1990)::NUMERIC, 2) AS
pct_change,
334        land_1990,
335        land_2016
336 FROM tab_join

```

```

337 WHERE forest_1990 IS NOT NULL AND forest_2016 IS NOT NULL AND
    country_name!='World'
338 ORDER BY pct_change
339
340 -- C. Quartiles
341 -- Calculate Table 3.3 Count of Countries Grouped by Forestation
    Percent Quartiles, 2016
342 WITH tab_quartile AS (
343     SELECT country_name,
344            pct_forestation
345     FROM forestation
346     WHERE year=2016 AND pct_forestation IS NOT NULL
347     ORDER BY 2),
348
349     tab_quartile1 AS (
350         SELECT country_name,
351                pct_forestation,
352                CASE
353                    WHEN pct_forestation<=25 THEN '0 - 25%'
354                    WHEN pct_forestation<=50 THEN '25% - 50%'
355                    WHEN pct_forestation<=75 THEN '50% - 75%'
356                    ELSE '75% - 100%'
357                END AS quartiles
358         FROM tab_quartile)
359
360 SELECT quartiles, count(country_name) number_of_countries
361 FROM tab_quartile1
362 GROUP BY 1
363 ORDER BY 1
364
365 -- List all of the countries that were in the 4th quartile (percent
    forest > 75%) in 2016.
366 WITH tab_quartile AS (
367     SELECT country_name,
368            region,
369            pct_forestation
370     FROM forestation
371     WHERE year=2016 AND pct_forestation IS NOT NULL
372     ORDER BY 2),
373
374     tab_quartile1 AS (
375         SELECT country_name,
376                region,
377                pct_forestation,
378                CASE
379                    WHEN pct_forestation<=25 THEN '0 - 25%'
380                    WHEN pct_forestation<=50 THEN '25% - 50%'

```

```

381         WHEN pct_forestation<=75 THEN '50% - 75%'
382         ELSE '75% - 100%'
383     END AS quartiles
384 FROM tab_quartile)
385
386 SELECT country_name, region, ROUND(pct_forestation::NUMERIC, 2)
387     Pct_Designated_as_Forest
388 FROM tab_quartile1
389 WHERE quartiles='75% - 100%'
390 ORDER BY 1
391
392 -- How many countries had a percent forestation higher than the
393 United States in 2016?
394 WITH tab_quartile AS (
395     SELECT country_name,
396            region,
397            pct_forestation
398     FROM forestation
399     WHERE year=2016 AND pct_forestation IS NOT NULL
400     ORDER BY 2),
401 tab_quartile1 AS (
402     SELECT country_name,
403            region,
404            pct_forestation,
405            CASE
406                WHEN pct_forestation<=25 THEN '0 - 25%'
407                WHEN pct_forestation<=50 THEN '25% - 50%'
408                WHEN pct_forestation<=75 THEN '50% - 75%'
409                ELSE '75% - 100%'
410            END AS quartiles
411     FROM tab_quartile)
412
413 SELECT COUNT(*)
414 FROM tab_quartile1
415 WHERE pct_forestation>
416     (SELECT pct_forestation
417     FROM tab_quartile1
418     where country_name='United States');

```