

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 **3.23%**.

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%	72
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  -- Method 1: Using SELF-JOIN
26  WITH t1 AS (
27      SELECT *
28      FROM forestation
29      WHERE country_code='WLD' and year in (1990, 2016)
30      ORDER BY year)
31
32  SELECT t1_a.forest_area_sqkm forestation_1990,
33         t1_b.forest_area_sqkm forestation_2016,
```

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32         (t1_b.forest_area_sqkm-t1_a.forest_area_sqkm) AS
forest_area_change,
33         t1_a.pct_forestation pct_1990,
34         t1_b.pct_forestation pct_2016,
35         ROUND((100*(t1_b.pct_forestation-
t1_a.pct_forestation)/t1_a.pct_forestation)::NUMERIC, 3) AS
pct_change
36 FROM t1 t1_a
37 JOIN t1 t1_b ON t1_a.country_name=t1_b.country_name
38 WHERE t1_a.year=1990 AND t1_b.year=2016;
39
40
41 -- Method 2: Using window function
42 WITH t1 AS (
43     SELECT *
44     FROM forestation
45     WHERE country_code='WLD' and year in (1990, 2016)
46     ORDER BY year)
47
48 SELECT year,
49        forest_area_sqkm,
50        LEAD(forest_area_sqkm) OVER (order by year) AS lead,
51        LEAD(forest_area_sqkm) OVER (order by year)-forest_area_sqkm AS
abs_diff,
52        ROUND((100*(LEAD(forest_area_sqkm) OVER (order by year)-
forest_area_sqkm)/forest_area_sqkm)::NUMERIC, 3) AS pct_diff
53 FROM t1
54
55 -- Find the country with its land area in 2016 closest to the world's
forestation area difference between 1990 and 2016
56 WITH t1 AS (
57     SELECT *
58     FROM forestation
59     WHERE country_code='WLD' and year in (1990, 2016)
60     ORDER BY year),
61     t2 AS (
62         SELECT year,
63                forest_area_sqkm,
64                LEAD(forest_area_sqkm) OVER (order by year) AS lead,
65                LEAD(forest_area_sqkm) OVER (order by year)-forest_area_sqkm AS
abs_diff,
66                ROUND((100*(LEAD(forest_area_sqkm) OVER (order by year)-
forest_area_sqkm)/forest_area_sqkm)::NUMERIC, 3) AS pct_diff
67         FROM t1)
68
69 SELECT DISTINCT country_name,
70                total_area_sq_km,

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71         (SELECT ABS(t2.abs_diff) FROM t2 ORDER BY year LIMIT
1) AS abs_diff,
72         ABS(total_area_sq_km-(SELECT ABS(t2.abs_diff) FROM t2
ORDER BY year LIMIT 1)) AS diff
73 FROM forestation
74 ORDER BY 4
75
76 -- Part II. Regional Outlook
77 -- Find the world's forestation area percentage in 2016
78 SELECT country_code,
79         country_name,
80         year,
81         forest_area_sqkm,
82         total_area_sq_km,
83         ROUND(pct_forestation::NUMERIC, 2) pct_forestation
84 FROM forestation
85 WHERE year=2016 AND country_code='WLD';
86
87 -- Find the region with the highest forestation percentage in 2016
88 SELECT year,
89         region,
90         SUM(forest_area_sqkm) total_forestation,
91         SUM(total_area_sq_km) total_land,
92
93         ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
forestation_pct
93 FROM forestation
94 GROUP BY 1,2
95 HAVING year=2016
96 ORDER BY forestation_pct DESC
97 LIMIT 1;
98
99 -- Find the region with the lowest forestation percentage in 2016
100 SELECT year,
101         region,
102         SUM(forest_area_sqkm) total_forestation,
103         SUM(total_area_sq_km) total_land,
104
105         ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
forestation_pct
105 FROM forestation
106 GROUP BY 1,2
107 HAVING year=2016
108 ORDER BY forestation_pct
109 LIMIT 1;
110
111 -- Find the world's forestation area percentage in 1990

```



```

112 SELECT country_code,
113         country_name,
114         year,
115         forest_area_sqkm,
116         total_area_sq_km,
117         ROUND(pct_forestation::NUMERIC, 2) pct_forestation
118 FROM forestation
119 WHERE year=1990 AND country_code='WLD';
120
121 -- Find the region with the highest forestation percentage in 1990
122 SELECT year,
123         region,
124         SUM(forest_area_sqkm) total_forestation,
125         SUM(total_area_sq_km) total_land,
126
127         ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
128         forestation_pct
129 FROM forestation
130 GROUP BY 1,2
131 HAVING year=1990
132 ORDER BY forestation_pct DESC
133 LIMIT 1;
134
135 -- Find the region with the lowest forestation percentage in 1990
136 SELECT year,
137         region,
138         SUM(forest_area_sqkm) total_forestation,
139         SUM(total_area_sq_km) total_land,
140
141         ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
142         forestation_pct
143 FROM forestation
144 GROUP BY 1,2
145 HAVING year=1990
146 ORDER BY forestation_pct
147 LIMIT 1;
148
149 -- Calculate Table 2.1: Percent Forest Area by Region, 1990 & 2016
150 DROP VIEW IF EXISTS t1;
151 CREATE VIEW t1 AS (
152 SELECT year yr,
153         region,
154         SUM(forest_area_sqkm) total_forestation,
155         SUM(total_area_sq_km) total_land,
156
157         ROUND((100*SUM(forest_area_sqkm)/SUM(total_area_sq_km))::NUMERIC,2)
158         forestation_pct

```

```

153 FROM forestation
154 GROUP BY 1,2
155 HAVING year in (1990, 2016)
156 ORDER BY region, yr);
157
158 WITH tab1 AS (
159     SELECT region,
160     forestation_pct
161     FROM t1
162     where yr=1990),
163
164     tab2 AS (
165     SELECT region,
166     forestation_pct
167     FROM t1
168     where yr=2016)
169
170 SELECT tab1.region,
171 tab1.forestation_pct AS pct_1990,
172 tab2.forestation_pct AS pct_2019
173 FROM tab1
174 JOIN tab2 ON tab1.region=tab2.region
175
176 -- Part III. Country-level Detail
177 -- A. Success Stories
178 -- Largest change in terms of forest_area
179 WITH tab_1990 AS (
180     SELECT country_code,
181     country_name,
182     forest_area_sqkm,
183     total_area_sq_km,
184     pct_forestation
185     FROM forestation
186     WHERE year=1990
187     ORDER BY country_name),
188
189     tab_2016 AS (
190     SELECT country_code,
191     country_name,
192     forest_area_sqkm,
193     total_area_sq_km,
194     pct_forestation
195     FROM forestation
196     WHERE year=2016
197     ORDER BY country_name),
198
199     tab_join AS (

```

```

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

```

```

246         tab_1990.total_area_sq_km land_1990,
247         tab_2016.total_area_sq_km land_2016,
248         tab_1990.pct_forestation pct_1990,
249         tab_2016.pct_forestation pct_2016
250     FROM tab_1990
251     JOIN tab_2016 ON tab_1990.country_code=tab_2016.country_code)
252
253     SELECT country_name,
254            forest_1990,
255            forest_2016,
256            (forest_2016-forest_1990) AS forest_area_change,
257            (100*(pct_2016-pct_1990)/pct_1990) AS pct_change,
258            land_1990,
259            land_2016
260 FROM tab_join
261 WHERE forest_1990 IS NOT NULL AND forest_2016 IS NOT NULL AND
262        country_name!='World'
263
264 -- B. Largest Concerns
265 -- Calculate Table 3.1 Top 5 Amount Decrease in Forest Area by
266 -- Country, 1990 & 2016
267 WITH tab_1990 AS (
268     SELECT country_code,
269            country_name,
270            region,
271            forest_area_sqkm,
272            total_area_sq_km,
273            pct_forestation
274     FROM forestation
275     WHERE year=1990
276     ORDER BY country_name),
277
278     tab_2016 AS (
279     SELECT country_code,
280            country_name,
281            region,
282            forest_area_sqkm,
283            total_area_sq_km,
284            pct_forestation
285     FROM forestation
286     WHERE year=2016
287     ORDER BY country_name),
288
289     tab_join AS (
290     SELECT tab_1990.country_name,
291            tab_1990.region,

```

```

291         tab_1990.forest_area_sqkm forest_1990,
292         tab_2016.forest_area_sqkm forest_2016,
293         tab_1990.total_area_sq_km land_1990,
294         tab_2016.total_area_sq_km land_2016,
295         tab_1990.pct_forestation pct_1990,
296         tab_2016.pct_forestation pct_2016
297     FROM tab_1990
298     JOIN tab_2016 ON tab_1990.country_code=tab_2016.country_code)
299
300     SELECT country_name,
301            region,
302            forest_1990,
303            forest_2016,
304            (forest_2016-forest_1990) AS forest_area_change,
305            (100*(pct_2016-pct_1990)/pct_1990) AS pct_change,
306            land_1990,
307            land_2016
308     FROM tab_join
309     WHERE forest_1990 IS NOT NULL AND forest_2016 IS NOT NULL AND
310            country_name!='World'
311
312     -- Calculate Table 3.2 Top 5 Percent Decrease in Forest Area by
313     Country, 1990 & 2016
314     WITH tab_1990 AS (
315         SELECT country_code,
316                country_name,
317                region,
318                forest_area_sqkm,
319                total_area_sq_km,
320                pct_forestation
321         FROM forestation
322         WHERE year=1990
323         ORDER BY country_name),
324
325     tab_2016 AS (
326         SELECT country_code,
327                country_name,
328                region,
329                forest_area_sqkm,
330                total_area_sq_km,
331                pct_forestation
332         FROM forestation
333         WHERE year=2016
334         ORDER BY country_name),
335
336     tab_join AS (

```

```

336     SELECT tab_1990.country_name,
337            tab_1990.region,
338            tab_1990.forest_area_sqkm forest_1990,
339            tab_2016.forest_area_sqkm forest_2016,
340            tab_1990.total_area_sq_km land_1990,
341            tab_2016.total_area_sq_km land_2016,
342            tab_1990.pct_forestation pct_1990,
343            tab_2016.pct_forestation pct_2016
344 FROM tab_1990
345 JOIN tab_2016 ON tab_1990.country_code=tab_2016.country_code)
346
347 SELECT country_name,
348        region,
349        forest_1990,
350        forest_2016,
351        (forest_2016-forest_1990) AS forest_area_change,
352        ROUND((100*(pct_2016-pct_1990)/pct_1990)::NUMERIC, 2) AS
pct_change,
353        land_1990,
354        land_2016
355 FROM tab_join
356 WHERE forest_1990 IS NOT NULL AND forest_2016 IS NOT NULL AND
country_name!='World'
357 ORDER BY pct_change
358
359 -- C. Quartiles
360 -- Calculate Table 3.3 Count of Countries Grouped by Forestation
Percent Quartiles, 2016
361 WITH tab_quartile AS (
362     SELECT country_name,
363            pct_forestation
364 FROM forestation
365 WHERE year=2016 AND pct_forestation IS NOT NULL
366 ORDER BY 2),
367
368 tab_quartile1 AS (
369     SELECT country_name,
370            pct_forestation,
371            CASE
372                WHEN pct_forestation<=25 THEN '0 - 25%'
373                WHEN pct_forestation<=50 THEN '25% - 50%'
374                WHEN pct_forestation<=75 THEN '50% - 75%'
375                ELSE '75% - 100%'
376            END AS quartiles
377 FROM tab_quartile)
378
379 SELECT quartiles, count(country_name) number_of_countries

```

```

380 FROM tab_quartile1
381 GROUP BY 1
382 ORDER BY 1
383
384 -- List all of the countries that were in the 4th quartile (percent
    forest > 75%) in 2016.
385 WITH tab_quartile AS (
386     SELECT country_name,
387            region,
388            pct_forestation
389     FROM forestation
390     WHERE year=2016 AND pct_forestation IS NOT NULL
391     ORDER BY 2),
392
393     tab_quartile1 AS (
394         SELECT country_name,
395                region,
396                pct_forestation,
397                CASE
398                    WHEN pct_forestation<=25 THEN '0 - 25%'
399                    WHEN pct_forestation<=50 THEN '25% - 50%'
400                    WHEN pct_forestation<=75 THEN '50% - 75%'
401                    ELSE '75% - 100%'
402                END AS quartiles
403         FROM tab_quartile)
404
405 SELECT country_name, region, ROUND(pct_forestation::NUMERIC, 2)
    Pct_Designated_as_Forest
406 FROM tab_quartile1
407 WHERE quartiles='75% - 100%'
408 ORDER BY 1
409
410 -- How many countries had a percent forestation higher than the
    United States in 2016?
411 WITH tab_quartile AS (
412     SELECT country_name,
413            region,
414            pct_forestation
415     FROM forestation
416     WHERE year=2016 AND pct_forestation IS NOT NULL
417     ORDER BY 2),
418
419     tab_quartile1 AS (
420         SELECT country_name,
421                region,
422                pct_forestation,
423                CASE

```

```
424         WHEN pct_forestation<=25 THEN '0 - 25%'
425         WHEN pct_forestation<=50 THEN '25% - 50%'
426         WHEN pct_forestation<=75 THEN '50% - 75%'
427         ELSE '75% - 100%'
428     END AS quartiles
429 FROM tab_quartile)
430
431 SELECT COUNT(*)
432 FROM tab_quartile1
433 WHERE pct_forestation>
434 (SELECT pct_forestation
435 FROM tab_quartile1
436 where country_name='United States');
```