

# Report for ForestQuery into Global Deforestation, 1990 to 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 **41,282,695** sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,246** sqkm, a loss of **-1,324,449** sqkm, 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 **1,280,000** sqkm,).

## 2. REGIONAL OUTLOOK

In 2016, the percent of the total land area of the world designated as forest was **31.4 %**. The region with the highest relative forestation was **Latin America & Caribbean**, with **46.2 %**, and the region with the lowest relative forestation was **Middle East & North Africa**, with **2.1 %** forestation.

In 1990, the percent of the total land area of the world designated as forest was **32.4 %**. The region with the highest relative forestation was **Latin America & Caribbean**, with **51.0 %**, and the region with the lowest relative forestation was **Middle East & North Africa**, with **1.8 %** forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	51.0	46.2
Europe & Central Asia	37.3	38.0
North America	35.7	36.0
Sub-Saharan Africa	30.7	28.8
East Asia & Pacific	25.8	26.4
South Asia	16.5	17.5
Middle East & North Africa	1.8	2.1
World	32.4	31.4

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Latin America & Caribbean** (dropped from **51.0%** to **46.2%**) and **Sub-Saharan Africa** (**30.7%** to **28.8%**). 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 **32.4%** to **31.4%**.

### 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 **527,229.1 sqkm**. 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 **79,200 sqkm**, much lower than the figure for **China**.

**China** and the **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 **213.65%** 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 5 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	-541,510.00
Indonesia	East Asia & Pacific	-282,193.98
Myanmar	East Asia & Pacific	-107,234.00
Nigeria	Sub-Saharan Africa	-106,506.00
Tanzania	Sub-Saharan Africa	-102,320.00

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	-75.45
Nigeria	Sub-Saharan Africa	-61.80
Uganda	Sub-Saharan Africa	-59.13
Mauritania	Sub-Saharan Africa	-46.75
Honduras	Latin America & Caribbean	-45.03

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:

Quartile	Number of Countries
0-25% forestation (1 <sup>st</sup> quartile)	85
25-50% forestation (2 <sup>nd</sup> quartile)	72
50-75% forestation (3 <sup>rd</sup> quartile)	38
>75% forestation (4 <sup>th</sup> quartile or top quartile)	9

The largest number of countries in 2016 were found in the **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
Suriname	Latin America & Caribbean	98.26
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.08
Seychelles	Sub-Saharan Africa	88.41
Palau	East Asia & Pacific	87.61
American Samoa	East Asia & Pacific	87.50
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11

Solomon Islands	East Asia & Pacific	77.86
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## 5. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*
- *Which countries should we focus on over others?*

There is a persistent global trend for deforestation in developing economies. Since 1990, major emerging markets like Brazil, Indonesia, Pakistan, and Nigeria have significantly reduced their forested areas. Furthermore, several smaller economies in Sub-Saharan Africa and Latin America & Caribbean keep deforesting at an alarming rate. However, most developed economies and several emerging markets reversed the trend and started increasing their forest areas. We should encourage countries to stop deforestation by promoting the allocation of property rights for the forests to their citizens. The introduction of tradeable CO2 credits allocated to the guardians of forests could help to reverse the trend. In addition, providing solar power and other substitutes for wood as an energy source can help to keep villagers from looting the forests. Furthermore, major food exporters like Brazil could be incentivized to stop the conversion of their forests into farmland. Trade policy can provide tools like tariffs to disincentivize the growth of palm oil plantations on pristine forests.

## APPENDIX: SQL queries used

```
1  /*
2  Steps to Complete
3
4      Create a View called "forestation" by joining all three tables - forest_area,
5      land_area and regions in the workspace.
6      The forest_area and land_area tables join on both country_code AND year.
7      The regions table joins these based on only country_code.
8
9      In the 'forestation' View, include the following:
10         All of the columns of the origin tables
11         A new column that provides the percent of the land area that is designated as forest.
12
13         Keep in mind that the column forest_area_sqkm in the forest_area table and the land_area_sqmi
14         in the land_area table are in different units (square kilometers and square miles, respectively),
15         so an adjustment will need to be made in the calculation you write (1 sq mi = 2.59 sq km).
16 */
17
18 CREATE VIEW forestation AS
19 SELECT f.country_code AS country_code, f.country_name AS country_name,
20 f.year AS year, f.forest_area_sqkm AS forest_area_sqkm,
21 l.total_area_sq_mi AS total_area_sq_mi, r.region AS region,
22 r.income_group AS income_group,
23 (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS percent_forest
24 FROM forest_area AS f, land_area AS l, regions AS r
25 WHERE f.country_code = l.country_code AND f.year = l.year
26 AND l.country_code = r.country_code;
27
```

```

29 1. GLOBAL SITUATION
30
31 Instructions:
32
33     Answering these questions will help you add information into the template.
34     Use these questions as guides to write SQL queries.
35     Use the output from the query to answer these questions.
36
37 1a. What was the total forest area (in sq km) of the world in 1990?
38     Please keep in mind that you can use the country record denoted as "World" in the region table.
39
40 1b. What was the total forest area (in sq km) of the world in 2016?
41     Please keep in mind that you can use the country record in the table is denoted as "World."
42
43 */
44 SELECT country_name, year, forest_area_sqkm
45 FROM forestation
46 WHERE country_name='World' AND (YEAR='1990' OR YEAR='2016')
47 ORDER BY year ASC;
48 ▾ /* results
49   country_name  year  forest_area_sqkm
50   World         1990  41282694.9
51   World         2016  39958245.9
52 */
53
54

```

```

54
55 ▾ /*
56 1c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?
57 */
58 SELECT (t1.forest_area_sqkm - t0.forest_area_sqkm) AS abs_change_sq_km
59 FROM forestation AS t1, forestation AS t0
60 WHERE t1.year = '2016' AND t1.country_name = 'World'
61 AND t0.year = '1990' AND t0.country_name = 'World';
62 ▾ /* results
63   abs_change_sq_km
64   -1324449
65 */
66
67 ▾ /*
68 1d. What was the percent change in forest area of the world between 1990 and 2016?
69 */
70 SELECT (((t1.forest_area_sqkm / t0.forest_area_sqkm)-1)*100) AS percent_change_forestArea
71 FROM forestation AS t1, forestation AS t0
72 WHERE t1.year = '2016' AND t1.country_name = 'World'
73 AND t0.year = '1990' AND t0.country_name = 'World';
74 ▾ /* results
75   percent_change_forestarea
76   -3.20824258980245
77 */
78

```

```
78
79  /*
80  1e. If you compare the amount of forest area lost between 1990 and 2016,
81      to which country's total area in 2016 is it closest to?
82  */
83  SELECT country_name, (total_area_sq_mi*2.59) AS total_area_sq_km
84  FROM forestation
85  WHERE year='2016' AND (total_area_sq_mi*2.59)>1270000 AND (total_area_sq_mi*2.59)<1324449;
86  /* results
87  country_name  total_area_sq_km
88  Peru          1279999.9891
89  */
90
```



93 2. REGIONAL OUTLOOK

94

95 2a. What was the percent forest of the entire world in 2016?

96 Which region had the HIGHEST percent forest in 2016,

97 and which had the LOWEST, to 2 decimal places?

98

99 2b. What was the percent forest of the entire world in 1990?

100 Which region had the HIGHEST percent forest in 1990,

101 and which had the LOWEST, to 2 decimal places?

102

103 2c. Based on the table you created, which regions of the world

104 DECREASED in forest area from 1990 to 2016?

105 \*/

106

107 SELECT t0.region, t0.country\_name, t0.forest\_area\_sqkm AS forest\_area\_1990

108 FROM forestation t0;

109 SELECT ROUND(CAST((region\_forest\_1990/region\_area\_1990)\*100 AS NUMERIC),2)

110 AS forest\_cover\_1990,

111 ROUND(CAST((region\_forest\_2016/region\_area\_2016)\*100 AS NUMERIC),2)

112 AS forest\_cover\_2016, region

113 v FROM (SELECT SUM(t0.forest\_area\_sqkm) AS region\_forest\_1990,

114 SUM (t0.total\_area\_sq\_mi\*2.59) AS region\_area\_1990, t0.region,

115 SUM (t1.forest\_area\_sqkm) AS region\_forest\_2016,

116 SUM (t1.total\_area\_sq\_mi\*2.59) AS region\_area\_2016

117 v FROM forestation t0, forestation t1

118 WHERE t0.year = '1990'

119 AND t1.year = '2016'

120 AND t0.region = t1.region

121 GROUP BY t0.region) region\_percent

122 ORDER BY forest\_cover\_1990 DESC;

123 v /\*

124 Output

125 8 results

126 Download CSV

127 forest\_cover\_1990 forest\_cover\_2016 region

128 51.0 46.2 Latin America & Caribbean

129 37.3 38.0 Europe & Central Asia

130 35.7 36.0 North America

131 32.4 31.4 World

132 30.7 28.8 Sub-Saharan Africa

133 25.8 26.4 East Asia & Pacific

134 16.5 17.5 South Asia

135 1.8 2.1 Middle East & North Africa

136 \*/

```

138  /*
139  3. COUNTRY-LEVEL DETAIL
140  A. SUCCESS STORIES
141  */
142  SELECT t1.country_name, t1.region,
143  ROUND(CAST(((t1.forest_area_sqkm-t0.forest_area_sqkm)) AS NUMERIC),2)
144  AS change_forestArea_sqkm
145  FROM forestation AS t1
146  JOIN forestation AS t0
147  ON (t1.year='2016' AND t0.year='1990')
148  AND t1.country_code = t0.country_code
149  WHERE t1.country_name !='World'
150  AND t1.forest_area_sqkm !=0 AND t0.forest_area_sqkm !=0
151  ORDER BY change_forestArea_sqkm DESC
152  Limit 5;
153  /*
154  Output
155  5 results
156  country_name      region                change_forestarea_sqkm
157  China              East Asia & Pacific    527229.06
158  United States      North America          79200.00
159  India              South Asia             69213.98
160  Russian Federation Europe & Central Asia   59395.00
161  Vietnam            East Asia & Pacific    55390.00
162  */

```

```

164  /*
165  Which 5 countries saw the largest absolute decrease in forest area from 1990 to 2016?
166  What was the sqkm change for each?
167  */
168  SELECT t1.country_name, t1.region,
169  ROUND(CAST(((t1.forest_area_sqkm-t0.forest_area_sqkm)) AS NUMERIC),2)
170  AS change_forestArea_sqkm
171  FROM forestation AS t1
172  JOIN forestation AS t0
173  ON (t1.year='2016' AND t0.year='1990')
174  AND t1.country_code = t0.country_code
175  WHERE t1.country_name !='World'
176  ORDER BY change_forestArea_sqkm ASC
177  Limit 5;
178  /*
179  Output
180  5 results
181  country_name      region                change_forestarea_sqkm
182  Brazil            Latin America & Caribbean -541510.00
183  Indonesia          East Asia & Pacific    -282193.98
184  Myanmar            East Asia & Pacific    -107234.00
185  Nigeria            Sub-Saharan Africa     -106506.00
186  Tanzania           Sub-Saharan Africa     -102320.00
187  */
188
189

```

```

191 ▾ /*
192   Which 5 countries saw the largest percent decrease in forest area from 1990 to 2016?
193   What was the percent change to 2 decimal places for each?
194   */
195   SELECT t1.country_name, t1.region,
196   ROUND(CAST((((t1.forest_area_sqkm/t0.forest_area_sqkm-1)*100) AS NUMERIC),2)
197   AS percent_change_forestArea
198   FROM forestation AS t1
199   JOIN forestation AS t0
200   ON (t1.year='2016' AND t0.year='1990')
201   AND t1.country_code = t0.country_code
202   ORDER BY percent_change_forestArea ASC
203   Limit 5;
204 ▾ /*
205   Output
206   5 results
207   country_name  region                                percent_change_forestarea
208   Togo          Sub-Saharan Africa                  -75.45
209   Nigeria       Sub-Saharan Africa                  -61.80
210   Uganda        Sub-Saharan Africa                  -59.13
211   Mauritania    Sub-Saharan Africa                  -46.75
212   Honduras      Latin America & Caribbean          -45.03
213   */
214
215

```

```

216
217 ▾ /*
218   Country with largest percent change in forest area from 1990 to 2016
219   */
220   SELECT t1.country_name, t1.region,
221   ROUND(CAST((((t1.forest_area_sqkm/(t0.forest_area_sqkm+0.01)-1)*100) AS NUMERIC),2)
222   AS percent_change_forestArea
223   FROM forestation AS t1
224   JOIN forestation AS t0
225   ON (t1.year='2016' AND t0.year='1990')
226   AND t1.country_code = t0.country_code
227   WHERE t0.forest_area_sqkm != 0 AND t1.forest_area_sqkm != 0
228   ORDER BY percent_change_forestArea DESC
229   LIMIT 1;
230 ▾ /*
231   Output
232   1 results
233   country_name  region                                percent_change_forestarea
234   Iceland       Europe & Central Asia                213.65
235   */
236

```

```

237  */
238  c. If countries were grouped by percent forestation in quartiles,
239  which group had the most countries in it in 2016?
240  */
241  With tab1 AS
242  (SELECT country_name, year, forest_area_sqkm, total_area_sq_mi*2.59
243   AS total_area_sqkm, percent_forest
244   FROM forestation
245   WHERE (year='2016' AND country_name!='World'
246         AND forest_area_sqkm !=0 AND total_area_sq_mi!=0)
247   ORDER BY percent_forest DESC),
248
249  tab2 AS
250  (SELECT tab1.country_name, tab1.year, tab1.percent_forest,
251   CASE WHEN tab1.percent_forest > 75 THEN 4
252   WHEN tab1.percent_forest <= 75 AND tab1.percent_forest > 50 THEN 3
253   WHEN tab1.percent_forest <= 50 AND tab1.percent_forest > 25 THEN 2
254   ELSE 1
255   END AS percentile
256   FROM tab1 ORDER BY 4 DESC)
257
258  SELECT tab2.percentile, COUNT(tab2.percentile)
259  FROM tab2
260  GROUP BY 1
261  ORDER BY 2 DESC;
262  */
263  Output
264  4 results
265  percentile  count
266  1           85
267  2           72
268  3           38
269  4            9
270  */

```

```

272  /*
273  d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.
274  */
275  SELECT country_name, region, year, forest_area_sqkm, total_area_sq_mi*2.59 AS total_area_sqkm,
276  ROUND(CAST((percent_forest) AS NUMERIC),2) AS percent
277  FROM forestation
278  WHERE (year='2016' AND country_name!='World'
279  AND forest_area_sqkm !=0 AND total_area_sq_mi!=0)
280  AND percent_forest > 75
281  ORDER BY percent_forest DESC;
282
283  /*
284  Output
285  9 results
286  country_name      region      year  forest_area_sqkm  total_area_sqkm  percent
287  Suriname          Latin America & Caribbean 2016  153282.002        155999.9994      98.26
288  Micronesia, Fed. Sts. East Asia & Pacific 2016  643.0000305       699.9993         91.86
289  Gabon             Sub-Saharan Africa 2016  232000            257670.0091      90.04
290  Seychelles        Sub-Saharan Africa 2016  406.6999817       460.0099         88.41
291  Palau             East Asia & Pacific 2016  402.9999924       460.0099         87.61
292  American Samoa    East Asia & Pacific 2016  175               199.9998         87.50
293  Guyana            Latin America & Caribbean 2016  165160            196849.9974      83.90
294  Lao PDR           East Asia & Pacific 2016  189505.8008       230800.0023      82.11
295  Solomon Islands   East Asia & Pacific 2016  21793.99902       27990.0005       77.86
296
297  */

```

```

298
299  /*
300  e. How many countries had a percent forestation higher than the United States in 2016?
301  */
302  With tab1 AS
303  (SELECT country_name, year, forest_area_sqkm, total_area_sq_mi*2.59
304  AS total_area_sqkm, percent_forest
305  FROM forestation
306  WHERE (year='2016' AND country_name!='World'
307  AND forest_area_sqkm !=0 AND total_area_sq_mi!=0)
308  ORDER BY percent_forest DESC)
309
310  SELECT COUNT(tab1.country_name)
311  FROM tab1
312  WHERE tab1.percent_forest > (SELECT tab1.percent_forest
313  FROM tab1
314  WHERE tab1.country_name = 'United States');
315  /*
316  Output
317  1 results
318  count
319  94
320  */
321

```