University of Pennsylvania

Mapping the Millennium Development Goals

Creating a data visualization tool for evaluating by-country progress on the United Nations' Millennium Development Goals in the final year of their implementation

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I. Background and Introduction – What are the Millennium Development Goals?

In 2000, the largest gathering of world leaders in history met at United Nations (UN) headquarters in New York for the UN Millennium Summit.[1] The result of the summit was the unanimously adopted Millennium Declaration, which included a short list of ambitious global development goals to be achieved over the next decade and a half. Designated the "Millennium Development Goals", the MDGs consist of eight specific goals that together address poverty and hunger, education, gender equality, child mortality, maternal health, combating AIDS, malaria and other diseases, environmental sustainability, and a global partnership for development.[2] Philosophically, the MDGs are significant for the statement they make about responsibility for change and improvement. By signing onto the Millennium Declaration, the countries present made it the shared responsibility of all governments of the world to achieve a radically improved standard of living for those living in the world's poorest nations, rather than leaving it to those countries to deal with on their own. Since their adoption, work toward the MDGs has involved simultaneous and cooperative efforts by many actors in the development sphere. They have motivated governments, NGOs, and businesses alike to develop new projects and initiatives, donate money and resources, and think critically about what can be done to rid the world of extreme poverty. The hope that work on the MDGs may truly help realize that goal makes accurate evaluation and clear presentation of the outcomes of that work essential.

II. Measuring Progress on the MDGs – Targets and Indicators

Each of the eight goals is broken down into one or more specific targets. For each of the established targets, the UN selected one or more "indicators" - concrete, numeric metrics with which to measure and report progress on a target. For every indicator, a country can be assigned a numerical value to indicate its progress. All indicators are represented as either a percentage (e.g. indicator 1.1, the percentage of the population living on less than $1.25 a day), or as a count (e.g. indicator 5.1, the number of maternal deaths per 100,000 live births). By collecting data on each of the indicators for a target at country and regional levels, the UN can track and report on the extent of progress being made each year, for each target. In total, 21 targets and 60 associated indicators are being used to measure progress toward the MDGs. The eight Millennium Development Goals and their targets are outlined below.[3] A detailed breakdown of the targets that includes the indicators for each can be found in Appendix A.

- Goal 1: Eradicate extreme poverty and hunger
    - Target 1A: Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day

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[1] "UN Millennium Project | About the MDGs." UN Millennium Project. UN Development Group, 2006. Web. 27 Mar. 2015.
[2] "United Nations MDGs." *United Nations.* The United Nations, n.d. Web. 29 Jan. 2015.
[3] "Unstats | Millennium Indicators." *RSS Main.* United Nations Statistical Division, n.d. Web. 21 Feb. 2015.

    - Target 1B: Achieve full and productive employment and decent work for all, including women and young people
    - Target 1C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger
- Goal 2: Achieve universal primary education
    - Target 2A: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling
- Goal 3: Promote gender equality and empower women
    - Target 3A: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015
- Goal 4: Reduce child mortality
    - Target 4A: Reduce by two thirds, between 1990 and 2015, the under-five mortality rate
- Goal 5: Improve maternal health
    - Target 5A: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio
    - Target 5B: Achieve, by 2015, universal access to reproductive health
- Goal 6: Combat HIV/AIDS, malaria and other diseases
    - Target 6A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS
    - Target 6B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it
    - Target 6C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases
- Goal 7: Ensure environmental sustainability
    - Target 7A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources
    - Target 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss
    - Target 7C: Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation
    - Target 7D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers
- Goal 8: Develop a global partnership for development
    - Target 8A: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system
    - Target 8B: Address the special needs of the least developed countries
    - Target 8C: Address the special needs of landlocked countries and small island developing states
    - Target 8D: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term

III. Statement of Thesis Project – Purpose and Scope

Since their inception in 2000, the Millennium Development Goals have represented the most ambitious, concrete, and promising unified effort that has ever been made toward eradicating extreme poverty and suffering in the developing world. After nearly a decade-and-a-half of work, the completion goal of December 31, 2015 is approaching, and efforts are now being directed toward evaluating how successful that work has been. The impending deadline has sparked discussion of many important questions regarding progress, of which I have been particularly interested in two: 1) How much progress has been made on each goal? 2) How has that progress been different in different places? The goal of this project is to visualize the answers to these two questions, with particular attention paid to the second. The data shows unquestionably that, overall, substantial progress has been made with regard to several of the goals. However, one of the largest criticisms of the MDGs is that this apparent large-scale

success may actually be due to disproportionate success in a few specific countries (such as China and India), misrepresenting how much has really changed everywhere else. It was for this reason that I chose a map format for this project, as a natural way to show progress broken down by country.

Progress evaluations are important for understanding what has and has not worked and what still requires the most attention, in order to inform where efforts should be focused next. By using interactive data-driven mapping to represent the by-country data that is currently available on MDG progress, such comparisons can be made visually apparent and accessible to those untrained (or disinclined) to process lengthy tables and charts of World Bank and UN data. The goal of this project was to synthesize this information in a clear, visually compelling, and user-friendly way. Specifically, the map was designed to present how a country's individual progress on each MDG stacks up to: a) the level of progress that would represent fulfillment of the target's stated goals, and b) the average extent of progress actually made over all developing nations.

The map is made up of several "layers," each of which presents a visualization of developing countries' progress on one of the targets, based upon a certain method of evaluating progress. The scope of the visualization was limited to developing countries only, since the MDGs were written to be relevant specifically to underdeveloped nations. Most of the targets are trivial for developed nations, and their presence on the map would skew and detract from a meaningful picture of those for whom it is truly relevant. The map includes all of the targets for MDGs 1-7, except target 6C. MDG 8 and its targets are more generic and collective in nature, and therefore cannot be meaningfully broken down by country. Goal 8 is also the only one for which each target is not assigned specific indicators, making the method of statistical evaluation I used for all of the other goals (explained in Section VII) impossible.

IV. The Method – What is Web Mapping and How Does it Work?

The cohesive visual experience we have come to expect when using tools like Google Maps is in fact the result of many components working together in a very specific way. While the experience appears seamless to a user, the ability to zoom and pan across a map at will requires constant and rapid changing of the information that is being displayed. Taking into account different zoom levels and panning positions, a single map must be able to display innumerable distinct images at a moment's notice. To store each of these images separately would be wildly inefficient and impractical. Instead, web maps employ the use of what are called "tiles". The image you see as you pan through a web map is actually the result of many small, square images being placed next to one another in the proper arrangement. A single map tile is generally a 256x256 pixel image that contains a very small portion of the overall image. Each map tile has an x, y and z coordinate that essentially tells the map: "If the current positioning of the map has point (x,y) within view, and the map is at zoom level z, show this tile at that point." In this way, the proper map display can always be achieved by correct retrieval and placement of the needed tiles.[4]

[4] "How Do Web Maps Work?" *Mapbox.com.* Mapbox, n.d. Web. 29 Jan. 2015.

V. Tools / Technology Stack

While it is useful to understand the concept behind map tiles, in practice there exist many pieces of software that abstract out this level of detail for users who wish to create their own map. For the majority of web mapping tools, the lowest level of detail a user will specify is a shapefile – a file format common in GIS (Geographic Information System) applications which "can spatially describe vector features (points, lines, and polygons)" to represent things like borders, bodies of water, etc.[5] Numerous shapefiles for different basic maps can be found online. As the starting point for all of my map layers for this project, I used a simple shapefile of the countries of the world, available for download from Natural Earth.[6] The combination of tools that I used to add onto these shapefiles and produce my final map, and how I used each of them, is as follows:

- Python – Used to parse the data from the UN Statistics Division (explained in Section VI), analyze and compute progress metrics by country, and then output the results for each target to .csv file format.
- QGIS – Used to join the .csv files containing target-level data to my basic starting shapefile of all countries. This produced a single shapefile for each target.
- Tile Mill – Used to import each target shapefile produced by QGIS, create a map layer from the file, and then style the layer based on the progress metrics associated with it (add color gradients, map legend, hover tooltips, etc.).
- Mapbox.js – After uploading each Tile Mill layer to the Mapbox website, the Mapbox JavaScript library was used to combine and display map layers in the final web app, and add interactivity.

VI. The Data – Source and Format

All of the measurements of progress incorporated into the map were calculated using very specific data about each of the indicators for each target. My source for this data was the UN Statistics Division's online database for the Millennium Development Goal Indicators, which can be found here: http://mdgs.un.org/unsd/mdg/Data.aspx. While far from a one hundred percent complete dataset, it contains sufficient by-country data on each indicator over the last 25 years. Without the existence of this database, completion of this project in the way it was done would not have been possible.

The database was organized hierarchically, in a similar structure to the outline in Appendix A. The data is available on a per-indicator basis; for every indicator, a table can be viewed of all data available, tabulated by country and year. For reference, a screenshot of one such table is available in Appendix B. Each table was available for download in .xml form, which made processing the data programmatically very convenient.

The UN's acquisition of the data for each indicator casts a wide net; one or more specific agencies are directly responsible for providing the data and analysis for each

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[5] "Shapefile." *Wikipedia*. Wikimedia Foundation, 7 Mar. 2015. Web. 23 Apr. 2015.
[6] "Admin 0 – Countries | Natural Earth." *Natural Earth RSS*. Natural Earth, n.d. Web. 2 Feb. 2015.

indicator. These agencies typically get their data from the official statistics that are released by governments on their own country's progress. In some cases of data gaps, that data is also supplemented by data collected through surveys by international agencies. A complete list of which agencies are responsible for providing data on the indicators for which targets is as follows:[7]

- Target 1A: World Bank (WB)
- Target 1B: International Labor Organization (ILO)
- Target 1C: Food and Agriculture Organization of the UN (FAO), United Nations Children's Fund (UNICEF)
- Target 2A: United Nations Educational, Scientific and Cultural Organization (UNESCO)
- Target 3A: ILO, Inter-Parliamentary Union (IPU), UN Women,
- Target 4A: UNICEF, United Nations Population Division, WB, World Health Organization (WHO)
- Target 5A: United Nations Population Fund (UNFPA), UNICEF, United Nations Population Division, WB, WHO
- Target 5B: UNFPA, UNICEF, United Nations Population Division
- Target 6A: Joint United Nations Programme on HIV/AIDS (UNAIDS), UNICEF, WHO
- Target 6B: UNAIDS, WHO
- Target 6C: UNICEF, WHO
- Target 7A: Carbon Dioxide Information Analysis Center (CDIAC), FAO, United Nations Environment Programme (UNEP), United Nations Framework Convention on Climate Change (UNFCCC)
- Target 7B: International Union for Conservation of Nature (IUCN), UNEP
- Target 7C: UNICEF
- Target 7D: UN-Habitat
- Target 8A: International Trade Center (ITC), United Nations Conference on Trade and Development (UNCTAD), WTO
- Target 8B: Organization for Economic Cooperation and Development (OECD)
- Target 8C: OECD
- Target 8D: International Telecommunication Union (ITU)

VII. Data Analysis and Aggregation – Method and Decisions Made

The first and most basic decision that needed to be made regarding data analysis was the granularity at which I wanted to construct my map. There were essentially three options: the goal level, the target level, and the indicator level. The decision to go with the target level was pretty easy to make. The goal level would miss too many meaningful distinctions between targets for those goals that have multiple. The indicator level would cloud the intended meaning in hyper-specificity, as the indicators were established solely as a means to evaluate targets. However, since the vast majority of targets have at least two official indicators, this decision left me with two other challenges to address: a) How should the values of multiple indicators be aggregated into a single evaluation of a target? b) If, for a given target, some indicators seem either more relevant or more practical to measure than others, how should certain indicators be either reweighted or eliminated from the analysis?

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[7] The Millennium Development Goals Report 2014. Rep. The United Nations, n.d. Web. 17 Feb. 2015. 56.

Ultimately, I based these decisions for each target on three things: a) Information from the UN Statistics Division on their rationale behind using, and expected interpretations of, each indicator; b) My own understanding of and intuition about what each target was intended to measure most, and which indicators were essential or unessential to that measurement; and c) Any practical limitations or major challenges that I foresaw in using certain indicators. My final decisions as to which indicators to use for each target and how to weight them are outlined below. If the decision I made was anything other than giving equal weight to all of the official indicators for the target, I also provide an explanation as to my reasoning. For many of these explanations, the information in Section IX on indicator details and defining the goal threshold for each indicator will be helpful for a full understanding of the relevance of the chosen indicators to measurement of the target. (Also recall that full descriptions of all of the indicators can be found in Appendix A).

- Target 1A: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day
    - Indicators Used: 1.1
    - Method of Aggregation: N/A
    - Reasoning: I elected to use only one indicator here because of the way the target is framed. The goal of the target is expressed specifically as halving a certain statistic, which is encompassed completely by indicator 1.1. To include either of the other indicators allotted for this target would require making an arbitrary decision on what an equivalent to "halving" would be for each of those measures. Because halving the portion of the population living below the poverty line is not equivalent to halving the poverty gap ratio (Indicator 1.2) or the share of poorest quintile in national consumption (Indicator 1.3), using these indicators in aggregate with 1.1 seemed unwise.
- Target 1B: Achieve full and productive employment and decent work for all, including women and young people
    - Indicators Used: 1.5, 1.6
    - Method of Aggregation: Each weighted to 50%
    - Reasoning: The target looks at 2 features of employment: fullness and productivity. Target 1.5 stands alone as a complete evaluation of fullness, while 1.4 and 1.6 both present different measurements of productivity. However, target 1.4 presented significant logistical challenges in devising a meaningful and practical goal threshold, so I elected to use target 1.6 alone as a measure of productive employment. Target 1.7 was excluded because it was harder to quantify clearly as a direct evaluation of either component.
- Target 1C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger
    - Indicators used: 1.9
    - Method of Aggregation: N/A
    - Reasoning: Indicator 1.9 (proportion of population undernourished) is the most complete and straightforward metric for the target. Indicator 1.8 is also informative, but is a more narrow evaluation and therefore less essential, and was ultimately impractical to include because no aggregate statistics were available for the developing world, which would have rendered comparative progress measurement impossible.
- Target 2A: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling
    - Indicators used: 2.1, 2.2
    - Method of Aggregation: Both weighted to 50%.

    - Reasoning: The target expresses two goals for primary education: full attendance, which is captured by indicator 2.1, and full completion, which is captured by indicator 2.2. Indicator 2.3 was excluded because it does not clearly provide a quantification of either component.
- Target 3A: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015
    - Indicators Used: 3.1
    - Method of Aggregation: N/A
    - Reasoning: Indicator 3.1 directly addresses the entirety of the target, while indicators 3.2 and 3.3 do not directly relate to an evaluation of the target. 3.2 is representative of the level of access women have to paid employment, and 3.3 of the level of representation women are afforded in government, but both of those measures do not directly say anything about gender disparity in the education system. There are many confounding factors and conditions that could mean a country has reasonable gender equality in education, but less so in the workforce and/or government, or (less likely but also possible) the other way around. Additionally, indicator 3.1 alone already represents an aggregation of 3 different datasets, because it encompasses the gender parity index in primary, secondary, and tertiary levels of education.
- Target 4A: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate
    - Indicators Used: 4.1
    - Method of Aggregation: N/A
    - Reasoning: Indicator 4.1 is a direct and complete evaluation of the entire target, so it is reasonable for it to be given total weight in the overall score. Indicator 4.3 is a measurement of something that would, in the future, be an indicator of expected improvement in the overall target, so it would have been reasonable to give it a small amount of weight in the overall score. However, due to the precise language with which this target is defined ("reduce by two-thirds…"), it was infeasible to determine an appropriate goal threshold for target 4.3 that would accurately reflect the target's goal. Indicator 4.2 essentially measures a subset of what 4.1 is already measuring, so it was also left out.
- Target 5A: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio
    - Indicators Used: 5.1
    - Method of Aggregation: N/A
    - Reasoning: Indicator 5.1 is a direct and complete evaluation of the entire target, so it is reasonable for it to be given total weight in the overall score. Indicator 5.2 was left out for the same reasoning described in target 4A: 5.2 is a measurement of something that would, in the future, be an indicator of expected improvement in the overall target, so it would have been reasonable to give it a small amount of weight in the overall score. However, due to the precise language with which this target is defined ("reduce by three quarters…"), it was infeasible to determine an appropriate goal threshold for target 4.3 that would accurately reflect the target's goal.
- Target 5B: Achieve, by 2015, universal access to reproductive health
    - Indicators Used: 5.5, 5.6
    - Method of Aggregation: Each weighted to 50%.
    - Reasoning: Indicators 5.5 (antenatal care coverage) and 5.6 (unmet need for family planning) each represent a straightforward measurement of whether or not everyone who needs and wants a certain type of reproductive healthcare is getting it, so they are both strong indicators for the target. (It should be noted that while 5.5 encompasses coverage based on thresholds of at least 1 visit, and of at least 4 visits, I used only the "at least 1" metric in my analysis, for reasons explained in Section X). Indicator 5.3 (contraceptive prevalence rate) was left out because while the assumption is that a higher rate of contraceptive usage indicates better access to care, it is also difficult to establish any meaningful goal threshold, since there will always be some people who do not want contraception. This makes indicator 5.6 a more informative and computationally useful form of indicator 5.3. Indicator 5.4 (adolescent birth

rate), while not a direct indication of access to reproductive health, has become accepted as a good one for the developing world, where high birth rates among particularly young women and girls tends to be a sign of lack of access to contraception and/or adequate education. However, it was ultimately necessary to exclude it, for reasons similar to 5.3; establishing a meaningful goal threshold relative to the target was not possible.

- Target 6A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS
    - Indicators Used: 6.1
    - Method of Aggregation: N/A
    - Reasoning: Indicator 6.1 (HIV prevalence rate) is the most complete and direct evaluative measure for this target, so it is reasonable to use this as the only metric. Indicators 6.3 (proportion of youth population properly educated about HIV) and 6.2 (condom use at last high-risk sexual encounter) would have been informative in a unique way, by indicating the potential for future improvements, but were both ultimately impractical to include because no aggregate statistics were available for the developing world, which would have rendered comparative progress measurement impossible. Indicator 6.4 was also left out due to unavailability of aggregate statistics, and lack of a clearly definable correlation with progress on the target.
- Target 6B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it
    - Indicators Used: 6.5
    - Method of Aggregation: N/A
    - Reasoning: There is only one official indicator for this target.
- Target 6C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases
    - *I ultimately chose to exclude Target 6C from my analysis because there was insufficient data available to adequately evaluate the entirety of the target. The by-country data available on malaria was very sparse, and there was no aggregate data for developing countries available at all. Since malaria was the primary focus of the target, utilizing the remainder of the indicators (which encompassed data on tuberculosis and a couple of equally sparse indicators associated with malaria treatment) seemed an incomplete and inaccurate picture of the stated target.*
- Target 7A: Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources.
    - Indicators Used: 7.2, 7.3
    - Method of Aggregation: Each weighted 50%.
    - Reasoning: Indicator 7.2 (CO_2 emissions) and 7.3 (consumption of ozone-depleting substances) are both very widely accepted indications of a country's environmental footprint, and very complete data is available for both. Indicators 7.4 and 7.5 were left out because 7.4 had no data available for developing countries at all, and 7.5 had very minimal data available, especially compared with the completeness of data for 7.2 and 7.3. Indicator 7.1 (proportion of land area covered by forest) was left out because of its questionable reliability as an accurate metric for the target; there would likely be major variability in the starting point for that metric, having nothing to do with the country's sustainability practices.
- Target 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss
    - Indicators Used: 7.6
    - Method of Aggregation: N/A
    - Reasoning: Indicator 7.7 had no data available for developing countries.
- Target 7C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation
    - Indicators Used 7.8, 7.9
    - Method of Aggregation: Each weighted 50%
    - Reasoning: Giving equal weight to both indicators of the target.

- Target 7D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers
    - Indicators Used: 7.10
    - Method of Aggregation: N/A
    - Reasoning: There is only one official indicator for this target.

Once indicators were selected, the next step was to take into account all of the differences in data availability between different indicators and different countries. None of the datasets for any of the indicators are one hundred percent complete, and many of them are far from it. There were two basic types of inconsistencies in the data: 1) For every indicator, there were some countries that had no information at all, and 2) For a given indicator, the range of years over which data was available varied for each country (for example, for indicator 1.1, Argentina had data for every year from 1991-2010, but Angola only had data for 2000 and 2009). Both of these inconsistencies came up in every dataset in some way. There are a total of 160 nations classified as "developing" by the UN dataset, but none of the indicators include data for all 160 of those countries, and some include data for far fewer than that. Similarly, every dataset presented some level of variations in the years of availability for different countries.

The issue of missing countries for an indicator had two possible manifestations. If a certain country had no data present for any of the indicators for a given target, then it appears grayed out on the map for any layers displaying progress on that target (since no meaningful data was available). For any targets being represented by multiple indicators, if a country was missing data for only some of the indicators, the remaining indicators were re-weighted in an appropriate manner and used to provide a score on the target for that country.

The issue of varying year ranges ultimately had a simple solution. As is explained in detail in Section VIII, the only way in which year ranges came into play in my evaluation of progress was in a calculation of rate of progress, i.e. progress made *per year*. In this way, variations in the actual number of years over which a country had data available were made inconsequential to the metric being used. Admittedly, the progress per year metrics for two countries with year ranges of 5 and 15 years respectively might have qualitatively different interpretations. But for purposes of commensurate quantitative measurement, this metric worked well.

VIII. Metrics of Progress Evaluation

The next step was to determine the best procedure for measuring a country's level of progress on each target, based upon the data available to me. Given the decision to construct my map at the target level, with data on each target coming from the selected indicators, I needed to select metrics of evaluation whose data would come from the indicator level, and could then be aggregated up to the target level. After considering what type of evaluations I most wanted to capture, I determined that there were two binary categorizations of metrics that were important to consider: a) Looking at the speed with which a country made progress on an indicator, versus the absolute point at which they were currently situated, and b) Looking at a country's progress on an individual level, versus in comparison to the average over all developing countries.

These two lenses led naturally to four primary categorizations of metrics: 1) *Progress rate*, which represents rate of progress on an individual level; 2) *Comparative progress rate*, which represents rate of progress compared to the average; 3) *Progress-to-goal*, which represents absolute status on an individual level; and 4) *Comparative progress-to-goal*, which represents absolute status compared to the average. The relationship between these metrics and the categorizations I set up can also be understood in the table below.

	Type of Measurement		
Point of Comparison		RATE OF PROGRESS	ABSOLUTE STATUS
	PERSONAL	Metric 1: Progress_rate	Metric 3: Progress_to_goal
	COMPARATIVE	Metric 2: Comparative_progress_rate	Metric 4: Comparative_progress_to_goal

Calculating these metrics for each country required each of the following pieces of information for each indicator, for each country:

Value_initial_c
- Definition: Earliest available value for a country on this indicator
- Possible values: Numeric

Value_final_c
- Definition: Latest available value for a country on this indicator
- Possible values: Numeric

Max_value_c
- Definition: Largest value recorded for a country on this indicator
- Possible values: Numeric

Num_years_c
- Definition: (year Value_final_c recorded) – (year Value_initial_c recorded)
- Possible values: Numeric

Value_initial_a
- Definition: Earliest available value for the average over all developing countries on this indicator
- Possible values: Numeric

Value_final_a
- Definition: Latest available value for the average over all developing countries on this indicator
- Possible values: Numeric

Max_value_a
- Definition: Largest value recorded over all developing countries on this indicator
- Possible values: Numeric

Num_years_a
- Definition: (year Value_final_a recorded) – (year Value_initial_a recorded)
- Possible values: Numeric

Goal_type
- Definition: The type of goal that this indicator embodies
- Possible values: EQUALS (Goal is for the indicator to reach some absolute value), PROPORTION (Goal is for the indicator to be decreased to some specific fraction of what it started at), GE (Goal is for the indicator to reach or exceed some absolute value)

Target_value
- Definition: The target value for the goal. If goal_type is EQUALS or GE, represents the value aiming to reach/exceed; if goal_type is PROPORTION, represents the fraction by which aiming to reduce. The selection and definition of this value for each indicator is explained in detail in Section IX.
- Possible values: Numeric

Directional_goal
- Definition: Indication of whether the goal of this indicator is to increase or decrease its value
- Possible values: INCREASING, DECREASING

From these values, my calculations for the rate of progress metrics were as follows:
Progress_rate = (value_final_c – value_initial_c) / num_years_c
Aggregate_progress_rate = (value_final_a – value_initial_a) / num_years_a
Comparative_progress_rate = Progress_rate / Aggregate_progress_rate

Calculating the absolute status metrics was more complicated, by virtue of the three different goal types. A simplified outline of the logic involved in computing these metrics is as follows, broken down by which goal type the indicator was. While the outline is written in terms of the Progress_to_goal metric for a country, it applies analogously to calculating the progress to goal metric for the aggregate as well, by replacing Value_final_c, Value_initial_c, and Max_value_c with Value_final_a, Value_initial_a, and Max_value_a respectively. I will call this analogous value Aggregate_progress_to_goal:

<u>Goal_type == EQUALS</u>:
- If Value_final_c == Target_value, then progress to goal is complete, so **Progress_to_goal** = 1.
- Otherwise, if Directional_goal == INCREASING, then progress can be computed as a proportion: **Progress_to_goal =** Value_final_c / Target_value
- Finally, if Directional_goal == DECREASING, then we compute a sort of reverse progress proportion as **Progress_to_goal** = (Max_value_c – Value_final_c) / Max_value_c, thus computing how much progress each country has made from its own "worst" point.

<u>Goal_type == GE</u>:
- if Value_final_c >= Target_value, then progress to goal is complete, so **Progress_to_goal** = 1

- Otherwise, progress can be computed as a proportion: **Progress_to_goal** = Value_final_c / Target_value

Goal_type == PROPORTION:

- If the value has increased, no progress has been made, so if Value_final_c > Value_initial_c, then **Progress_to_goal** = 0
- Otherwise:
    - Proportion_reduced_by = (Value_initial_c – Value_final_c) / Value_initial_c
    - If the proportional reduction is greater than the target, then the goal has been fully reached, so if Proportion_reduced_by > Target_value, then **Progress_to_goal** = 1
    - Otherwise, the level of progress can be represented as ratio between the proportion reduced by and the target reduction: **Progress_to_goal** = Proportion_reduced_by / Target_value

And finally: **Comparative_progress_to_goal** = Progress_to_goal / Aggregate_progress_to_goal

With these four values computed for each indicator over a target, the same four values could be assigned to each target by giving corresponding values for each indicator their proper weighting (as determined in Section VII), and summing the weighted indicator values together to give one final value for the target as a whole. Thus for each target, I had the computed values for Progress_rate, Comparative_progress_rate, Progress_to_goal, and Comparative_progress_to_goal. While I had all four of these values available to me in the process of determining how best to display my results, ultimately two of them were essential to the final map layers: Comparative_progress_rate and Progress_to_goal. The precise way in which these metrics were used in creating the map is described in detail in Section X.

IX. Indicator Details – Definitions, Goal Thresholds, and Aggregate Data

In order to complete the progress-to-goal component of my data analysis, I needed a precise numeric value for each indicator that would signal a country having reached the goal expressed by the target that the indicator was representing (termed from here forward "goal threshold"). The UN does not pre-define goal threshold values for each indicator, so I used careful interpretation of the goal of each target, and of the definition of each indicator, to do so myself. Below I have outlined for each indicator the official UN definition of what it is measuring, the goal threshold value I chose for use in my analysis, and the reasoning behind each choice.[8] Goal thresholds are expressed as "Value = {some expression}". For some indicators, the best expression of its goal threshold was not in terms of an absolute value, but rather as a proportion of a starting value or some other type of threshold. In these cases, the alternate form threshold is explained. Also included for each indicator is the aggregate values that were used in calculating aggregate progress statistics (i.e. the values on average for all developing

[8] "Unstats | Millennium Indicators." *RSS Main.* United Nations Statistics Division, n.d. Web. 21 Feb. 2015.

countries), which were given in the 2014 Millennium Development Goals Statistical Annex, available for download from the UN Statistical Division[9].

- Indicator 1.1: Proportion of population below $1.25 (PPP) per day
  - Defined as: "The proportion of the population living on less than $1.25 a day, measured at 2005 international prices, adjusted for purchasing power parity (PPP)."
  - Indicator of: Target 1A
  - Goal Threshold used: Value <= ½ of initially measured value
  - Reasoning: The goal of target 1A is to halve the proportion of people whose income is less than one dollar a day.
  - Aggregate initial (value, year): 46.7%, 1990
  - Aggregate final (value, year): 22%, 2010
- Indicator 1.5: Employment-to-population ratio
  - Defined as: "The proportion of a country's working-age population that is employed."
  - Indicator of: Target 1B
  - Goal Threshold used: Value = 100.0
  - Reasoning: An employment-to-population ratio of 100% represents full employment, the stated goal of target 1B.
  - Aggregate initial (value, year): 64.1%, 1991
  - Aggregate final (value, year): 60.8%, 2013
  - *Note that for this indicator, aggregate progress was actually in the undesired direction. Had this been the only indicator for Target 1B, having an aggregate rate of progress of 0 would have complicated the calculation of Comparative_progress_rate. However, since Indicator 1.6 was also used for Target 1B, the aggregate rate for the target was still meaningful and usable.*
- Indicator 1.6: Proportion of employed people living below $1.25 (PPP) per day
  - Defined as: "The share of individuals who are employed, but nonetheless live in a household whose members are estimated to be living below the international poverty line of $1.25 a day, measured at 2005 international prices, adjusted for purchasing power parity (PPP)."
  - Indicator of: Target 1B
  - Goal Threshold used: Value = 0
  - Reasoning: To be considered fully productive, employment should not leave a person living in poverty.
  - Aggregate initial (value, year): 46.9%, 1991
  - Aggregate final (value, year): 14.5%, 2013
- Indicator 1.9: Proportion of population undernourished
  - Defined as: "The proportion of the population whose food intake falls below the minimum level of dietary energy requirements."
  - Indicator of: Target 1C
  - Goal Threshold used: Value <= ½ of initially measured value
  - Reasoning: To have succeeded in reducing the proportion of people suffering from hunger by one half, a final measurement would have to be equal to or less than ½ of the starting measurement.
  - Aggregate initial (value, year): 23.6%, 1990-1992
  - Aggregate final (value, year): 14.3%, 2011-2013
- Indicator 2.1: Net enrolment ratio in primary education
  - Defined as: "The number of children of official primary school age who are enrolled in primary education as a percentage of the total children of the official school age population."
  - Indicator of: Target 2A
  - Goal Threshold used: Value = 100.0
  - Reasoning: An enrollment ratio of 100% represents full primary school enrollment.

[9] http://mdgs.un.org/unsd/mdg/Host.aspx?Content=Data/Trends.htm

  - Aggregate initial (value, year): 79.8%, 1991
  - Aggregate final (value, year): 90.5%, 2012
- Indicator 2.2: Proportion of pupils starting grade 1 who reach last grade of primary
  - Defined as: "The percentage of a cohort of pupils enrolled in grade 1 of the primary level of education in a given school year who are expected to reach the last grade of primary school, regardless of repetition."
  - Indicator of: Target 2A
  - Goal Threshold used: Value = 100.0
  - Reasoning: A value of 100% here represents full primary school completion for all who are enrolled.
  - Aggregate initial (value, year): 67.4%, 1991
  - Aggregate final (value, year): 72.7%, 2011
- Indicator 3.1: Gender parity index (Ratio of girls to boys) enrolled in primary, secondary and tertiary education
  - Defined as: "The ratio of the number of female students enrolled at primary, secondary and tertiary levels of education to the number of male students in each level."
  - Indicator of: Target 3A
  - Goal Threshold used: Value >= 1
  - Reasoning: A gender parity index of 1 or more in each level of education would indicate an elimination of gender disparity in education at that level.
  - Aggregate initial *(for primary)* (value, year): .87, 1991
  - Aggregate final *(for primary)* (value, year): .97, 2012
  - Aggregate initial *(for secondary)* (value, year): .77, 1991
  - Aggregate final *(for secondary)* (value, year): .96, 2012
  - Aggregate initial *(for tertiary)* (value, year): .71, 1991
  - Aggregate final *(for tertiary)* (value, year): .99, 2012
- Indicator 4.1: Under-five mortality rate
  - Defined as: "The probability (expressed as a rate per 1,000 live births) of a child born in a specified year dying before reaching the age of five if subject to current age-specific mortality rates."
  - Indicator of: Target 4A
  - Goal Threshold used: Value <= 1/3 of initially measured value
  - Reasoning: To have succeeded in reducing the under-five mortality rate by two-thirds, a final measurement would have to be at most 1/3 of the starting measurement.
  - Aggregate initial (value, year): 99, 1990
  - Aggregate final (value, year): 53, 2012
- Indicator 5.1: Maternal mortality ratio
  - Defined as: "The number of maternal deaths per 100,000 live births."
  - Indicator of: Target 5A
  - Goal Threshold used: Value <= ¼ of initially measured value
  - Reasoning: To have succeeded in reducing the maternal mortality rate by three quarters, a final measurement would have to be at most 1/4 of the starting measurement.
  - Aggregate initial (value, year): 430, 1990
  - Aggregate final (value, year): 230, 2013
- Indicator 5.5: Antenatal care coverage *(*Note: Using only "at least one visit" metric)*
  - Defined as: "The percentage of women aged 15-49 with a live birth in a given time period that received antenatal care provided by a skilled health personnel (doctors, nurses, or midwives) at least once during pregnancy, as a percentage of women age 15-49 years with a live birth in a given time period."
  - Indicator of: Target 5B
  - Goal Threshold used: Value = 100.0
  - Reasoning: A value of 100% here represents universal access to antenatal care. I elected to use only the "at least one visit" metric, and not include the "at least four visits" metric, specifically for this reason. Because the goal of the target is defined as "universal access", I

wanted this indicator to be a measure strictly of access or no access. A woman who did not get at least one visit can be said with complete confidence to have had no access to antenatal care.
    - Aggregate initial (value, year): 65%, 1990
    - Aggregate final (value, year): 83%, 2012
- Indicator 5.6: Unmet need for family planning
    - Defined as: "The percentage of women of reproductive age who are married or in a consensual union and have an unmet need for family planning [defined as 'being fecund and sexually active, but not using any method of contraception, and report not wanting any more children or wanting to delay the next child'], as a percentage of all women of reproductive age who are married or in a consensual union."
    - Indicator of: Target 5B
    - Goal Threshold used: Value = 0
    - Reasoning: To have succeeded in providing universal access to reproductive health, all women who want family planning should be able to get it.
    - Aggregate initial (value, year): 16.5%, 1990
    - Aggregate final (value, year): 12.4%, 2012
- Indicator 6.1: HIV incidence rate
    - Defined as: "The number of new HIV infections per year per 100 people aged 15 to 49 years."
    - Indicator of: Target 6A
    - Goal Threshold used: Value = 0
    - Reasoning: While ambitious, for purposes of evaluating progress, the ideal goal is for the HIV prevalence rate to eventually reach 0.
    - Aggregate initial (value, year): .1, 2001
    - Aggregate final (value, year): .06, 2012
- Indicator 6.5: Proportion of population with advanced HIV infection with access to antiretroviral drugs
    - Defined as: "The percentage of adults and children currently receiving antiretroviral therapy according to nationally approved treatment protocols (or WHO/Joint UN Programme on HIV and AIDS standards) among the estimated number of people eligible for treatment."
    - Indicator of: Target 6B
    - Goal Threshold used: Value = 100.0
    - Reasoning: In order to have achieved universal access to treatment for HIV/AIDS for all in need, access to antiretroviral drugs would have to be 100% for those with advanced HIV infection.
    - Aggregate initial (value, year): 46%, 2010
    - Aggregate final (value, year): 61%, 2012
- Indicator 7.2: CO_2 emissions, total, per capita and per $1 GDP (PPP) *(*Note: Using only per capita metric)*
    - Defined as: "Metric tons of CO_2 emissions per capita in a given year."
    - Indicator of: Target 7A
    - Goal Threshold used: Value = 2.1 (metric tons)
    - Reasoning: According to "Shrink That Footprint", an online guide to understanding and reducing your personal environmental footprint, the target per capita emissions rate in order to keep warming to less than 2°C before 2100 is 2.1 tons per person.[10]
    - Aggregate initial (value, year): 1.66, 1990
    - Aggregate final (value, year): 3.16, 2010
    - ***Note that is another indicator for which the aggregate progress was actually in the undesired direction. Again, since this is not the only indicator for Target 7A, the overall aggregate rate of progress still had a meaningful value. In this case it is not altogether*

[10] "Carbon Targets for Your Footprint." *Shrinkthatfootprint.com*. Shrink, 22 Nov. 2012. Web. 25 Apr. 2015.

surprising that there was negative progress, since global warming is an issue that has become larger and more focused upon only in the last decade or so.

- Indicator 7.3: Consumption of ozone-depleting substances
  - Defined as: "The level of consumption of Ozone-Depleting Substances [as defined in the Montreal Protocol], measured in metric tons as weighted by their Ozone Depletion Potential (ODP), also known as ODP tons."
  - Indicator of: Target 7A
  - Goal Threshold used: Value = 0
  - Reasoning: The Montreal Protocol called for the gradual complete phasing out of use of all ODS.[11]
  - Aggregate initial (value, year): 1510.44, 1990
  - Aggregate final (value, year): 256.39, 2012
- Indicator 7.6: Proportion of terrestrial and marine areas protected
  - Defined as: The proportion of terrestrial areas and marine areas in territorial waters (up to 12 nautical miles from the coast) that are protected, where a protected area is defined as a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.
  - Indicator of: Target 7B
  - Goal Threshold used: Value = 100.0
  - Reasoning: A value of 100 on this indicator would represent full protection of terrestrial and marine areas.
  - Aggregate initial (value, year): 7.8%, 1990
  - Aggregate final (value, year): 13.8%, 2012
- Indicator 7.8: Proportion of population using an improved drinking water source
  - Defined as: "The percentage of the population who use any of the following types of water supply for drinking: piped water into dwelling, plot or yard; public tap/standpipe; borehole/tube well; protected dug well; protected spring; rainwater collection and bottled water (if a secondary available source is also improved)."
  - Indicator of: Target 7C
  - Goal Threshold used: Value = 100.0
  - Reasoning: A value of 100 on this indicator would indicate that all people have access to source of drinking water considered moderately safe and reliable.
  - Aggregate initial (value, year): 70%, 1990
  - Aggregate final (value, year): 87%, 2012
- Indicator 7.9: Proportion of population using an improved sanitation facility
  - Defined as: "The percentage of the population with access to facilities that hygienically separate human excreta from human contact."
  - Indicator of: Target 7C
  - Goal Threshold used: Value = 100.0
  - Reasoning: A value of 100 on this indicator would indicate that all people have access to an improved sanitation facility.
  - Aggregate initial (value, year): 36%, 1990
  - Aggregate final (value, year): 57%, 2012
- Indicator 7.10: Proportion of urban population living in slums
  - Defined as: "The proportion of the urban population living in a slum household, which is defined as a group of individuals living under the same roof lacking one or more of the following conditions: access to improved water, access to improved sanitation, sufficient-living area, durability of housing, security of tenure."
  - Indicator of: Target 7D

[11] The Millennium Development Goals Report 2014. Rep. The United Nations, n.d. Web. 17 Feb. 2015.

- Goal Threshold used: Value = 0
- Reasoning: While ambitious, for purposes of evaluating progress, the ideal goal is for the entire urban population to eventually be living outside of slums.
- Aggregate initial (value, year): 46.2%, 1990
- Aggregate final (value, year): 32.7%, 2012

X. Presentation and Use of Data in Map

As stated, my primary goal in creating this map was to present clearly how individual country progress on each MDG target stacks up to: a) the level of progress that would represent fulfillment of the target's stated goals, and b) the average level of progress for all developing nations. After considering the metrics of progress I had available to me, I determined that I was going to provide two different visualizations of comparative progress for each target. The two different types of map layers for each target that I used to accomplish this are as follows:

1. Rate Layers: This layer was based upon the Comparative_progress_rate metric, as defined in Section VIII. For each target, the rate layer is a visual representation of each country's rate of progress as compared with the average. Countries that appear any shade of purple had rates of progress equal to or greater than the average, while countries that appear any shade of green had rates of progress below the average. From there, darker shades represent more extreme values of both ends, with each color broken up into 5 shades. For the above average values, the 5 bands are: between 1 and 2 times the average (1 <= comparative_rate < 2), between 2 and 3 times the average (2 <= comparative_rate < 3), between 3 and 5 times the average (3 <= comparative_rate < 5), between 5 and 9 times the average (5 <= comparative_rate < 9), and equal to or greater than 9 times the average (comparative_rate >= 9). For the below average values, the 5 bands are split evenly: between 0 and .2 times the average (0 <= comparative_rate < .2), between .2 and .4 (.2 <= comparative_rate < .4), between .4 and .6 (.4 <= comparative_rate < .6), between .6 and .8 (.6 <= comparative_rate < .8), and between .8 and 1 (.8 <= comparative_rate < 1).

2. Status Layers: This layer was based upon the Progress_to_goal metric, as defined in Section VIII. For each target, the status layer is a visual representation of the point at which a country stands relative to the goal that was defined by the target. Increasing levels of progress are indicated by increasingly darker shades on the map. This layer therefore uses a monochrome color gradient broken up into 5 equal bands based upon percent completion of the established target. From darkest to lightest, the bands are as follows: between 80% completion and full completion (1 <= absolute_status < .8), between 60% and 80% completion (.80 <= absolute_status < .6), between 40% and 60% completion (.6 <= absolute_status < .4), between 20% and 40% completion (.4 <= absolute_status < .2), and between 0% and 20% completion (.2 <= absolute_status <= 0).

XI. Outcomes – Features and Meanings of the Map

The final map and associated web pages can be viewed at: http://mdg-map.herokuapp.com/. It is comprised of 28 total layers: the two layers described in Section X for each of the 14 targets included in the map (all targets of MDGs 1-7 except 6C, as explained in Section VII). At any given time, the user's view of the map shows 1 of these 28 layers. The overall map offers the following basic features:

- Ability to easily toggle between each of the different targets, and between the two layers of each target
- A distinct map legend for each layer that includes the name of the target, the layer type, the average rate of progress if it is a rate layer (since the layer is constructed as a comparison to the average), a description of the target and of the goal to which the target belongs, and a color key indicating the precise meaning of the color scheme for that layer.
- Tooltips for each country that appear when the user hovers over that country. The tooltip provides country name and the value of relevance to the current layer for that country.

The real utility of the map, however, comes from a full understanding of what the two types of map layers represent. For each target, they provide two qualitatively distinct pictures of comparative progress. The first layer, termed the "Rate of Progress Layer" on the map, should be viewed as a comparison of how quickly different countries have made progress over the last 25 years. The map legend for each layer of this type provides what the average rate of progress over all developing countries was. The diverging color scheme then provides a clear visualization of whether each country falls above or below that average, and to what extent. This metric is important for classifying how productive individual countries have been on a certain target over the period of MDG implementation. The ability to easily identify which countries have been most – and least – productive is the first step in being able to identify the causes of differential progress.

The second layer, termed the "Status on Goal Layer" on the map, should be viewed as a comparison of the absolute point of progress at which each country lies for a given target. The monochrome color gradient provides a clear visual of relative percent completions of the established target amongst countries. This metric is important for straightforward classification of which countries are doing better or worse as they currently stand. The ability to easily identify and understand which countries are suffering most on a given target is essential to any decisions being made regarding future plans of action.

XII. Source Code

- The source code for all of my data processing, analysis, and aggregation, as well as the .xml files containing the original data from the UN Statistics Division and the final .csv files that were used to create my map layers, can be found at: https://github.com/amstone326/MDG-Data.
- The source code for the final website in which the map is embedded can be found at: https://github.com/amstone326/MDG-Map.

XIII. Shortcomings and Potential Improvements

In my eyes, the largest shortcomings with the map as it exists currently are related to limitations on how I was able to use the indicator data in progress calculations. First, while I believe the decisions I outlined in Section VII on which indicators to use for each target are sound and were made with practicality in mind, they did result in not using a substantial proportion of the total indicators available. Given the time constraints of the thesis project, it was necessary to make these decisions relatively swiftly and with feasibility and ease of implementation as a top priority. However, with more time available, I would like very much to be able to explore in more detail how to incorporate more of the indicators into evaluations of each target. Further, to the extent that the decisions on which indicators to use were based upon which indicators I felt truly best represented the target's stated goals, this was in fact no more than my own opinion. To make this map truly useful to people and groups working in development – which I firmly believe it has the potential to be – the opinions of people more educated than myself on the specifics of each target would be necessary in making those decisions.

Secondly, the map is currently incomplete in that it does not include MDG 8. I believe that the reasons for this (explained in Section III) were sound, and that it was the right decision given the time limitations of the initial project. However this still means that one of the MDGs is not represented on the map at all, which is far from ideal. Given more time and the input of others with more expert knowledge than my own, it would be a major improvement to find a way to include the targets of MDG 8 on the map.

Finally, due to time constraints, the overall results conveyed by the map have not been thoroughly analyzed to determine how consistent they are with other existing understandings of relative progress on the MDGs. While to my knowledge nothing of the same scope and nature as this map exists elsewhere, there have certainly been many other efforts to synthesize and understand MDG progress, be it in visual form or otherwise. In order for the results of this map to be considered more rigorous, it would be important to crosscheck the overall indications that it conveys with these other efforts. While the map is based upon the best source of data available for this information, and the decisions I made were done with as much rigor and thought as possible, it is also true that there are many small changes in statistical and analytical methods that could be made, which would alter the results in different ways. Careful consideration of how different changes affect the outcomes, as well as cross-comparison with other known information and trends to determine what aspects of the current map are or are not accurate, would be the next step in making the map as reliable and accurate as possible.

XIV. Conclusions – Noteworthy Observations and Looking Ahead

The full utility of the map I have created is in its versatility – the ability for anyone wishing to analyze or conduct work related to the MDGs to draw the conclusions that are relevant and necessary to their own work. This report is not going to attempt to draw all of those conclusions independent of context. However, there are a few notable trends that are worth pointing out for what they communicate about some of the most prominent MDGs.

First, the "Status on Goal" layer for Target 1A is extremely telling. Target 1A aims to "Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day." This is one of the MDG targets that have gotten the most attention as having seen substantial improvement. And it has – in some places. Looking at this layer on the map, it is immediately apparent that there is a lot of dark purple (80-100% completion), but also a lot of white (0-20% completion), indicating that countries are generally doing either very well or very poorly on this target. This is precisely the sort of obfuscation of detail by averages that I was referring to in Section III, which a map of this sort reveals. A very similar reality can be seen for Target 1C, which aims to halve the proportion of people suffering from hunger.

Another example: Target 6B – "Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it" – has received particularly high levels of attention and funding (for example, initiatives like PEPFAR, the United States President's Emergency Plan for AIDS Relief) as compared with some of the other MDGs. And yet, it is interesting to note that overall progress on the target is not as extensive as most other targets (evident by an overall higher prevalence of lighter shades of purple). Information like this is important for evaluating what Bjorn Lomborg emphasizes in his article on the future of development work about the importance of identifying "where dollars can do the most good."[12] While some may view this as a crude perspective to take, Lomborg's argument represents an increasingly important reality to accept as the world prepares to confront the next stages of poverty elimination. It goes without saying that the arrival of December 31, 2015 does not mean the end of development work, or even of work on the Millennium Development Goals. It does, however, represent an important opportunity to take stock, look at how things currently stand, and evaluate where to focus attentions going forward. The map shows that some of the MDGs have truly seen extensive progress across a majority of nations, such as on Targets 2A and 3A. This is something to celebrate, and while certainly not a license to let those issues fall by the wayside, an indication that perhaps others can now take center stage. Others have evidently seen much less improvement, at least for certain nations, and it is essential to respond appropriately to that information. Does slow progress on the treatment of HIV/AIDS means that the goal should be given up? Of course not. But it does provide useful feedback, and an indication that perhaps new strategies or approaches could be explored.

A set of successor goals to the Millennium Development Goals, dubbed the "Sustainable Development Goals" (SDGs), is currently underway. The UN Open Working Group established to take on the task is comprised of representatives from 70 governments, as well as international institutions and nongovernmental organizations.[13] The purpose of Lomborg's article entitled "Promises to Keep" is to discuss how to ensure that those new goals are focused and practical – so that the international community can really mean it when it says that it intends to get them done. His biggest criticism of the proposed SDGs as they were shaping up at the end of 2014 was that there were too many of them. He argues that in order to make the resources of international aid and the efforts

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[12] Lomborg, Bjorn. "Promises to Keep." *Foreign Affairs*. Council on Foreign Relations, Nov.-Dec. 2014. Web. 23 Jan. 2015.
[13] *Ibid*.

of the international development community most effective, they cannot be spread too thin. As he says, "Having 1,400 development targets is like having no targets at all."[14] But there *are* a lot of things that need to get done, and making those cuts is hard to do. This is where I believe project such as this one can come in. As it stands now, the map I have created needs thorough review and critiquing before I could recommend it as a fully credible source for information to aid in such decision-making. But this project has been so exciting and important to me precisely because I believe that the holistic picture it offers of differential MDG progress would truly be a useful tool in making these decisions, as the Sustainable Development Goals, and the work they will entail, take shape.

[14] *Ibid*.

Appendix

Appendix A: Detailed break-down of MDG targets and indicators[15]

Goal 1: Eradicate extreme poverty and hunger
- Target 1A: Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day
    - Indicator 1.1: Proportion of population living below $1.25 (PPP) per day
    - Indicator 1.2: Poverty gap ratio
    - Indicator 1.3: Share of poorest quintile in national consumption
- Target 1B: Achieve full and productive employment and decent work for all, including women and young people
    - Indicator 1.4: Growth rate of GDP per person employed
    - Indicator 1.5: Employment-to-population ratio
    - Indicator 1.6: Proportion of employed people living below $1.25 (PPP) per day
    - Indicator 1.7: Proportion of own-account and contributing family workers in total employment
- Target 1C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger
    - Indicator 1.8: Prevalence of underweight children under-five years of age
    - Indicator 1.9: Proportion of population below minimum level of dietary energy consumption

Goal 2: Achieve universal primary education
- Target 2A: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling
    - Indicator 2.1: Net enrolment ratio in primary education
    - Indicator 2.2: Proportion of pupils starting grade 1 who reach last grade of primary
    - Indicator 2.3: Literacy rate of 15-24 year-olds, women and men

Goal 3: Promote gender equality and empower women
- Target 3A: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015
    - Indicator 3.1: Ratios of girls to boys in primary, secondary and tertiary education
    - Indicator 3.2: Share of women in wage employment in the non-agricultural sector
    - Indicator 3.3: Proportion of seats held by women in national parliament

Goal 4: Reduce child mortality
- Target 4A: Reduce by two thirds, between 1990 and 2015, the under-five mortality rate
    - Indicator 4.1: Under-five mortality rate
    - Indicator 4.2: Infant mortality rate
    - Indicator 4.3: Proportion of 1 year-old children immunised against measles

Goal 5: Improve maternal health
- Target 5A: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio
    - Indicator 5.1: Maternal mortality ratio
    - Indicator 5.2: Proportion of births attended by skilled health personnel
- Target 5B: Achieve, by 2015, universal access to reproductive health
    - Indicator 5.3: Contraceptive prevalence rate
    - Indicator 5.4: Adolescent birth rate
    - Indicator 5.5: Antenatal care coverage (at least one visit and at least four visits)

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[15] "Unstats | Millennium Indicators." RSS Main. United Nations Statistics Division, n.d. Web. 21 Feb. 2015.

    - Indicator 5.6: Unmet need for family planning

Goal 6: Combat HIV/AIDS, malaria and other diseases

- Target 6A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS
    - Indicator 6.1: HIV prevalence among population aged 15-24 years
    - Indicator 6.2: Condom use at last high-risk sex
    - Indicator 6.3: Proportion of population aged 15-24 years with comprehensive correct knowledge of HIV/AIDS
    - Indicator 6.4: Ratio of school attendance of orphans to school attendance of non-orphans aged 10-14 years
- Target 6B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it
    - Indicator 6.5: Proportion of population with advanced HIV infection with access to antiretroviral drugs
- Target 6C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases
    - Indicator 6.6: Incidence and death rates associated with malaria
    - Indicator 6.7: Proportion of children under 5 sleeping under insecticide-treated bednets
    - Indicator 6.8: Proportion of children under 5 with fever who are treated with appropriate anti-malarial drugs
    - Indicator 6.9: Incidence, prevalence and death rates associated with tuberculosis
    - Indicator 6.10: Proportion of tuberculosis cases detected and cured under directly observed treatment short course

Goal 7: Ensure environmental sustainability

- Target 7A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources
    - Indicator 7.1: Proportion of land area covered by forest
    - Indicator 7.2: CO2 emissions, total, per capita and per $1 GDP (PPP)
    - Indicator 7.3: Consumption of ozone-depleting substances
    - Indicator 7.4: Proportion of fish stocks within safe biological limits
    - Indicator 7.5: Proportion of total water resources used
- Target 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss
    - Indicator 7.6: Proportion of terrestrial and marine areas protected
    - Indicator 7.7: Proportion of species threatened with extinction
- Target 7C: Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation
    - Indicator 7.8: Proportion of population using an improved drinking water source
    - Indicator 7.9: Proportion of population using an improved sanitation facility
- Target 7D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers
    - Indicator 7.10: Proportion of urban population living in slums

Goal 8: Develop a global partnership for development *[Indicators for MDG 8 are not target-specific; note that MDG 8 was not included in the final map for this and other reasons explained in Section III]*

- Target 8A: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system
- Target 8B: Address the special needs of the least developed countries
- Target 8C: Address the special needs of landlocked countries and small island developing states

- Target 8D: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term
- Official development assistance (ODA) Indicators
    - Indicator 8.1: Net ODA, total and to the least developed countries, as percentage of OECD/DAC donors' gross national income
    - Indicator 8.2: Proportion of total bilateral, sector-allocable ODA of OECD/DAC donors to basic social services (basic education, primary health care, nutrition, safe water and sanitation)
    - Indicator 8.3: Proportion of bilateral official development assistance of OECD/DAC donors that is untied
    - Indicator 8.4: ODA received in landlocked developing countries as a proportion of their gross national incomes
    - Indicator 8.5: ODA received in small island developing States as a proportion of their gross national incomes
- Market access Indicators
    - Indicator 8.6: Proportion of total developed country imports (by value and excluding arms) from developing countries and least developed countries, admitted free of duty
    - Indicator 8.7: Average tariffs imposed by developed countries on agricultural products and textiles and clothing from developing countries
    - Indicator 8.8: Agricultural support estimate for OECD countries as a percentage of their gross domestic product
    - Indicator 8.9: Proportion of ODA provided to help build trade capacity
- Debt sustainability Indicators
    - Indicator 8.10: Total number of countries that have reached their HIPC decision points and number that have reached their HIPC completion points (cumulative)
    - Indicator 8.11: Debt relief committed under HIPC and MDRI Initiatives
    - Indicator 8.12: Debt service as a percentage of exports of goods and services

Appendix B: Example of UN Statistics Division dataset for an MDG indicator

Poverty gap ratio at $1.25 a day (PPP), percentage — Last updated: 07 Jul 2014

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Algeria						1.4[1]																	
Angola											29.9[1]									16.5[1]			
Argentina		0.2[4]	1.1[4]	1.2[4]	1.4[4]	2.2[4]	2.8[4]	2.2[4]	2.1[4]	2.4[4]	2.8[4]	4.6[4]	5.0[4]	4.6[4]	2.9[4]	2.0[4]	1.7[4]	1.5[4]	1.0[4]	1.2[4]	0.7[4]		
Bangladesh			23.8[1]				19.3[1]				18.6[1]					14.2[1]					11.2[1]		
Belize				4.9[3]	5.2[3]	5.4[1]	4.6[3]	6.9[3]	4.7[3]	5.5[3]													
Benin														15.7[1]									
Bhutan														7.0[1]				1.8[1]					0.3[1]
Bolivia		0.7[3]		3.5[3]				9.1[3]		14.1[3]	17.8[3]	12.1[3]	12.9[3]			9.7[3]	8.4[3]	6.6[3]	8.6[3]				
Botswana					11.0[1]																		
Brazil	7.2[3]		8.5[3]	8.1[3]		5.4[3]	6.2[3]	6.2[3]	5.6[3]	5.7[3]		6.3[3]	5.5[3]	5.9[3]	5.1[3]	4.6[3]	4.1[3]	4.2[3]	3.4[3]	3.6[3]			

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