RESEARCH SUMMARY

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CONSIDERING THE COUNTRY-SPECIFIC CLIMATE AND FRESHWATER IMPACT OF MEATLESS MONDAY

The 2019 study by the Johns Hopkins Center for a Livable Future (CLF), *Country-specific dietary shifts for climate and water crises*,[1] measured the climate and freshwater impacts of nine plant-forward diets in 140 countries and compared them to the typical consumption patterns in those countries.

One of the diets included in the study is a "meatless day" in which people replace meat and fish with other foods for one day per week. This summarizes the study's methods and key findings about the impacts of a person adopting a vegetarian diet for one day each week.

Overall, the research found that in order to counterbalance the added climate and water burdens associated with low and middle income countries meeting certain nutrition targets, ambitious plant-forward dietary shifts in high income countries are urgently needed.

The country-specific results included in the study present evidence that helps illustrate the value of the Meatless Monday campaign as part of a wider effort to increasingly adopt plant forward diets, in particular in higher income countries.

How did the study model the nine diets?

Each diet used the country's baseline consumption pattern as the starting point. First, all foods in the diet were scaled up or down to the recommended target of 2300 calories and 69 g protein (12% of energy) per day. Doing this step first helped reflect the relative amounts of each food for that country. Then, in order to ensure diets were nutritionally adequate, where applicable, added sugars were scaled down to a recommended limit, fruits and vegetables were scaled up to a recommended minimum, and selected animal foods were reduced or removed, depending on the different diets that were modeled. For the lacto-ovo vegetarian diet, for example, red meat, poultry, and aquatic meats were removed; dairy, eggs, and pulses and soy were scaled up to meet the protein floor; and grains and starchy roots were adjusted up or down to meet the caloric target. The relative proportions of items within each food group (for instance, protein from animal source, plant source and staple foods) were preserved in the scaling, reflecting each country's unique dietary pattern. For example, the residents of South Korea consume relatively little dairy, so if they removed red meat from their diet, and other foods had to be increased in order to still have the required amount of protein in the diet, milk products would not likely be a major protein substitute.

For the "meatless day" diet, one seventh of a country's meat and fish intake was replaced with choices from the lacto-ovo vegetarian diet (i.e., it also included dairy and eggs, scaled from their baseline diet, and only if the protein floor had to be met). Thus, if a country only had 700 g per week to start with, it would now be 600 g/per week, regardless of the number of days that

this intake was actually spread across. The higher the original meat intake, the larger the impact, unless it ended up being replaced by dairy (only if the protein dropped below 69 grams).

The model also accounted for the fact that the greenhouse gases and water footprints of different foods vary based on where and how they are produced. The impacts of different diets in each of the 140 countries in the study reflect that country's food production and import patterns and footprint data unique to items' countries of origin. By doing so, the researchers sought to calculate the climate and freshwater impact of people adopting the different diets in a way that reflected their specific country's nutrition, cultural and trade context.

Figure 1: Parameters for study diets

Diet	Scaled to 2300 kcal	Red meat[a]	Poultry	Aquatic animals	Dairy[b]	Eggs	Pulses & soy	Grains & starchy roots	Fruits & vegetables	Nuts, seeds, & oils	Added sugars	Insects
Baseline	no											
OECD average	no											
Baseline adjusted	yes		P	P	P	P	P	⚡				
Meatless day[c]	yes		P	P	P	P	P	⚡	6c		⬇c	
Low red meat	yes	⬇	P	P	P	P	P	⚡	5		⬇	
No dairy	yes		P	P		P	P	⚡	5		⬇	
No red meat	yes		P	P	P	P	P	⚡	5		⬇	
Pescetarian	yes			P			P	⚡	6		⬇	
Lacto-ovo vegetarian	yes				P	P	P	⚡	6		⬇	
2/3 vegan[d]	yes		P	P	P	P	P	⚡	7d		⬇d	
Low food chain[e]	yes			e			P	⚡	7		⬇	e
Vegan	yes						P	⚡	7		⬇	

Legend:
▨ Included in diet   ⬇ Capped at ceiling   5-7 Minimum number of servings per day
☐ Removed from diet   P Scaled to protein floor
▨ Not considered   ⚡ Energy staple

Partial shading indicates food groups that were included only on selected days/meals, e.g., meat was included in six of seven days for meatless day, and in one of three meals for two-thirds vegan.

[a] Red meat includes bovine, sheep, goat, and pig meat. [b] When dairy products were scaled to meet the protein floor, only the FBS item "Milk, Excluding Butter" (which also includes some milk-derived products such as cheese and yogurt) was scaled. The FBS items "Butter, Ghee" and "Cream" were not scaled for protein. [c] The fruits and vegetables floor and added sugars cap for meatless day were only applied for one day of the week, reflecting one day of the lacto-ovo vegetarian diet and six days of the adjusted baseline. [d] The 2/3 vegan diet reflects the vegan diet for two out of three meals per day and the adjusted baseline for the third. The fruits and vegetables floor and added sugars cap were only applied to the two vegan meals. [e] For the low-food chain diet, protein from insects replaced 10% of the protein from terrestrial animal products, and protein from forage fish and bivalve mollusks replaced 70% and 30%, respectively, of the protein from aquatic animals.

Using the research modeling tool, what was the net impact of shifting to a diet with adequate protein and calories across all 140 countries?

The study incorporates an understanding that obesity, undernutrition, and climate change are major global challenges that greatly affect the world's population. While these problems may appear to be unrelated, they share food production and consumption as key underlying drivers. In many low and middle income countries, particularly some of the most populous countries baseline consumption patterns are deficient in protein and/or calories. Providing the additional nutrients needed by these populations for healthy growth and development—especially children under the age of two—would require increased food consumption, and thus a larger climate and water footprint from increased food production.

For the "baseline adjusted" diet in this study, in order to be comparable for energy and protein intake by meeting WHO/FAO recommendations, energy was scaled down to 2300 calories where it was too high and scaled up to 2300 calories where it was too low. Protein was scaled up to 69 grams when it was too low, but it was not scaled down where it was above 69 grams per person per day. This scaling reflects improving energy and protein where it is too low and bringing energy down where it's too high. All combined, there is a 16.4 percent increase in greenhouse gas emissions globally when modeling a baseline adjusted diet in all 140 countries, which is due to the fact that in a number of countries, the total food intake is too low. This immediate need requires that those populations consume more nutrient-dense foods, including some animal-sourced foods. Such improvement in nutrition will in turn result in a larger global climate and water footprint, although it will vary greatly by country, represented by the baseline adjusted diet in Figure 2.

Figure 2: Impact of shifting to baseline adjusted diet
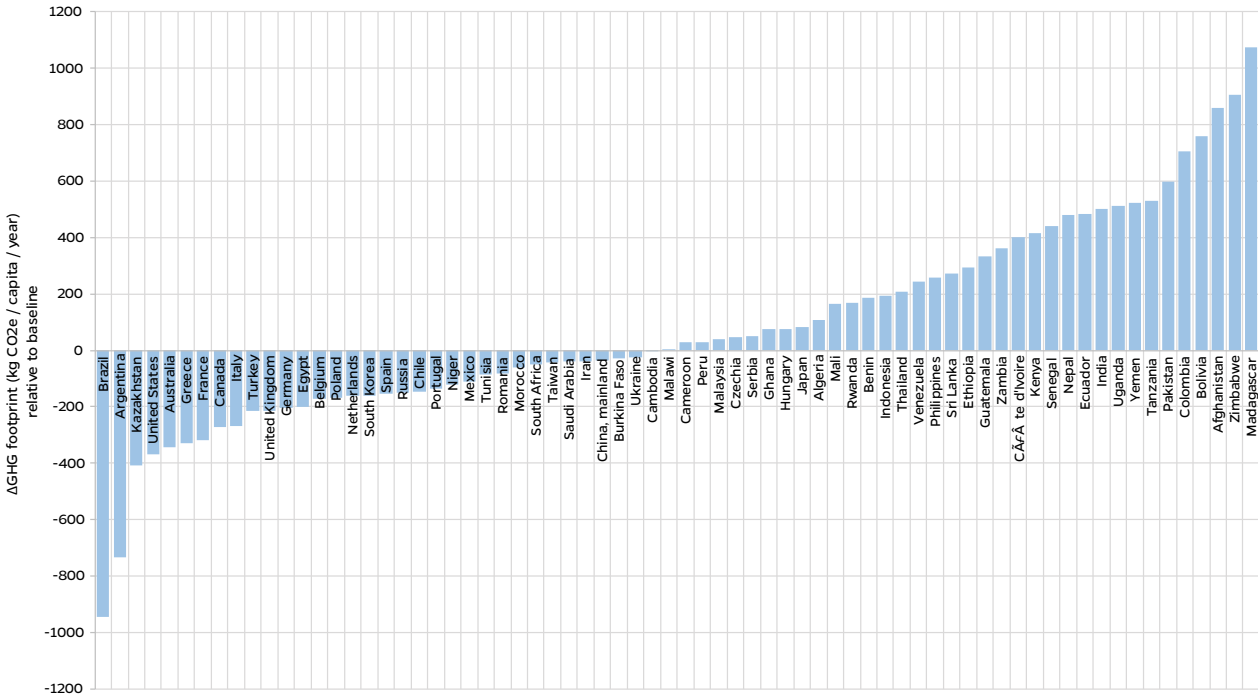
What was the net impact of a meatless day across 140 countries?

The environmental benefits of replacing meat and fish with other foods for one day per week vary by country. This is due to several factors, including differences in what people typically eat (i.e., "baseline diets"), the foods that people were assumed to use as substitutes for meat and fish (relative to current consumption and main protein sources when the protein floor was not reached), where the food in that country comes from, and how it is produced.

The "meatless day" in Figure 3 represents the per capita impact of shifting to a meatless day (one that includes 6 servings of fruits and vegetables and limited sugar) from a baseline-adjusted diet across all 140 countries. This shift decreased the greenhouse gas footprint by 2.8 percent or 267 megatons of carbon dioxide equivalents per year, compared to the baseline adjusted diet. This is equivalent to the annual climate impact of 251 coal-fired power plants. The annual blue water (freshwater used for irrigation) savings of 17 trillion liters is almost equivalent to the volume of water in Oregon's Crater Lake—the deepest lake in the United States.

According to the study, the benefits of one meatless day per week, as shown in Figure 3, reflect a diet in which meat and fish are replaced with a vegetarian menu containing dairy and eggs (a lacto-ovo vegetarian diet). If meat was replaced with only plant foods one day per week, the impact would be larger: a 10.6 percent reduction in greenhouse gas emissions per year.

Figure 3: Impact of a meatless day over 140 study countries
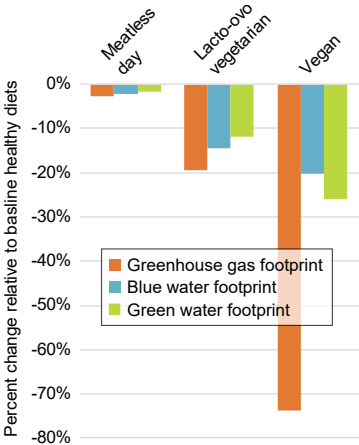
The impact of a meatless day varies across different countries

It is helpful to consider this new research using three categories of countries. The first type is high income countries where a meatless day is shown to significantly reduce the per capita climate footprint. The second type is middle income countries where a meatless day provides a modest reduction in climate footprint. The third type includes low-income countries where the adjusted baseline diet with a 15 percent reduction in meat (equivalent to one-seventh or one meatless day per week) actually has a higher climate footprint, compared to baseline typical intake in that country. (Table 1)

Table 1: Study countries, grouped by change in GHG footprint from baseline to meatless day (with the adjusted calorie and protein parameters)

Countries where a meatless day has a lower GHG footprint (more than 10% less, relative to the baseline)	Countries where a meatless day has a comparable GHG footprint (-10% to 10% relative to the baseline)	Countries where a meatless day[i] has a higher GHG footprint (>10% relative to the baseline)
43 countries, 1.63 billion people	45 countries, 2.09 billion people	52 countries, 2.45 billion people
Albania Argentina Australia Austria Brazil Canada Chile Denmark Belarus Egypt Finland France Germany Greece Hong Kong SAR Iceland Ireland Israel Italy Kazakhstan South Korea Kuwait Lithuania Malta Mauritius Mexico Netherlands Niger Norway Paraguay Poland Portugal Russia Slovenia Spain Sweden Turkey United Kingdom United States Uruguay Belgium Luxembourg Montenegro	Armenia Algeria Barbados Bermuda Belize Brunei Darussalam Bulgaria Cameroon China, mainland Cyprus Azerbaijan Estonia Fiji French Polynesia Bosnia and Herzegovina Hungary Croatia Iran Japan Kyrgyzstan Cambodia Latvia Lebanon China, Macao SAR Malawi Malaysia Maldives Mauritania Morocco New Caledonia New Zealand Panama Czechia Peru Romania Saudi Arabia South Africa Switzerland Taiwan Oman Tunisia Ukraine Burkina Faso Venezuela Serbia	Afghanistan Antigua and Barbuda Bahamas Bolivia Botswana Solomon Islands Cabo Verde Central African Republic Sri Lanka Colombia Congo Costa Rica Benin Dominica Ecuador El Salvador Georgia Gambia Ghana Kiribati Guatemala Guyana Honduras India Indonesia Cote d'Ivoire Jamaica Jordan Kenya Madagascar Mali Republic of Moldova Namibia Nepal Republic of Macedonia Vanuatu Nicaragua Pakistan Philippines Zimbabwe Rwanda Sao Tome and Principe Senegal Slovakia Suriname Tanzania Thailand Togo Uganda Ethiopia Yemen Zambia

i. The meatless day diet has adequate energy, protein, 6 servings of fruit and vegetable, max sugar intake and 6/7 of existing meat consumption – compared to current baseline diet.

The results shown in Figure 4 below are averaged over the 77 high income countries included in the study. Figure 4 shows how much a person's diet-related climate and freshwater impact changes when they shift from the typical consumption pattern in their high income country ("baseline") to various plant-forward diets.

The per-person impacts of following a meatless day are clearly shown to be greatest in high income countries, where people often consume much more animal protein than they need. These are also countries with high rates of non-communicable diseases (NCDs) and obesity and low rates of undernutrition. On average, following a meatless day in the high income countries reduced annual greenhouse gas emissions by an estimated 304 kilograms per person (weighted average baseline—weighted average meatless day). This is equivalent to the climate benefit of burning 332 fewer pounds of coal or using 34 fewer gallons of gasoline. A meatless day in those countries could also save an estimated 18,335 liters of blue water (freshwater used for irrigation) per person per year, equivalent to the amount of water used if someone took a shower for 38 hours.

Figure 4: Per-person impact of shifting from baseline consumption patterns to adjusted baseline for plant-forward diets, averaged over 77 high income countries
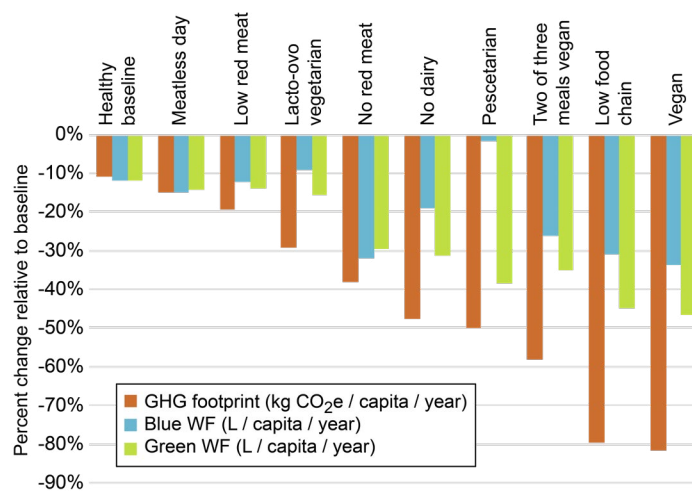
The beneficial impact of a meatless day is further demonstrated when looking at individual countries— for both a per capita and whole country impact.

Figure 5 shows the reduction in greenhouse gas emissions achieved by people in 12 different countries by forgoing meat and fish once a week. Figure 6 shows the conservation in blue water (freshwater used for irrigation) from a meatless day. (These figures presume that on the meatless day, the person adopts a vegetarian diet that includes eggs and dairy.)

As we can see from the figures, switching to a vegetarian diet one day per week can have a significant beneficial climate impact in many countries, and in some countries, the impact is greater than in others. Meatless Monday, which is active in more than 40 countries, can play a role in achieving that positive impact. For instance, if a person in Denmark were to observe a meatless day once a week for a year, she would reduce greenhouse gas emissions by 107 kilograms per year, comparable to reducing yearly mileage by 262 miles in a typical US passenger vehicle. If a person in Israel were to do the same, she would save 2,029 liters of blue water, equivalent to the water savings from skipping 31 showers.

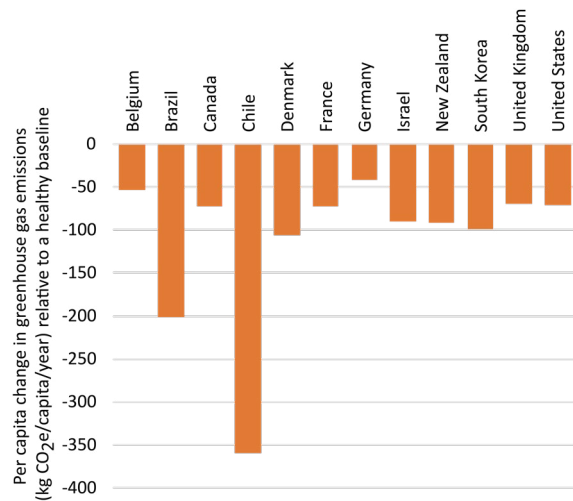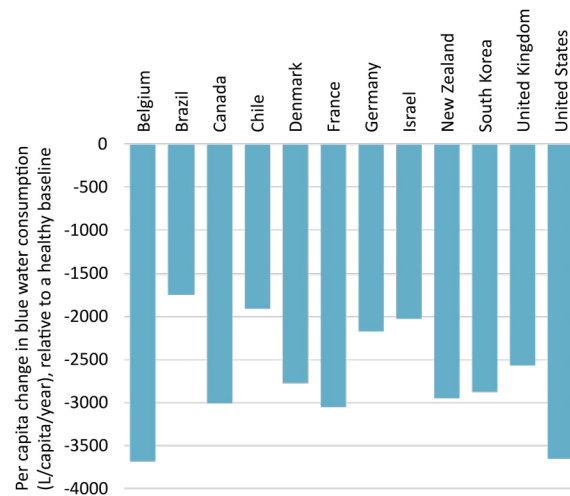Figure 5: Climate impact of one person following a meatless day

Figure 6: Freshwater impact of one person following a meatless day

What would be the impact if everyone in these countries followed a meatless day each week?

Figures 7 and 8 show the greenhouse gas reductions and blue water conservation for each country if its entire population replaced meat and fish with other protein sources for one day per week. If the entire population of Brazil, for example, were to forgo meat and fish one day per week for a year, this would reduce greenhouse gas emissions by 40 megatons per year. This is equivalent to the annual emissions from 10 coal-fired power plants. Meanwhile, if the entire population of the United States were to do so, that would save more than a trillion liters of blue water per year. That is equivalent to nearly half of the water used to irrigate golf courses across the US each year.

As these findings demonstrate, a meatless day, as promoted by the global Meatless Monday campaign, can provide substantial environmental benefits.

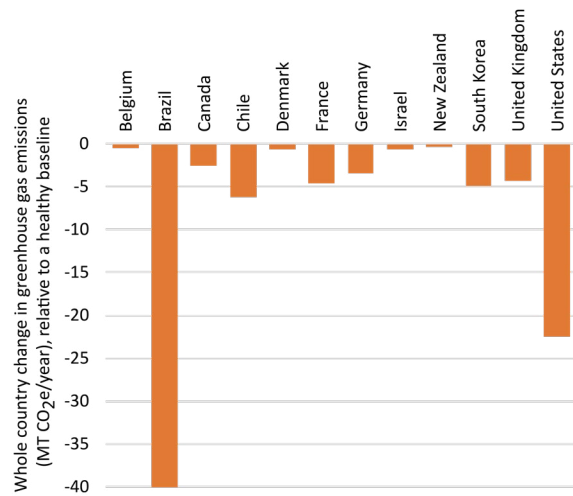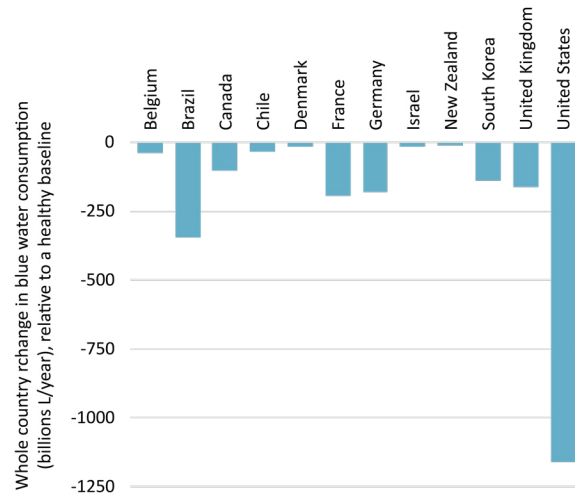Figure 7: Climate impact of a whole country following a meatless day

Figure 8: Blue water impact of a whole country following a meatless day

Meatless Monday can serve as a first step toward healthy, sustainable diets.

The differences in impact across different countries underscore the responsibility of high income countries to reduce their meat consumption for climate and freshwater impacts as well as health so that low and middle-income countries can achieve adequate nutrition without adding to the overall climate burden. These high income countries can use strategies such as Meatless Monday to make dramatic, positive changes. Meatless Monday's message of healthy, sustainable diets also supports the vital importance of working toward nutritionally adequate diets that meet human capital and health needs and address environmental sustainability in low- and middle-income countries.

Meatless Monday alone can result in significant shifts, but this practice is likely to have broader impact as more people participate. Studies have shown that people who forgo meat one day per week are more likely to eat fewer animal foods on other days of the week, too (see textbox) [ii]. This means that actual benefits of campaigns such as Meatless Monday are likely far greater than the results modeled in this study.

Going meatless one day a week is a powerful first step toward addressing climate crisis. It is a strategy that may lead people and institutions to reduce their incorporating more plant-based foods and meatless meals throughout the week, as well.

> **Meatless day can lead to other changes**
>
> 58% of Americans familiar with the Meatless Monday campaign state that they have made other changes in their cooking or eating habits because of Meatless Monday, including:
>
> ▸ experimenting with meatless recipes
> ▸ trying to incorporate more meatless meals throughout week
> ▸ trying more meatless meals when eating out
> ▸ eating more fruits and vegetables
> ▸ eating less meat
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> Source: Monday Campaigns Awareness 2017 Study Survey Report, Data Decisions Group, October 2017

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ii. 2.1 gallons per minute *https://blog.constellation.com/2016/07/05/average-shower-length-flowchart/*

References

1. Kim BF, Santo RE, Scatterday AP, Fry JP, Synk CM, Cebron SR, Mekonnen MM, Hoekstra AY, de Pee S, Bloem MW, Neff RA, Nachman KE. 2019. Country-specific dietary shifts to mitigate climate and water crises. Global Environment Change. In press.

2. Meatless Monday and the Johns Hopkins Center for a Livable Future. 2019. Meat, Menus and Meatless Monday.