Demography is not destiny: Probabilistic scenarios of future fertility change in Sub-Saharan Africa

Patrick Gerland, Ann Biddlecom, Vladimíra Kantorová, Stephen Kisambira, Thomas Spoorenberg, Cheryl Sawyer, Lina Bassarsky, Francois Pelletier, Petra Nahmias
Population Division, Department of Economic and Social Affairs, United Nations

DRAFT
31 July 2015

An initial version of this paper was presented to the US National Academies of Science Workshop on Recent Trends in Fertility in Sub-Saharan Africa, June 14-15, 2015, Washington D.C.

Acknowledgements: Programming assistance by Hana Ševčíková, University of Washington; initial insights from Adrian Raftery, University of Washington; and foundational work in preparing the revisions of the estimates and projections in *World Population Prospects* by colleagues of the Population Estimates and Projections Section, Population Division/DESA, United Nations.

Abstract

This paper reviews recent fertility declines within sub-Saharan Africa and examines the implications of different fertility decline patterns for future fertility and population projections in the region. We begin with a direct acknowledgement of the variation in fertility across countries[i] in sub-Saharan Africa, drawing attention to the timing of the onset of fertility decline and the estimated pace of fertility decline. We then analyze fertility declines among countries worldwide that are advanced in (or have completed) their first fertility transition and identify distinct, systematic patterns. These different fertility decline patterns are then used to construct probabilistic fertility and population projections for sub-Saharan African countries. We compare them to projections based on the fertility decline experiences of all countries worldwide. The simulations are based on the same statistical models that are used to generate probabilistic projections for the United Nations *World Population Prospects*.

Note: This initial draft paper is based on the 2012 Revision of these data, but since the official release of the 2015 Revision new dataset and projections on 29 July 2015, we plan to update this paper to incorporate the latest set of data and assumptions, analyze further the underlying factors associated to specific fertility scenarios, and examine further implications for the demographic dividend of the different scenarios considered.

Introduction

Fertility decline has proceeded slowly in most countries of sub-Saharan Africa compared to the experiences of countries in other regions over the past several decades. The relatively slow transition from high to low fertility in the region has prompted research on the characteristics of fertility decline patterns and the socio-economic, cultural and institutional determinants and enabling conditions that may make fertility decline within sub-Saharan Africa qualitatively different from that experienced by countries outside the region (Caldwell, Orubuloye and Caldwell 1992; Casterline and Bongaarts 2012; Cleland, Onuoha and Timæus 1994; Garenne 2008; Kirk and Pillet 1998; Timæus and Moultrie 2008). Other research has taken a closer look at slow fertility declines to understand differences in fertility change among population or economic subgroups within countries (Ezeh, Mberu and Emina 2009; Rossier, Corker and Schoumaker 2015) or to examine the sensitivity of definitions of fertility stalls and the quality of data underlying estimates of fertility trends (Garenne 2011; Machiyama et al 2010; Schoumaker 2009, 2014).

The pace of fertility decline figures prominently in shaping the future population size and age structure of sub-Saharan Africa. The region's population is projected to grow from 831 million people in 2010 to 3.8 billion people in 2100 (the medium variant), and above-replacement fertility accounts for 79 per cent of the population increase compared to 8 per cent from mortality reduction, 14 per cent from a young age structure in 2010 (population momentum) and a small negative contribution of migration (Andreev et al. 2013). For high-fertility countries in the region, the wide uncertainty around where fertility is headed results

in substantial differences in population projections (see Gerland et al. 2014b). Different fertility decline pathways matter at the macro level in myriad ways: for example, how fast the shift will occur toward a higher working-age population to non-working age population and the consequent effects on economic growth (Bloom et al. 2013) or how much greenhouse gas emissions can be reduced by slowing population growth (O'Neill et al. 2010).
The two objectives of this paper are to describe fertility declines within sub-Saharan Africa and examine the implications of different fertility decline patterns for future fertility and population projections in the region. We begin with a direct acknowledgement of the variation in fertility across countries[ii] in sub-Saharan Africa, drawing attention to the timing of the onset of fertility decline and the estimated pace of fertility decline. We then analyze fertility declines among countries worldwide that are advanced in (or have completed) their first fertility transition and identify distinct, structured patterns. These different fertility decline patterns are then used to construct probabilistic fertility and population projections for sub-Saharan African countries. We compare them to projections based on the fertility decline experiences of all countries worldwide. The simulations are based on the same statistical models that are used to generate probabilistic projections for *World Population Prospects*.

Data

The Population Division publishes estimates and projections of period total fertility rates in *World Population Prospects* (WPP) every two years. The estimates of total fertility presented in this paper are from the 2012 Revision and are shown for countries or areas with 90,000 persons or more in 2013 (United Nations 2013a). The most recent data source underlying the total fertility estimates from the 2012 Revision for 50 sub-Saharan African countries[iii] (United Nations 2013b) is from the period 2010-2011 for 27 countries, 2005-2009 for 18 countries and 2000-2004 for 5 countries (Central African Republic, Comoros, Equatorial Guinea, Eritrea and Mayotte).

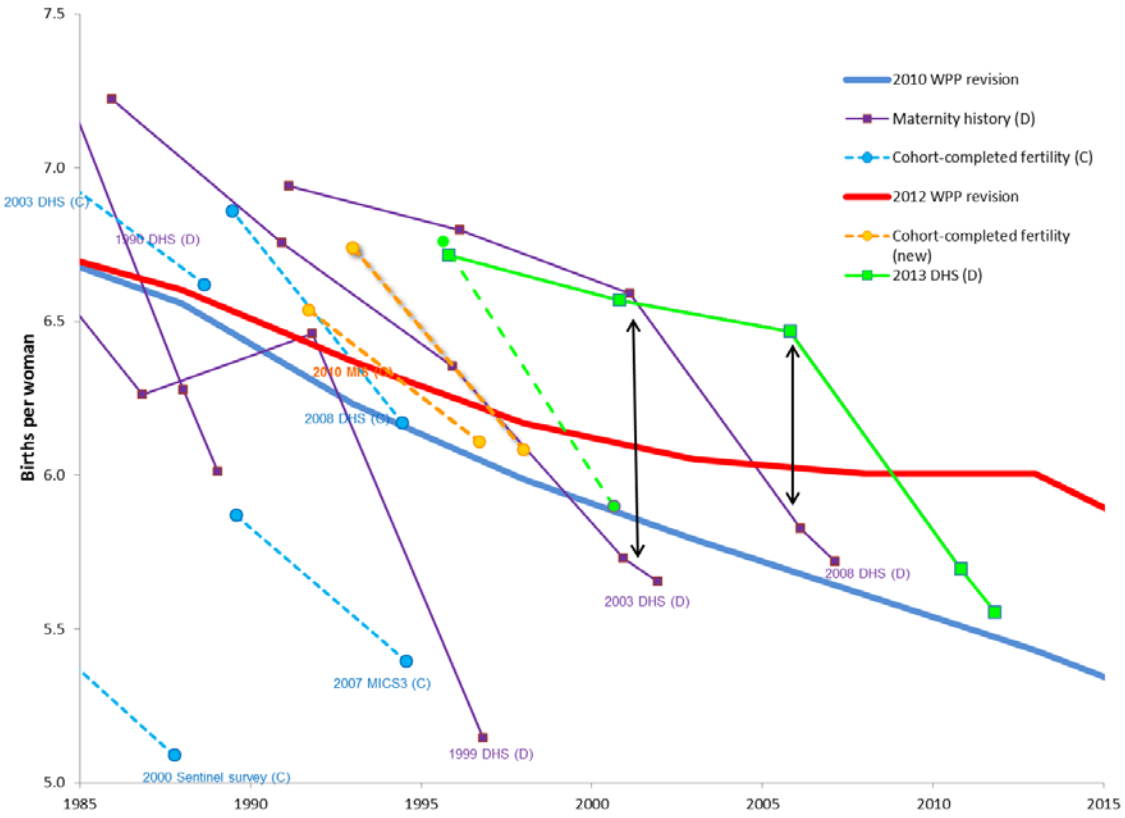
A common challenge in estimating total fertility over time, especially for countries without accurate or complete vital registration data, as is the case for most countries in sub-Saharan Africa,[iv] is that estimates will vary across data sources and by the methodology used to derive those estimates. Even the underlying data from standardized, high quality surveys such as the Demographic and Health Surveys vary considerably across countries, yielding total fertility estimates from recent fertility data of good quality (e.g., Gabon, Lesotho, Namibia and Zimbabwe) and of poor quality (e.g., Benin, Burkina Faso, Cameroon, Chad, Ethiopia, Guinea, Madagascar, Mali, Mozambique, Niger, Nigeria and Uganda) (Schoumaker 2014). Total fertility estimates based on the last three years of births tend to be under-estimated by 10 per cent or more in most of the surveys with "poor quality" fertility data from retrospective birth histories (Schoumaker 2014).

Figure 1 is an illustration of the variation in total fertility estimates based on survey data and estimation methods (direct methods and cohort-completed fertility) for Nigeria for the recent period 1985 to 2015. The thick trend lines show the total fertility estimates from the 2010 Revision (blue line) and 2012 Revision (red line) of WPP. Given new data from the 2008 DHS and other surveys, total fertility in the 2012 Revision was re-estimated at a higher level

than the 2010 Revision beginning in the mid-1980s, resulting in almost half a birth per woman difference in the 2005-2010 period.

The 2013 Demographic and Health Survey for Nigeria was not available in time to be included in the 2012 Revision. We show these new data (the green squared markers at the far right of the figure 1) because they highlight a recurring pattern of fertility estimates based on a recent reference period being consistently lower than fertility estimates from reconstructed birth histories for the same time point (identified on figure 1 using vertical black lines with arrows for the 2003 and 2008 DHS). Looking only at fertility estimates from a three-year reference period, the 2013 DHS survey shows a decline in total fertility to 5.5 births per woman from a stalling pattern of 5.7 births per woman in the 2003 and 2008 DHS. Yet the absolute differences are large between these three-year reference period estimates and those for the same time point from the reconstructed birth histories: about half a birth difference in the mid-2000s (comparing the 2008 and 2013 survey estimates) and about one birth difference in the early 2000s (comparing the 2003 survey estimate to those from the 2008 and 2013 surveys).

Figure 1. Nigeria 1985-2015 total fertility rate estimates based on various data sources and estimation methods, and WPP estimates for the 2010 and 2012 Revisions



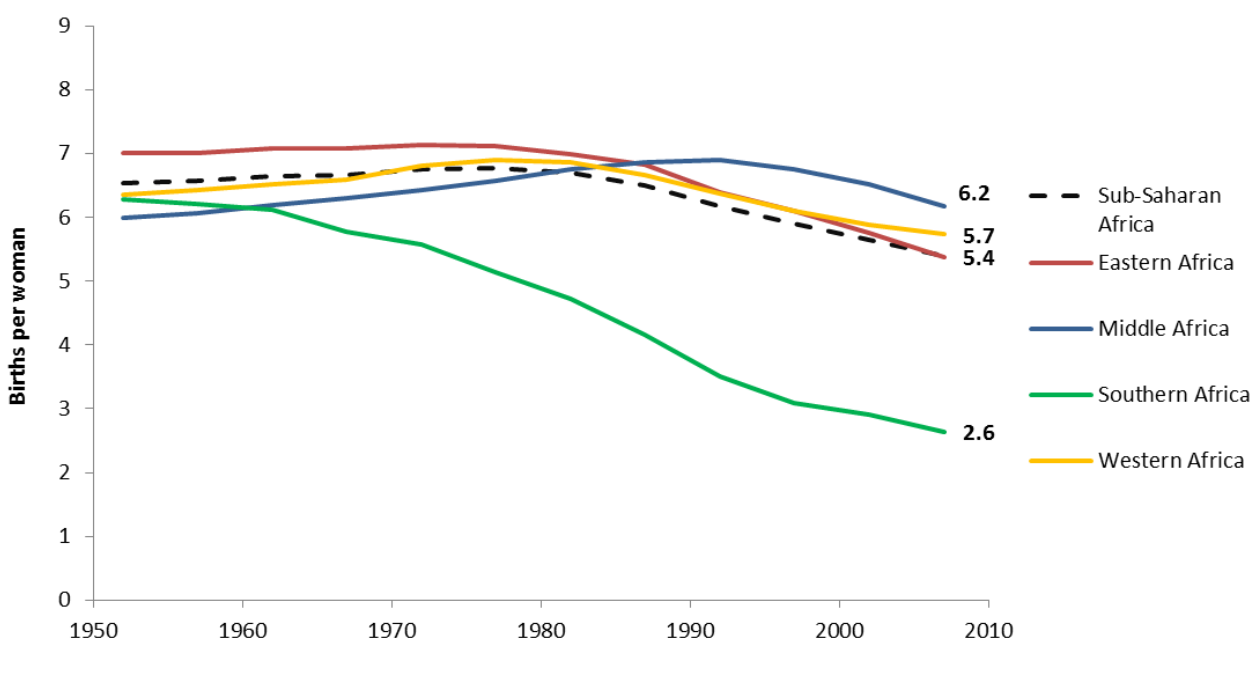
WPP considers potentially as many types and sources of empirical estimates as possible, including retrospective birth histories, direct and indirect fertility estimates (Gerland 2014a). The 2015 Revision will update all total fertility estimates taking into account new data and the inconsistencies among estimates. Moreover, total fertility estimates are derived to ensure

as much internal consistency as possible with all other demographic components and intercensal cohorts enumerated in successive censuses (United Nations 2014). The advantages of this approach are that the estimates are internally consistent within a country and with respect to other related demographic information, there is improved comparability over time within a country and countries can be compared at one time period. A disadvantage is that the estimates can depart from what a country considers its official estimates of fertility.

Regional and national fertility trends in sub-Saharan Africa

Figure 2 shows the estimated trends in period total fertility for sub-Saharan Africa and its sub-regions from 1950 to 2010. Fertility was high (above six births per woman) in all sub-regions in 1950-1955. Fertility remained high in Eastern Africa and Western Africa until the 1980s, whereby it began a slow decline to an average in 2005-2010 of 5.4 births per woman in Eastern Africa and 5.7 births per woman in Western Africa. Fertility in Middle Africa began to decline a decade later and more slowly, resulting in an average of 6.2 births per woman in 2005-2010. Southern Africa departed from the overall trends with a decline beginning in the 1950s and dropping below three births per woman in the 2000s. The 2005-2010 estimate of 2.6 births per woman in Southern Africa is less than half the total fertility level in Eastern, Middle and Western Africa.

Figure 2. Sub-regional trends in total fertility, sub-Saharan Africa, 1950-2010



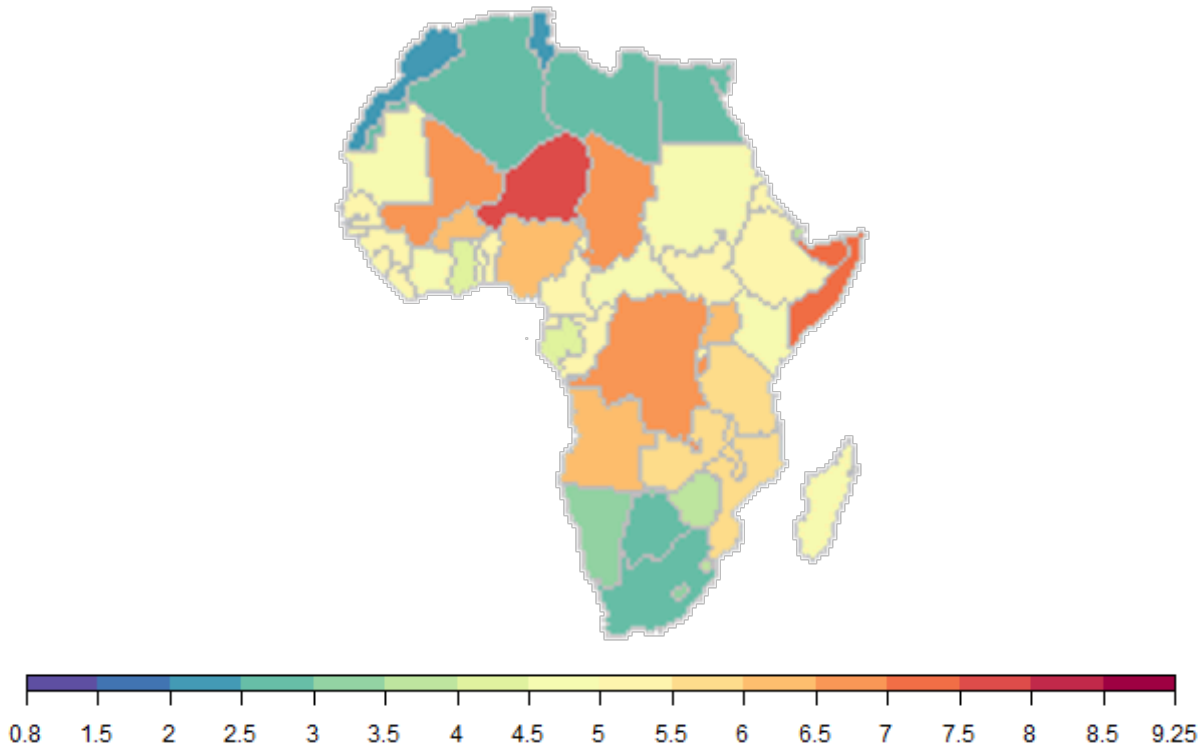
SOURCE: Based on data from United Nations 2013a.

The sub-regional fertility levels mask diverse fertility levels among countries. Figure 3 shows a map of Africa with the country-specific total fertility levels in 2005-2010. Among the 16 countries in Western Africa, total fertility ranged from 2.6 in Cabo Verde (a small island

country not shown on the map) to 7.6 in Niger. Four countries had current fertility levels of six or more births per woman (Burkina Faso, Mali, Niger and Nigeria), 10 countries had fertility between five and six births per woman, and four countries had fertility between four and five births per woman (Ghana, Côte d'Ivoire, Mauritania and Togo).

Total fertility levels ranged more widely among the 20 countries in Eastern Africa, from 1.6 births per woman in Mauritius (not shown on the map) to 7.1 births per woman in Somalia. Only three countries in Eastern Africa still had fertility levels of six or more in 2005-2010 (Burundi, Somalia and Uganda). Nearly half of the countries in Eastern Africa had fertility between five and six births per woman and five countries had moderate levels of fertility (from 3.8 births per woman in Djibouti to 4.8 births per woman in Madagascar). The small island countries of Mauritius, Réunion and Seychelles had fertility levels less than three births per woman.

Figure 3. Total fertility levels among countries in Africa, 2005-2010



SOURCE: United Nations 2013a.

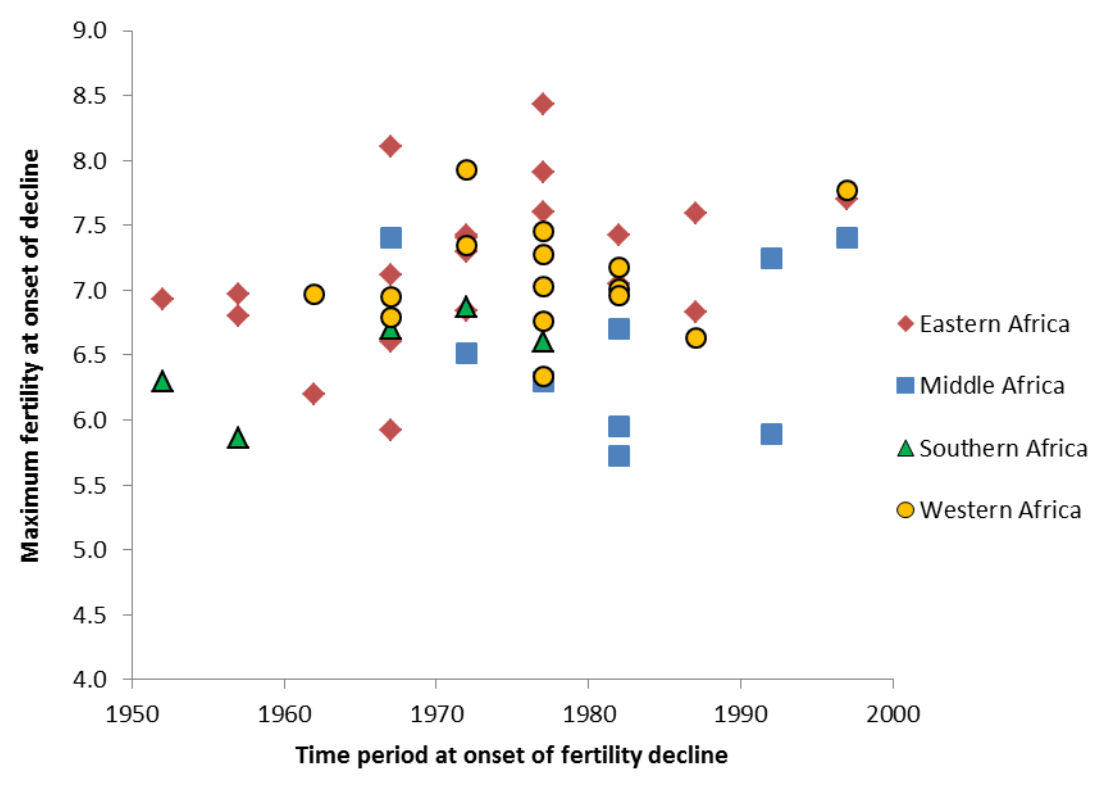
The nine countries of Middle Africa reflected medium-high to high fertility, from 4.3 births per woman in Gabon to six or more births per woman in three countries (Angola, Chad and the Democratic Republic of the Congo). Three countries had fertility between five and six births per woman (Cameroon, Congo and Equatorial Guinea) and the remaining three countries had fertility between four and five births per woman (Central African Republic, Gabon and Sao Tome and Principe).

While fertility in Southern Africa is dominated by South Africa’s pattern, the range in fertility among the five countries in the sub-region is narrow, from 2.6 births per woman in

South Africa to 3.8 births per woman in Swaziland. Both Botswana and South Africa now have fertility levels below three births per woman.

The onset of the fertility transition and the level of fertility at that point also vary widely across sub-Saharan African countries. We use a definition of the start of the fertility transition as the most recent period in a country with a maximum total fertility level that is within half a child of the maximum fertility in the country over the 1950-2010 estimation period (Alkema et al. 2011). The definition is intended to exclude random fluctuations in pre-transition fertility. Among the 50 sub-Saharan countries, Mali is the one country where there is still ambiguity as to whether a decline has commenced since the mid-1980s.

Figure 4. Maximum total fertility and time period at onset of fertility transition, 49 sub-Saharan African countries by sub-region



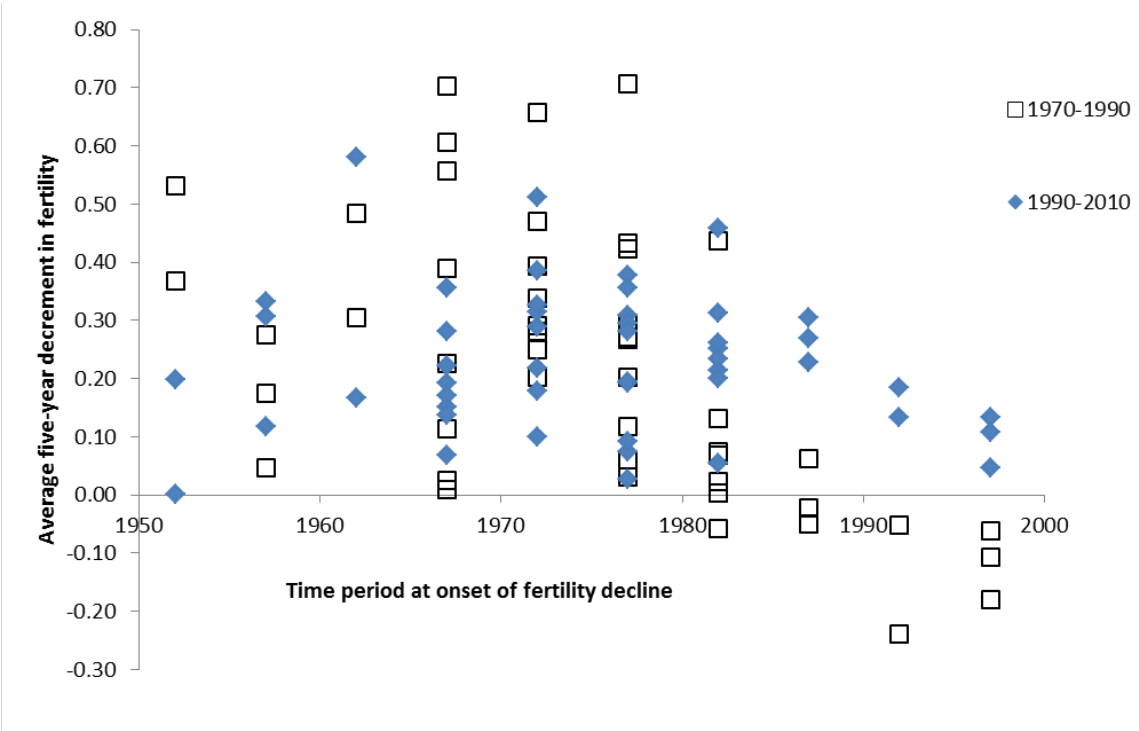
SOURCE: Based on data from United Nations 2013a.

Figure 4 shows the diversity across countries and within sub-regions in the total fertility level and timing at the start of the fertility transition, as assessed in the 2012 Revision. By the late 1970s, 33 sub-Saharan African countries had started a fertility decline, increasing to 41 countries by the early 1980s. While all countries in Southern Africa had commenced a fertility transition by the late 1970s, the range of experiences was much wider among countries in Eastern Africa (from the early 1950s in Réunion to the late 1990s in Somalia; unweighted median = 1972), Middle Africa (from the late 1960s in Angola to the late 1990s in Chad; unweighted median = 1982) and Western Africa (from the early 1960s in Cabo Verde to the late 1990s in Niger; unweighted median = 1977).

The maximum fertility at the onset of the fertility transition ranged from less than six births per woman in five countries (Central African Republic, Equatorial Guinea, Gabon, Lesotho and Seychelles) to more than 7.5 births per woman in eight countries (Burundi, Côte d'Ivoire, Kenya, Malawi, Mayotte, Niger, Rwanda and Somalia). The later the start of the fertility transition, the higher the maximum level of fertility at onset, although the correlation across the 49 countries is small (R^2 = .05).

The transition from the maximum fertility experienced at the onset of the fertility transition to the current estimated fertility level in 2005-2010 has been slow for most countries across sub-Saharan Africa, regardless of when the transition started (figures 5 and 6). Among the 23 sub-Saharan African countries that began a fertility transition by the early 1970s, five countries had a rapid fertility decline of 0.5 births or more per woman on average per five-year period from 1970 to 1990 (Botswana, Kenya, Seychelles, South Africa and Zimbabwe; the square markers in figure 5). On the other end of the spectrum, five countries had very slow declines of less than 0.2 births per woman during this period (Angola, Eritrea, Mozambique, Tanzania and Uganda), a pace where it would take 25 years to realize a decline of one birth per woman. Cabo Verde and Djibouti stand out among the 23 "early" transition countries for a fast pace of decline in the recent time period 1990-2010 (a five-year decrement of 0.5 births or more per woman; the diamond markers in figure 5).

Figure 5. Average five-year decline in total fertility for 1970-1990 and 1990-2010 by time period of fertility transition onset, sub-Saharan African countries



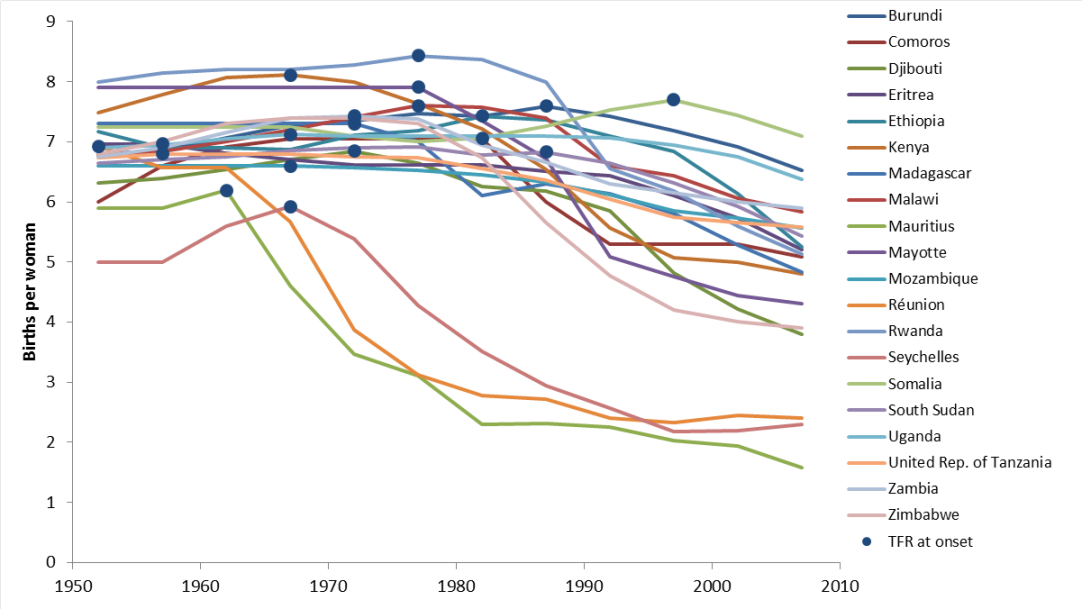
SOURCE: Based on data from United Nations 2013a.

Among the 23 countries where the fertility transition started later (between the late 1970s and the early 1990s), the pace of decline over the recent time period from 1990 to 2010 was

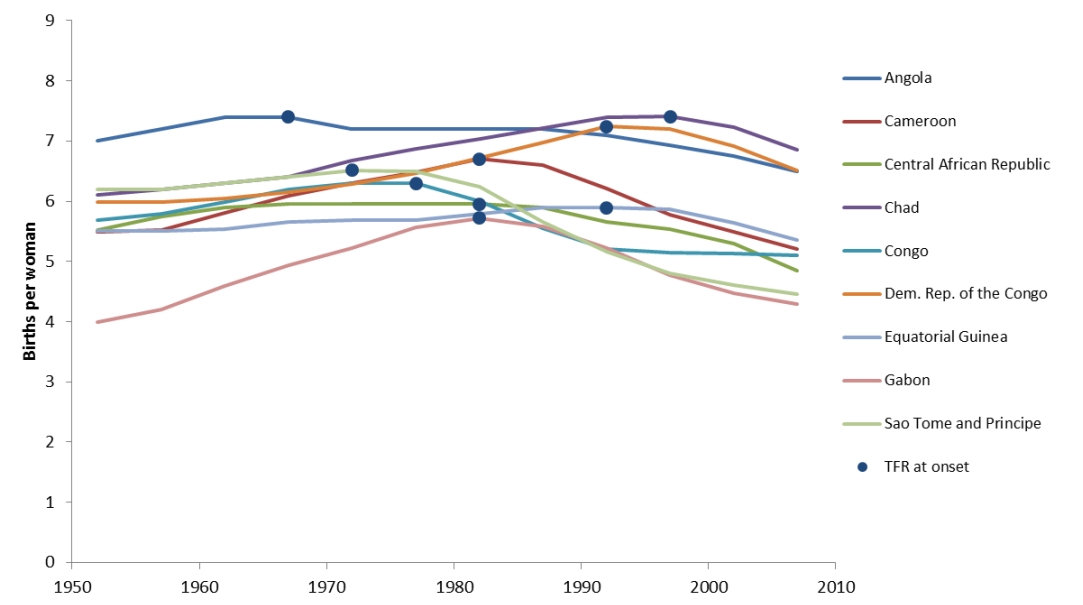
slower than the “early” transition countries had experienced in their first phase of fertility decline. No country in this later transition group experienced a rapid pace of decline on average (i.e., five-year decrement of 0.5 births or more per woman), and seven countries experienced slow declines of less than 0.2 births per woman per five-year period on average from 1990 to 2010 (Comoros, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gambia, Malawi and Nigeria).

Figure 6. Fertility trends and time period of fertility transition onset, sub-Saharan African countries by sub-region, 1950-2010

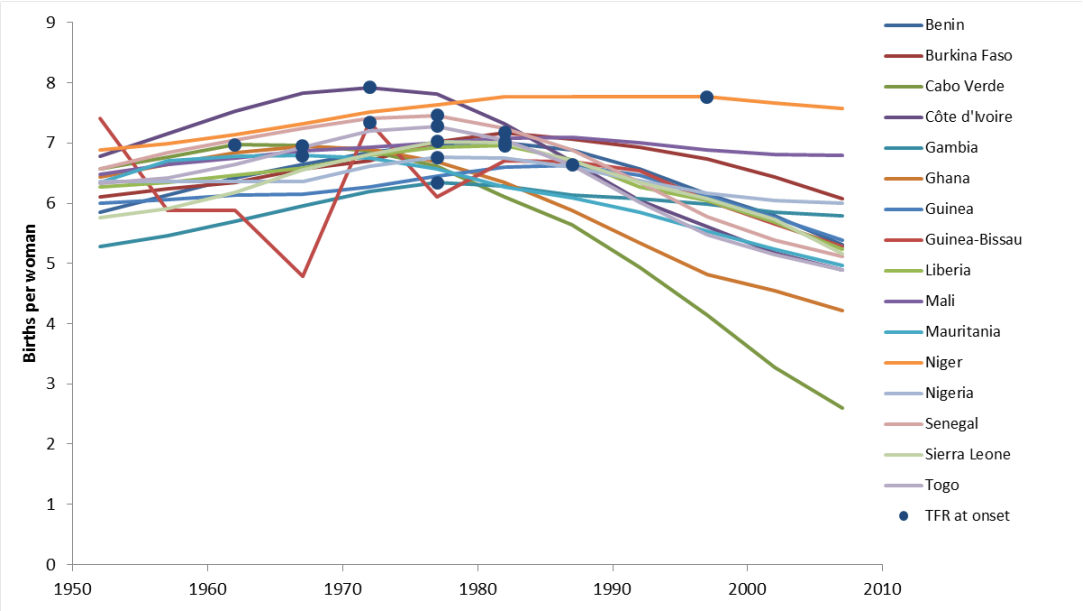
A. Eastern Africa



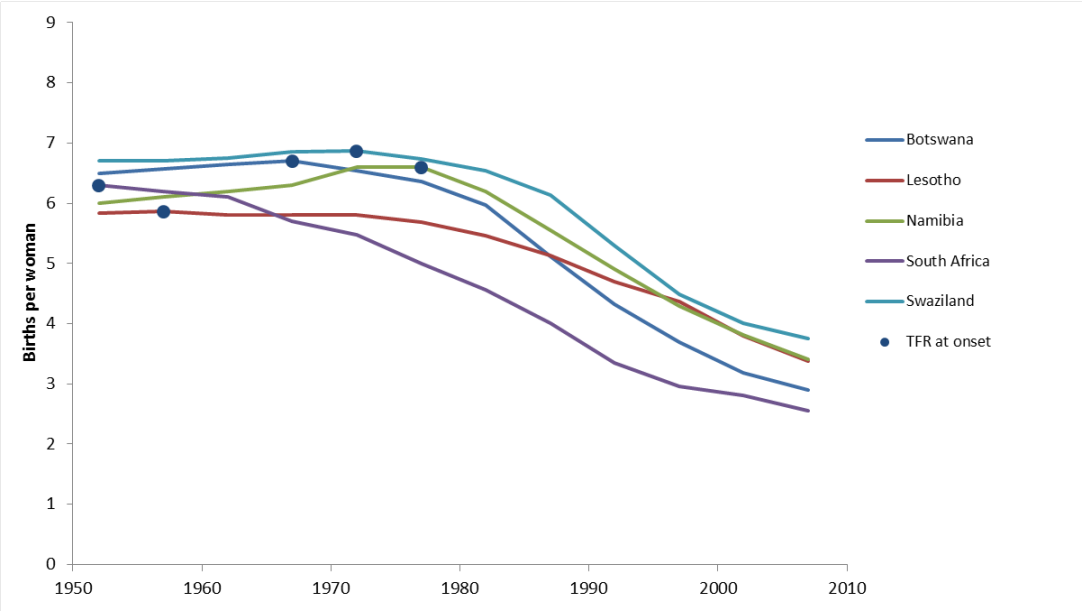
B. Middle Africa



C. Western Africa



D. Southern Africa

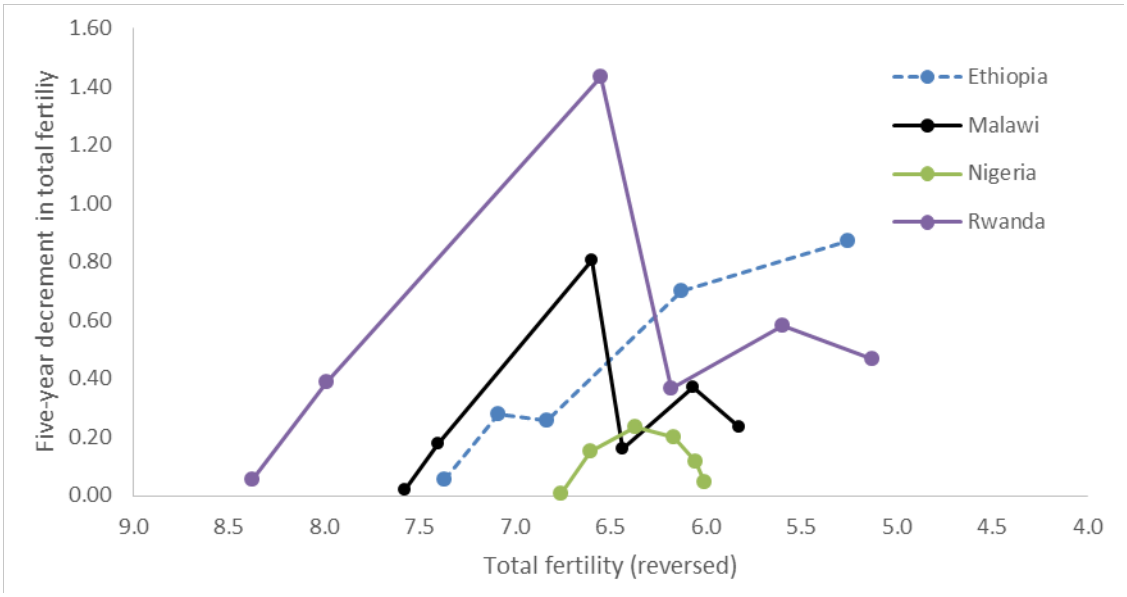


SOURCE: Based on data from United Nations 2013a.

The distinct patterns in the pace of decline are illustrated in figure 7 for four of the 23 later transition countries. Ethiopia, Malawi, Nigeria and Rwanda began a fertility transition around the same time between the late 1970s and early 1980s and all currently have total fertility levels above five births per woman in 2005-2010. Rwanda experienced a steady, rapid decline, reaching a peak five-year decline in total fertility of more than one birth per woman

and has had a sustained rapid pace of fertility decline over the last 10 years (a five-year decrement of more than half a birth). Malawi followed a similar pattern as Rwanda of a steady increase in the pace of fertility decline except that it never reached as rapid a pace and in the last 10 years it has had a moderate pace of decline (a five-year decline between 0.2 and 0.4 births per woman). Ethiopia reached around the same peak pace of decline as Malawi but it took longer to do so. Nigeria's fertility decline has been consistently slow, with a low peak pace of decline and little change over the past 10 years.

Figure 7. Five-year decrements in total fertility from the start of the fertility transition to 2005-2010, four sub-Saharan African countries



SOURCE: Based on data from United Nations 2013a.

Types of fertility declines

Given that most countries in sub-Saharan Africa are still in the beginning or middle of the fertility transition, what are the prospects for the pace of future fertility decline? To advance discussion of the possible pathways, we construct fertility decline scenarios based on the distinct experiences of 130 countries that are advanced in or have already completed the fertility transition, defined as countries where total fertility was less than or equal to three births per woman in 2005-2010. This definition excludes all sub-Saharan African countries except for Mauritius, Réunion and Seychelles in Eastern Africa, Botswana and South Africa in Southern Africa and Cabo Verde in Western Africa.

We draw on fertility estimates from the 2012 Revision of WPP and historical data on period total fertility prior to 1950.[1] The extended historical data used in this analysis includes 40

[1] This analysis uses a consolidated historical dataset (tfr_supplemental .txt) for 103 countries or areas covering the period 1740-1950 (including 24 countries with data before 1850) as part of the R Packages used for this analysis (wpp2012 and bayesTFR), and based on series for five-year periods from the following sources: (1) Max Planck Institute for Demographic Research (Germany) and Vienna Institute of Demography (Austria). (2012). *Human Fertility Database (HFD).* Available at

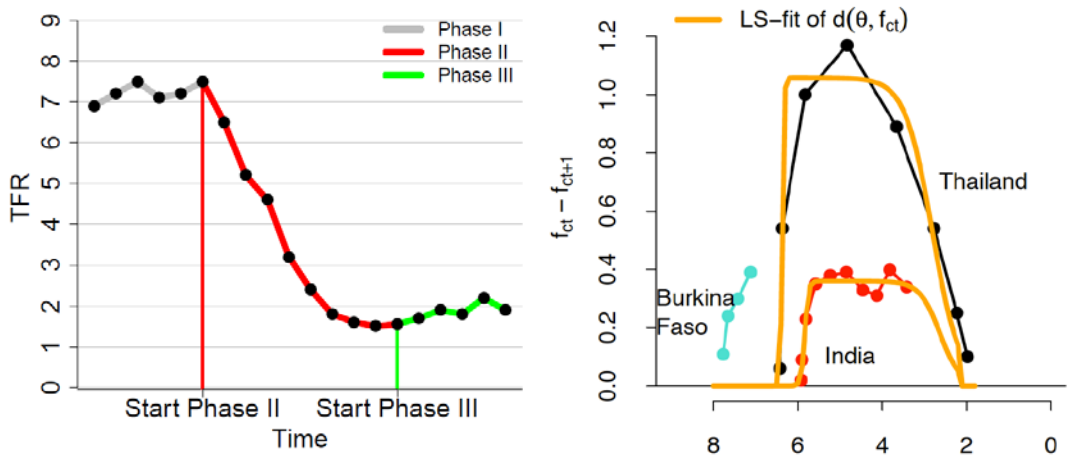
countries in Europe, 23 in the Americas, 24 in Asia, 4 in Oceania, and 3 in Africa that already had an estimated total fertility level less than or equal to three births per woman in 2005-2010. The expanded data set provides a more comprehensive picture of the different fertility declines that have occurred among countries, including the earlier, slower fertility declines in Europe that started at lower levels of fertility (Skirbekk et al. forthcoming) and took place before the wide availability and use of effective contraceptive methods. Thus, the fertility decline patterns that we distinguish are not limited to the more rapid fertility decline experiences of countries in Asia and Latin America and the Caribbean since the 1950s.

The pace of decline from high to low fertility (phase II in the schema in figure 8) is modelled using a double-logistic curve (an inverted U-shape) and as a function of the total fertility level. The pace of decline is modelled as a systematic trend of accelerating rates of decline followed by slowing rates of decline toward lower fertility and with random distortion terms added to reflect country-specific fluctuations around this systematic trend (see details in Alkema et al. 2011; United Nations 2014). The parameters of the model are estimated using a Bayesian statistical approach, producing country-specific distributions of the parameters of fertility decline that are informed by historical trends in a country. The second panel in figure 8 shows different country experiences in fertility decline (a least-squares fit of the five-year decrements in total fertility associated with a specific level of total fertility). The hierarchical nature of the model takes into account both a country's experience and the global experience using information from all countries in the timing of onset, level of fertility at onset and peak pace of decline.

---

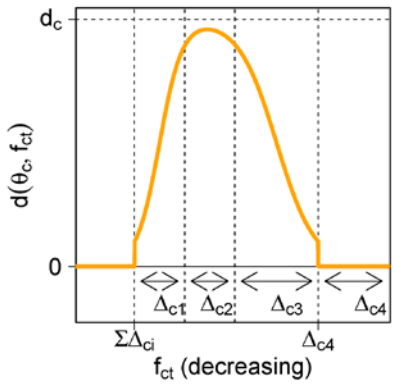
www.humanfertility.org. Data downloaded on 13 May 2012; (2) Festy, P. (1979). *La fécondité des pays occidentaux de 1870 à 1970*. Paris: Presses universitaires de France; (3) Chesnais, J.C. (1992). *The demographic transition: stages, patterns, and economic implications: a longitudinal study of sixty-seven countries covering the period 1720-1984*. Oxford ; New York: Clarendon Press; (4) Bhat, P.N.M. (1989). "Mortality and fertility in India, 1881-1961: a reassessment." pp. 73-118 in *India's historical demography: studies in famine, disease and society*, edited by T. Dyson. London and Riverdale, Md: Curzon and Riverdale Co.; (5) Hofsten, E.A.G.v. and H. Lundström. (1976). *Swedish population history: Main trends from 1750 to 1970*. Stockholm: Statistiska centralbyran: LiberForlag; (6) Ajus, F. and M. Lindgren. (2012). *Gapminder fertility dataset, 2010 (including documentation for Children per Woman (Total Fertility Rate) for countries and territories, Version 2*. The Gapminder Foundation. Sweden, Stockholm. http://www.gapminder.org/data/documentation/gd008/. Data downloaded on 8 April 2012.

Figure 8. Schematic phases of the fertility transition



The decline function modelling the five-year decrements in the total fertility rate ($d(\theta_c , f_{ct})$) at a given fertility level ($f_{c,t}$) as shown on figure 9 uses five probabilistic parameters (Δ_{c1}, Δ_{c2}, Δ_{c3}, Δ_{c4}, d_c) to summarize the overall fertility decline, in addition to the start level of the fertility decline itself (Uc) defined deterministically (Alkema et al. 2011). These six parameters were estimated for the purpose of this study for all 201 countries included in the 2012 Revision of WPP using 1950-2010 estimates and historical series prior to 1950 (upon data availability). For each country, a sample of 300,000 double-logistic curves were computed (five simulations were run in parallel with 62,000 iterations performed for each simulation, and the first 2,000 were discarded). Summary statistics (mean, lower and upper 95% percentiles) were computed on a systematic sub-sample of 100,000 sets of six double-logistic parameters.

Figure 9. Parameters of the fertility decline function



The subsequent analysis focuses on the subset of 130 countries that had three or fewer births per woman as of 2005-2010, and uses a model-based clustering algorithm (Fraley and Raftery 2012; implemented in the 'mclust' package in R) to group countries into homogeneous clusters using the summary statistics of the model parameters of fertility decline.

Nine fertility decline clusters provided distinct patterns and a reasonable number of countries within each cluster for interpretation.[v] The general pattern and the country-specific

experiences for each of the nine clusters are in appendix figure A1, which reflect country-level variation within each cluster.

Figure 10. Pace of decline by distinct fertility decline pattern (nine clusters)

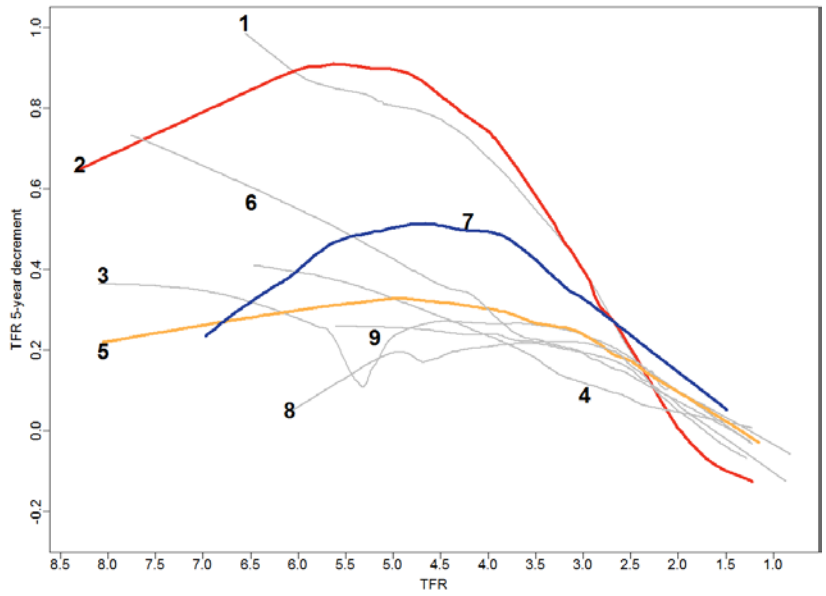


Figure 10 shows the overall smoothed five-year decrements in total fertility by total fertility level for the nine clusters. We focus on three clusters for generating alternative fertility and population scenarios for sub-Saharan African countries:

- Cluster 2 ("Very fast-slow") has a fast initial pace of decline at high fertility levels that increases to an even higher peak pace nearing a one birth decrease per five-year period around a total fertility level of five before starting to decline. Eleven countries make up this group, including three Northern African countries (Algeria, Libya and Morocco) and Iran, Mongolia, the Republic of Korea and Viet Nam. At low fertility levels (around 2.5 births per woman), some countries in this group experienced stagnation or even small increases in total fertility.

- Cluster 5 ("Slow-steady") represents a moderately slow and steady decline (the peak pace of decline is no higher than 0.4 births per woman per five-year period) that persists until total fertility reaches around four births per woman and gradually tapers off. Twenty-eight countries are characterized by this pattern of decline, including Botswana, Brazil, Myanmar, South Africa and Turkey.

- Cluster 7 ("Slow-moderately fast") is an intermediate pattern, with a slow pace at the start of the transition that sharply rises to a peak pace of decline that is no more than half a birth per five-year decrement (half the level of cluster 2) before steadily tapering off after total fertility has reached about four births per woman. Sixteen countries are in this cluster, including Bangladesh, Cabo Verde, India, Malaysia, Mexico and Thailand.

Fertility and population scenarios in sub-Saharan Africa

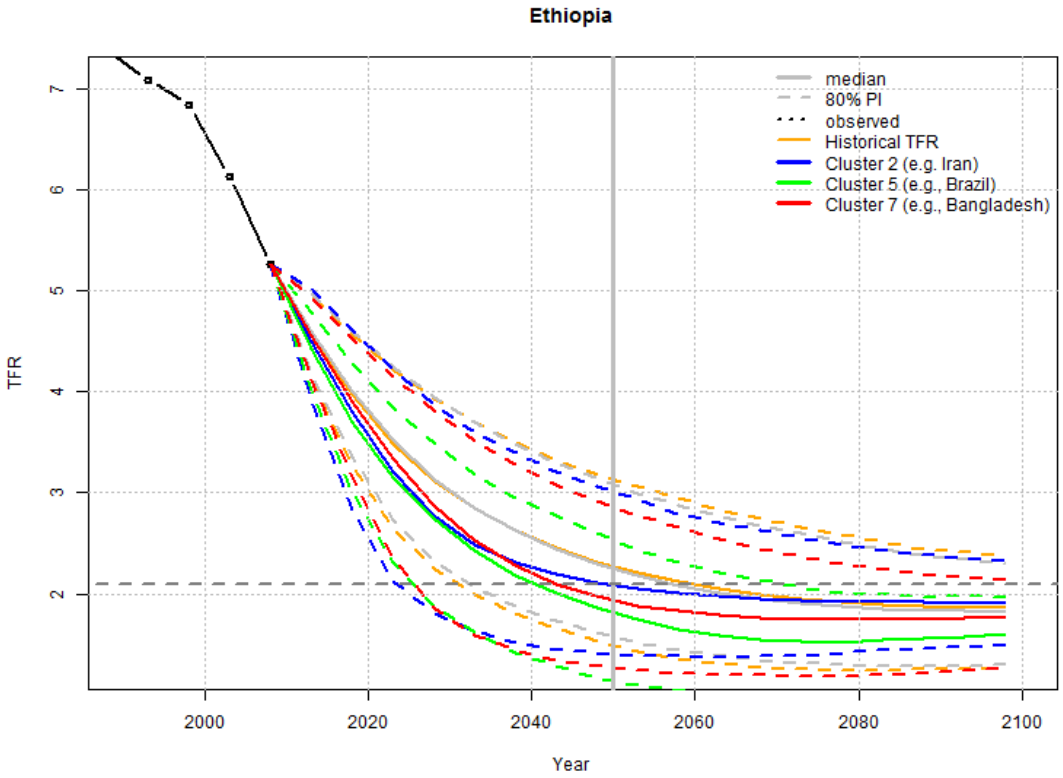
The probabilistic fertility scenarios for 2010-2100 are produced by applying the probabilistic fertility projection model implemented in BayesTFR (Ševčíková et al. 2011) and censoring all countries except those in a given cluster. All other countries are treated as extra countries; that is, all other countries are treated as not informative priors used in the Bayesian hierarchical modelling and estimation of the distribution of parameters for the double logistic function in phase II of the fertility decline. The prediction of the cluster is then applied to all the other countries. This is repeated for each cluster and provides alternative probabilistic scenarios based on the distinct fertility decline experience of a group of countries. The results contrast five scenarios:

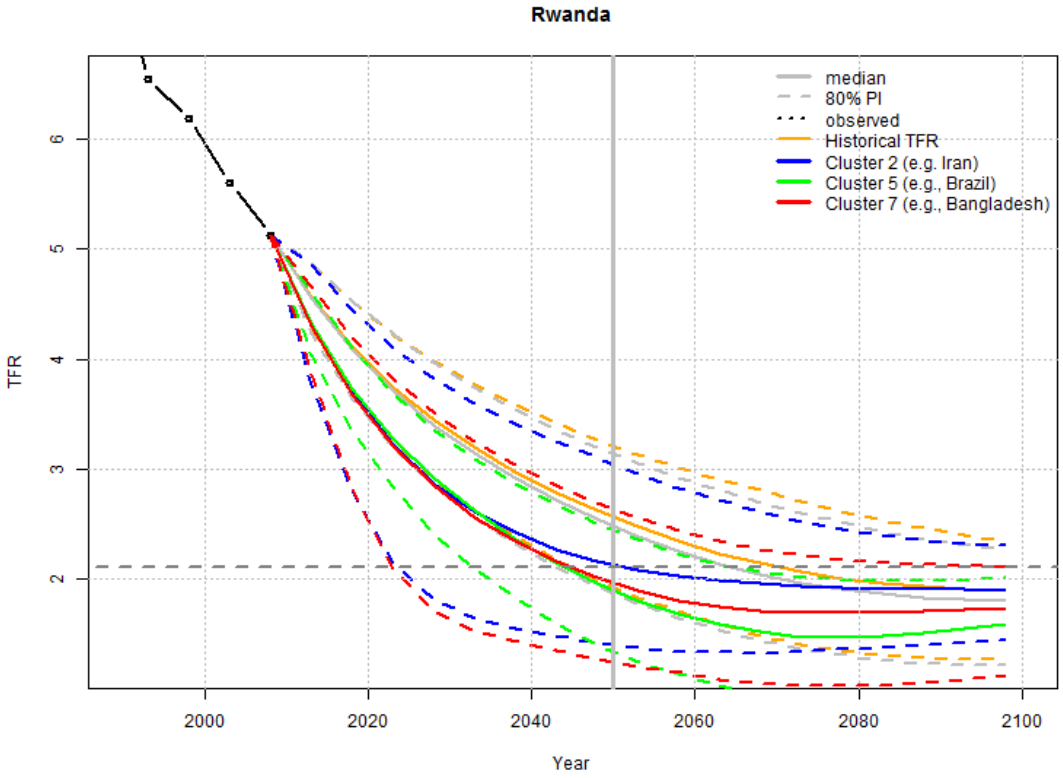
- Baseline: the probabilistic total fertility projections from the 2012 Revision of WPP and based on the fertility decline experiences of all countries and using fertility estimates since 1950 (United Nations 2013a)
- Historical: the probabilistic total fertility projections based on the fertility decline experiences of all countries but using the full historical series of fertility estimates, including those prior to 1950 (upon data availability)
- Cluster 2 "Very fast-slow" fertility decline
- Cluster 5 "Slow-steady" fertility decline
- Cluster 7 "Slow-moderately fast" fertility decline

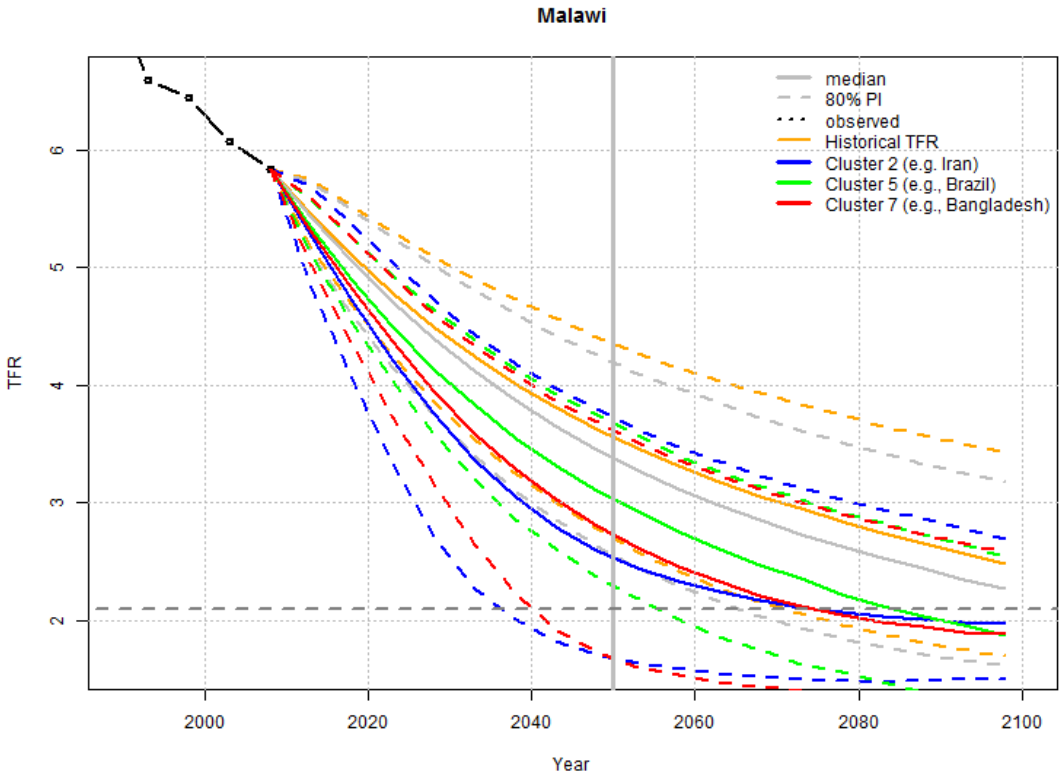
Each fertility scenario is used to simulate 10,000 probabilistic population projections for 2010-2100 under the same conditions (i.e., using the same mortality and migration assumptions) that show the population growth trajectories if sub-Saharan African countries were to follow a specific fertility decline pattern.[vi] We discuss the implications of the different scenarios for sub-Saharan Africa, the sub-regions of Eastern Africa and Western Africa and selected high-fertility countries of Eastern Africa and Western Africa. Appendix tables A1 and A2 include the estimates of total fertility and total population in 2010 from the 2012 Revision of WPP and the probabilistic projections of total fertility and total population for the median and 80 per cent prediction intervals for the five scenarios.

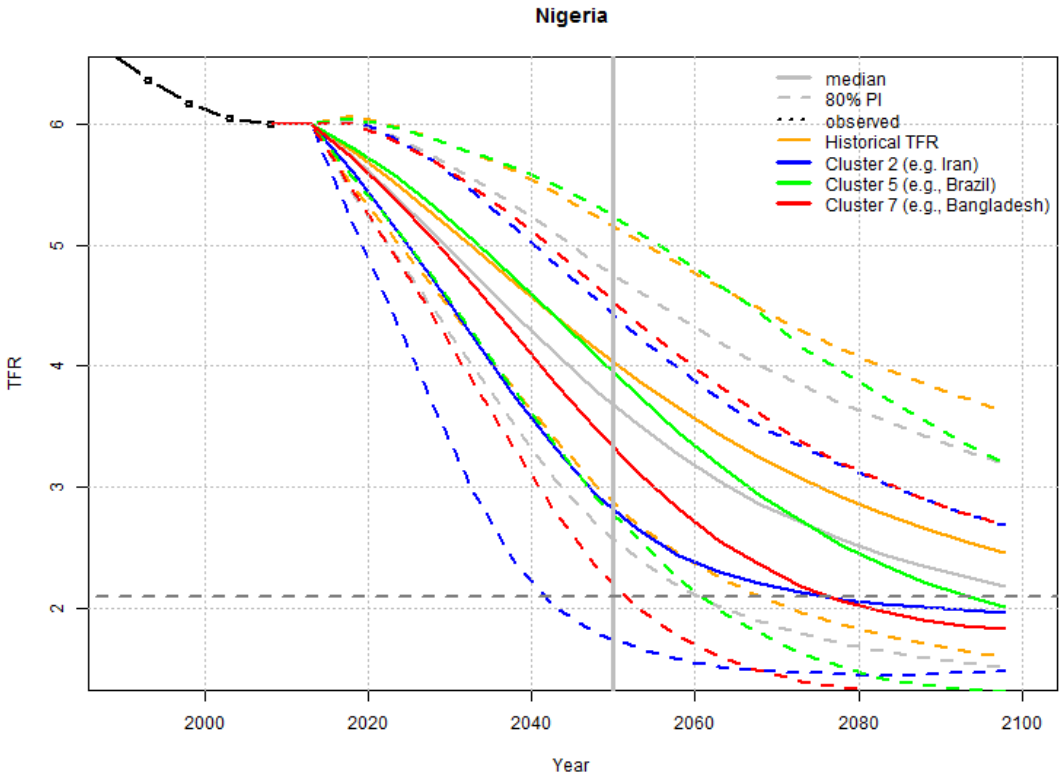
The implications of these specific fertility decline patterns for future fertility trends are shown in figure 11 for Ethiopia, Malawi, Nigeria and Rwanda, the four countries described earlier (in figure 7) that started the fertility transition around the same time and were still above five births per woman in 2005-2010. For Ethiopia and Rwanda, the baseline scenario (grey lines) and historical scenario (yellow lines) produce similar total fertility projections. The distinct fertility decline scenarios (clusters 2 "very fast-slow", 5 "slow-steady" and 7 "slow-moderately fast") all lead to much more rapid fertility declines for both countries and, up to 2040, the different pathways lead to similar outcomes. By 2050 (the vertical grey line), the median projected total fertility across the three fertility decline clusters ranges in Ethiopia from 1.9 (cluster 5 "slow-steady") to 2.1 (cluster 2 "very fast-slow") and in Rwanda from 2.0 (clusters 5 and 7) to 2.2 (cluster 2) (see appendix table A1).

Figure 11. Probabilistic fertility projections (median and 80 per cent prediction intervals) for five scenarios: baseline, historical, 2-“very fast-slow”, 5-“slow-steady” and 7-“slow-moderately fast”






Malawi
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2000
2020
2040
2060
2080
2100
2
3
4
5
6


Nigeria
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2000
2020
2040
2060
2080
2100
2
3
4
5
6

The median projected fertility from these scenarios reaches replacement-level fertility by 2050 and 10-15 years earlier than the projections from the baseline and historical scenarios. The “very fast-slow” pattern of cluster 2 leads to higher fertility levels in the long-term—approaching projected levels from the baseline and historical scenarios—than the “slow-steady” decline in cluster 5 as experienced by Brazil and the “slow-moderately fast” decline of cluster 7 as experienced by Bangladesh.

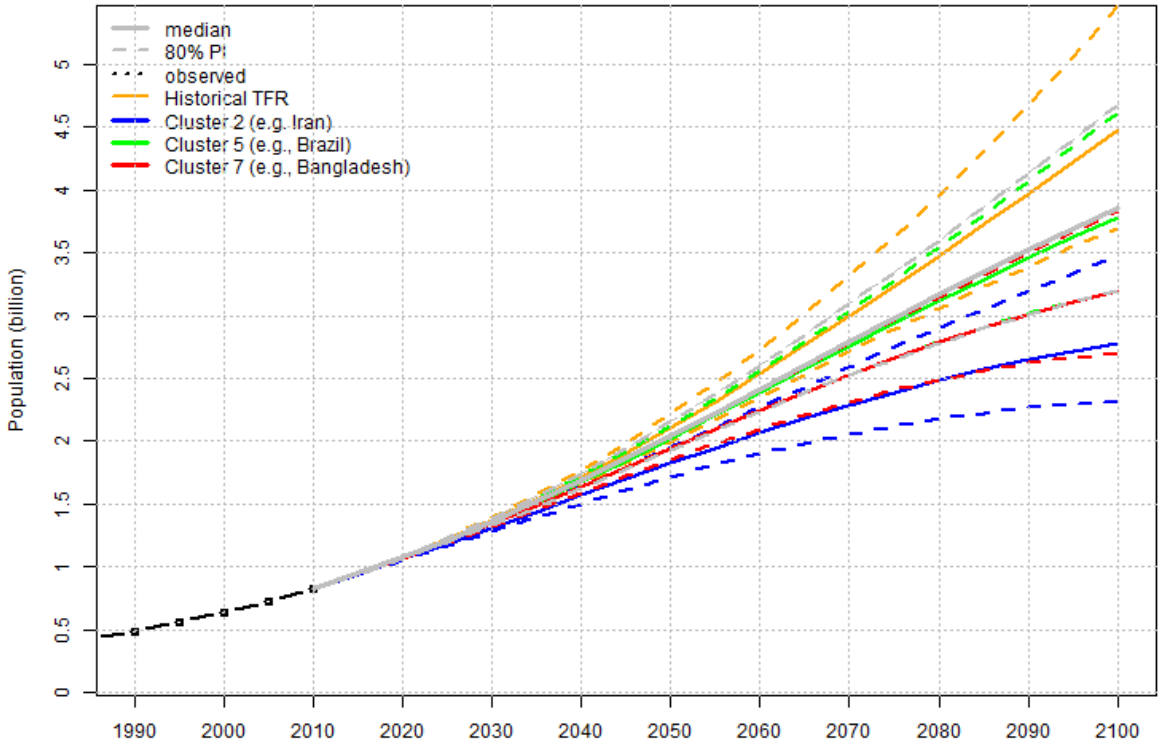
The different fertility scenarios have bigger implications for projected fertility in Malawi and Nigeria, where the recent pace of fertility decline has been much lower than that experienced by Ethiopia and Rwanda. Accounting for the longer, historical record of fertility decline results in higher fertility projections than in the baseline scenario, an average difference of 0.2-0.3 births per woman by 2050. While the steady-slow fertility decline pattern of Brazil and South Africa (cluster 5) also produces lower projected fertility in Malawi compared to the baseline scenario, Nigeria is projected to experience even higher fertility levels well past mid-century than under the baseline scenario.

If Malawi and Nigeria follow a “very fast-slow” scenario (cluster 2), fertility would drop steeply in both countries compared to the baseline scenario (a difference of at least one birth per woman by 2050), with fertility declining in Malawi from 5.8 in 2010 to 2.6 in 2050 (80 per cent prediction interval of 1.7 to 3.8) and declining in Nigeria from 6.0 in 2010 to 2.9 in 2050 (80 per cent prediction interval of 1.8 to 4.6). In Malawi, the projected median of this scenario aligns with the lower bound of the baseline scenario, suggesting that Malawi would have to have a rapid fertility decline, much as Iran and Viet Nam have already experienced, in order to realize the lower bound fertility level of the baseline scenario.

The “slow-moderately fast” fertility scenario (cluster 7) projects lower fertility in Malawi and Nigeria than in the baseline scenario and higher fertility than in the initially faster pattern of cluster 2. Both scenarios result in median fertility reaching replacement level before 2080 in Malawi and Nigeria whereas fertility is not projected to reach replacement level in this century for either country under the baseline scenario.

Figure 12. Probabilistic population projections median and 80 per cent prediction intervals) for five scenarios: baseline, historical, 2-“very fast-slow”, 5-“slow-steady” and 7-“slow-moderately fast”

A. Sub-Saharan Africa



The full historical record of fertility decline experiences, even in a model that accounts for country-specific decline patterns, slows the underlying global pattern of fertility decline and results in a projected median total population in sub-Saharan Africa of 4.5 billion people in 2100 compared with the 3.9 billion people in the baseline projection based on the fertility decline experiences of countries since 1950 (figure 12, panel A; numbers are in appendix table A2). While the historical record of fertility declines prior to 1950 may be substantively irrelevant for contemporary and future contexts in high-fertility countries (Fuchs and Goujon 2014), the 80 per cent upper bound of the baseline scenario is similar to the median of the historical scenario and could be interpreted as reflecting population growth when slower and longer-duration fertility decline experiences are taken into account in the global model (i.e., declines prior to the wide availability of a range of effective methods of contraceptives, amongst many other developments).

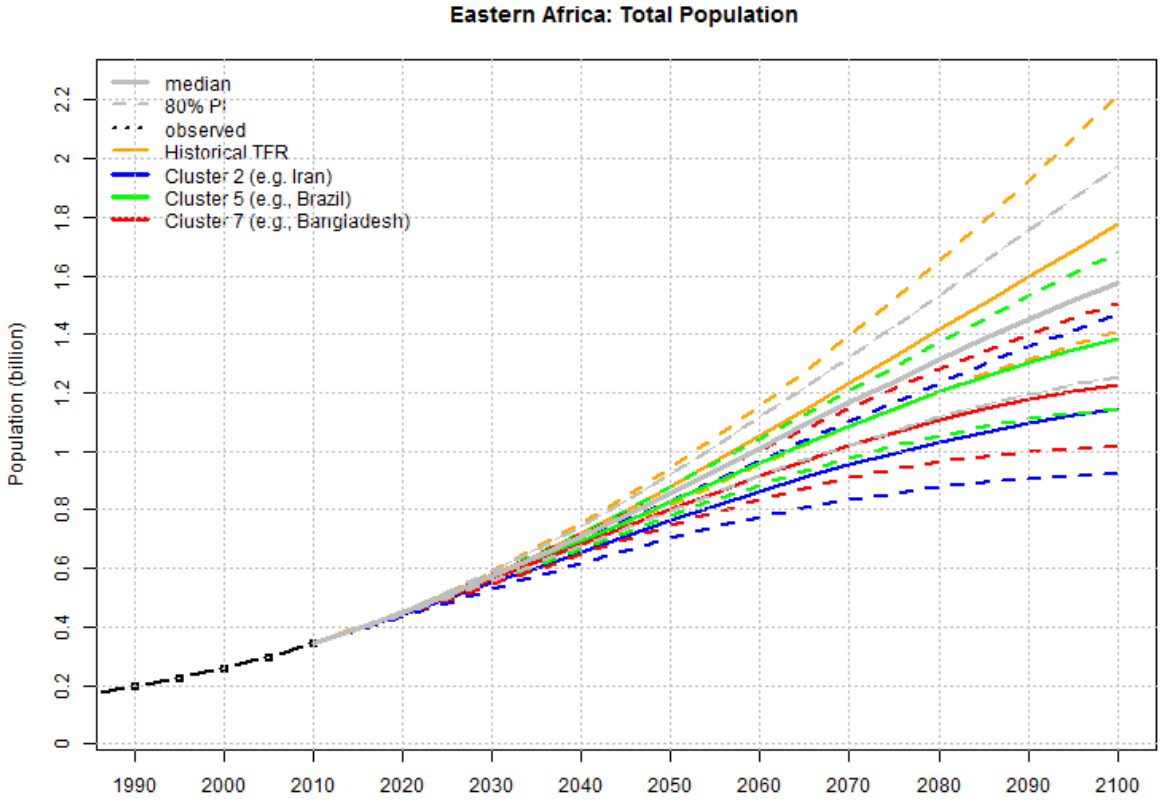
The counterfactual of sub-Saharan African countries following a slow-steady fertility decline, as experienced by Botswana, Brazil, South Africa and other countries in cluster 5, is nearly identical to population growth under the baseline scenario. Thus, the baseline projections of population growth in the region are interpretatively similar to sub-Saharan African countries experiencing slow and sustained fertility declines. Assuming sub-Saharan African countries follow the very fast fertility decline experiences in cluster 2 of Iran, Viet Nam and countries in Northern Africa (except Egypt) that then slowed sharply around 2.5 births per woman, still

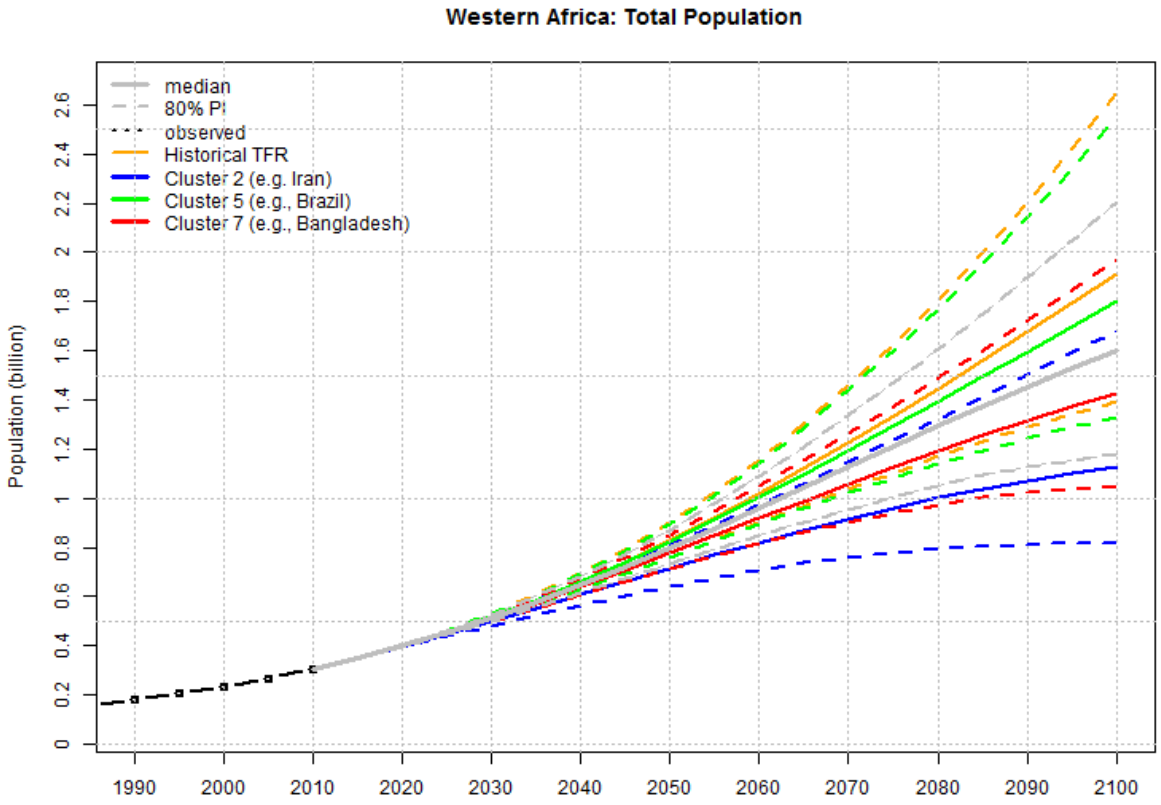
results in a projected total population increase from 831 million people in 2010 to 2.8 billion people by the end of the century (with 80 per cent probability of being between 2.3 and 3.5 billion people). The total population projection for the "slow-moderately fast" scenario (cluster 7) is similar to the lower bound of the baseline scenario.

In Eastern Africa and Western Africa, the historical scenario leads to consistently higher population projections and the "very fast-slow" decline experiences of countries in cluster 2 lead to substantially lower population projections compared with the baseline scenario (figure 12, panel B). Under the "very fast-slow" scenario, the projected median total population in Eastern Africa would still almost triple from 343 million in 2010 to 1.1 billion in 2100 (80 per cent prediction interval of 922 million to 1.5 billion) but results in a far lower population than the 1.6 billion people projected under the baseline scenario. In Western Africa the median projected population of 1.1 billion people in 2100 under the "very fast-slow" scenario is close to the lower bound of the baseline scenario, suggesting an interpretation that the 10 per cent chance that total population in Western Africa will be no more than 1.2 billion people by the end of the century under the baseline scenario is akin to Western Africa following a fast fertility decline like that experienced in Iran and Viet Nam.

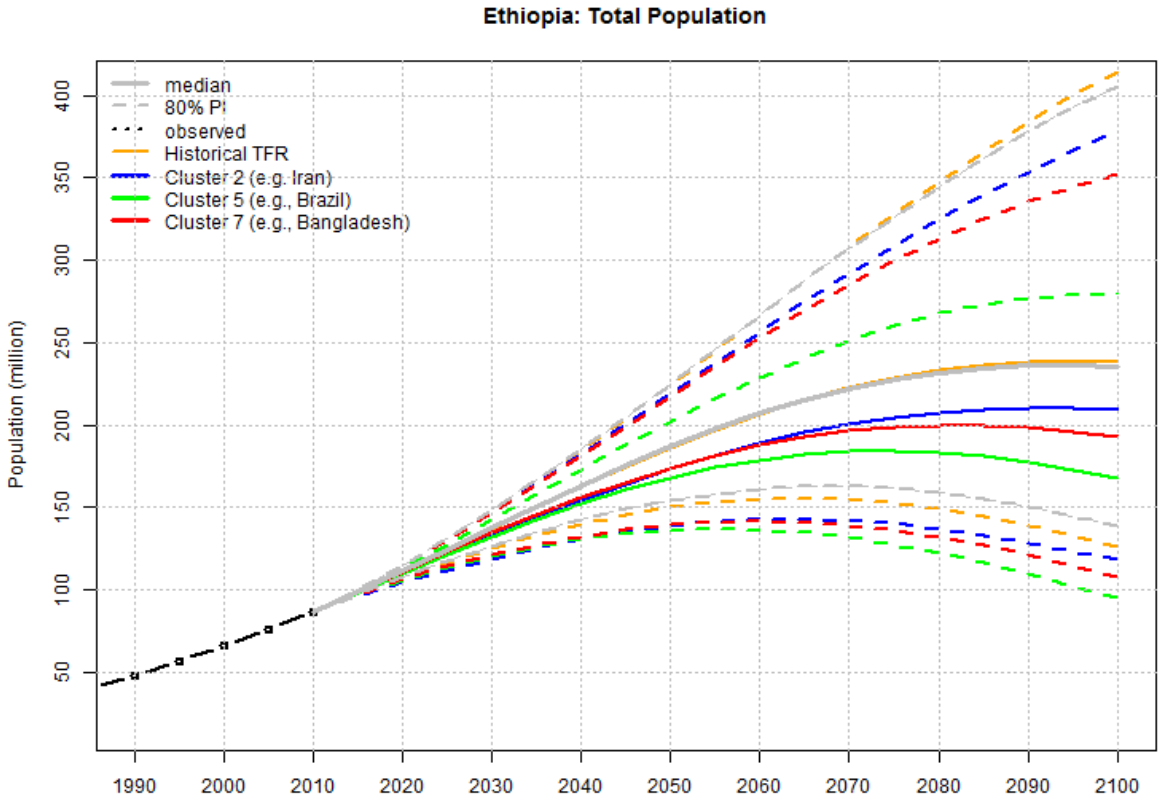
The slow-steady decline of cluster 5 produces divergent total population projections for Eastern Africa and Western Africa compared to the baseline scenario. In Eastern Africa a slow-steady fertility decline as experienced by Botswana and South Africa is projected to produce a lower total population in 2100 (1.4 billion, 80 per cent prediction interval of 1.1 billion to 1.7 billion) compared to the projected median of 1.6 billion people in the baseline scenario. In contrast, in Western Africa such a pattern of fertility decline results in a higher projected population by 2100 (1.8 billion people versus 1.6 billion people under the baseline scenario). In both Eastern Africa and Western Africa, total population projections for the "slow-moderately fast" decline scenario of cluster 7 are between the "very fast-slow" and "slow-steady" declines of clusters 2 and 5.

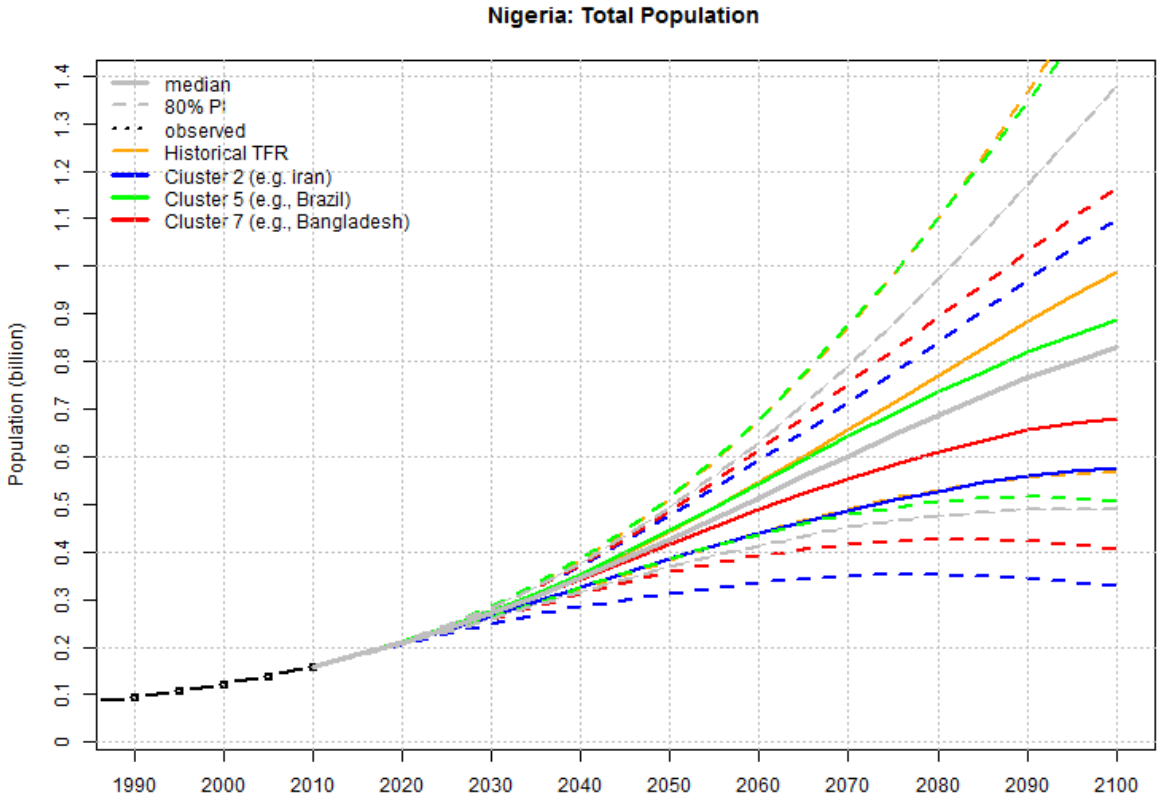
B. Eastern Africa and Western Africa





C. Ethiopia and Nigeria





As with the sub-region projections, Ethiopia and Nigeria present two contrasting implications of the fertility decline scenarios for future population growth (figure 12, panel C). In Ethiopia, the baseline projections of population are similar to the projections from the full historical data. If Ethiopia followed the cluster 2 pattern of a very fast fertility decline with a stall in decline after 2.5 births per woman, the projected population grows from 87 million people in 2010 to 209 million people by 2100 compared with the higher median projections of 236-238 million people under the baseline and historical scenarios. The slow-steady decline pattern of Botswana, Brazil and South Africa in cluster 5, with sustained fertility decline past 2.5 births per woman, would result in an even lower projected population in Ethiopia by 2100 to 167 million people (80 per cent prediction interval of 95 million to 280 million people), with population peaking around 2075.

In contrast, if Nigeria adopted the slow-steady decline pattern of Botswana, Brazil and South Africa, the projected population grows from 160 million people in 2010 to a median of 888 million by 2100 (80 per cent prediction interval of 508 million to 1.6 billion people) rather than the lower projected growth to 830 million people of the baseline scenario. Under the very fast fertility decline experiences of Iran and Viet Nam, Nigeria is projected to experience a substantial slowing of population growth to 577 million people in 2100 (80 per cent prediction interval of 328 million to 1.1 billion people) with a 10 per cent chance that the country's population would peak in 2080.

Conclusion

This paper highlighted the variation in fertility transitions experienced thus far among countries and sub-regions within sub-Saharan Africa and the implications for fertility and population projections if sub-Saharan African countries follow particular fertility decline patterns that have been experienced by other countries. Our focus was on fertility declines over time and across countries and not the reasons underlying these different patterns.

Limitations of this analysis are that we assume that the fertility estimates from the *World Population Prospects* (and additional estimates for a group of countries and subnational areas prior to 1950) are without error, and no uncertainty around the estimates of period total fertility is taken into account. By basing scenarios on the distinct fertility decline patterns that have been experienced thus far by countries that have completed or are advanced in their fertility transitions, we implicitly assume no new patterns of fertility decline in the projections. Since most countries in Middle Africa and Western Africa are still in the early stages of fertility transition, the "exceptionalism" of fertility change in sub-Saharan Africa, apart from the nine distinct patterns identified in this paper, may still emerge.

As a next step, we will apply the cluster analysis and scenario projections to the 2015 Revision of WPP that will be released in July 2015. In every revision there are changes in recent estimates and, at times, past estimates due to new data on fertility, mortality, migration and population age structures. Though the 2015 Revision is not yet finalized, new data

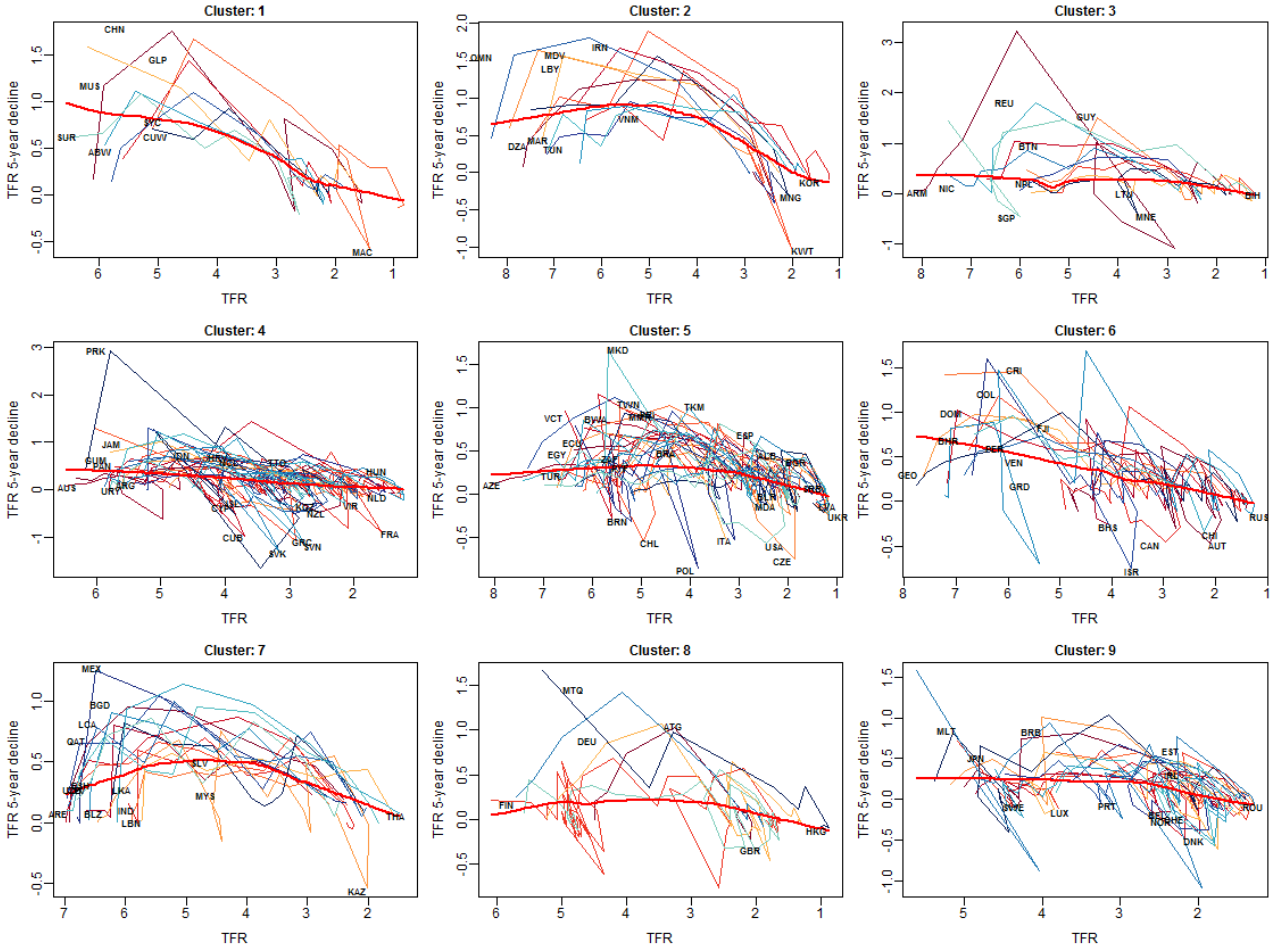
underlying fertility estimates for the most recent 10-year time period indicate that the total fertility could be revised downwards compared to the Revision 2012 in Eritrea, Malawi, Nigeria, Rwanda and Zambia (with differences up to 0.5 births per woman in 2010-2015). Figure 1 showed the example of prior estimates for Nigeria and new data available from the 2013 DHS survey, indicating total fertility of close to 5.5 births per woman for a three-year reference period before the survey compared to an estimate of 6.0 births per woman estimated in the 2012 Revision. Other countries, however, could have their fertility levels revised upwards in the 2015 Revision. For example, total fertility for the Democratic Republic of Congo was 6.0 births per woman in 2010-2015 in the 2012 Revision, while new available data from the 2013-2014 DHS indicate 6.6 births per woman for a three-year reference period before the survey. Similarly, new data show higher fertility levels compared to the 2012 Revision in Angola, Ghana, Mozambique, Namibia and Zimbabwe. Furthermore, the composition and characteristics of clusters might change with revised fertility estimates for other countries in the 2015 Revision; for example, a number of the cluster 2 countries in Northern Africa experienced increases in total fertility in the period 2010-2015.

While this paper applied the cluster analysis to projection scenarios for total fertility, the distinctive patterns of age-specific fertility merit further analysis. What if sub-Saharan African countries imitated the fertility decline pattern leading to early childbearing patterns at low fertility levels (such as those in some countries of Latin America and the Caribbean or South Asia) or a rapid postponement of entry into motherhood (leading to a higher mean age at first birth comparable to countries in Northern Africa)? These scenarios could be then compared to a “postponement” ideal type specific for sub-Saharan Africa (Moultrie, Sayi and Timæus 2012; Timæus and Moultrie 2008).

APPENDIX I

Figure A1. Fertility trends and pace of decline among countries by fertility decline pattern (nine clusters)

A. Five-year decrements in total fertility



B. Fertility trends

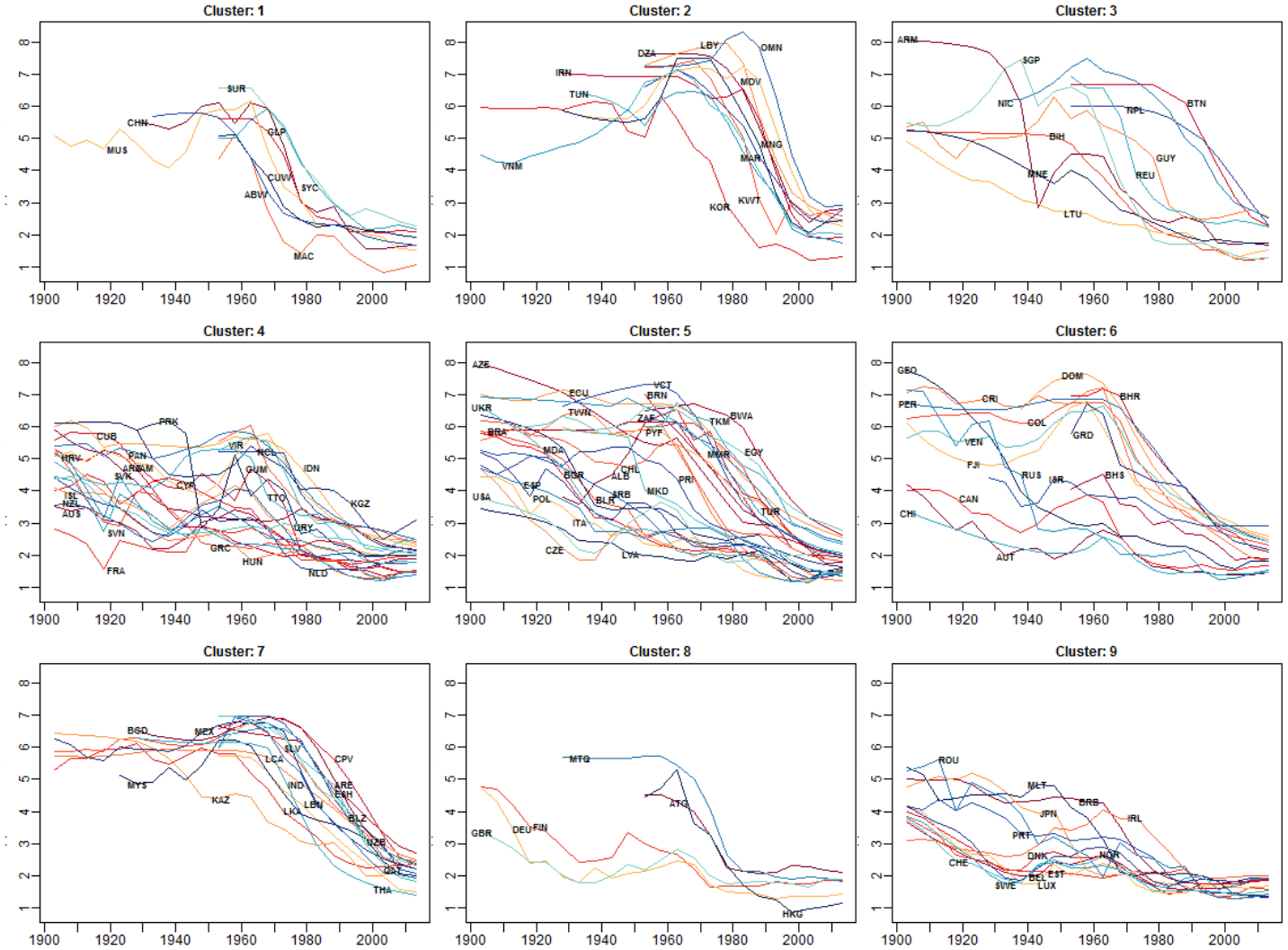


Table A1. Total fertility in 2005-2010 and probabilistic projections in 2045-2050, median and 80 per cent prediction intervals for five scenarios

		Total Fertility Rate probabilistic projection in 2045-2050									
	TFR	Excluding historical TFR		Including historical TFR		TFR simulation Cluster 2		TFR simulation Cluster 5		TFR simulation Cluster 7	
Name	2005-2010	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals
Sub-Saharan Africa											
Eastern Africa											
Burundi	6.5	3.6	[2.3, 4.6]	3.9	[2.5, 4.9]	2.5	[1.6, 4.1]	3.3	[1.7, 4.5]	3.1	[1.7, 4.3]
Comoros	5.1	3.1	[2.4, 3.9]	3.4	[2.6, 4.1]	2.4	[1.6, 3.5]	3.0	[2.2, 3.8]	2.7	[1.8, 3.5]
Djibouti	3.8	2.2	[1.6, 2.8]	2.2	[1.6, 2.9]	2.1	[1.4, 2.8]	1.9	[1.3, 2.6]	1.9	[1.3, 2.6]
Eritrea	5.2	2.6	[1.8, 3.5]	2.8	[1.9, 3.7]	2.1	[1.4, 3.1]	2.5	[1.6, 3.4]	2.1	[1.4, 3.0]
Ethiopia	5.3	2.3	[1.6, 3.1]	2.3	[1.5, 3.2]	2.1	[1.4, 3.1]	1.9	[1.2, 2.6]	2.0	[1.3, 2.9]
Kenya	4.8	2.8	[2.2, 3.5]	2.9	[2.3, 3.6]	2.4	[1.6, 3.6]	2.7	[2.0, 3.4]	2.7	[1.7, 3.5]
Madagascar	4.8	3.0	[2.3, 3.8]	3.2	[2.4, 3.9]	2.4	[1.6, 3.5]	2.8	[2.1, 3.4]	2.5	[1.6, 3.3]
Malawi	5.8	3.4	[2.6, 4.3]	3.6	[2.8, 4.4]	2.6	[1.7, 3.8]	3.1	[2.4, 3.7]	2.8	[1.7, 3.7]
Mauritius	1.6	1.7	[1.2, 2.0]	1.7	[1.2, 2.0]	1.8	[1.3, 2.1]	1.5	[1.0, 1.9]	1.7	[1.2, 2.0]
Mayotte	4.3	2.3	[1.7, 2.9]	2.4	[1.8, 2.9]	2.2	[1.5, 3.0]	1.8	[1.3, 2.3]	2.1	[1.5, 2.7]
Mozambique	5.6	3.1	[2.1, 4.0]	3.4	[2.3, 4.3]	2.3	[1.5, 3.6]	3.1	[2.0, 4.1]	2.6	[1.7, 3.6]
Reunion	2.4	1.9	[1.3, 2.2]	1.9	[1.4, 2.3]	1.9	[1.4, 2.4]	1.6	[1.0, 2.0]	1.8	[1.2, 2.2]
Rwanda	5.1	2.5	[1.9, 3.2]	2.6	[2.0, 3.3]	2.2	[1.4, 3.1]	2.0	[1.4, 2.5]	2.0	[1.3, 2.7]
Seychelles	2.3	1.8	[1.3, 2.2]	1.9	[1.3, 2.3]	2.0	[1.6, 2.3]	1.5	[1.0, 1.9]	1.7	[1.1, 2.1]
Somalia	7.1	3.6	[2.3, 4.8]	4.1	[2.4, 5.3]	2.5	[1.6, 4.2]	3.5	[1.8, 4.9]	3.2	[1.8, 4.5]
South Sudan	5.4	2.9	[2.0, 3.7]	3.1	[2.1, 3.9]	2.2	[1.5, 3.3]	2.7	[1.7, 3.6]	2.4	[1.6, 3.3]
Uganda	6.4	3.2	[2.2, 4.3]	3.6	[2.3, 4.7]	2.4	[1.6, 3.7]	3.3	[2.2, 4.4]	2.9	[1.9, 4.0]
UR of Tanzania	5.6	3.3	[2.4, 4.2]	3.6	[2.7, 4.4]	2.5	[1.6, 3.8]	3.3	[2.3, 4.1]	2.9	[1.9, 3.8]
Zambia	5.9	4.0	[3.1, 4.8]	4.0	[3.1, 4.8]	2.9	[1.8, 4.2]	3.8	[2.8, 4.5]	3.4	[2.3, 4.3]
Zimbabwe	3.9	2.2	[1.6, 2.8]	2.3	[1.7, 2.8]	2.1	[1.4, 2.9]	1.9	[1.4, 2.4]	2.1	[1.5, 2.6]
Middle Africa											
Angola	6.5	3.1	[2.2, 4.1]	3.4	[2.3, 4.4]	2.4	[1.5, 3.7]	3.2	[2.1, 4.1]	2.8	[1.8, 3.8]

		Total Fertility Rate probabilistic projection in 2045-2050									
	TFR	Excluding historical TFR		Including historical TFR		TFR simulation Cluster 2		TFR simulation Cluster 5		TFR simulation Cluster 7	
Name	2005-2010	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals
Cameroon	5.2	3.0	[2.2, 3.8]	3.2	[2.3, 4.0]	2.3	[1.5, 3.3]	2.9	[2.0, 3.7]	2.5	[1.7, 3.4]
Central African Rep.	4.8	2.5	[1.7, 3.3]	2.7	[1.8, 3.5]	2.1	[1.4, 2.9]	2.3	[1.5, 3.2]	2.1	[1.4, 2.9]
Chad	6.9	3.3	[2.1, 4.5]	3.7	[2.2, 5.0]	2.4	[1.5, 3.8]	3.2	[1.7, 4.5]	2.8	[1.7, 4.1]
Congo	5.1	3.3	[2.5, 4.0]	3.5	[2.7, 4.2]	2.5	[1.7, 3.6]	3.2	[2.4, 3.9]	2.9	[2.0, 3.7]
DR of the Congo	6.5	3.2	[2.1, 4.3]	3.6	[2.2, 4.7]	2.4	[1.5, 3.7]	3.0	[1.5, 4.2]	2.8	[1.7, 4.0]
Equatorial Guinea	5.4	2.5	[1.8, 3.5]	2.8	[1.8, 3.8]	2.1	[1.4, 2.9]	2.6	[1.6, 3.7]	2.2	[1.4, 3.0]
Gabon	4.3	2.6	[2.0, 3.2]	2.8	[2.1, 3.4]	2.2	[1.5, 3.0]	2.5	[1.7, 3.1]	2.3	[1.6, 2.9]
Sao Tome and Principe	4.5	2.7	[2.0, 3.4]	2.8	[2.2, 3.5]	2.2	[1.5, 3.1]	2.5	[1.8, 3.2]	2.4	[1.6, 3.1]
Southern Africa											
Botswana	2.9	1.8	[1.3, 2.3]	1.9	[1.3, 2.4]	2.0	[1.4, 2.5]	1.6	[1.1, 2.1]	1.7	[1.2, 2.2]
Lesotho	3.4	2.1	[1.5, 2.7]	2.2	[1.5, 2.8]	2.0	[1.4, 2.6]	1.9	[1.3, 2.5]	1.8	[1.3, 2.4]
Namibia	3.4	2.0	[1.5, 2.6]	2.1	[1.5, 2.7]	2.0	[1.4, 2.6]	1.8	[1.3, 2.4]	1.8	[1.3, 2.4]
South Africa	2.6	1.9	[1.4, 2.3]	1.9	[1.3, 2.4]	2.0	[1.4, 2.4]	1.6	[1.1, 2.1]	1.7	[1.2, 2.2]
Swaziland	3.8	2.1	[1.6, 2.7]	2.2	[1.6, 2.8]	2.1	[1.4, 2.8]	1.9	[1.4, 2.5]	1.9	[1.3, 2.5]
Western Africa											
Benin	5.3	2.9	[2.1, 3.8]	3.1	[2.2, 4.0]	2.3	[1.5, 3.4]	2.9	[1.8, 3.7]	2.5	[1.7, 3.4]
Burkina Faso	6.1	3.3	[2.2, 4.3]	3.6	[2.3, 4.5]	2.4	[1.5, 3.7]	3.1	[1.8, 4.2]	2.7	[1.7, 3.8]
Cape Verde	2.6	1.7	[1.2, 2.2]	1.7	[1.1, 2.2]	1.9	[1.3, 2.4]	1.5	[1.0, 1.9]	1.6	[1.0, 2.0]
Cote d'Ivoire	4.9	3.2	[2.5, 3.9]	3.3	[2.6, 4.0]	2.7	[1.7, 3.8]	3.0	[2.4, 3.6]	2.9	[1.8, 3.6]
Gambia	5.8	3.4	[2.4, 4.7]	3.9	[2.7, 5.2]	2.6	[1.6, 4.2]	3.8	[2.7, 5.2]	3.2	[2.1, 4.5]
Ghana	4.2	2.5	[1.9, 3.3]	2.7	[2.0, 3.4]	2.2	[1.5, 3.1]	2.4	[1.7, 3.1]	2.2	[1.5, 3.0]
Guinea	5.4	2.9	[2.1, 3.7]	3.1	[2.2, 4.0]	2.2	[1.5, 3.3]	2.8	[1.8, 3.7]	2.4	[1.6, 3.3]
Guinea-Bissau	5.3	3.1	[2.1, 4.1]	3.3	[2.2, 4.3]	2.4	[1.5, 3.7]	2.9	[1.9, 3.9]	2.3	[1.5, 3.5]
Liberia	5.2	3.0	[2.2, 3.8]	3.2	[2.3, 4.0]	2.3	[1.5, 3.4]	2.9	[1.9, 3.7]	2.5	[1.7, 3.4]
Mali	6.8	4.2	[2.6, 5.8]	4.7	[2.6, 6.2]	2.3	[1.5, 3.9]	4.8	[3.0, 6.3]	4.0	[2.4, 5.5]
Mauritania	5.0	3.1	[2.3, 3.8]	3.2	[2.4, 4.0]	2.4	[1.6, 3.5]	2.9	[2.0, 3.6]	2.7	[1.8, 3.5]
Niger	7.6	5.0	[3.4, 6.7]	5.7	[3.9, 7.2]	4.3	[2.3, 6.7]	6.5	[5.1, 7.3]	6.0	[4.4, 7.2]

Total Fertility Rate probabilistic projection in 2045-2050

Name	TFR 2005-2010	Excluding historical TFR		Including historical TFR		TFR simulation Cluster 2		TFR simulation Cluster 5		TFR simulation Cluster 7	
		median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals
Nigeria	6.0	3.8	[2.7, 4.8]	4.1	[3.0, 5.2]	2.9	[1.8, 4.6]	4.1	[2.9, 5.3]	3.5	[2.3, 4.7]
Senegal	5.1	3.2	[2.5, 3.9]	3.3	[2.6, 4.0]	2.6	[1.7, 3.7]	3.1	[2.3, 3.7]	2.8	[2.0, 3.6]
Sierra Leone	5.2	2.9	[2.0, 3.7]	3.0	[2.0, 3.9]	2.3	[1.5, 3.4]	2.6	[1.4, 3.5]	2.4	[1.6, 3.4]
Togo	4.9	3.0	[2.3, 3.7]	3.1	[2.4, 3.8]	2.4	[1.7, 3.5]	2.9	[2.2, 3.4]	2.6	[1.8, 3.4]

Table A2. Total population (millions) in 2010 and probabilistic projections in 2100, median and 80 per cent prediction intervals for five scenarios

		Total population in 2100 (in million)									
	Pop.	Excluding historical TFR		Including historical TFR		TFR simulation Cluster 2		TFR simulation Cluster 5		TFR simulation Cluster 7	
Name	2010	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals
Sub-Saharan Africa	**831.5**	**3,852.0**	**[3,199.2, 4,679.8]**	**4,477.1**	**[3,698.6, 5,466.8]**	**2,778.7**	**[2,312.7, 3,476.9]**	**3,780.2**	**[3,200.6, 4,615.9]**	**3,198.1**	**[2,705.1, 3,830.9]**
Eastern Africa	**342.6**	**1,575.0**	**[1,255.3, 1,975.8]**	**1,778.0**	**[1,411.1, 2,220.1]**	**1,144.5**	**[922.6, 1,470.8]**	**1,385.3**	**[1,148.1, 1,679.0]**	**1,230.1**	**[1,012.9, 1,508.0]**
Burundi	9.2	53.0	[26.9, 90.8]	63.1	[28.6, 106.1]	31.4	[16.7, 64.5]	44.6	[17.3, 88.0]	39.2	[18.7, 76.5]
Comoros	0.7	2.5	[1.5, 4.1]	3.0	[1.8, 4.7]	1.5	[0.9, 2.9]	2.3	[1.3, 3.7]	1.8	[1.0, 3.1]
Djibouti	0.8	1.3	[0.8, 2.0]	1.3	[0.8, 2.1]	1.1	[0.6, 2.0]	1.0	[0.6, 1.7]	1.0	[0.6, 1.7]
Eritrea	5.7	19.8	[11.6, 33.8]	22.8	[12.1, 39.5]	14.8	[8.6, 26.8]	18.1	[10.3, 31.9]	15.0	[9.0, 25.2]
Ethiopia	87.1	235.7	[138.8, 405.8]	238.4	[126.7, 414.4]	209.5	[118.3, 378.3]	167.4	[95.0, 280.1]	193.0	[108.0, 351.8]
Kenya	40.9	147.9	[95.9, 226.6]	162.2	[104.4, 245.2]	118.6	[68.7, 227.3]	138.5	[82.3, 205.3]	132.6	[72.3, 224.8]
Madagascar	21.1	101.3	[61.3, 163.7]	115.2	[65.9, 183.1]	67.0	[38.0, 129.6]	87.2	[52.6, 131.1]	72.7	[39.7, 122.1]
Malawi	15.0	79.9	[46.6, 128.3]	88.9	[51.3, 143.4]	49.6	[27.3, 93.8]	62.6	[37.8, 95.5]	53.4	[28.2, 92.7]
Mauritius	1.2	1.0	[0.6, 1.3]	1.0	[0.6, 1.3]	1.1	[0.6, 1.4]	0.8	[0.5, 1.2]	0.9	[0.6, 1.3]
Mayotte	0.2	0.7	[0.5, 1.0]	0.7	[0.5, 1.0]	0.6	[0.4, 1.0]	0.5	[0.3, 0.7]	0.6	[0.4, 0.9]
Mozambique	24.0	122.0	[62.8, 219.1]	148.6	[72.1, 267.7]	74.5	[39.9, 159.1]	114.6	[57.5, 219.2]	86.3	[46.7, 164.1]
Reunion	0.8	1.1	[0.8, 1.5]	1.2	[0.8, 1.6]	1.2	[0.8, 1.7]	0.9	[0.6, 1.2]	1.1	[0.7, 1.4]
Rwanda	10.8	33.8	[22.6, 49.6]	35.7	[23.6, 51.7]	26.8	[15.1, 45.2]	22.1	[14.8, 32.0]	23.1	[12.6, 36.8]
Seychelles	0.1	0.1	[0.1, 0.1]	0.1	[0.1, 0.1]	0.1	[0.1, 0.1]	0.1	[0.0, 0.1]	0.1	[0.0, 0.1]
Somalia	9.6	52.4	[23.2, 104.0]	66.6	[24.6, 133.7]	29.8	[14.3, 67.5]	45.6	[16.5, 103.6]	38.8	[17.0, 84.6]
South Sudan	9.9	36.6	[20.3, 62.2]	41.6	[21.8, 71.6]	25.4	[14.1, 46.8]	32.7	[16.0, 57.5]	28.0	[15.7, 48.8]
Uganda	34.0	198.3	[101.7, 356.4]	249.7	[115.0, 450.7]	122.4	[69.2, 238.5]	201.7	[101.7, 361.7]	159.4	[89.2, 289.3]
UR of Tanzania	45.0	262.7	[150.0, 426.9]	314.3	[176.7, 497.9]	161.5	[92.2, 316.4]	250.9	[138.2, 410.6]	193.3	[111.6, 328.9]
Zambia	13.2	107.6	[66.9, 162.1]	106.6	[63.8, 158.5]	55.5	[30.7, 107.6]	93.5	[49.1, 136.4]	72.5	[39.1, 116.7]
Zimbabwe	13.1	30.6	[20.2, 45.2]	32.9	[21.2, 47.9]	29.3	[17.1, 48.7]	24.3	[16.0, 35.4]	27.8	[17.6, 41.2]
Middle Africa	**125.0**	**541.8**	**[382.9, 782.7]**	**643.6**	**[431.0, 942.5]**	**361.1**	**[258.0, 536.8]**	**483.9**	**[327.7, 721.2]**	**427.0**	**[306.7, 614.2]**

		Total population in 2100 (in million)									
	Pop.	Excluding historical TFR		Including historical TFR		TFR simulation Cluster 2		TFR simulation Cluster 5		TFR simulation Cluster 7	
Name	**2010**	**median**	**80% prediction intervals**	**median**	**80% prediction intervals**	**median**	**80% prediction intervals**	**median**	**80% prediction intervals**	**median**	**80% prediction intervals**
Angola	19.5	90.6	[48.3, 163.9]	104.9	[51.9, 192.7]	60.8	[33.3, 120.0]	88.2	[46.4, 155.8]	72.5	[40.2, 129.7]
Cameroon	20.6	78.3	[48.1, 123.9]	91.7	[53.6, 144.4]	51.6	[30.5, 93.6]	74.5	[41.1, 117.0]	59.5	[35.4, 98.4]
Central African Rep.	4.3	10.5	[6.3, 17.2]	11.9	[6.5, 19.8]	8.1	[4.8, 13.4]	9.1	[5.2, 15.5]	8.2	[5.1, 13.4]
Chad	11.7	61.2	[28.2, 119.9]	75.4	[29.0, 152.7]	36.5	[18.9, 76.9]	52.7	[21.2, 113.9]	45.7	[22.5, 93.1]
Congo	4.1	20.4	[12.9, 30.7]	23.9	[14.8, 35.2]	13.2	[8.0, 23.4]	18.9	[11.4, 28.5]	15.6	[9.7, 25.0]
DR of the Congo	62.2	248.7	[123.4, 456.0]	297.0	[127.3, 558.9]	154.6	[84.2, 309.0]	205.3	[80.9, 430.6]	194.8	[99.1, 372.1]
Equatorial Guinea	0.7	2.3	[1.3, 3.9]	2.7	[1.4, 4.8]	1.7	[1.0, 2.8]	2.3	[1.2, 4.1]	1.8	[1.1, 3.1]
Gabon	1.6	4.8	[3.2, 7.1]	5.5	[3.5, 8.1]	3.7	[2.4, 5.8]	4.3	[2.7, 6.4]	3.8	[2.5, 5.8]
Sao Tome and Principe	0.2	0.6	[0.4, 0.9]	0.6	[0.4, 1.0]	0.4	[0.2, 0.7]	0.5	[0.3, 0.8]	0.4	[0.3, 0.7]
Southern Africa	**58.8**	**75.5**	**[52.5, 104.4]**	**76.8**	**[51.3, 108.4]**	**79.0**	**[50.7, 112.0]**	**60.3**	**[43.7, 83.9]**	**65.7**	**[46.0, 91.4]**
Botswana	2.0	2.9	[1.9, 4.1]	3.0	[1.8, 4.3]	3.1	[1.8, 4.6]	2.3	[1.5, 3.3]	2.5	[1.6, 3.6]
Lesotho	2.0	3.1	[1.9, 4.9]	3.3	[1.8, 5.5]	2.7	[1.5, 4.6]	2.5	[1.4, 4.1]	2.4	[1.4, 3.9]
Namibia	2.2	4.2	[2.8, 6.3]	4.4	[2.7, 6.7]	4.0	[2.4, 6.3]	3.4	[2.2, 5.1]	3.4	[2.2, 5.3]
South Africa	51.5	63.0	[41.3, 89.8]	63.7	[39.1, 93.7]	66.8	[38.7, 99.4]	50.1	[33.5, 73.3]	55.2	[35.9, 80.7]
Swaziland	1.2	1.9	[1.2, 3.0]	2.1	[1.2, 3.2]	1.8	[1.0, 3.1]	1.6	[1.0, 2.5]	1.6	[1.0, 2.6]
Western Africa	**305.1**	**1,598.2**	**[1,180.7, 2,201.5]**	**1,912.2**	**[1,394.0, 2,649.6]**	**1,124.7**	**[814.6, 1,679.2]**	**1,799.2**	**[1,331.0, 2,552.8]**	**1,424.1**	**[1,047.6, 1,969.9]**
Benin	9.5	33.3	[19.6, 55.5]	38.0	[20.7, 63.6]	21.9	[12.4, 42.0]	31.3	[15.7, 52.0]	24.9	[14.4, 43.9]
Burkina Faso	15.5	74.2	[38.7, 130.1]	89.9	[42.5, 156.7]	45.2	[24.7, 91.7]	67.5	[29.9, 127.2]	52.5	[28.3, 97.2]
Cape Verde	0.5	0.5	[0.3, 0.8]	0.5	[0.3, 0.8]	0.6	[0.4, 0.9]	0.4	[0.3, 0.6]	0.4	[0.3, 0.7]
Cote d'Ivoire	19.0	75.6	[48.9, 114.7]	82.7	[53.1, 122.9]	55.8	[32.6, 105.2]	65.8	[43.0, 95.4]	61.9	[34.1, 98.6]
Gambia	1.7	7.6	[4.6, 13.1]	9.4	[5.4, 17.0]	5.4	[3.2, 10.2]	8.6	[5.0, 16.9]	6.4	[3.9, 11.3]
Ghana	24.3	57.0	[35.4, 90.9]	62.2	[37.2, 99.4]	44.5	[26.0, 80.7]	50.7	[30.6, 81.0]	45.1	[26.6, 74.4]
Guinea	10.9	35.1	[19.3, 61.2]	40.8	[20.7, 71.8]	23.2	[12.3, 44.2]	32.2	[15.7, 57.7]	26.4	[14.2, 46.9]
Guinea-Bissau	1.6	5.6	[2.8, 10.2]	6.2	[3.1, 11.1]	3.7	[1.9, 7.7]	4.7	[2.4, 8.8]	3.4	[1.8, 6.7]
Liberia	4.0	15.5	[8.7, 26.0]	17.9	[9.5, 30.1]	10.1	[5.6, 19.3]	14.8	[7.2, 24.8]	11.7	[6.4, 20.5]
Mali	14.0	92.0	[42.8, 190.5]	114.1	[44.0, 241.8]	40.4	[22.2, 78.0]	116.8	[49.4, 252.3]	78.3	[39.1, 157.2]

		Total population in 2100 (in million)									
	Pop.	Excluding historical TFR		Including historical TFR		TFR simulation Cluster 2		TFR simulation Cluster 5		TFR simulation Cluster 7	
Name	2010	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals	median	80% prediction intervals
Mauritania	3.6	11.8	[7.5, 18.1]	13.4	[8.2, 20.0]	8.2	[5.0, 14.5]	10.7	[6.2, 16.5]	9.2	[5.6, 14.8]
Niger	15.9	188.5	[93.3, 370.2]	257.4	[114.7, 520.6]	126.9	[62.8, 317.9]	333.4	[177.0, 617.8]	246.8	[119.0, 569.6]
Nigeria	159.7	830.3	[489.1, 1,380.3]	988.3	[567.8, 1,662.9]	576.9	[328.6, 1,096.5]	887.5	[507.7, 1,586.9]	680.4	[404.4, 1,166.2]
Senegal	13.0	57.3	[36.5, 87.1]	64.5	[40.5, 97.7]	40.7	[23.8, 74.8]	52.5	[32.7, 77.7]	46.4	[27.5, 75.6]
Sierra Leone	5.8	13.8	[6.7, 25.4]	15.1	[6.9, 29.0]	9.3	[4.4, 19.5]	10.7	[4.2, 22.7]	10.2	[5.0, 20.1]
Togo	6.3	24.3	[15.7, 37.0]	27.0	[17.1, 40.5]	17.7	[10.9, 31.6]	22.0	[14.2, 31.8]	19.6	[11.8, 30.7]

References

Alkema, Leontine, et al. 2011. “Probabilistic projections of the total fertility rate for all countries,” *Demography* 48: 815-839.

Andreev, Kirill, Vladimíra Kantorová and John Bongaarts. 2013. “Demographic components of future population growth,” Technical Paper No. 2013/3, United Nations, Population Division/DESA, New York, NY.

Bloom, David E., Salal Humair, Larry Rosenberg, J.P. Sevilla and James Trussell. 2013. “A demographic dividend for sub-Saharan Africa: Source, magnitude, and realization,” Discussion Paper No. 7855, IZA, Germany.

Bongaarts, John and John Casterline. 2012. “Fertility transition: Is sub-Saharan Africa different?” *Population and Development Review* 38(Supp): 153-168.

Caldwell, John C., I.O. Orubuloye and Pat Caldwell. 1992. “Fertility decline in Africa: A new type of transition?” *Population and Development Review* 18(2): 211-242.

Cleland, John, Nelson Onuoha and Ian M. Timæus. 1994. “Fertility change in sub-Saharan Africa: A review of the evidence,” pp. 1-20 in *The Onset of Fertility Transition in Sub-Saharan Africa*, eds. T. Locoh and V. Hertrich. Ordina Editions.

Ezeh, Alex C., Blessing U. Mberu and Jacques O. Emina. 2009. “Stall in fertility decline in Eastern African countries: regional analysis of patterns, determinants and implications,” *Philosophical Transactions of the Royal Society* B 364: 2991–3007.

Fraley, Chris, Adrian E. Raftery, T. Brendan Murphy and Luca Scrucca. 2012. “mclust Version 4 for R: Normal Mixture Modeling for Model-Based Clustering, Classification, and Density Estimation,” Technical Report No. 597, University of Washington, Seattle, WA.

Fuchs, Regina and Anne Goujon. 2014. “Future fertility in high fertility countries,” pp. 147-225 in *World Population and Human Capital in the Twenty-First Century*, eds. W. Lutz, W.P. Butz and Samir KC. Oxford University Press.

Garenne, Michel. 2008. Fertility changes in sub-Saharan Africa. DHS Comparative Reports No. 18. Calverton, Maryland, USA: Macro International Inc.

Garenne, Michel L. 2011. “Testing for fertility stalls in demographic and health surveys,” *Population Health Metrics* 9: 59. doi:10.1186/1478-7954-9-59

Gerland, Patrick. 2014a. “UN Population Division's methodology in preparing base population for projections: Case study for India,” *Asian Population Studies* 10(3): 274-303.

Gerland, Patrick, et al. 2014b. “World population stabilization unlikely this century,” *Science* 346: 234-237.

Kirk, Dudley and Bernard Pillet. 1998. “Fertility levels, trends, and differentials in sub-Saharan Africa in the 1980s and 1990s,” *Studies in Family Planning* 29(1): 1-22.

Machiyama Kazuyo, Richard Silverwood, Andy Sloggett and John Cleland. 2010. “Recent fertility declines in sub-Saharan Africa: Analysis of country trends of fertility decline,” Paper prepared for the 2010 Quetelet Seminar, 24-26 November 2010, Louvain-la-Neuve, Belgium.

Moultrie, Tom A., Takudzwa S. Sayi and Ian M. Timæus. 2012. “Birth intervals, postponement, and fertility decline in Africa: A new type of transition?” *Population Studies* DOI:10.1080/00324728.2012.701660

O’Neill, Brian C., Michael Dalton, Regina Fuchs, Leiwen Jiang, Shonali Pachauri and Katarina Zigova. 2010. “Global demographic trends and future carbon emissions,” PNAS 107:41. www.pnas.org/cgi/doi/10.1073/pnas.1004581107

Rossier, Clémentine, Jamaica Corker and Bruno Schoumaker. 2015 “The fertility decline in sub-Saharan Africa: Who’s next after the elite?” Paper presented at the 2015 Annual Meeting of the Population Association of America, San Diego, 30 April – 2 May.

Schoumaker, Bruno. 2009. “Stalls and reversals in fertility transitions in sub-Saharan Africa: real or spurious?” Working Paper no. 30, Université catholique de Louvain: Louvain, Belgium.

Schoumaker, Bruno. 2014. “Quality and consistency of DHS fertility estimates, 1990 to 2012.” DHS Methodological Reports No. 12, ICF International: Rockville, Maryland.

Ševčíková Hana, Leontine Alkema and Adrian Raftery. 2011. “bayesTFR: An R Package for Probabilistic Projections of the Total Fertility Rate,” *Journal of Statistical Software* 43(1): 1-29.

Ševčíková, Hana et al. 2015. “Age-Specific Mortality and Fertility Rates for Probabilistic Population Projections,” Center for Statistics and the Social Sciences (Ed.), Working Paper 150. Seattle, WA: University of Washington.

Skirbekk, Vegard, Marcin Stonawski and Guido Alfani. (forthcoming). “Consequences of a universal European demographic transition on regional and global population distributions,” *Technological Forecasting & Social Change*.

Timæus, Ian M. and Tom A. Moultrie. 2008. “On postponement and birth intervals,” *Population and Development Review* 34(3): 483–510.

United Nations, Department of Economic and Social Affairs, Population Division. 2013a. *World Population Prospects: The 2012 Revision*. New York, United Nations. Available from http://esa.un.org/unpd/wpp/index.htm.

United Nations, Department of Economic and Social Affairs, Population Division. 2013b. *World Population Prospects: The 2012 Revision - Online and DVD Edition - Data Sources*

and Meta Information (POP/DB/WPP/Rev.2012/F0-2). New York: Population Division, Dept. of Economic and Social Affairs. Available from http://esa.un.org/unpd/wpp/Excel-Data/data-sources.htm.

United Nations, Department of Economic and Social Affairs, Population Division. 2014. *World Population Prospects: The 2012 Revision, Methodology of the United Nations Population Estimates and Projections*, Working Paper No. ESA/P/WP.235.

[i] The term 'country' as used in this paper also refers, as appropriate, to territories or areas; the designations employed and the presentation of the material do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Major country groupings referred to in this paper are informed by the classification of the United Nations Statistical Division. The boundaries and names shown and designations used on the map presented in this paper do not imply official endorsement or acceptance by the United Nations.

[ii] The term 'country' as used in this paper also refers, as appropriate, to territories or areas; the designations employed and the presentation of the material do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Major country groupings referred to in this paper are informed by the classification of the United Nations Statistical Division. The boundaries and names shown and designations used on the map presented in this paper do not imply official endorsement or acceptance by the United Nations.

[iii] Sub-Saharan Africa includes 50 countries and does not include Sudan. For the purpose of this analysis, Saint-Helena with a total population of 4,000 persons was not included.

[iv] Countries in sub-Saharan Africa with birth registration coverage of 90 per cent or more are Cabo Verde, Mauritius, Réunion, Seychelles and South Africa (United Nations Statistics Division, 2014; see http://unstats.un.org/unsd/demographic/CRVS/CR_coverage.htm)

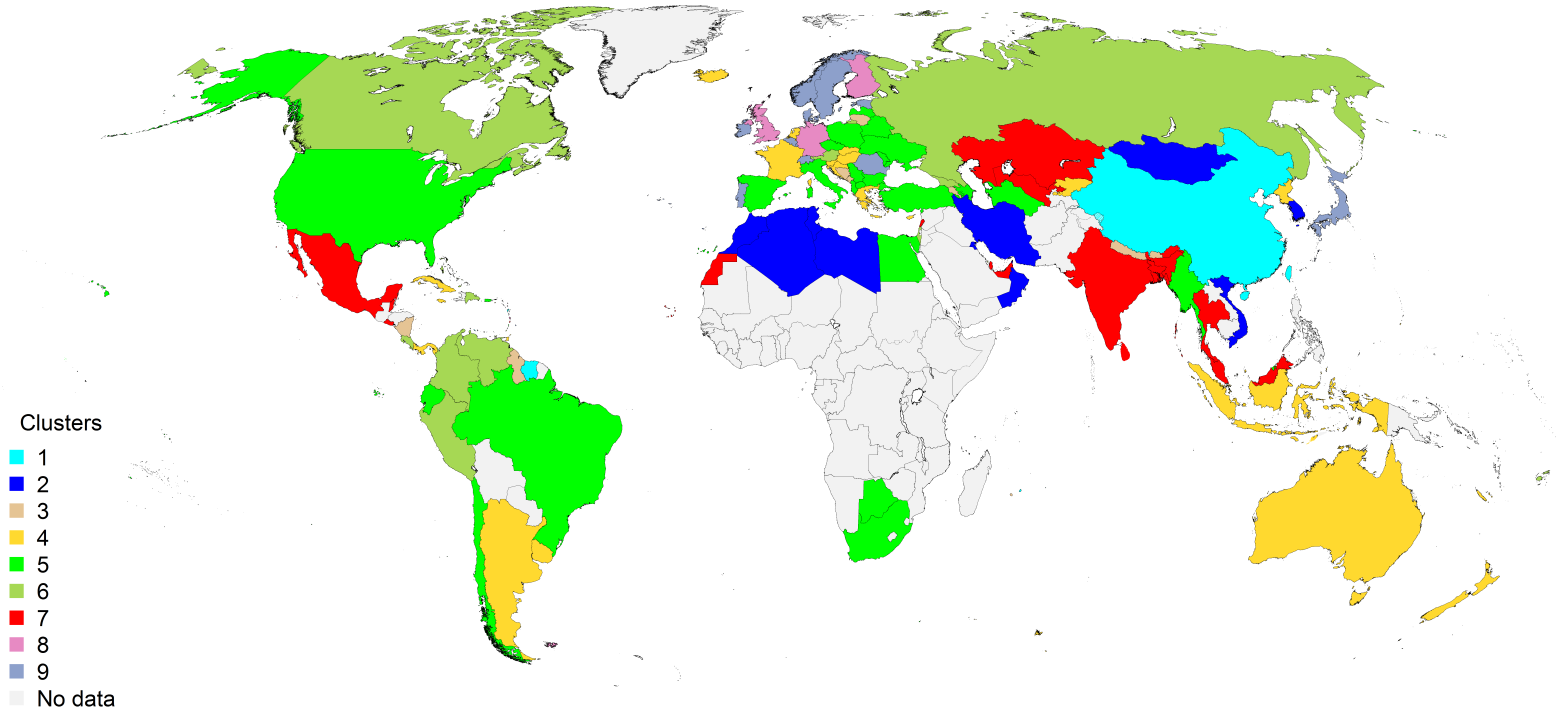
[v] Preliminary analyses of three and five clusters included too many countries to be meaningful for generating scenarios based on country experiences.

[vi] The baseline probabilistic population projections in this paper differ slightly from those published in the 2012 Revision of WPP because we updated the projection models for the age patterns of fertility and mortality in the probabilistic projection models (Sevcikova et al. 2015). The difference between the two sets of population projections for sub-Saharan Africa is small (e.g., projected population in 2100 for the region is 3.815 billion (medium variant) from the 2012 Revision and 3.852 billion in the baseline scenario). The baseline probabilistic projections of total fertility are the same as those published in the 2012 Revision of WPP (United Nations, 2013a).

Supplementary materials

I. Map and list of countries by clusters of fertility decline

TFR clusters



Data source: World Population Prospects: The 2012 Revision (including historical series)

Table C1: Alphabetic list of countries

Location	ISO3	Cluster
Albania	ALB	5
Algeria	DZA	2
Antigua and Barbuda	ATG	8
Argentina	ARG	4
Armenia	ARM	3
Aruba	ABW	1
Australia	AUS	4
Austria	AUT	6
Azerbaijan	AZE	5
Bahamas	BHS	6
Bahrain	BHR	6
Bangladesh	BGD	7
Barbados	BRB	9
Belarus	BLR	5
Belgium	BEL	9
Belize	BLZ	7
Bhutan	BTN	3
Bosnia and Herzegovina	BIH	3
Botswana	BWA	5
Brazil	BRA	5
Brunei Darussalam	BRN	5
Bulgaria	BGR	5
Canada	CAN	6
Cape Verde	CPV	7
Channel Islands	CHI	6
Chile	CHL	5
China	CHN	1
China, Hong Kong SAR	HKG	8
China, Macao SAR	MAC	1
Colombia	COL	6
Costa Rica	CRI	6
Croatia	HRV	4
Cuba	CUB	4
Curaçao	CUW	1
Cyprus	CYP	4
Czech Republic	CZE	5
Dem. People's Republic of Korea	PRK	4
Denmark	DNK	9
Dominican Republic	DOM	6
Ecuador	ECU	5
Egypt	EGY	5
El Salvador	SLV	7
Estonia	EST	9
Fiji	FJI	6
Finland	FIN	8
France	FRA	4
French Polynesia	PYF	5
Georgia	GEO	6
Germany	DEU	8
Greece	GRC	4
Grenada	GRD	6
Guadeloupe	GLP	1
Guam	GUM	4
Guyana	GUY	3
Hungary	HUN	4
Iceland	ISL	4
India	IND	7
Indonesia	IDN	4
Iran (Islamic Republic of)	IRN	2
Ireland	IRL	9
Israel	ISR	6
Italy	ITA	5
Jamaica	JAM	4
Japan	JPN	9
Kazakhstan	KAZ	7
Kuwait	KWT	2
Kyrgyzstan	KGZ	4
Latvia	LVA	5
Lebanon	LBN	7
Libya	LBY	2
Lithuania	LTU	3
Luxembourg	LUX	9
Malaysia	MYS	7
Maldives	MDV	2
Malta	MLT	9
Martinique	MTQ	8
Mauritius	MUS	1
Mexico	MEX	7
Mongolia	MNG	2
Montenegro	MNE	3
Morocco	MAR	2
Myanmar	MMR	5
Nepal	NPL	3
Netherlands	NLD	4
New Caledonia	NCL	4
New Zealand	NZL	4
Nicaragua	NIC	3
Norway	NOR	9
Oman	OMN	2
Other non-specified areas	TWN	5
Panama	PAN	4
Peru	PER	6
Poland	POL	5
Portugal	PRT	9
Puerto Rico	PRI	5
Qatar	QAT	7
Republic of Korea	KOR	2
Republic of Moldova	MDA	5
Réunion	REU	3
Romania	ROU	9
Russian Federation	RUS	6
Saint Lucia	LCA	7
Saint Vincent and the Grenadines	VCT	5
Serbia	SRB	5
Seychelles	SYC	1
Singapore	SGP	3
Slovakia	SVK	4
Slovenia	SVN	4
South Africa	ZAF	5
Spain	ESP	5
Sri Lanka	LKA	7
Suriname	SUR	1
Sweden	SWE	9
Switzerland	CHE	9
TFYR Macedonia	MKD	5
Thailand	THA	7
Trinidad and Tobago	TTO	4
Tunisia	TUN	2
Turkey	TUR	5
Turkmenistan	TKM	5
Ukraine	UKR	5
United Arab Emirates	ARE	7
United Kingdom	GBR	8
United States of America	USA	5
United States Virgin Islands	VIR	4
Uruguay	URY	4
Uzbekistan	UZB	7
Venezuela (Bolivarian Republic of)	VEN	6
Viet Nam	VNM	2
Western Sahara	ESH	7

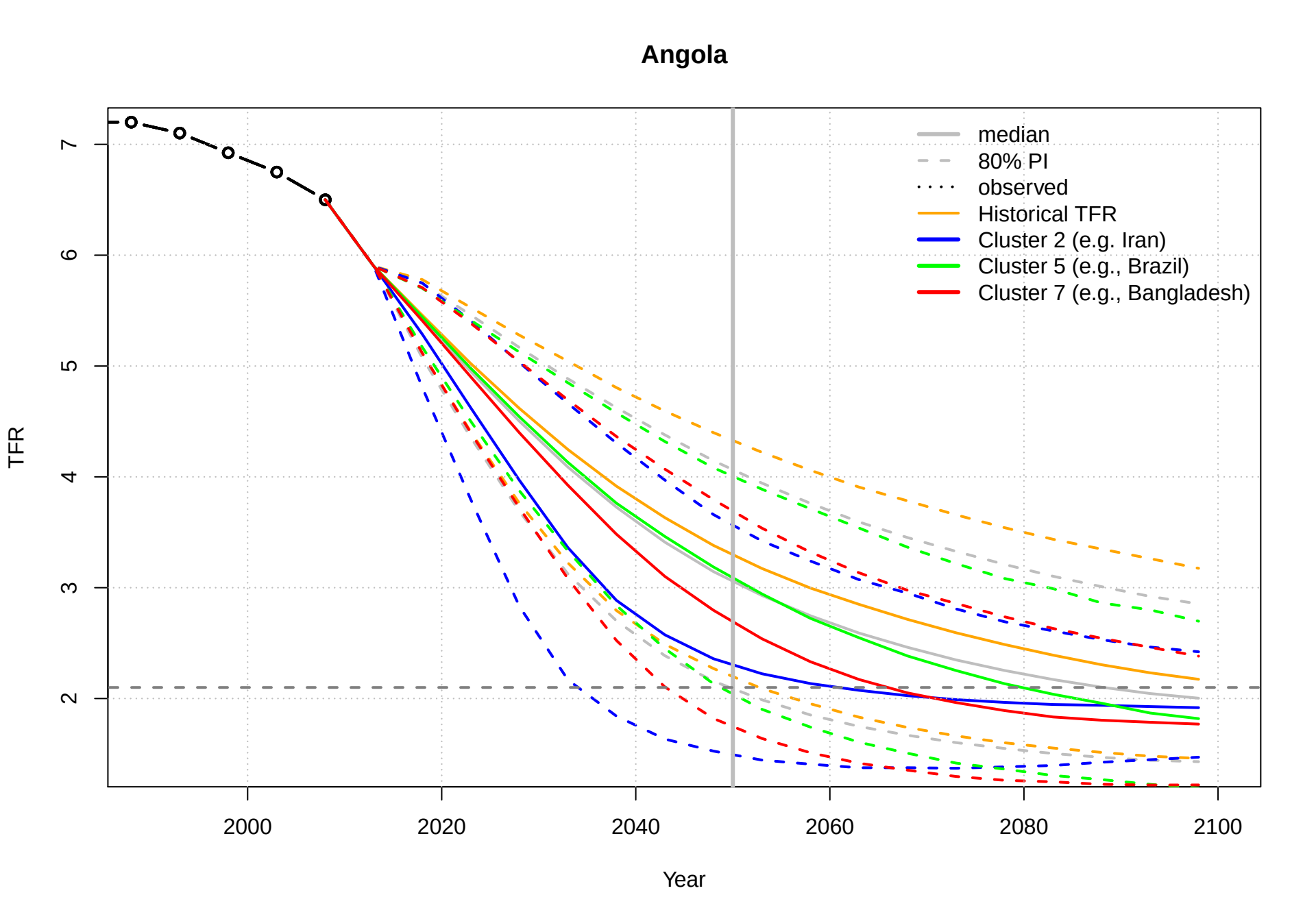
Table C2: List of countries by ISO 3-letter codes

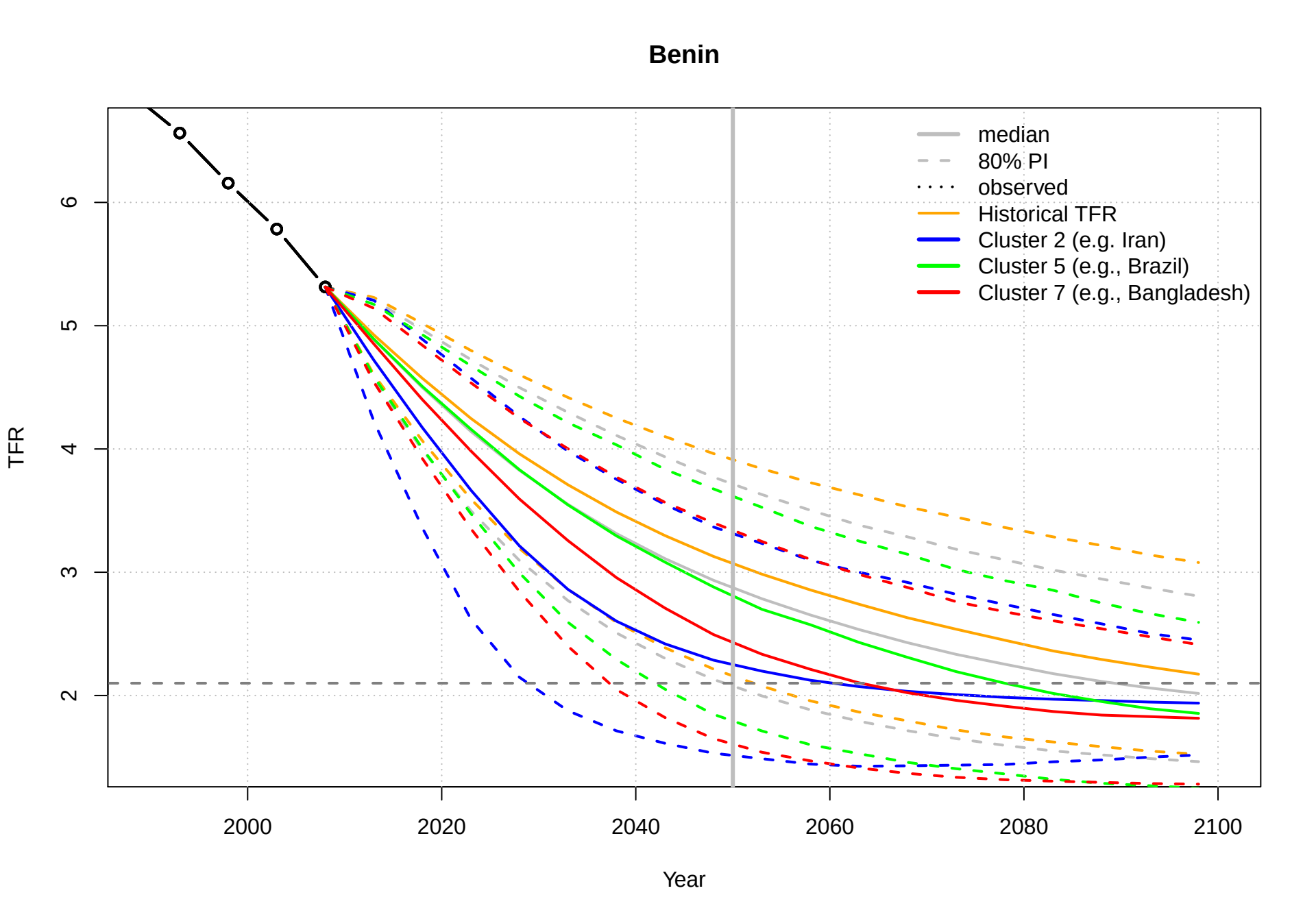
ISO3	Location	Cluster
ABW	Aruba	1
ALB	Albania	5
ARE	United Arab Emirates	7
ARG	Argentina	4
ARM	Armenia	3
ATG	Antigua and Barbuda	8
AUS	Australia	4
AUT	Austria	6
AZE	Azerbaijan	5
BEL	Belgium	9
BGD	Bangladesh	7
BGR	Bulgaria	5
BHR	Bahrain	6
BHS	Bahamas	6
BIH	Bosnia and Herzegovina	3
BLR	Belarus	5
BLZ	Belize	7
BRA	Brazil	5
BRB	Barbados	9
BRN	Brunei Darussalam	5
BTN	Bhutan	3
BWA	Botswana	5
CAN	Canada	6
CHE	Switzerland	9
CHI	Channel Islands	6
CHL	Chile	5
CHN	China	1
COL	Colombia	6
CPV	Cape Verde	7
CRI	Costa Rica	6
CUB	Cuba	4
CUW	Curaçao	1
CYP	Cyprus	4
CZE	Czech Republic	5
DEU	Germany	8
DNK	Denmark	9
DOM	Dominican Republic	6
DZA	Algeria	2
ECU	Ecuador	5
EGY	Egypt	5
ESH	Western Sahara	7
ESP	Spain	5
EST	Estonia	9
FIN	Finland	8
FJI	Fiji	6
FRA	France	4
GBR	United Kingdom	8
GEO	Georgia	6
GLP	Guadeloupe	1
GRC	Greece	4
GRD	Grenada	6
GUM	Guam	4
GUY	Guyana	3
HKG	China, Hong Kong SAR	8
HRV	Croatia	4
HUN	Hungary	4
IDN	Indonesia	4
IND	India	7
IRL	Ireland	9
IRN	Iran (Islamic Republic of)	2
ISL	Iceland	4
ISR	Israel	6
ITA	Italy	5
JAM	Jamaica	4
JPN	Japan	9
KAZ	Kazakhstan	7
KGZ	Kyrgyzstan	4
KOR	Republic of Korea	2
KWT	Kuwait	2
LBN	Lebanon	7
LBY	Libya	2
LCA	Saint Lucia	7
LKA	Sri Lanka	7
LTU	Lithuania	3
LUX	Luxembourg	9
LVA	Latvia	5
MAC	China, Macao SAR	1
MAR	Morocco	2
MDA	Republic of Moldova	5
MDV	Maldives	2
MEX	Mexico	7
MKD	TFYR Macedonia	5
MLT	Malta	9
MMR	Myanmar	5
MNE	Montenegro	3
MNG	Mongolia	2
MTQ	Martinique	8
MUS	Mauritius	1
MYS	Malaysia	7
NCL	New Caledonia	4
NIC	Nicaragua	3
NLD	Netherlands	4
NOR	Norway	9
NPL	Nepal	3
NZL	New Zealand	4
OMN	Oman	2
PAN	Panama	4
PER	Peru	6
POL	Poland	5
PRI	Puerto Rico	5
PRK	Dem. People's Republic of Korea	4
PRT	Portugal	9
PYF	French Polynesia	5
QAT	Qatar	7
REU	Réunion	3
ROU	Romania	9
RUS	Russian Federation	6
SGP	Singapore	3
SLV	El Salvador	7
SRB	Serbia	5
SUR	Suriname	1
SVK	Slovakia	4
SVN	Slovenia	4
SWE	Sweden	9
SYC	Seychelles	1
THA	Thailand	7
TKM	Turkmenistan	5
TTO	Trinidad and Tobago	4
TUN	Tunisia	2
TUR	Turkey	5
TWN	Other non-specified areas	5
UKR	Ukraine	5
URY	Uruguay	4
USA	United States of America	5
UZB	Uzbekistan	7
VCT	Saint Vincent and the Grenadines	5
VEN	Venezuela (Bolivarian Republic of)	6
VIR	United States Virgin Islands	4
VNM	Viet Nam	2
ZAF	South Africa	5

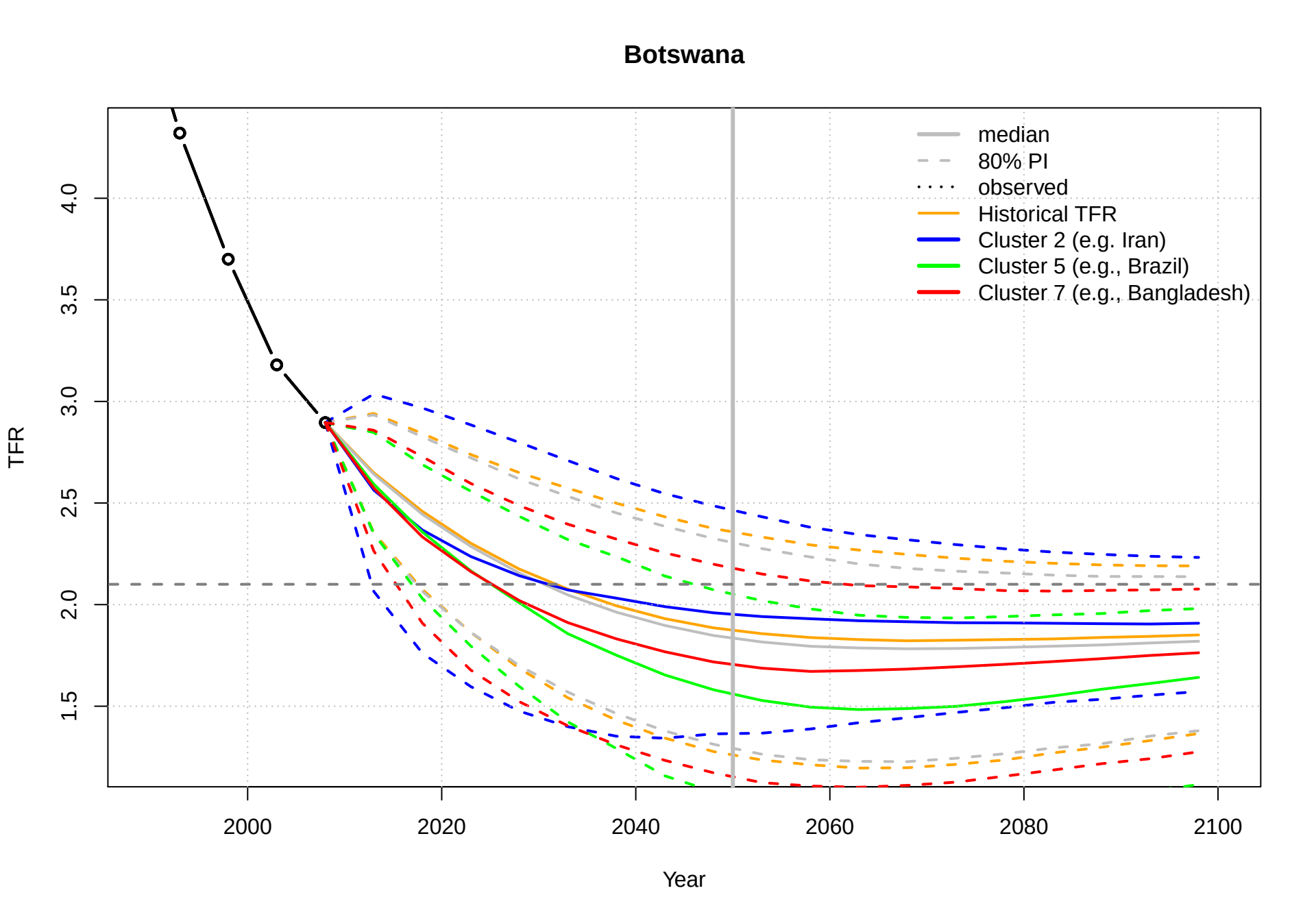
Table C3: List of countries by TFR clusters

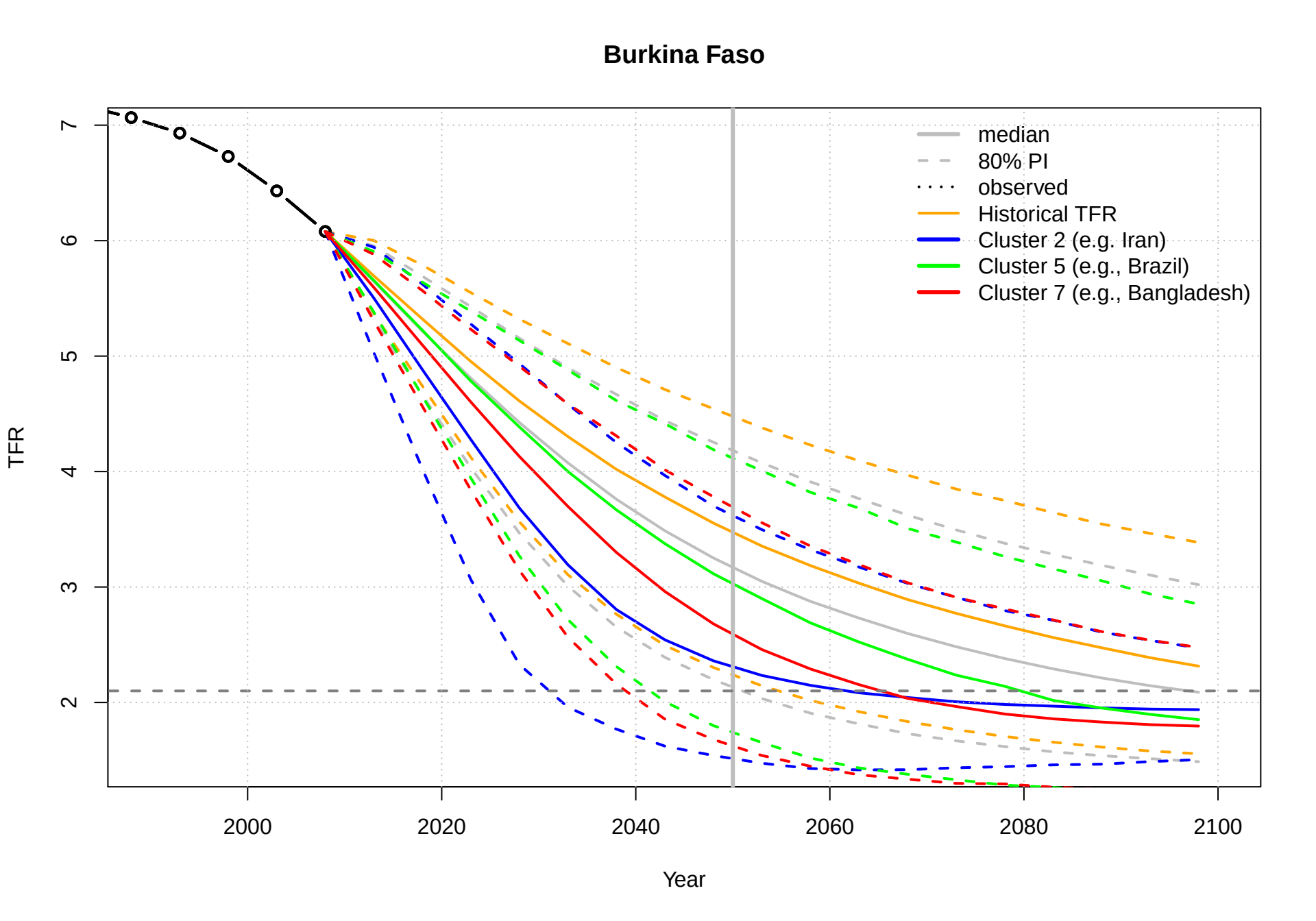
Cluster	Location	ISO3_Code
1	Aruba	ABW
1	China	CHN
1	China, Macao SAR	MAC
1	Curaçao	CUW
1	Guadeloupe	GLP
1	Mauritius	MUS
1	Seychelles	SYC
1	Suriname	SUR
2	Algeria	DZA
2	Iran (Islamic Republic of)	IRN
2	Kuwait	KWT
2	Libya	LBY
2	Maldives	MDV
2	Mongolia	MNG
2	Morocco	MAR
2	Oman	OMN
2	Republic of Korea	KOR
2	Tunisia	TUN
2	Viet Nam	VNM
3	Armenia	ARM
3	Bhutan	BTN
3	Bosnia and Herzegovina	BIH
3	Guyana	GUY
3	Lithuania	LTU
3	Montenegro	MNE
3	Nepal	NPL
3	Nicaragua	NIC
3	Réunion	REU
3	Singapore	SGP
4	Argentina	ARG
4	Australia	AUS
4	Croatia	HRV
4	Cuba	CUB
4	Cyprus	CYP
4	Dem. People's Republic of Korea	PRK
4	France	FRA
4	Greece	GRC
4	Guam	GUM
4	Hungary	HUN
4	Iceland	ISL
4	Indonesia	IDN
4	Jamaica	JAM
4	Kyrgyzstan	KGZ
4	Netherlands	NLD
4	New Caledonia	NCL
4	New Zealand	NZL
4	Panama	PAN
4	Slovakia	SVK
4	Slovenia	SVN
4	Trinidad and Tobago	TTO
4	United States Virgin Islands	VIR
4	Uruguay	URY
5	Albania	ALB
5	Azerbaijan	AZE
5	Belarus	BLR
5	Botswana	BWA
5	Brazil	BRA
5	Brunei Darussalam	BRN
5	Bulgaria	BGR
5	Chile	CHL
5	Czech Republic	CZE
5	Ecuador	ECU
5	Egypt	EGY
5	French Polynesia	PYF
5	Italy	ITA
5	Latvia	LVA
5	Myanmar	MMR
5	Other non-specified areas	TWN
5	Poland	POL
5	Puerto Rico	PRI
5	Republic of Moldova	MDA
5	Saint Vincent and the Grenadines	VCT
5	Serbia	SRB
5	South Africa	ZAF
5	Spain	ESP
5	TFYR Macedonia	MKD
5	Turkey	TUR
5	Turkmenistan	TKM
5	Ukraine	UKR
5	United States of America	USA
6	Austria	AUT
6	Bahamas	BHS
6	Bahrain	BHR
6	Canada	CAN
6	Channel Islands	CHI
6	Colombia	COL
6	Costa Rica	CRI
6	Dominican Republic	DOM
6	Fiji	FJI
6	Georgia	GEO
6	Grenada	GRD
6	Israel	ISR
6	Peru	PER
6	Russian Federation	RUS
6	Venezuela (Bolivarian Republic of)	VEN
7	Bangladesh	BGD
7	Belize	BLZ
7	Cape Verde	CPV
7	El Salvador	SLV
7	India	IND
7	Kazakhstan	KAZ
7	Lebanon	LBN
7	Malaysia	MYS
7	Mexico	MEX
7	Qatar	QAT
7	Saint Lucia	LCA
7	Sri Lanka	LKA
7	Thailand	THA
7	United Arab Emirates	ARE
7	Uzbekistan	UZB
7	Western Sahara	ESH
8	Antigua and Barbuda	ATG
8	China, Hong Kong SAR	HKG
8	Finland	FIN
8	Germany	DEU
8	Martinique	MTQ
8	United Kingdom	GBR
9	Barbados	BRB
9	Belgium	BEL
9	Denmark	DNK
9	Estonia	EST
9	Ireland	IRL
9	Japan	JPN
9	Luxembourg	LUX
9	Malta	MLT
9	Norway	NOR
9	Portugal	PRT
9	Romania	ROU
9	Sweden	SWE
9	Switzerland	CHE

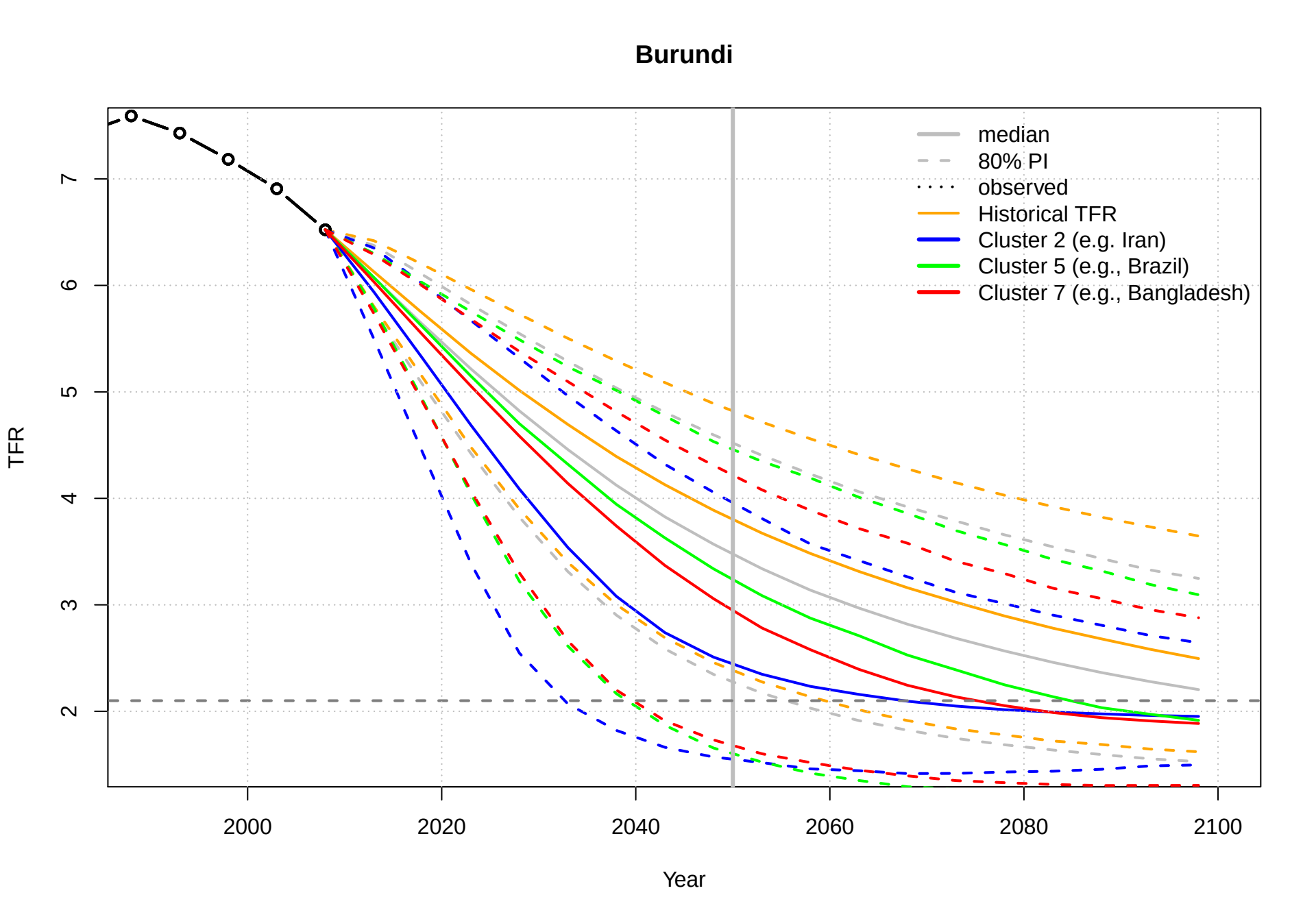
II. Probabilistic fertility projections (median and 80 per cent prediction intervals) for five scenarios: baseline, historical, 2-“very fast-slow”, 5-“slow-steady” and 7-“slow-moderately fast” by region and country

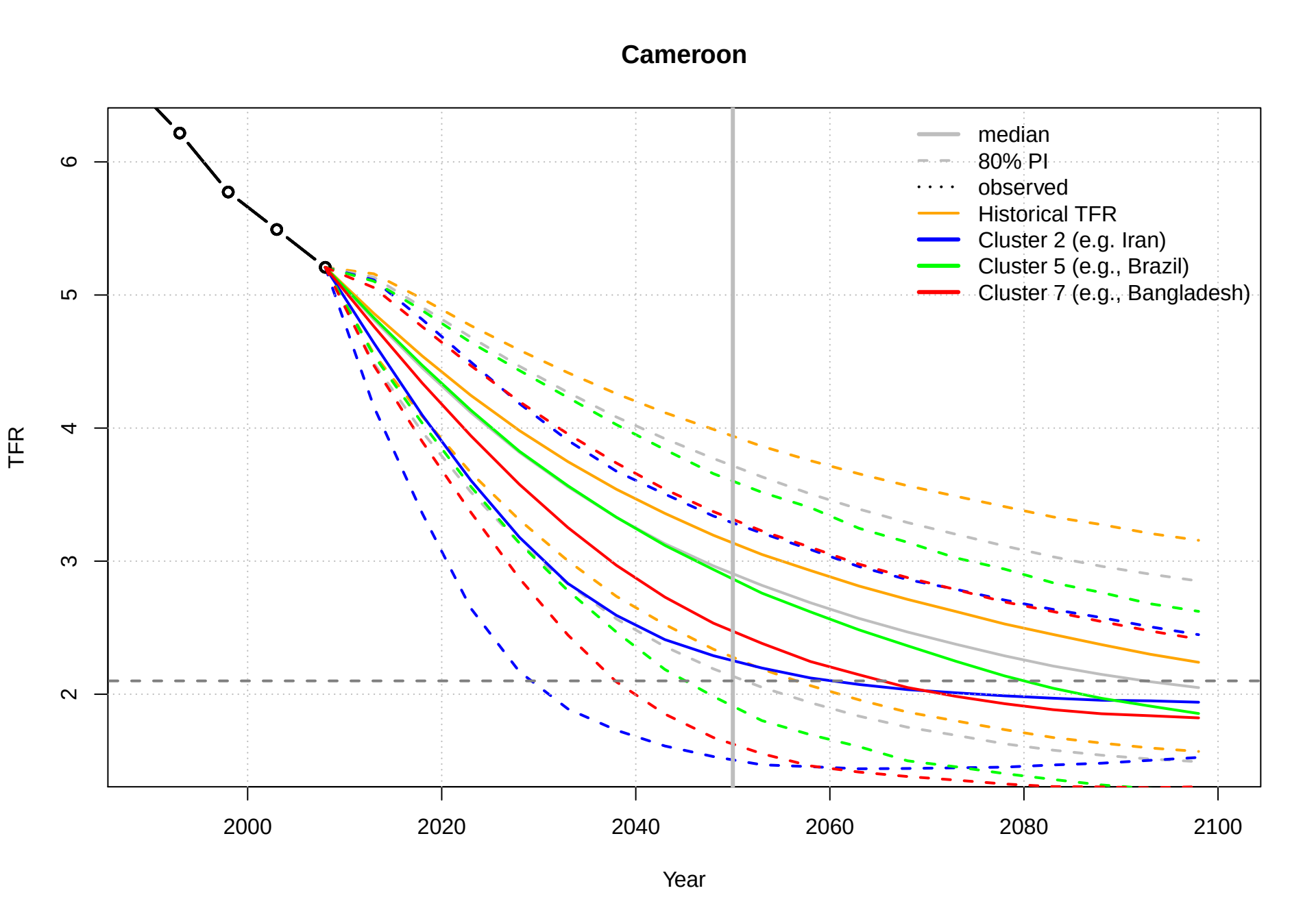

Angola
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100
Year

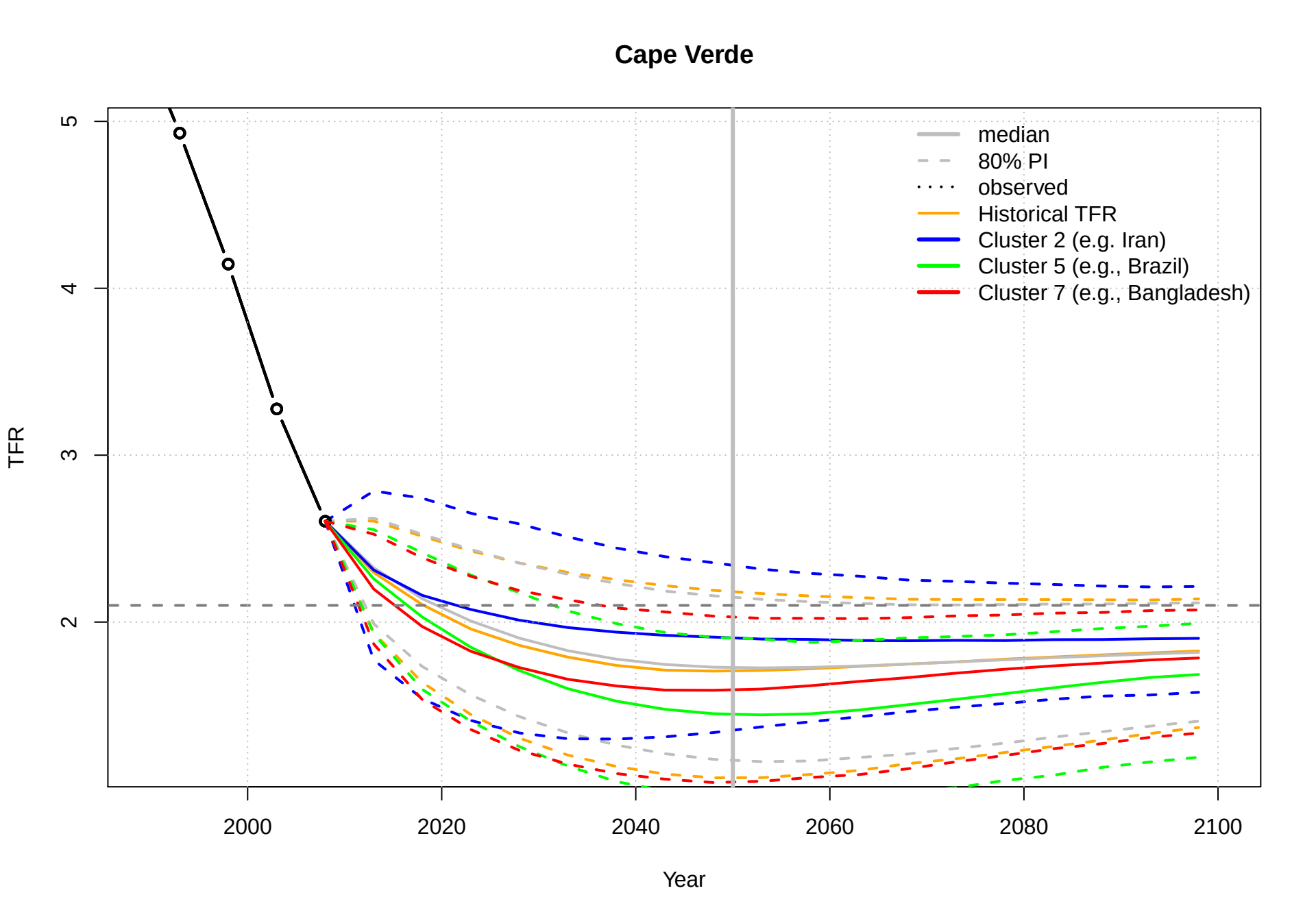

Benin
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

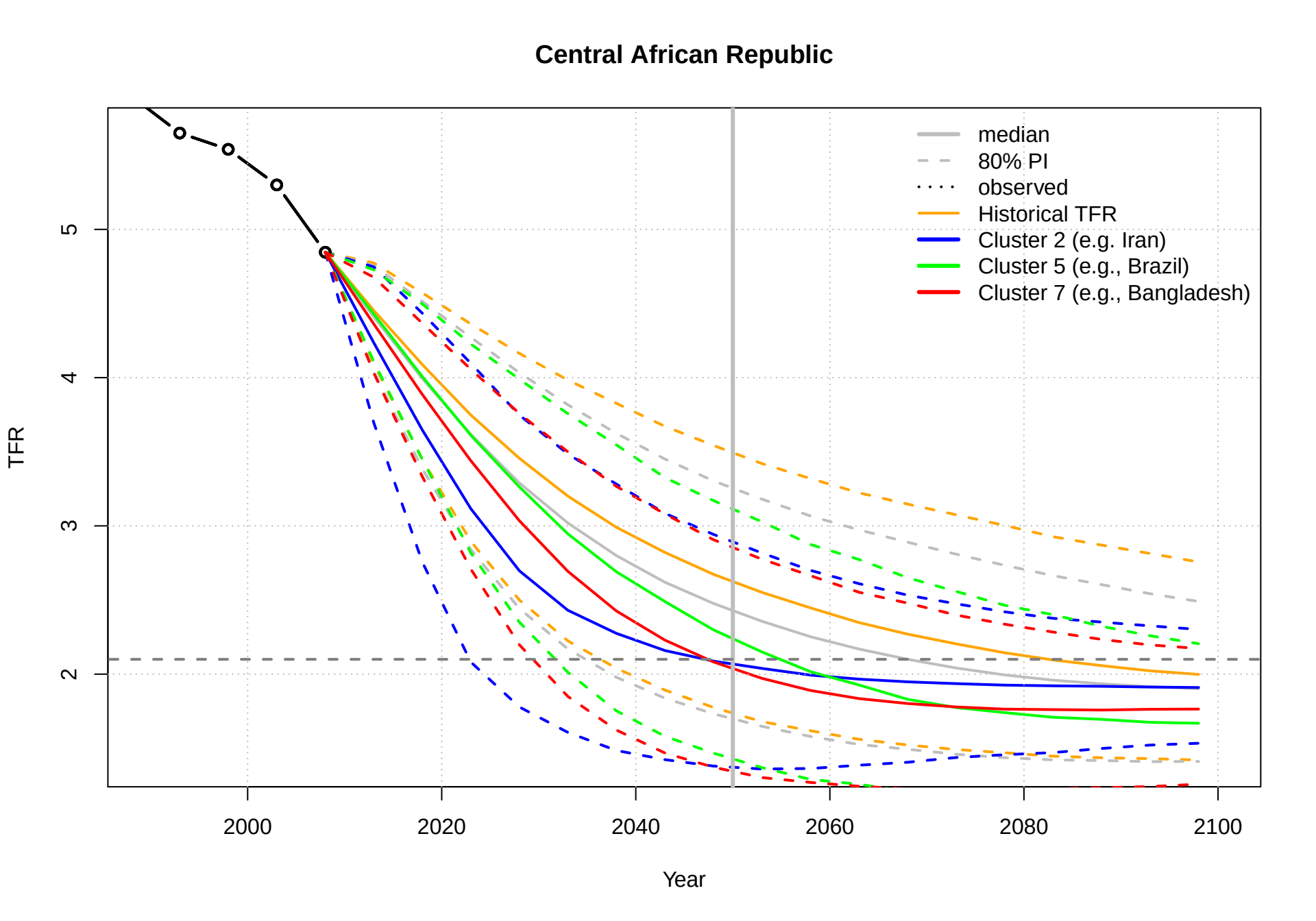

Botswana
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
4.0
3.5
3.0
2.5
2.0
1.5
2000
2020
2040
2060
2080
2100
Year

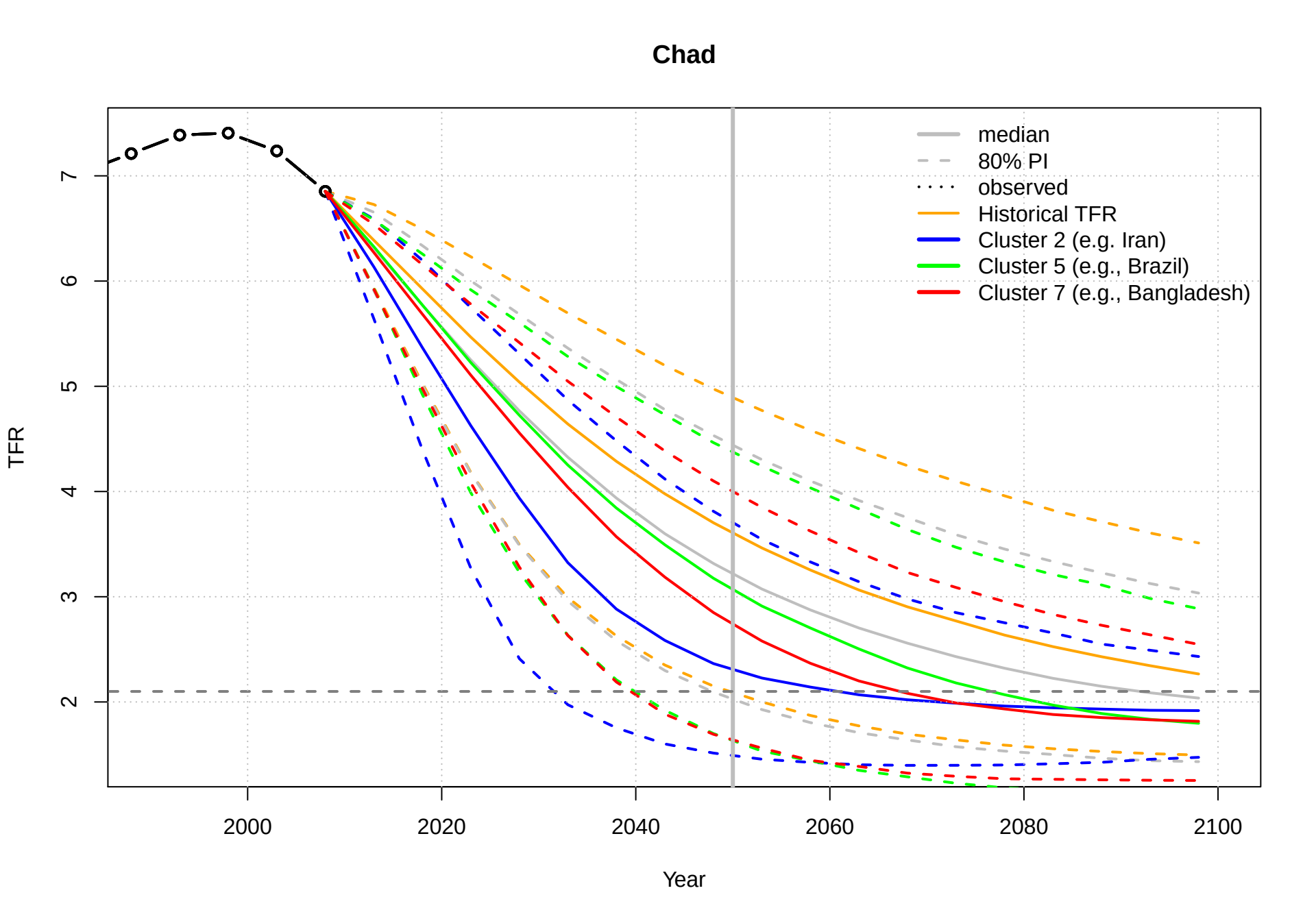

Burkina Faso
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100
Year

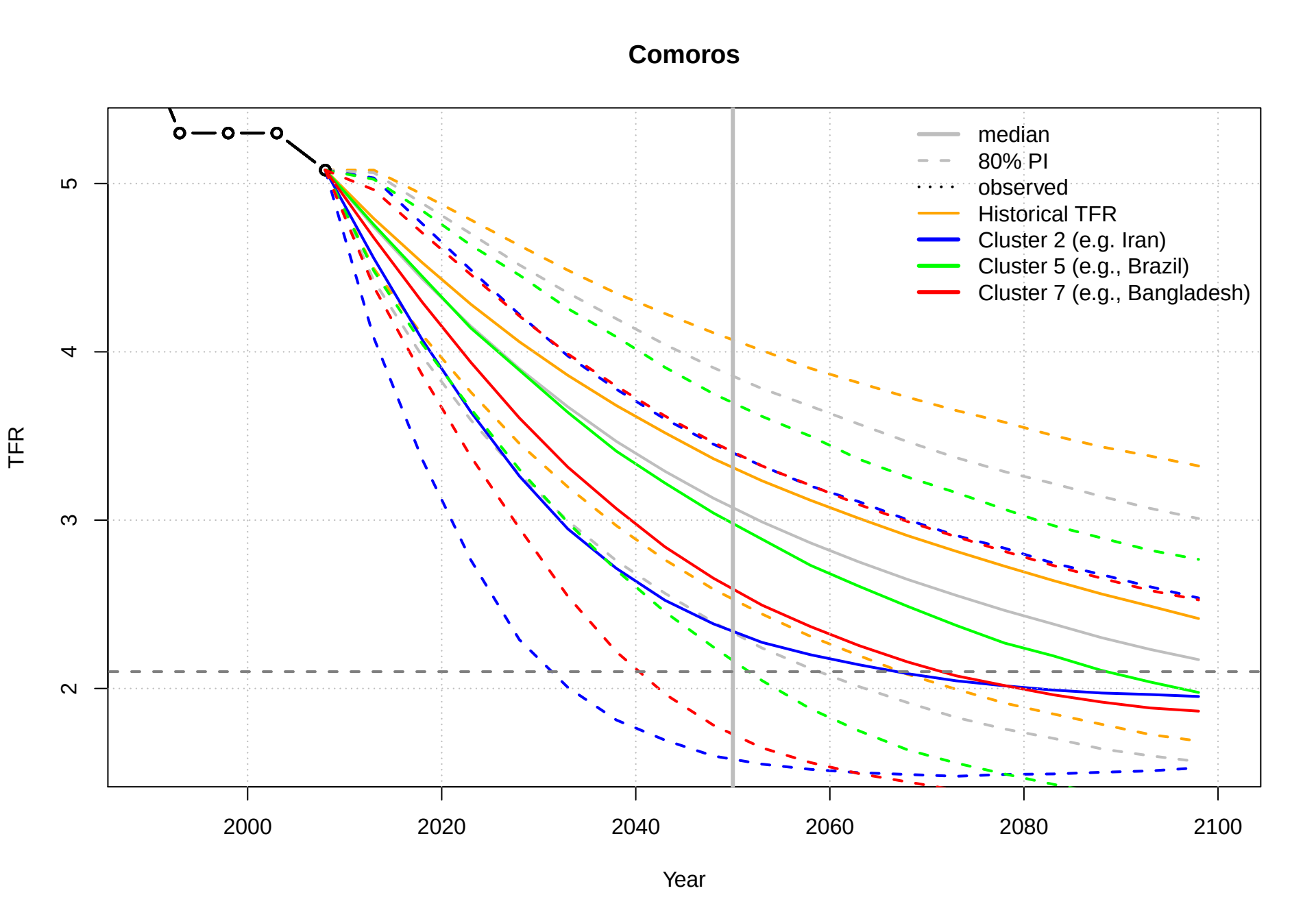

Burundi
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100
Year

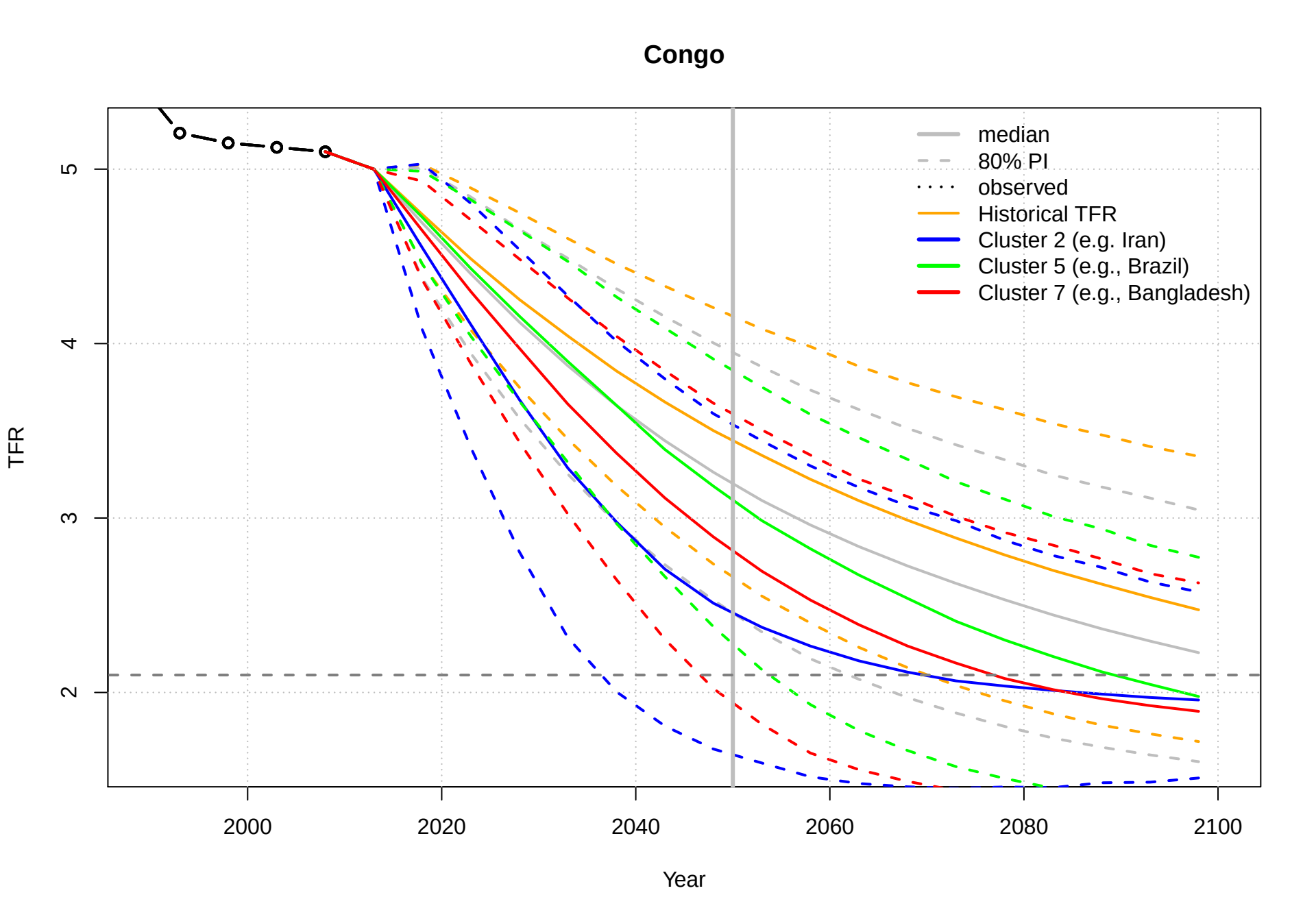

Cameroon
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

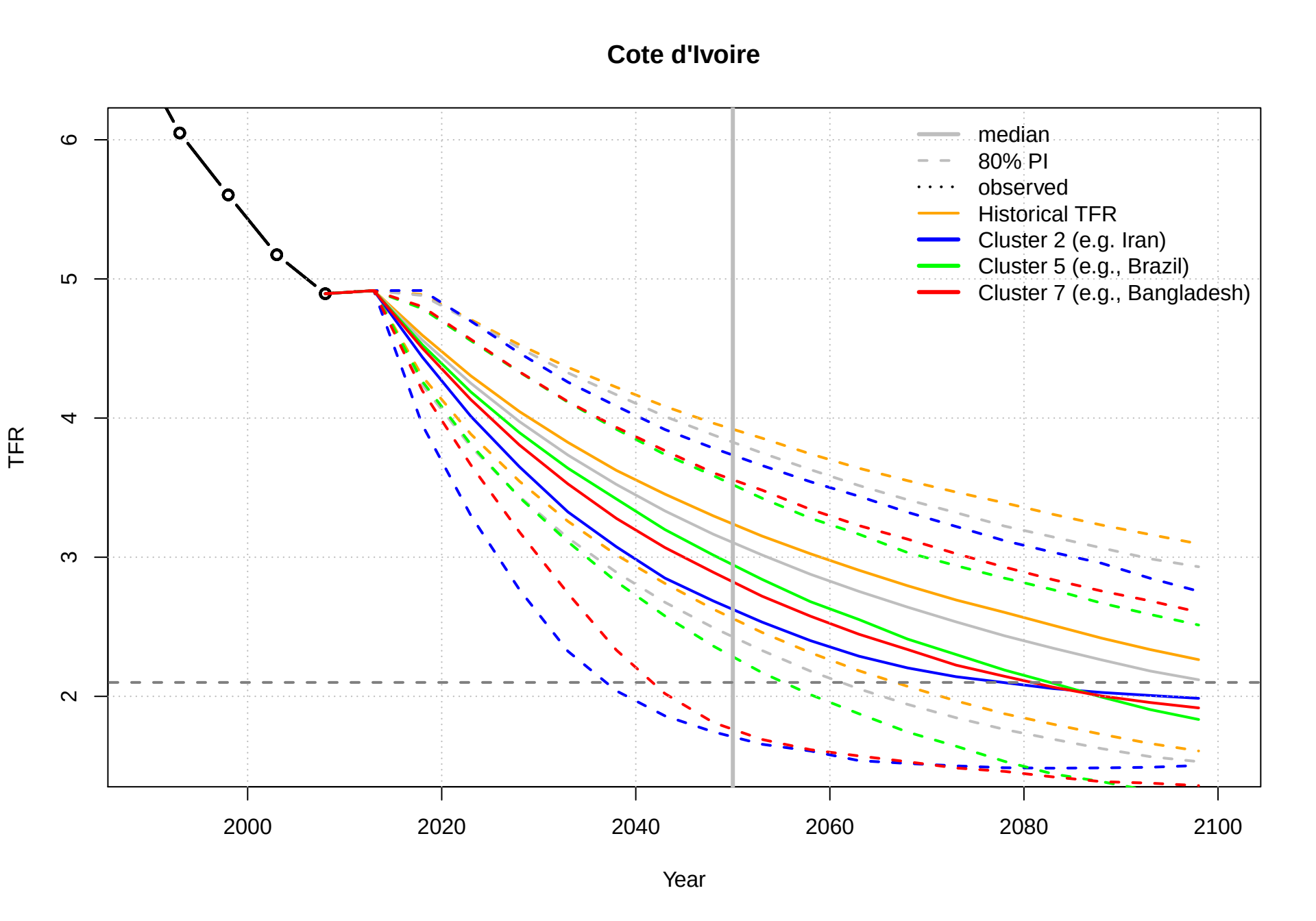

Cape Verde
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
2000
2020
2040
2060
2080
2100

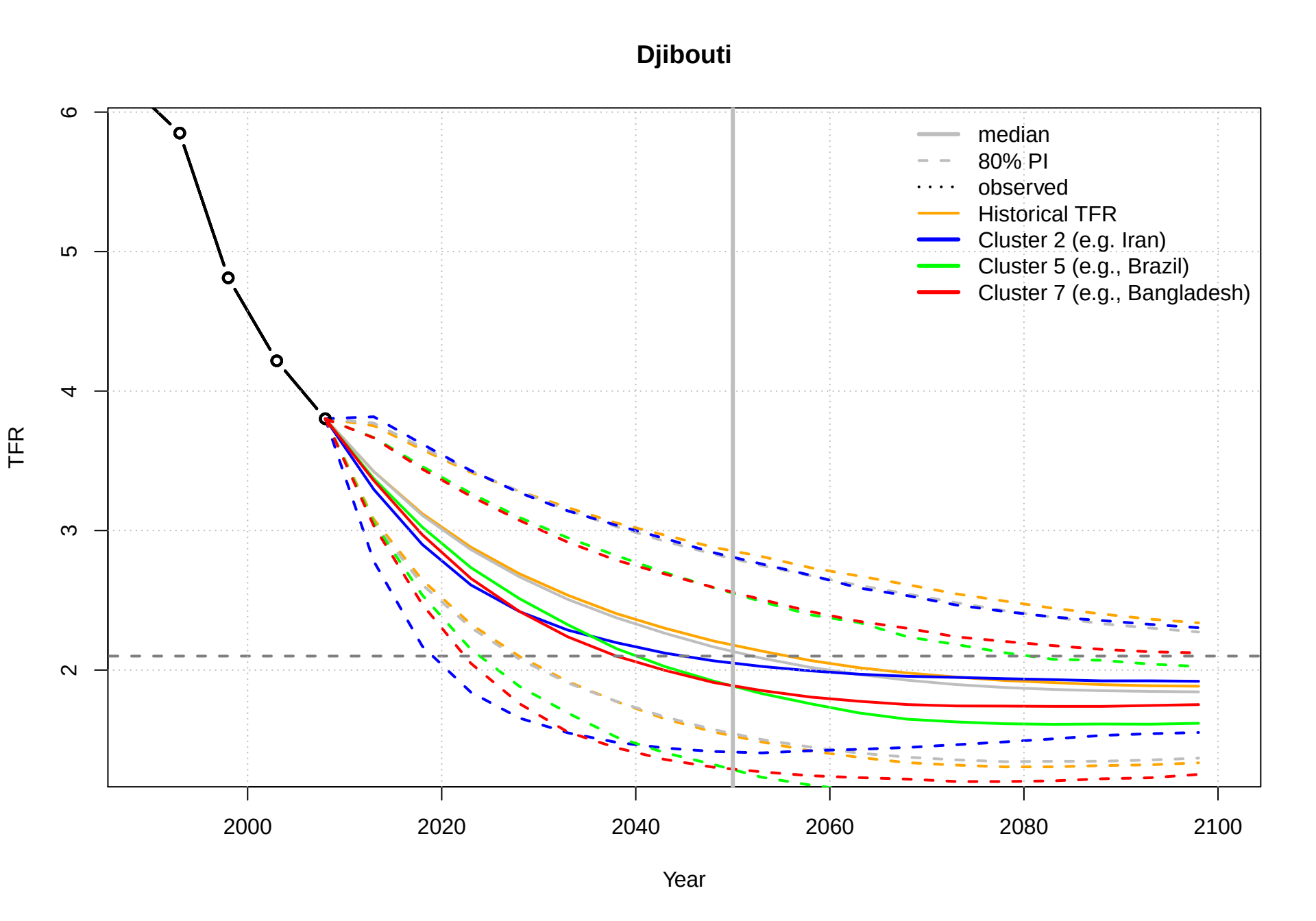

Central African Republic
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
5
4
3
2
2000
2020
2040
2060
2080
2100
Year

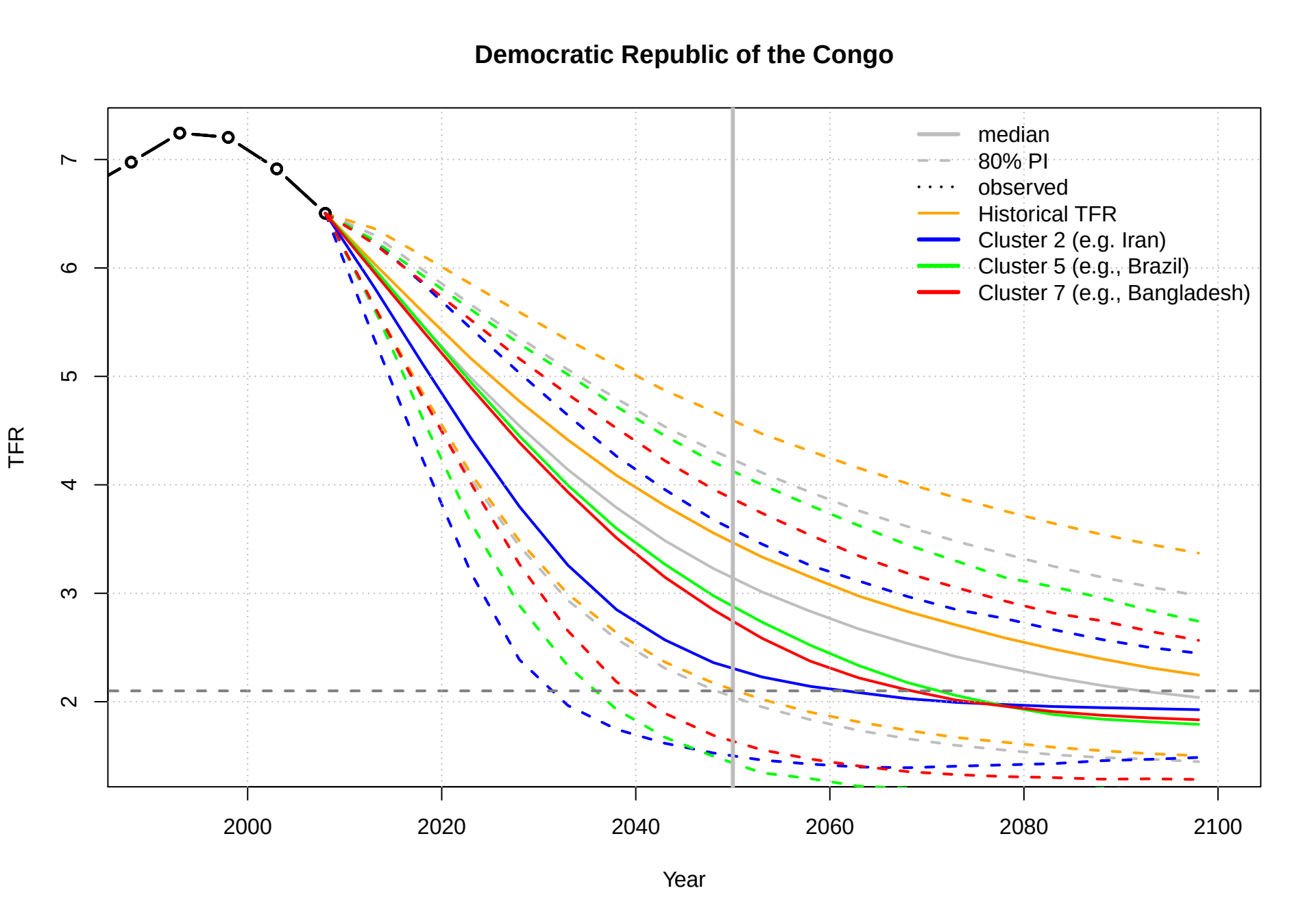

Chad
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100
Year

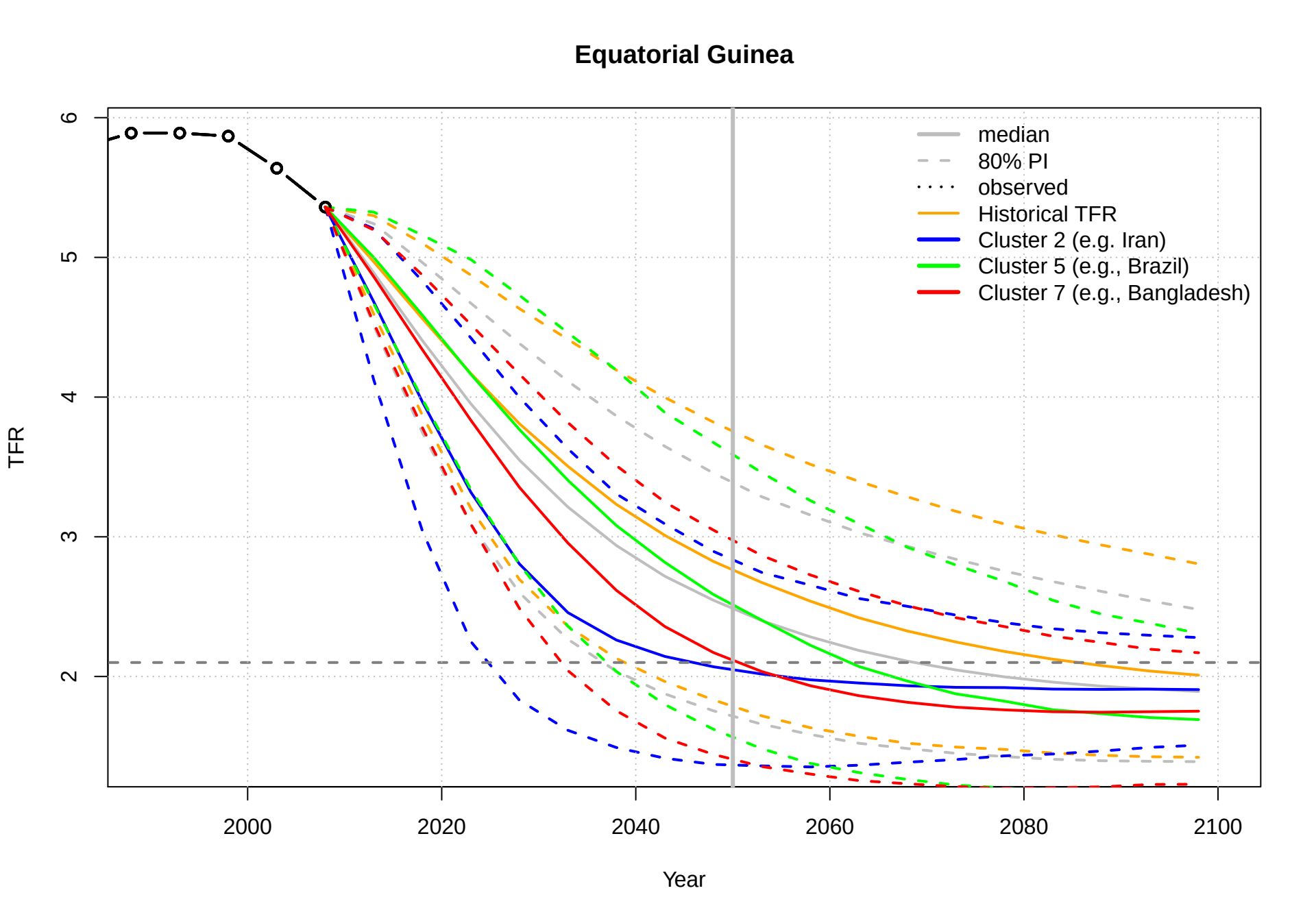

Comoros
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
2000
2020
2040
2060
2080
2100
Year

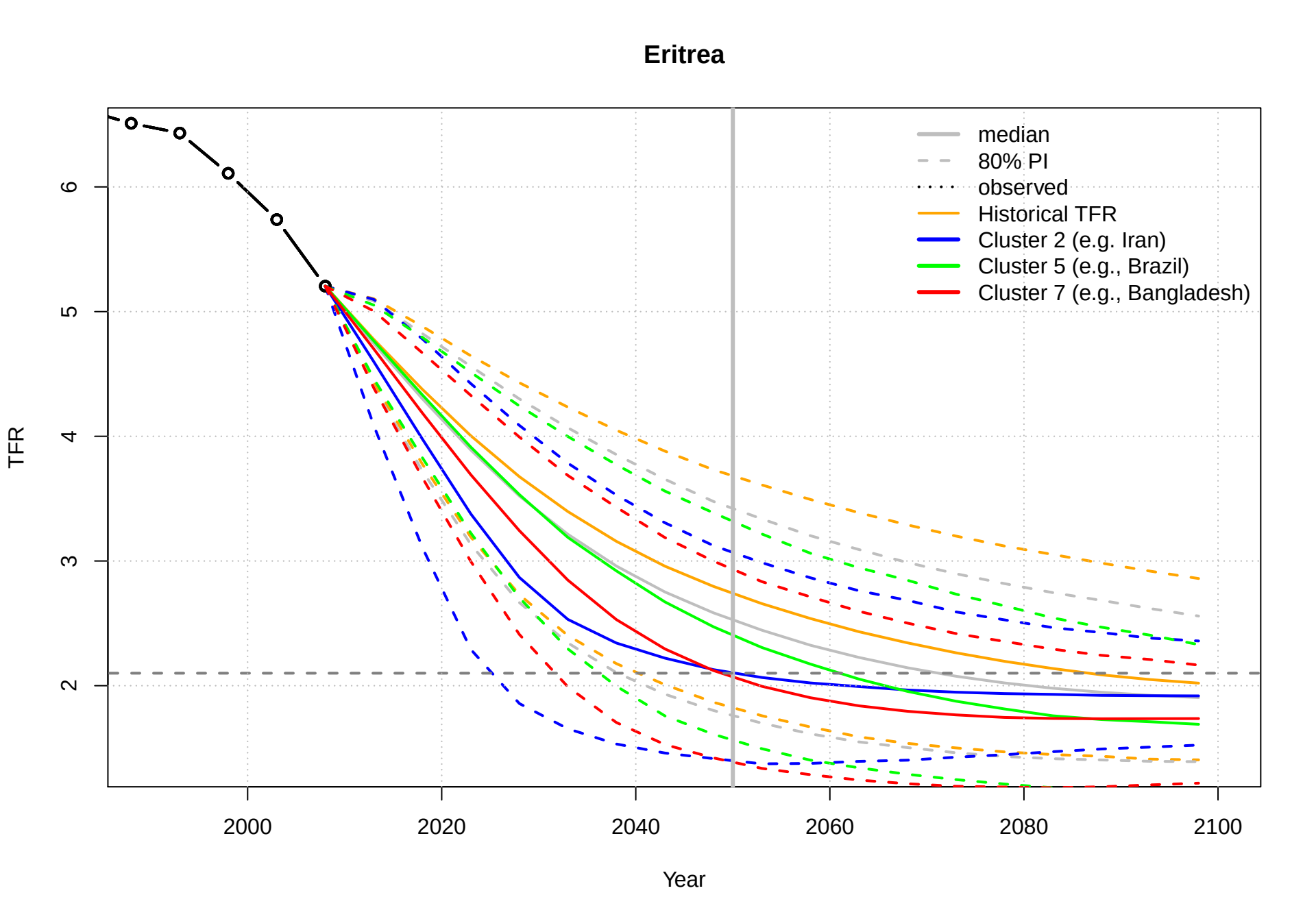

Congo
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
5
4
3
2
2000
2020
2040
2060
2080
2100
Year

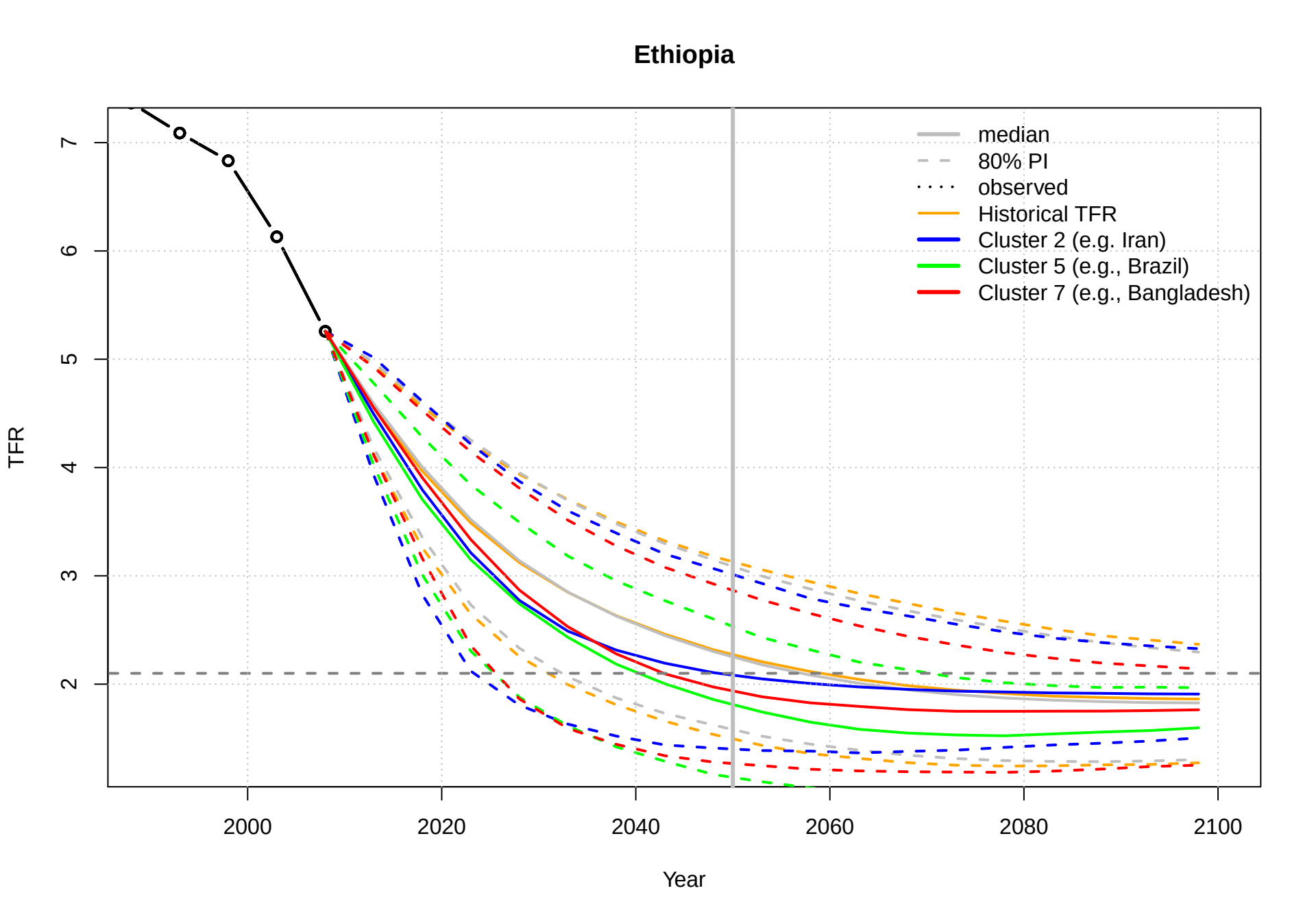

Cote d'Ivoire
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
6
2000
2020
2040
2060
2080
2100

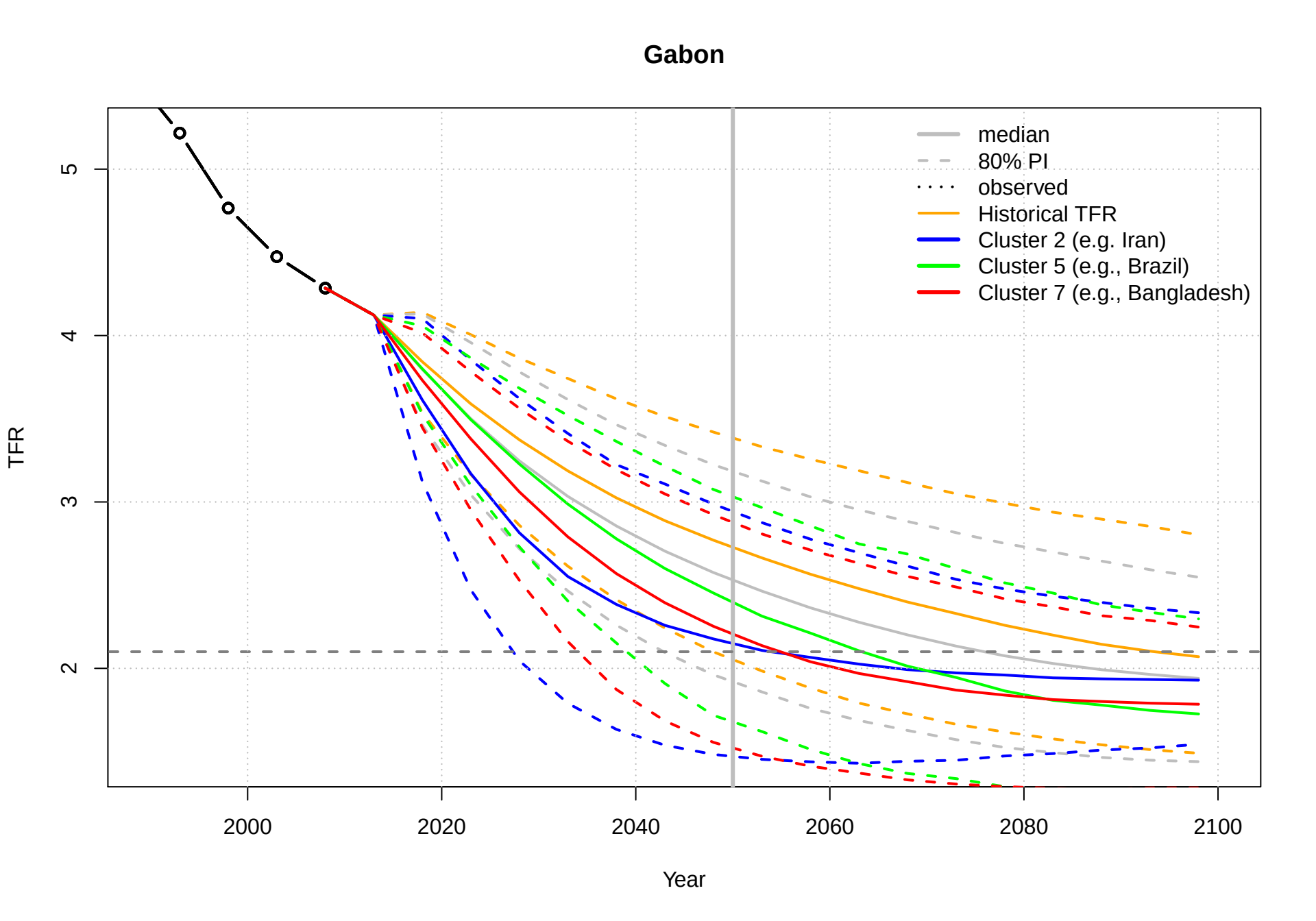

Djibouti
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
6
2000
2020
2040
2060
2080
2100

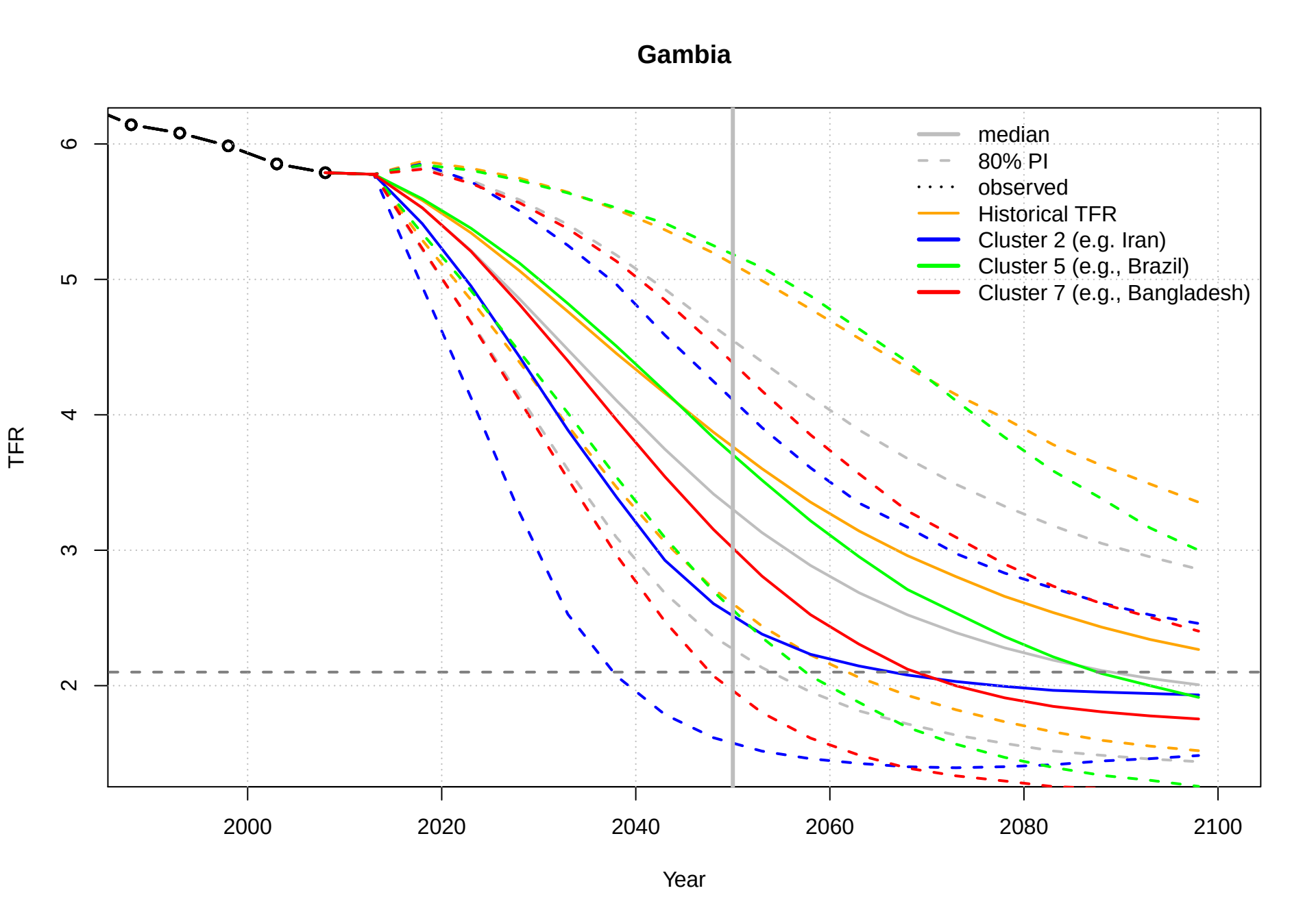

Democratic Republic of the Congo
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100
Year

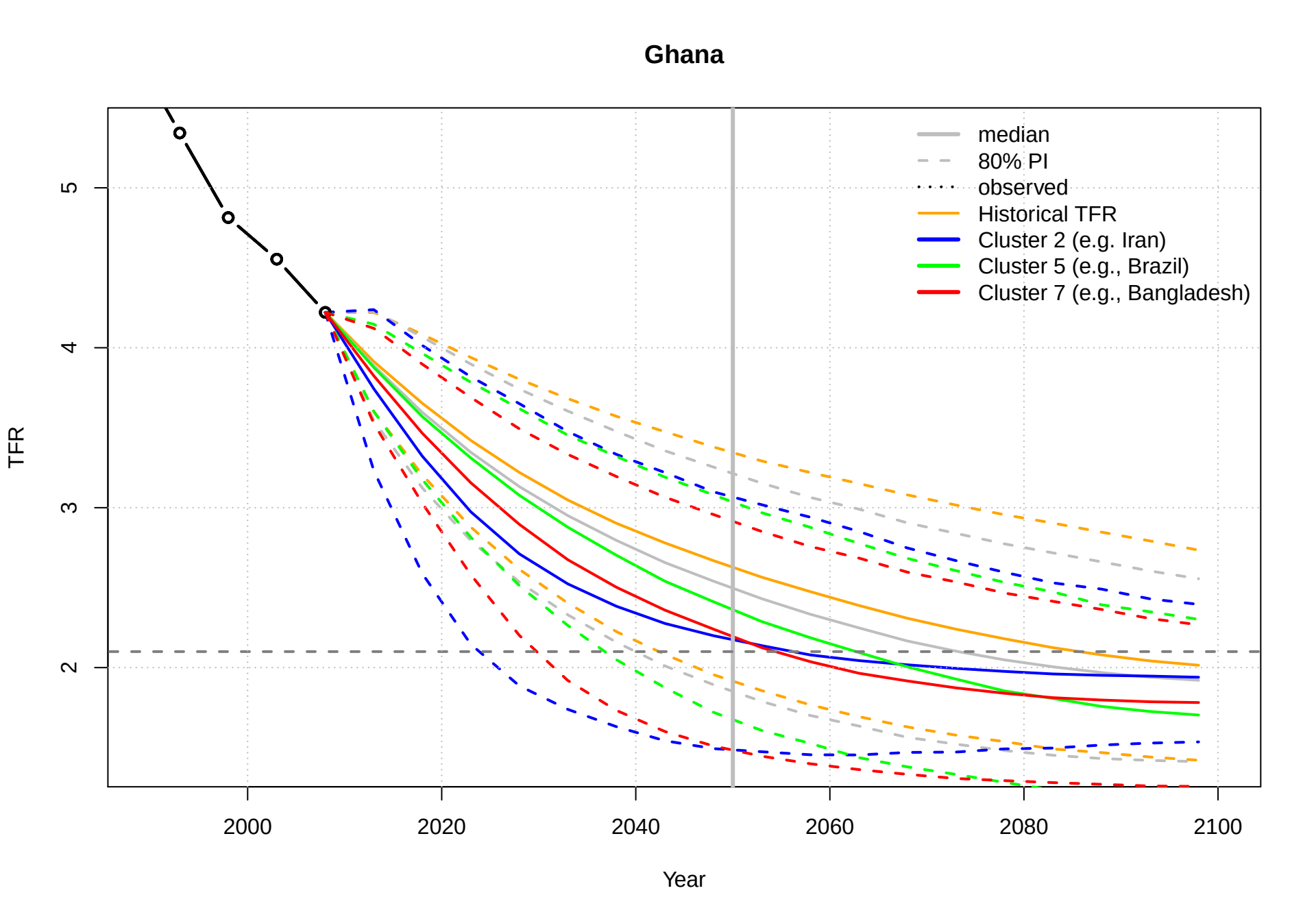

Equatorial Guinea
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
6
2000
2020
2040
2060
2080
2100

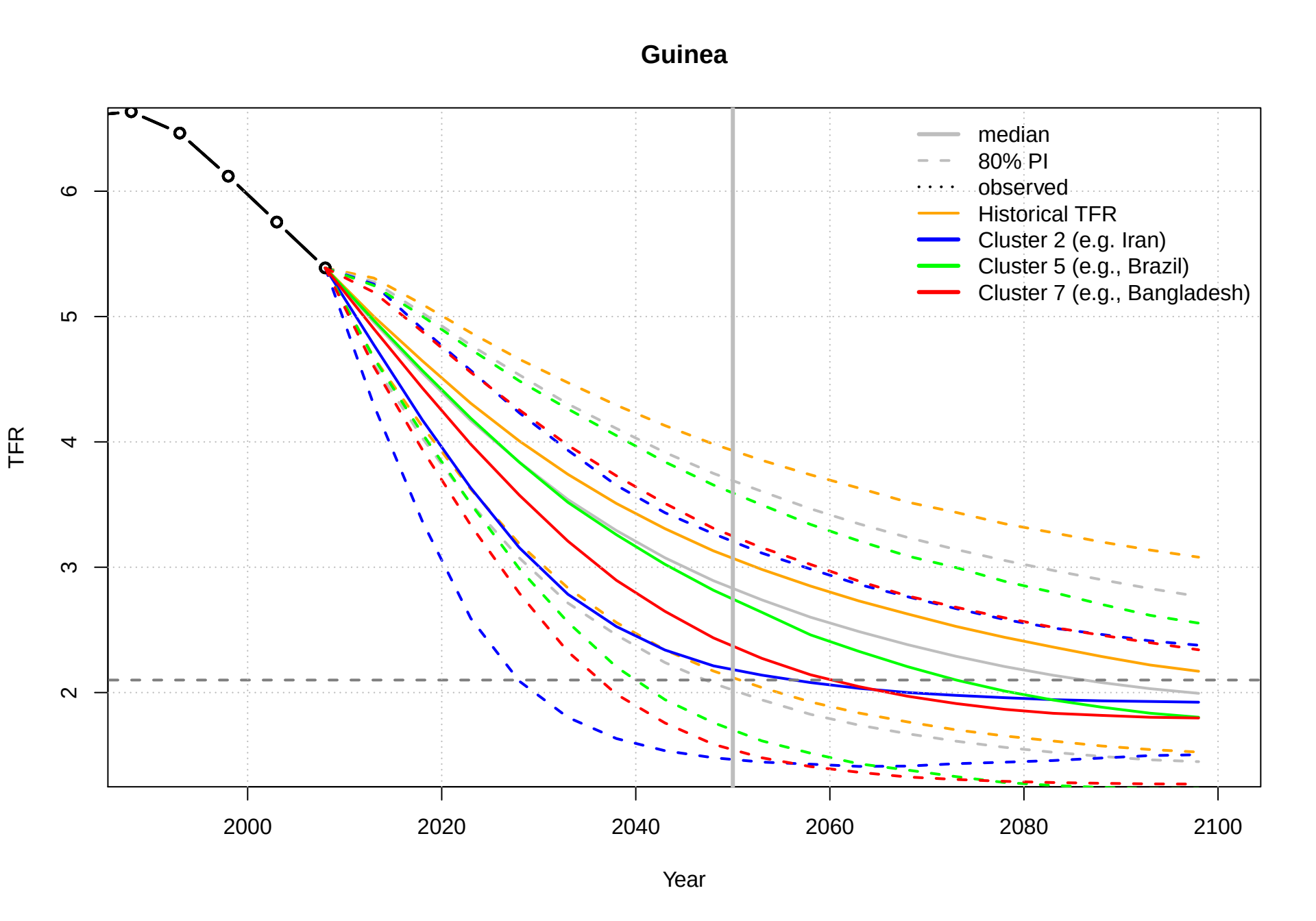

Eritrea
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

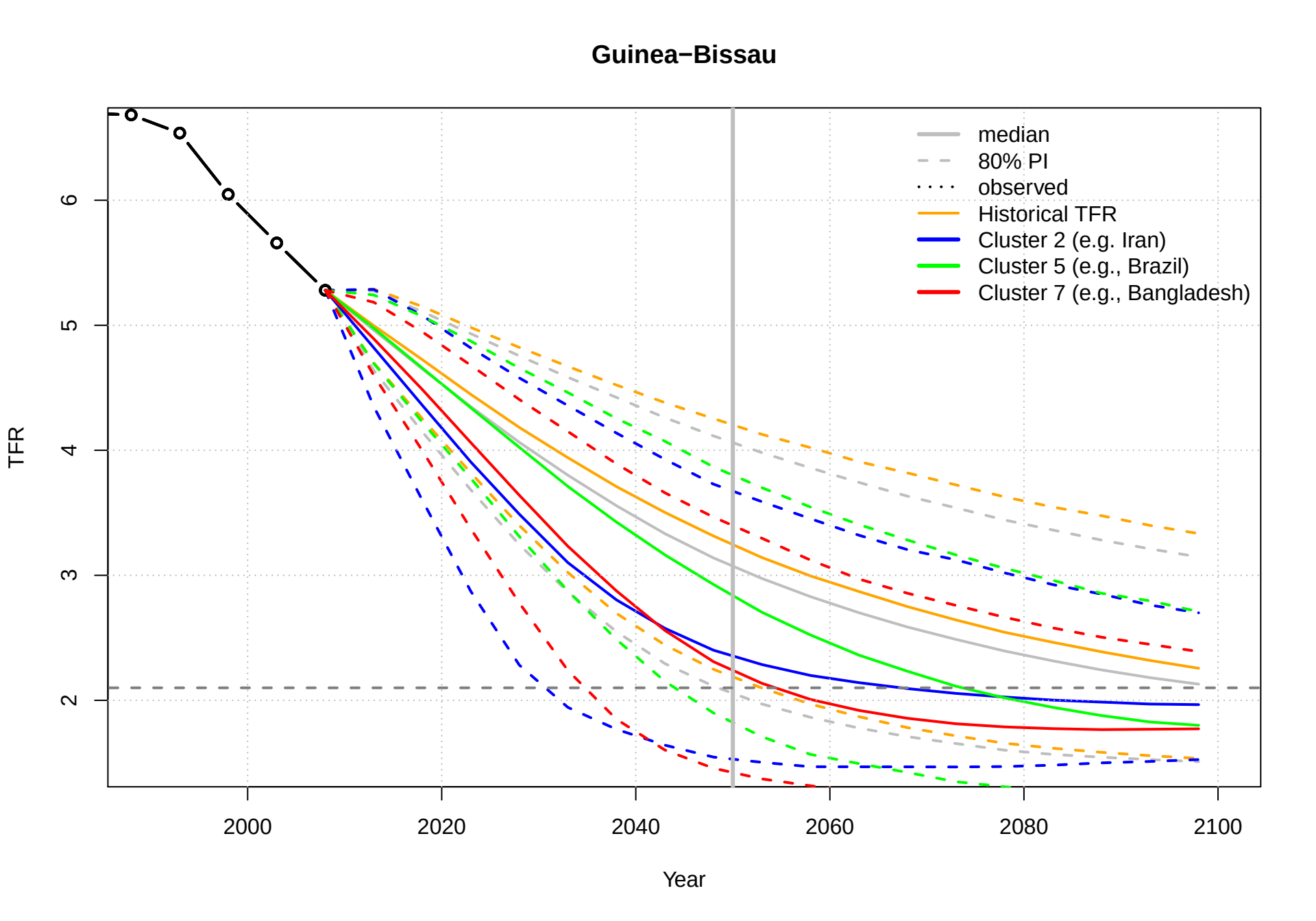

Ethiopia
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100
Year

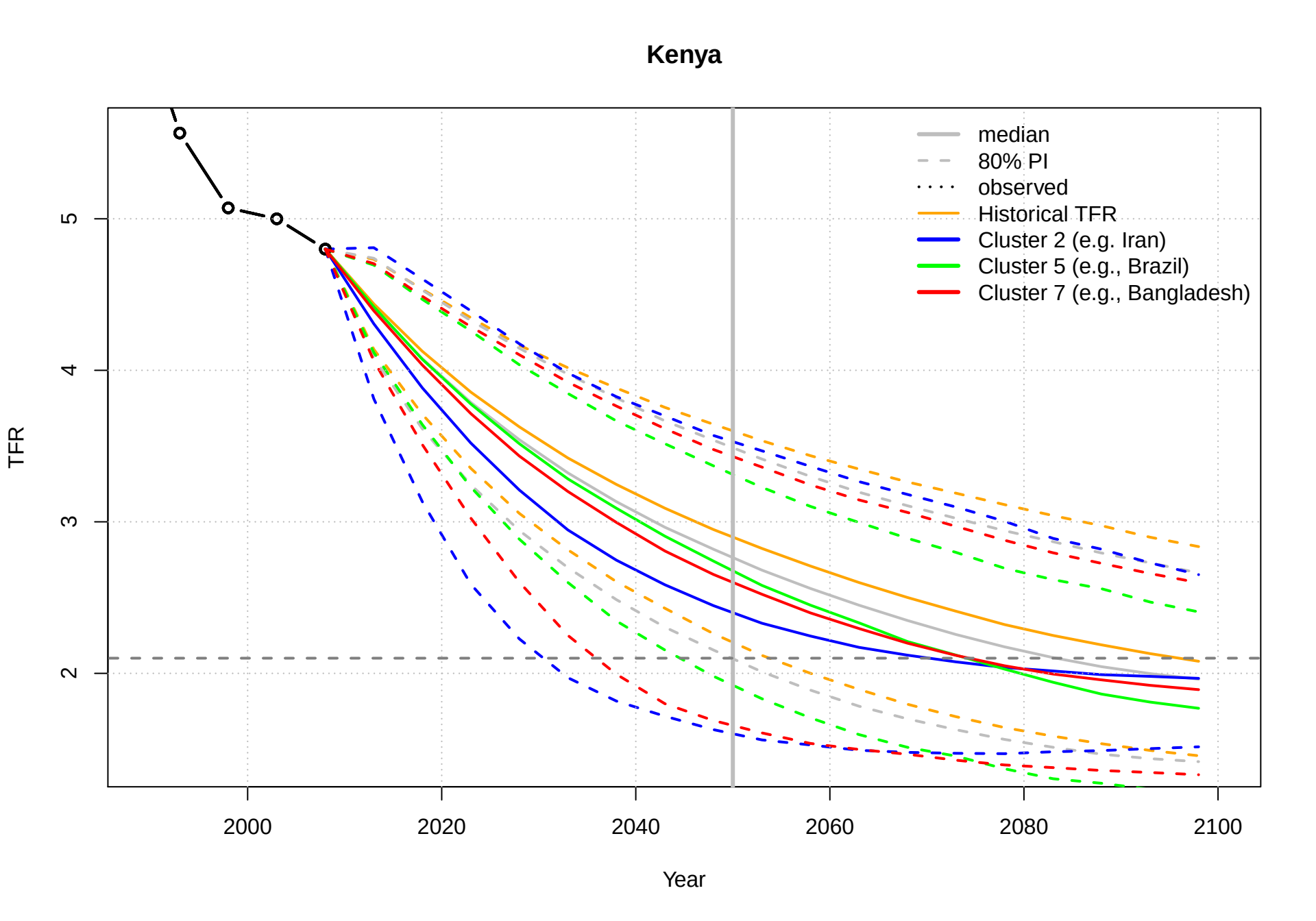

Gabon
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
5
4
3
2
2000
2020
2040
2060
2080
2100
Year

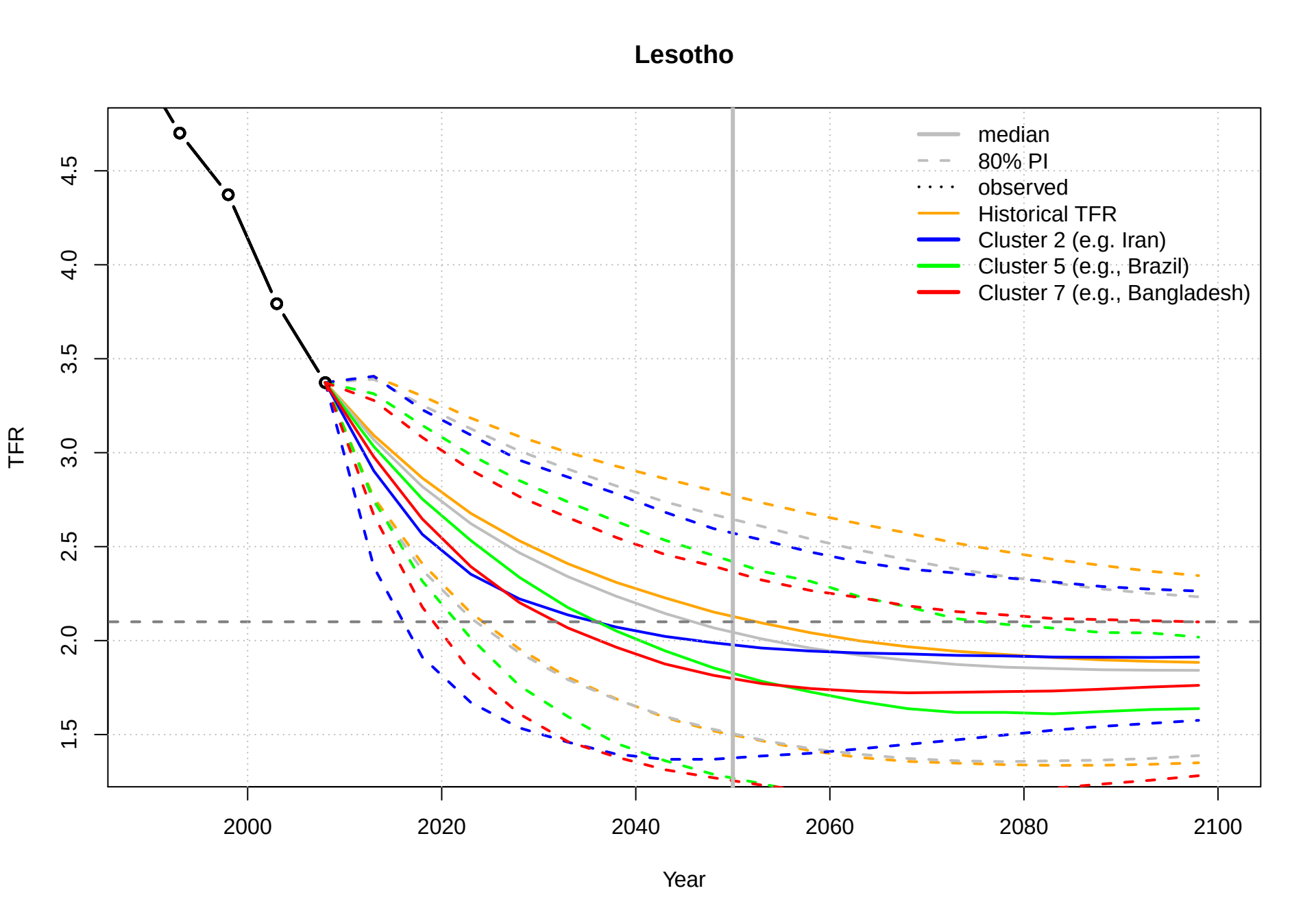

Gambia
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

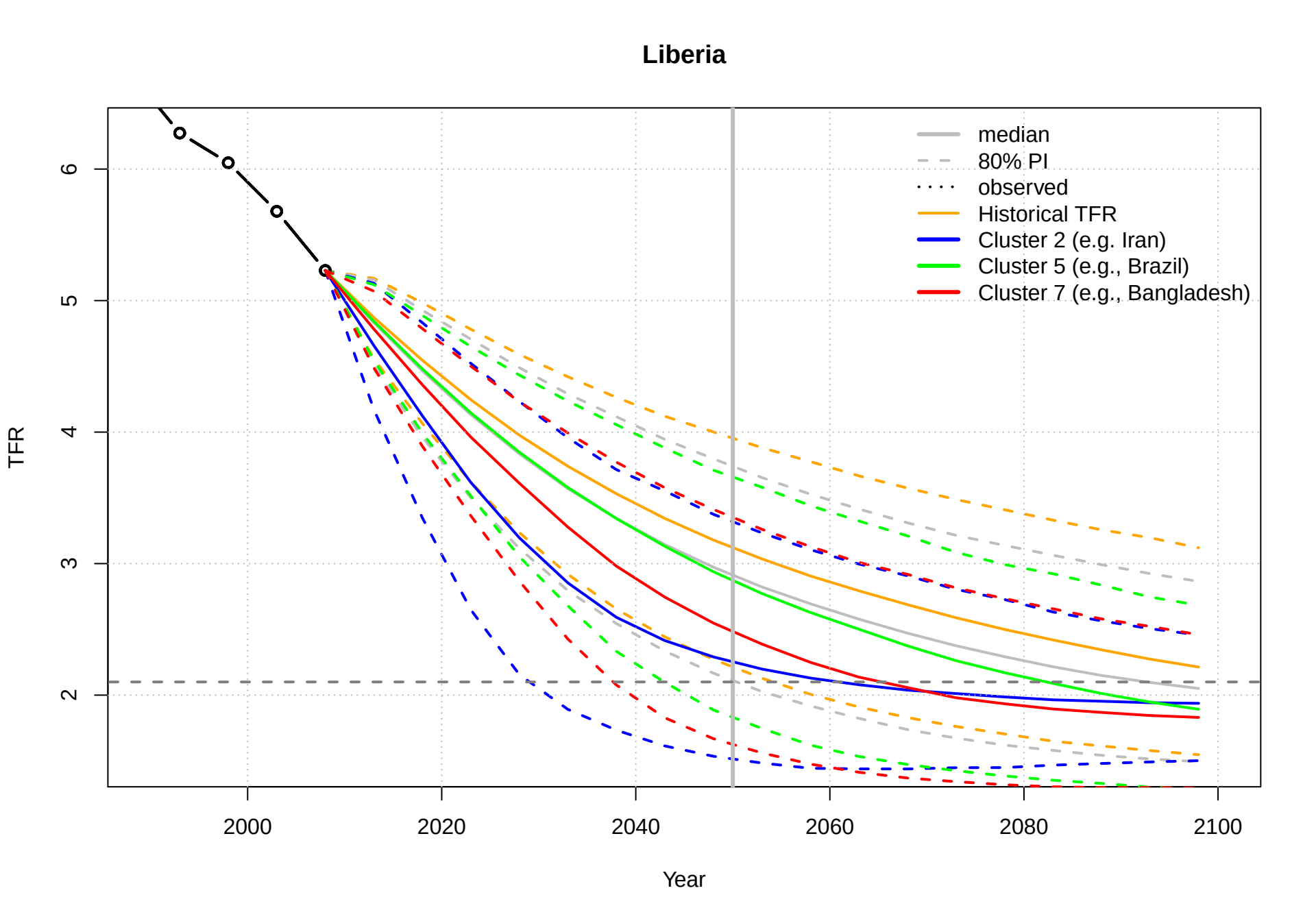

Ghana
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
5
4
3
2
2000
2020
2040
2060
2080
2100
Year

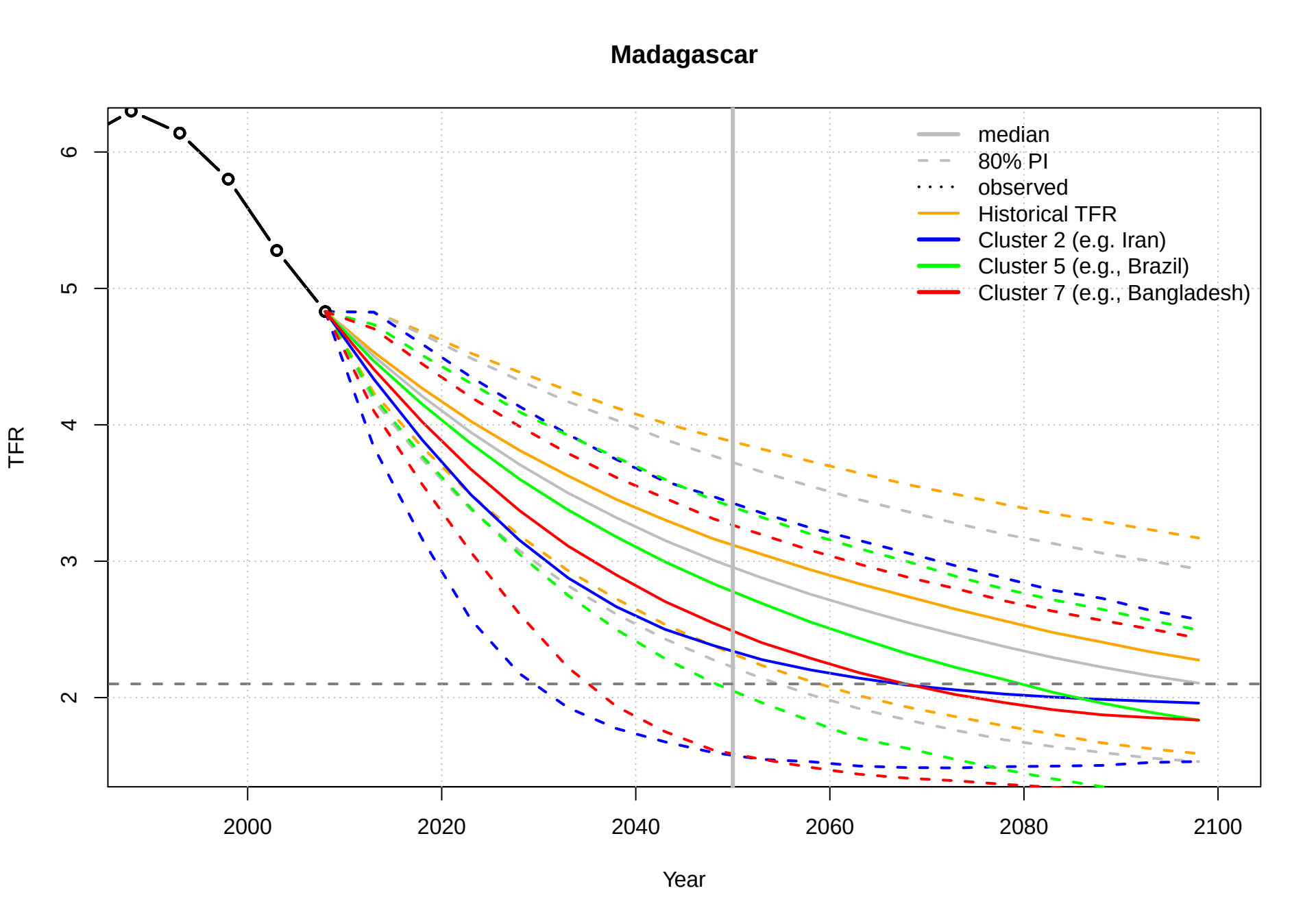

Guinea
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

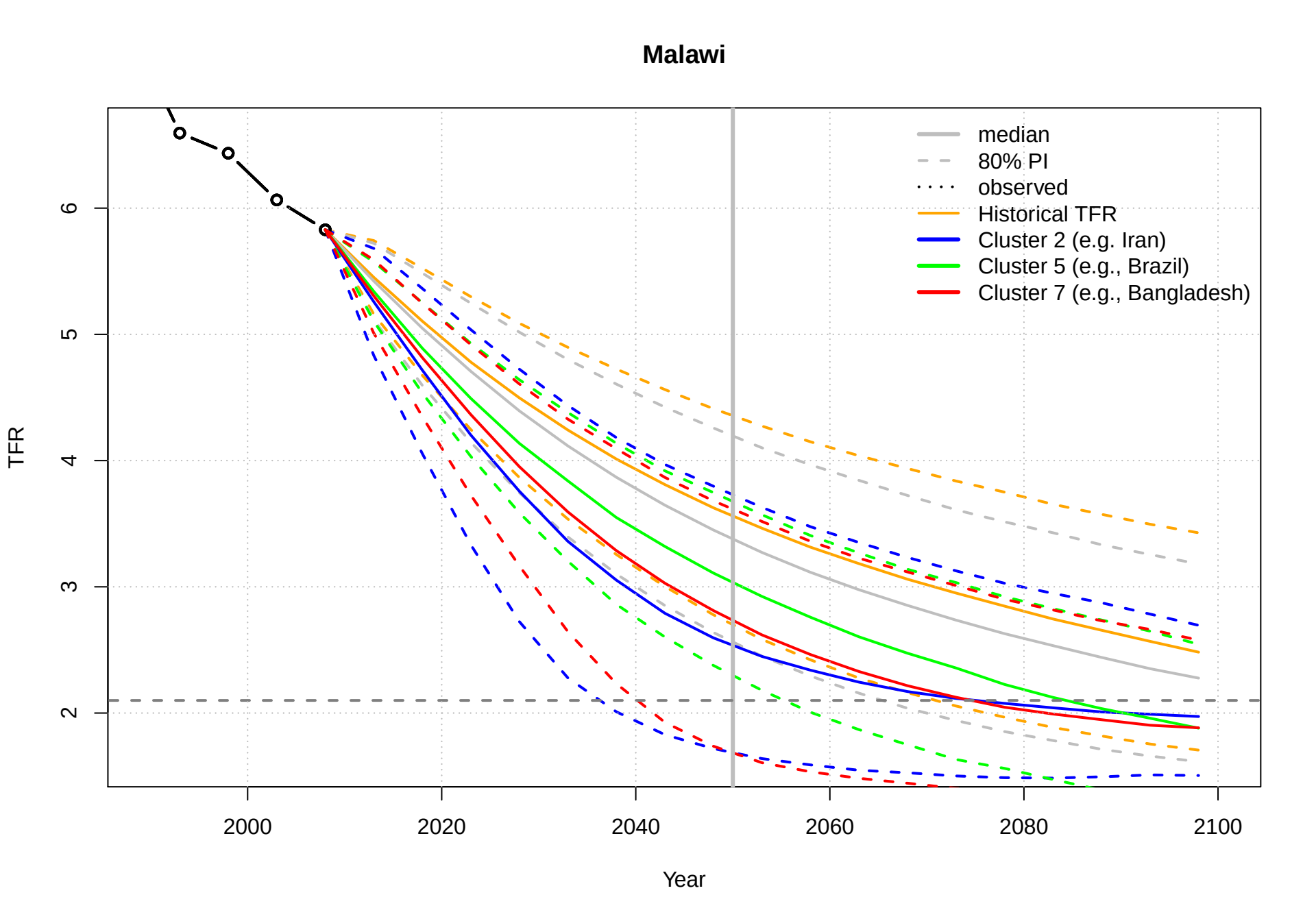

Guinea−Bissau
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

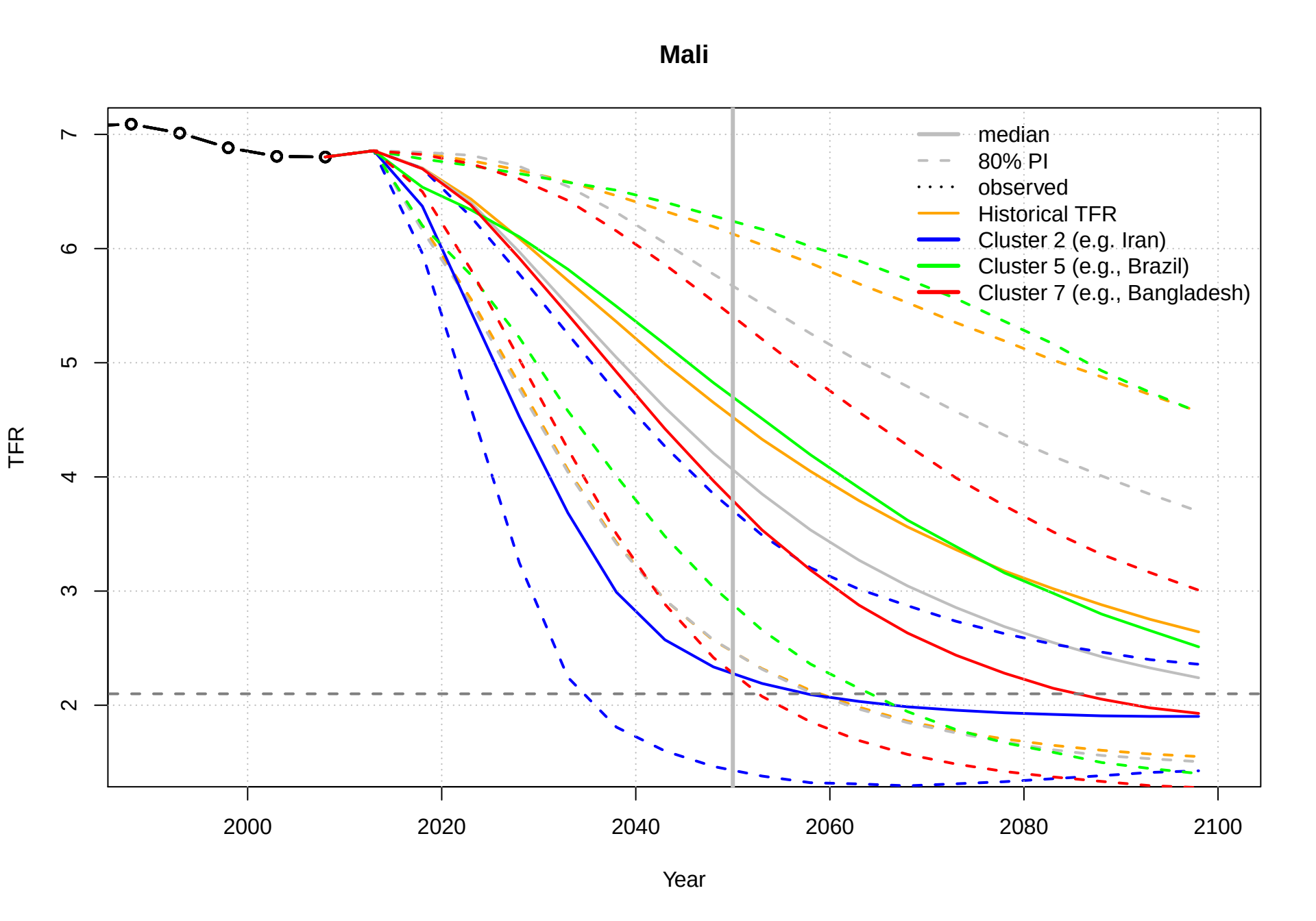

Kenya
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
5
4
3
2
2000
2020
2040
2060
2080
2100
Year

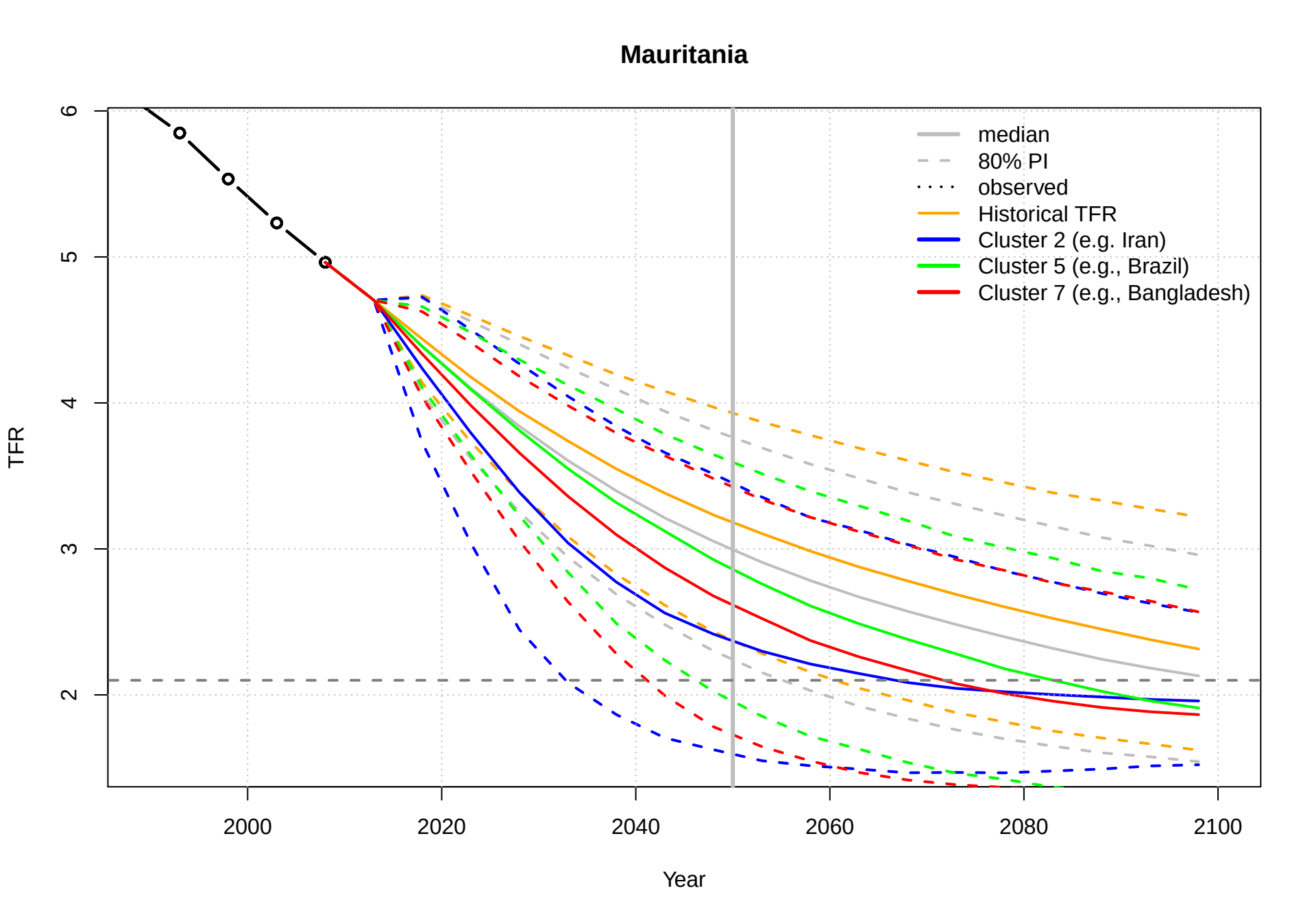

Lesotho
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
1.5
2.0
2.5
3.0
3.5
4.0
4.5
2000
2020
2040
2060
2080
2100
Year

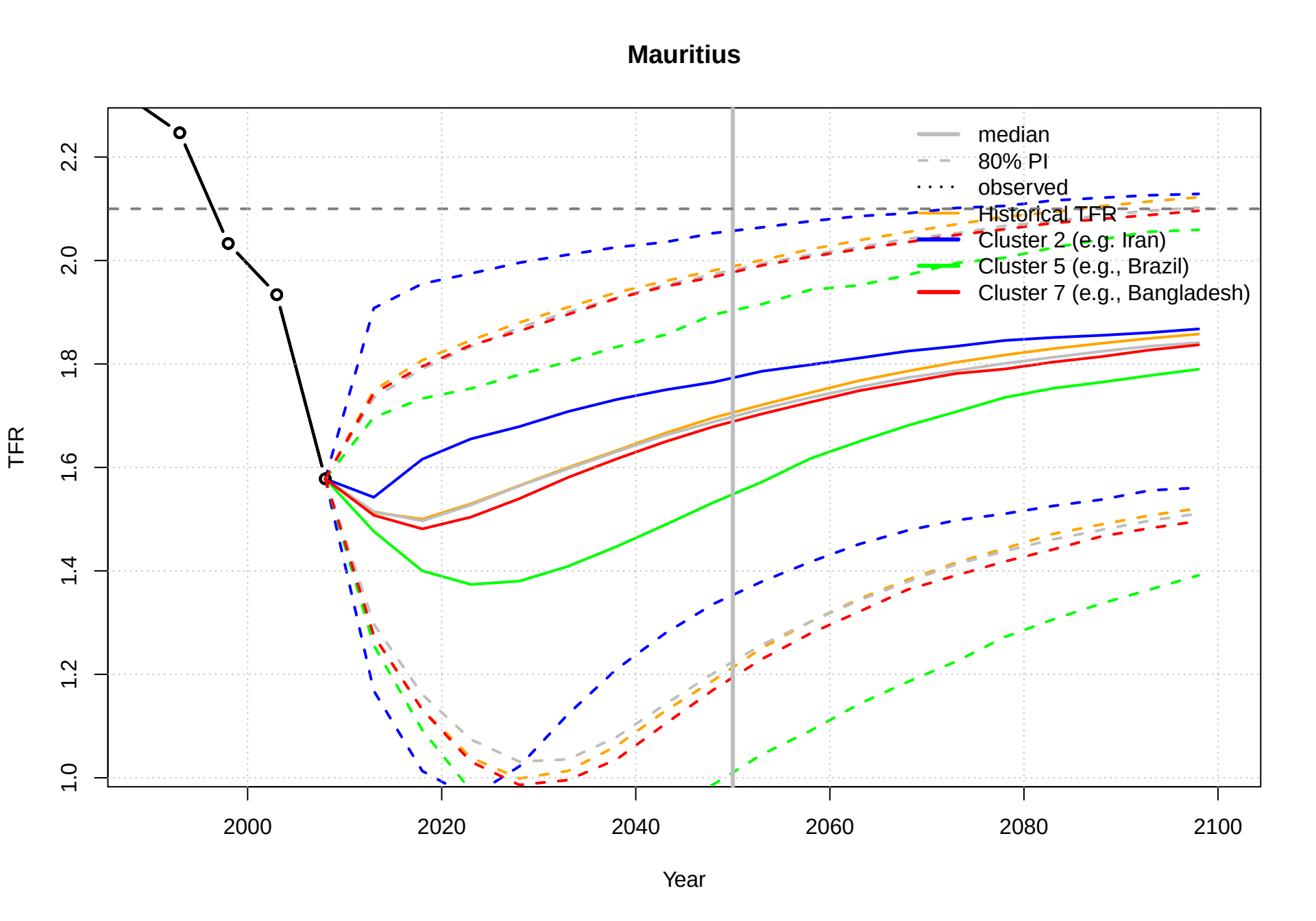

Liberia
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

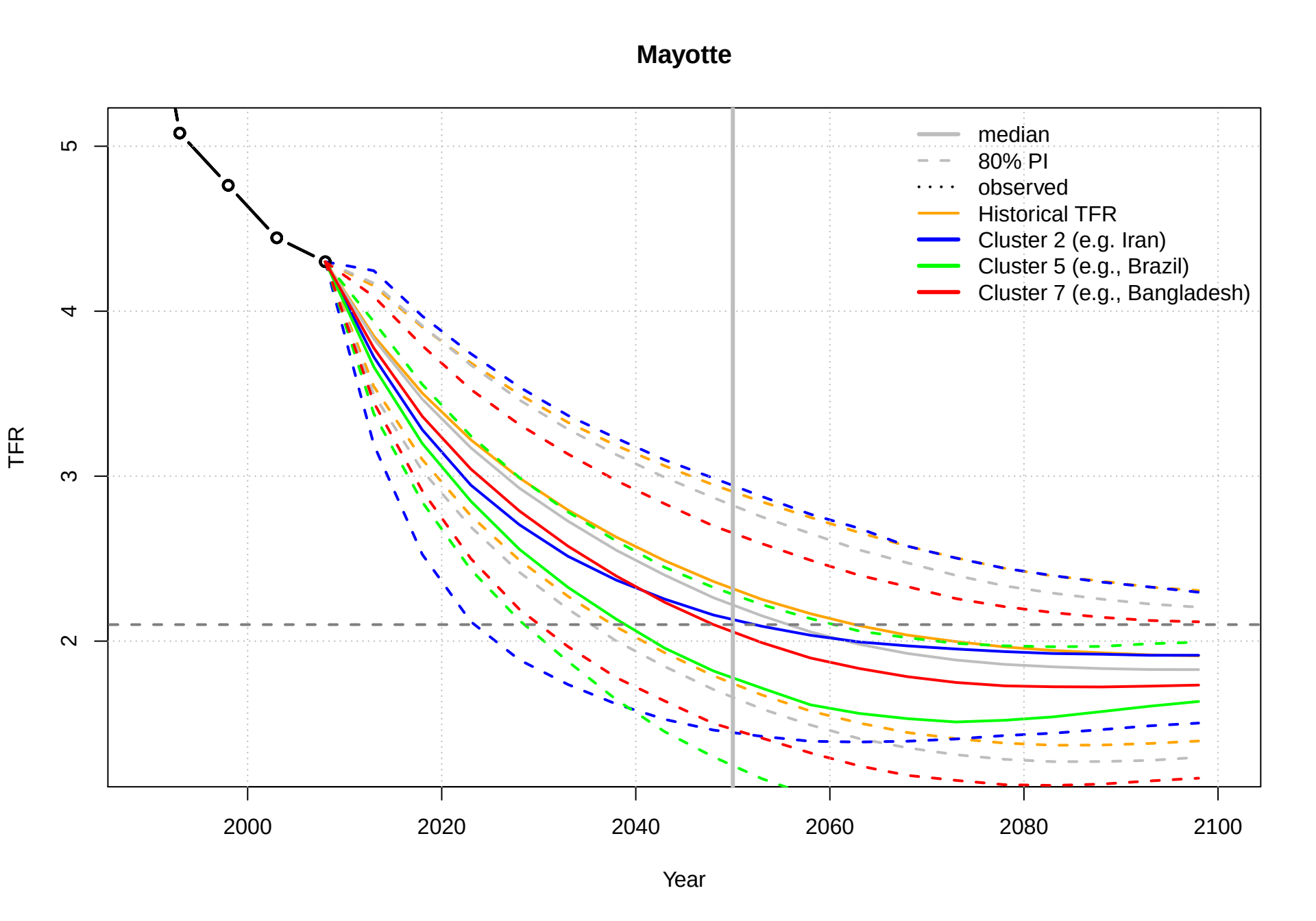

Madagascar
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

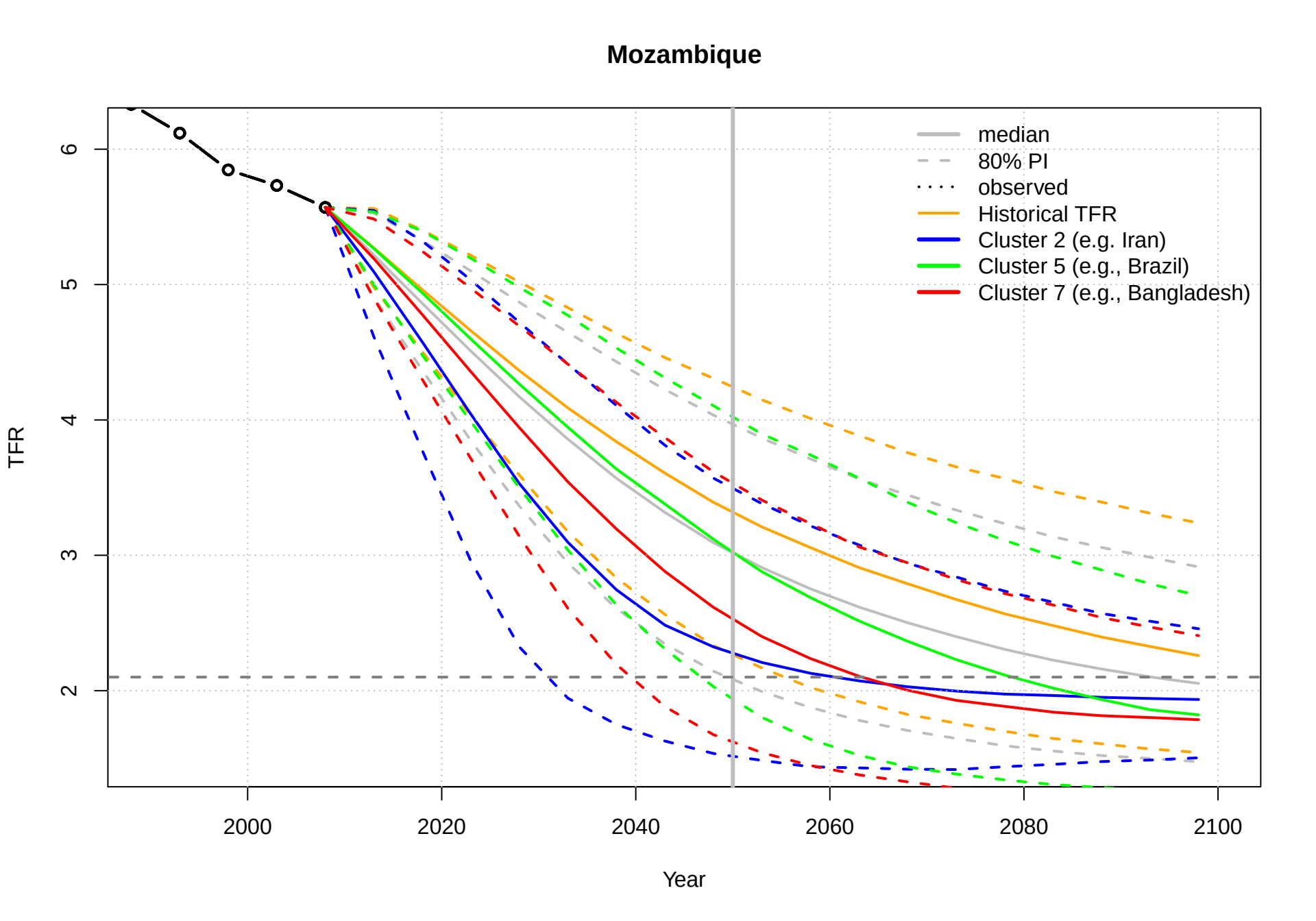

Malawi
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

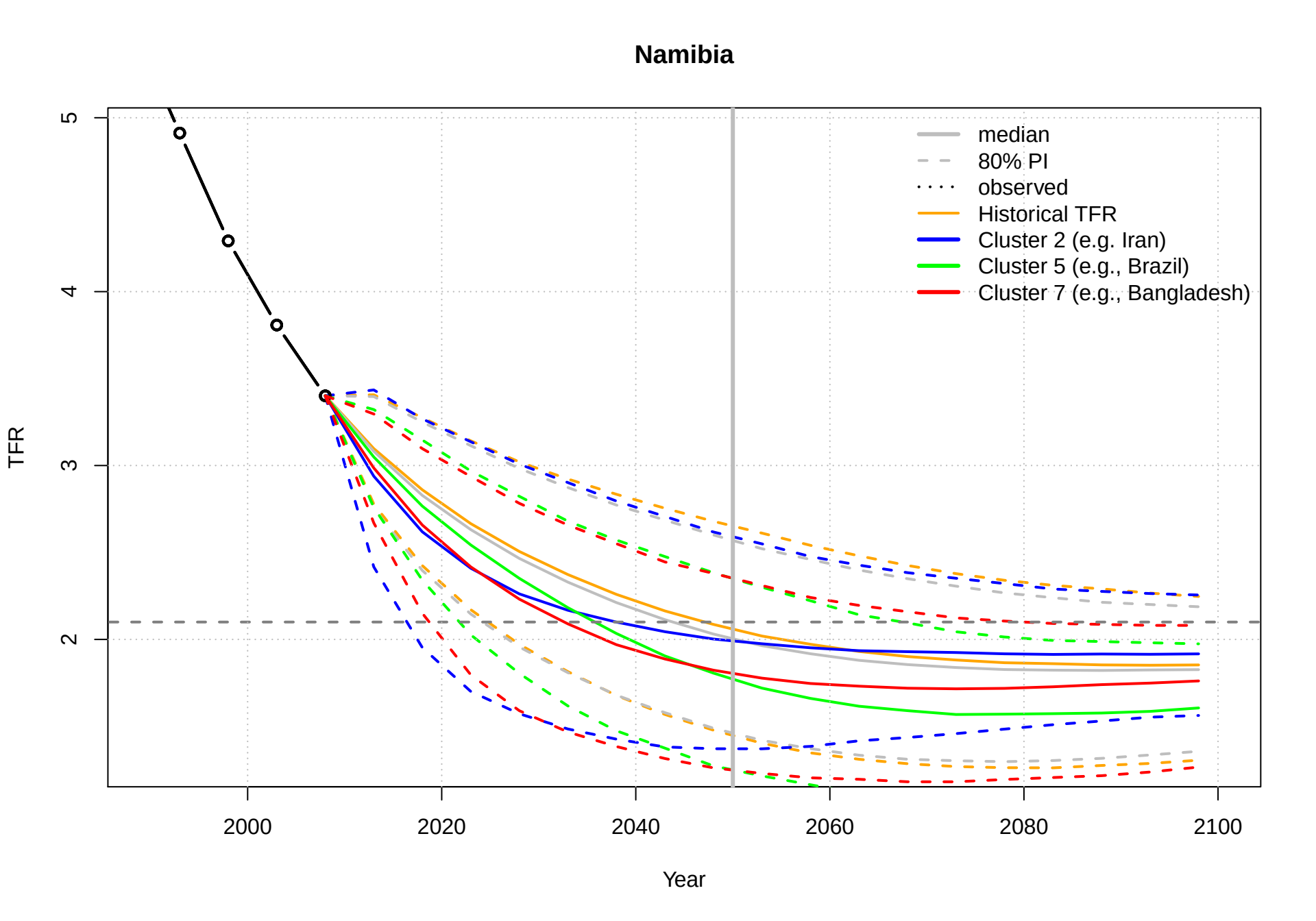

Mali
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100

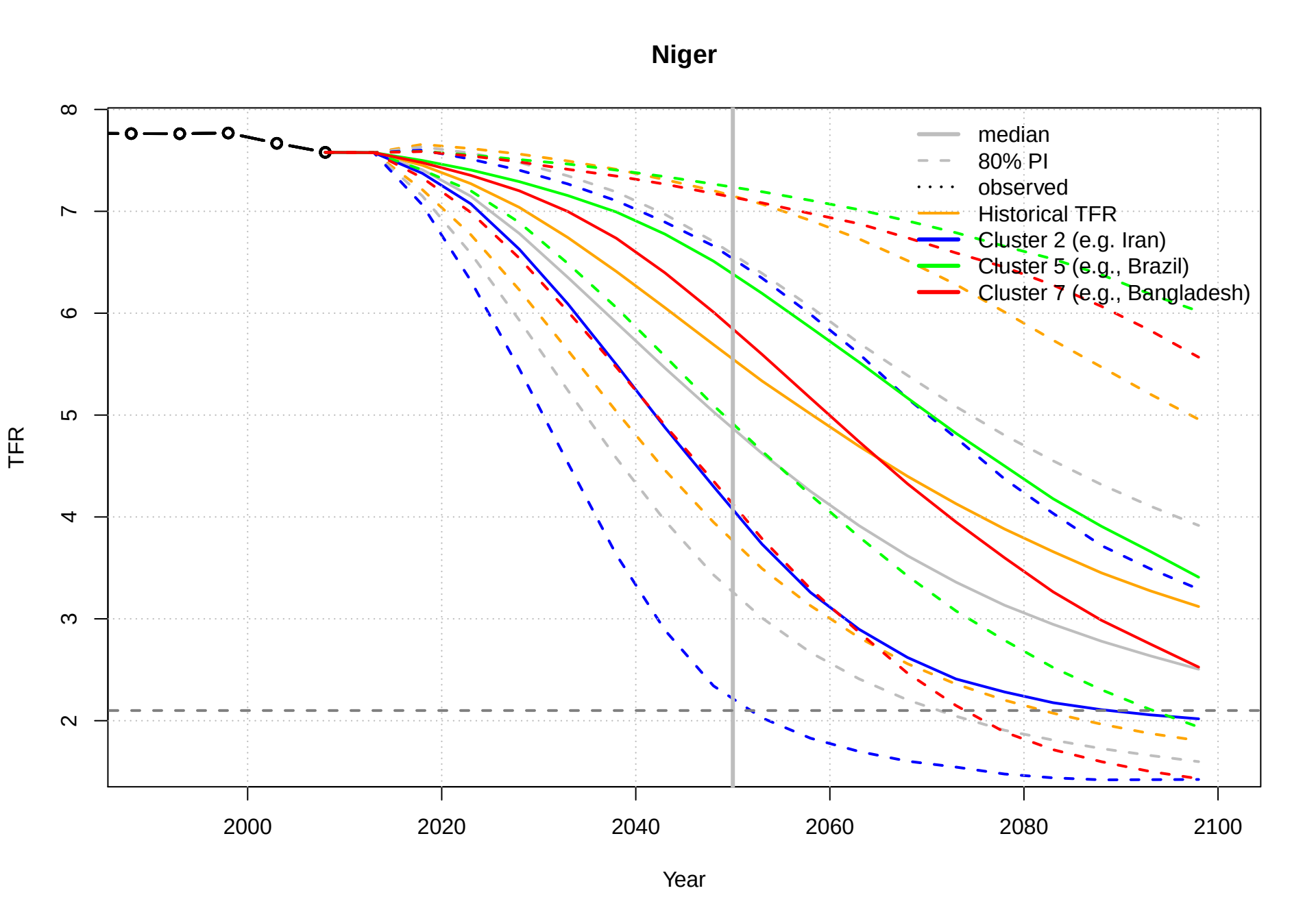

Mauritania
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
6
2000
2020
2040
2060
2080
2100

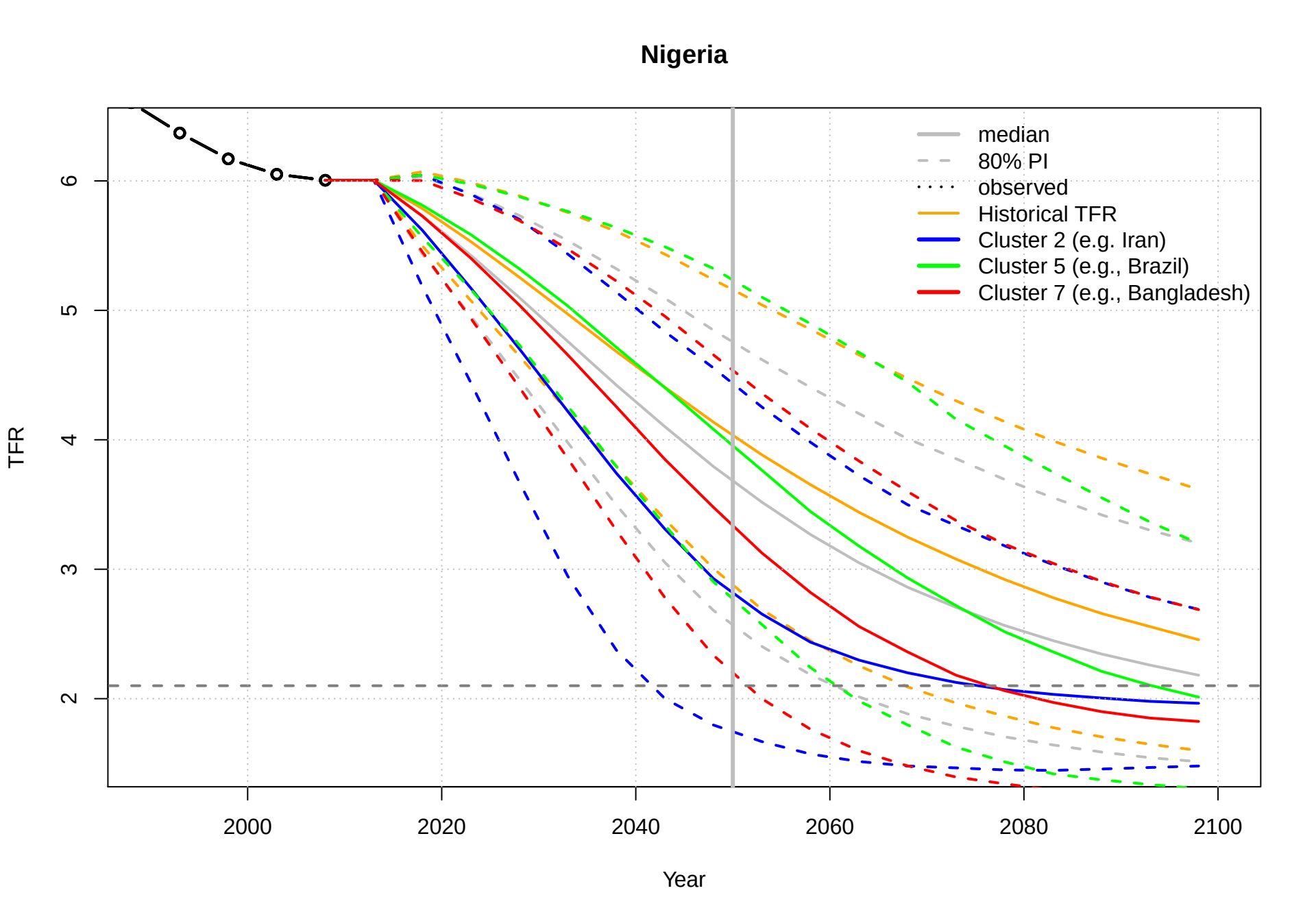

Mauritius
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2000
2020
2040
2060
2080
2100
Year

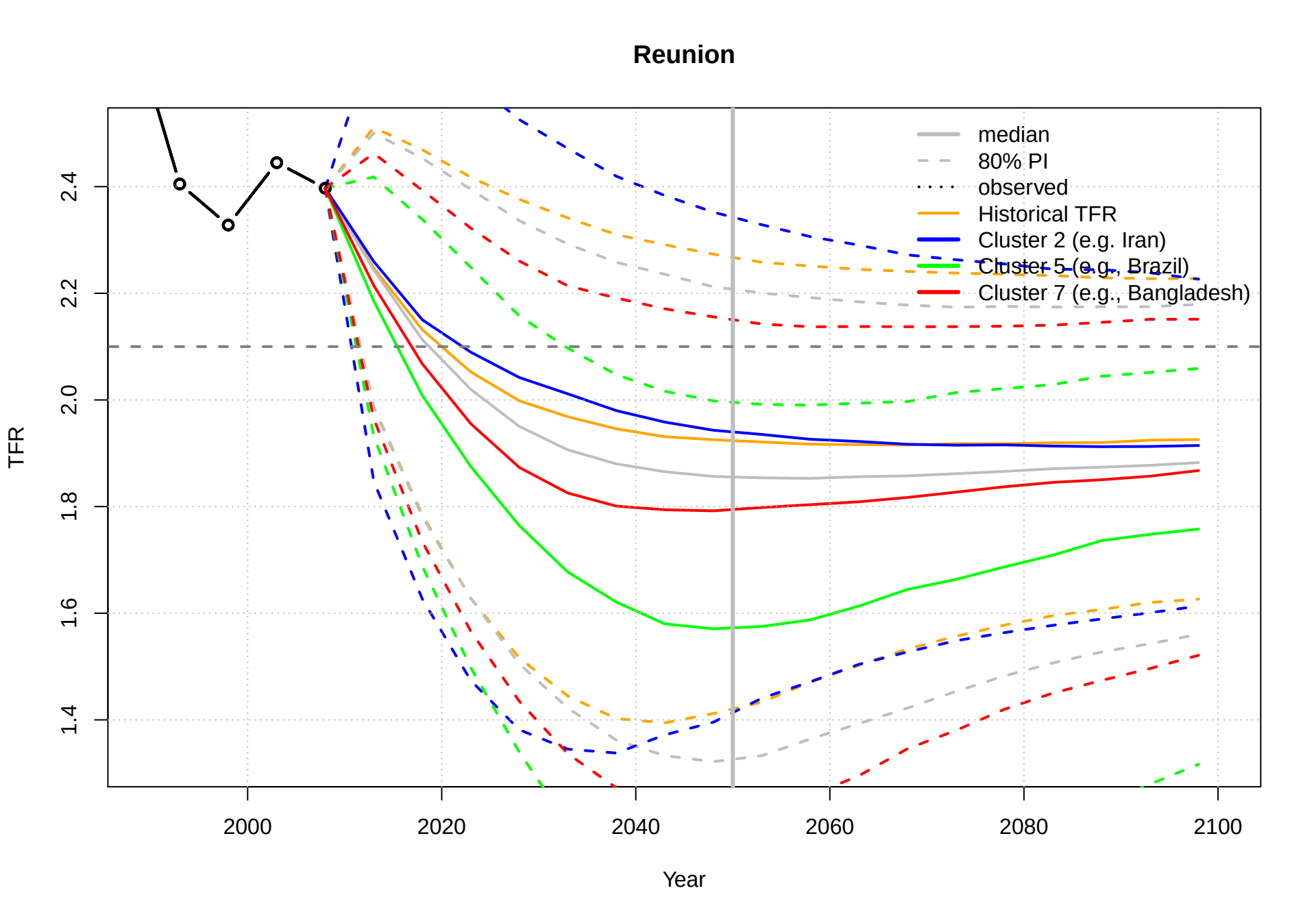

Mayotte
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
2000
2020
2040
2060
2080
2100

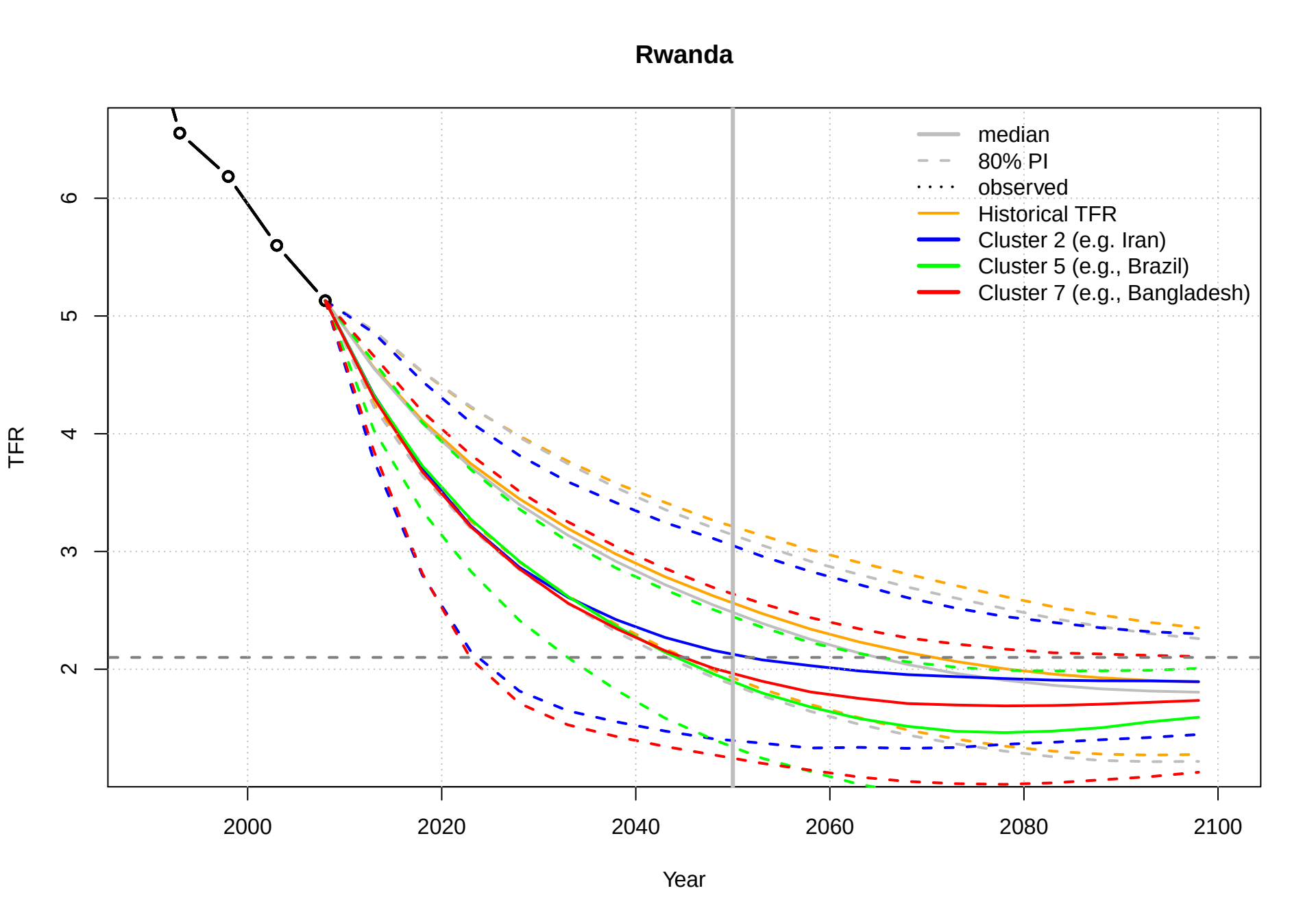

Mozambique
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

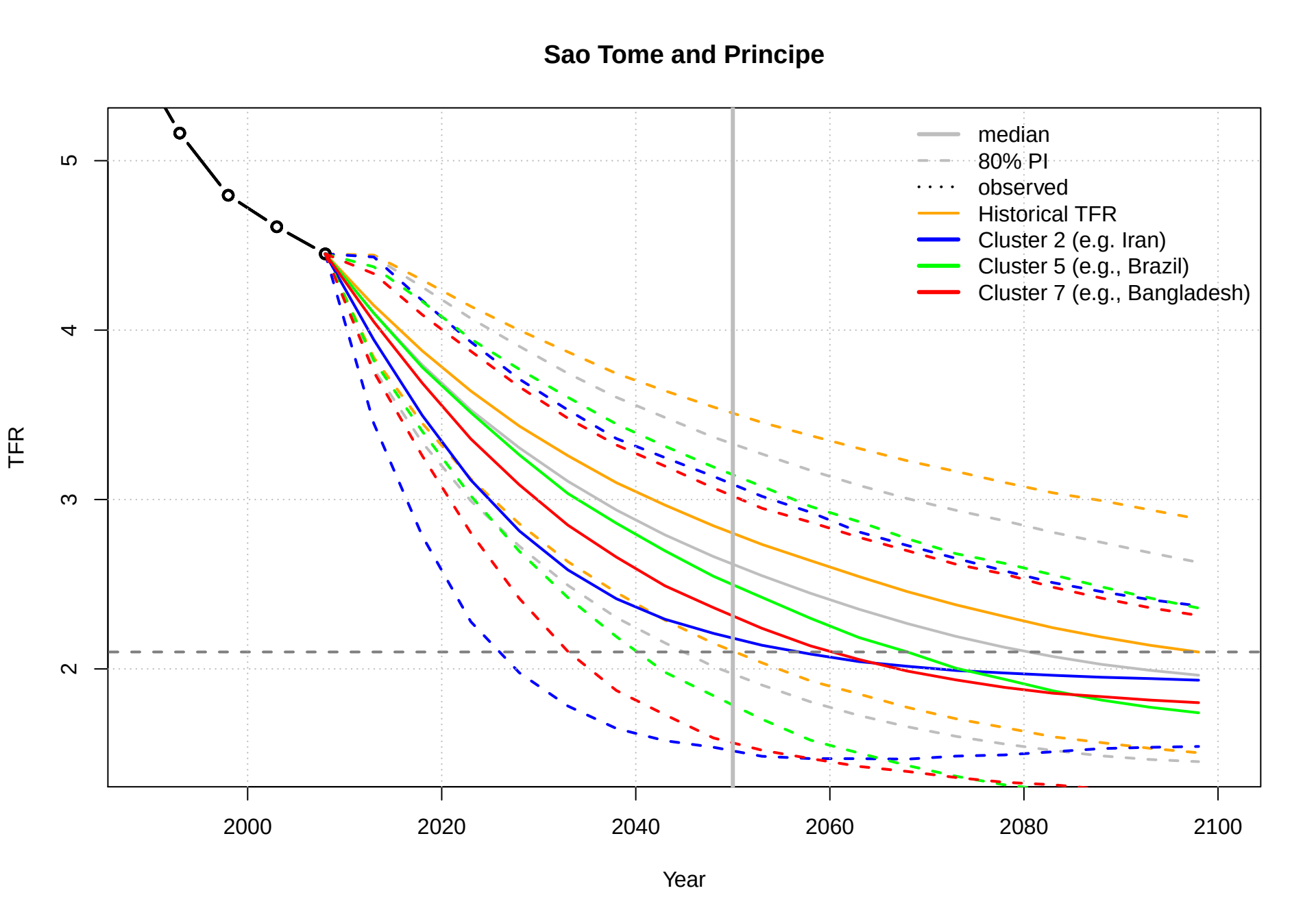

Namibia
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
2000
2020
2040
2060
2080
2100

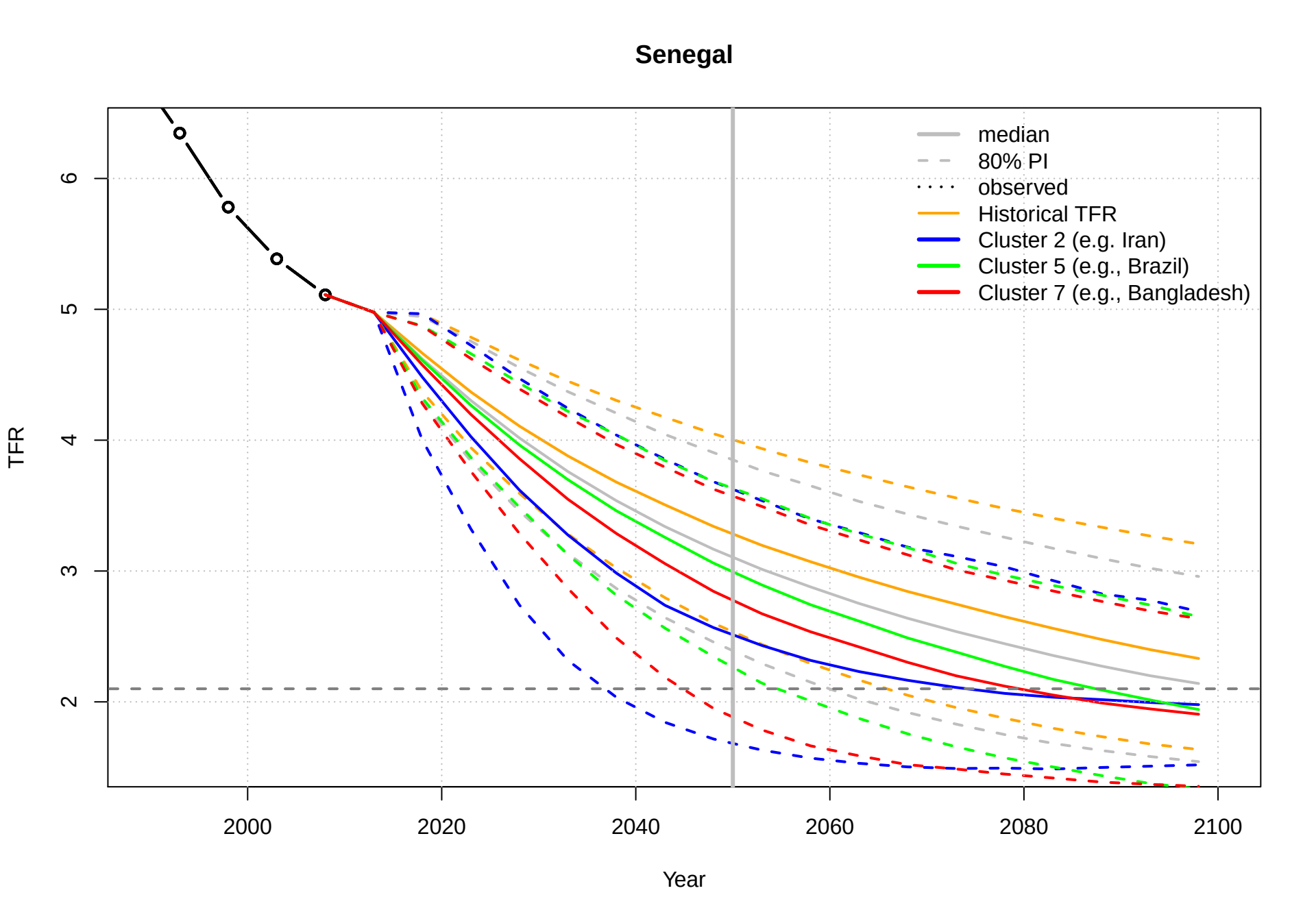

Niger
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
6
7
8
2000
2020
2040
2060
2080
2100

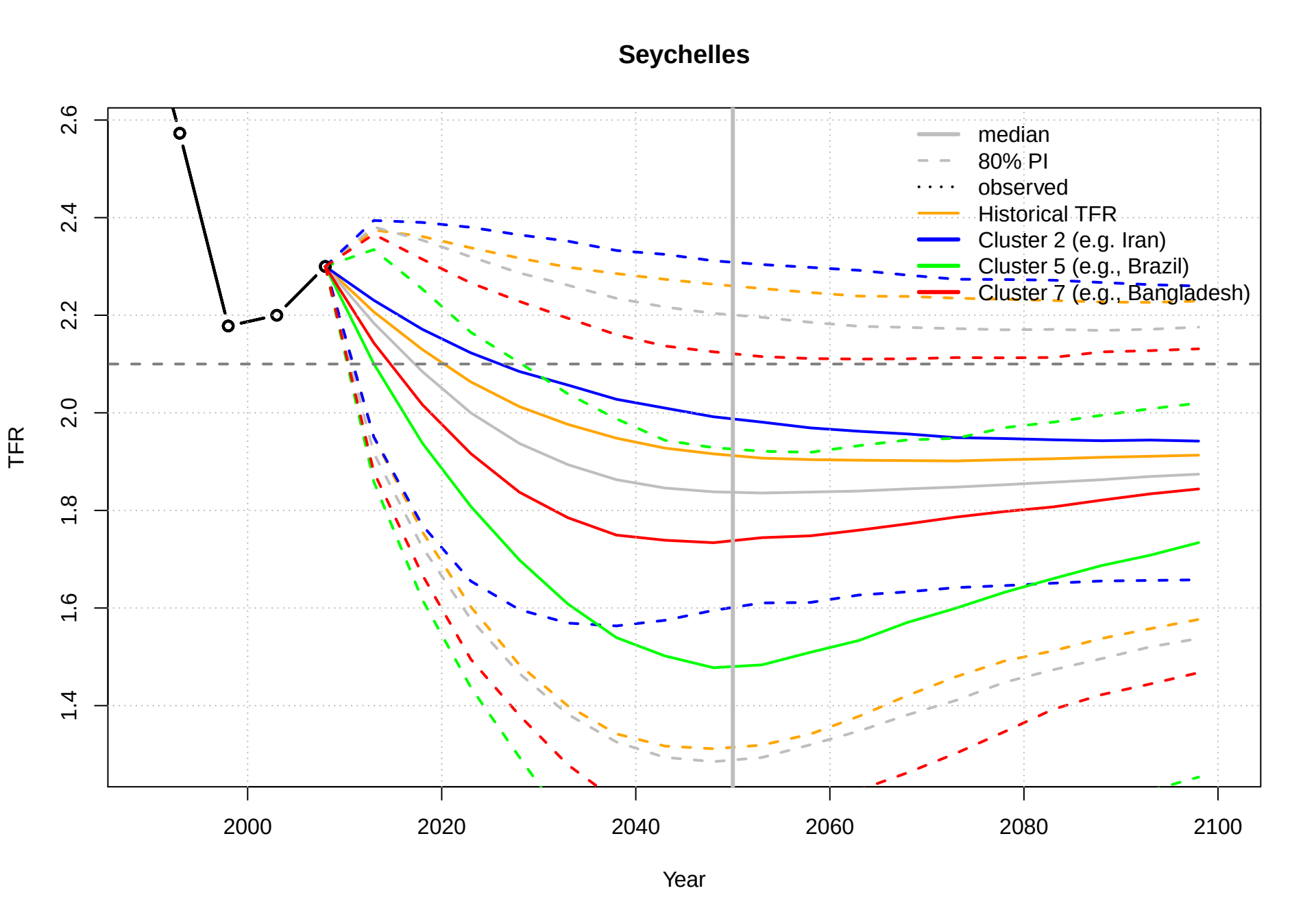

Nigeria
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

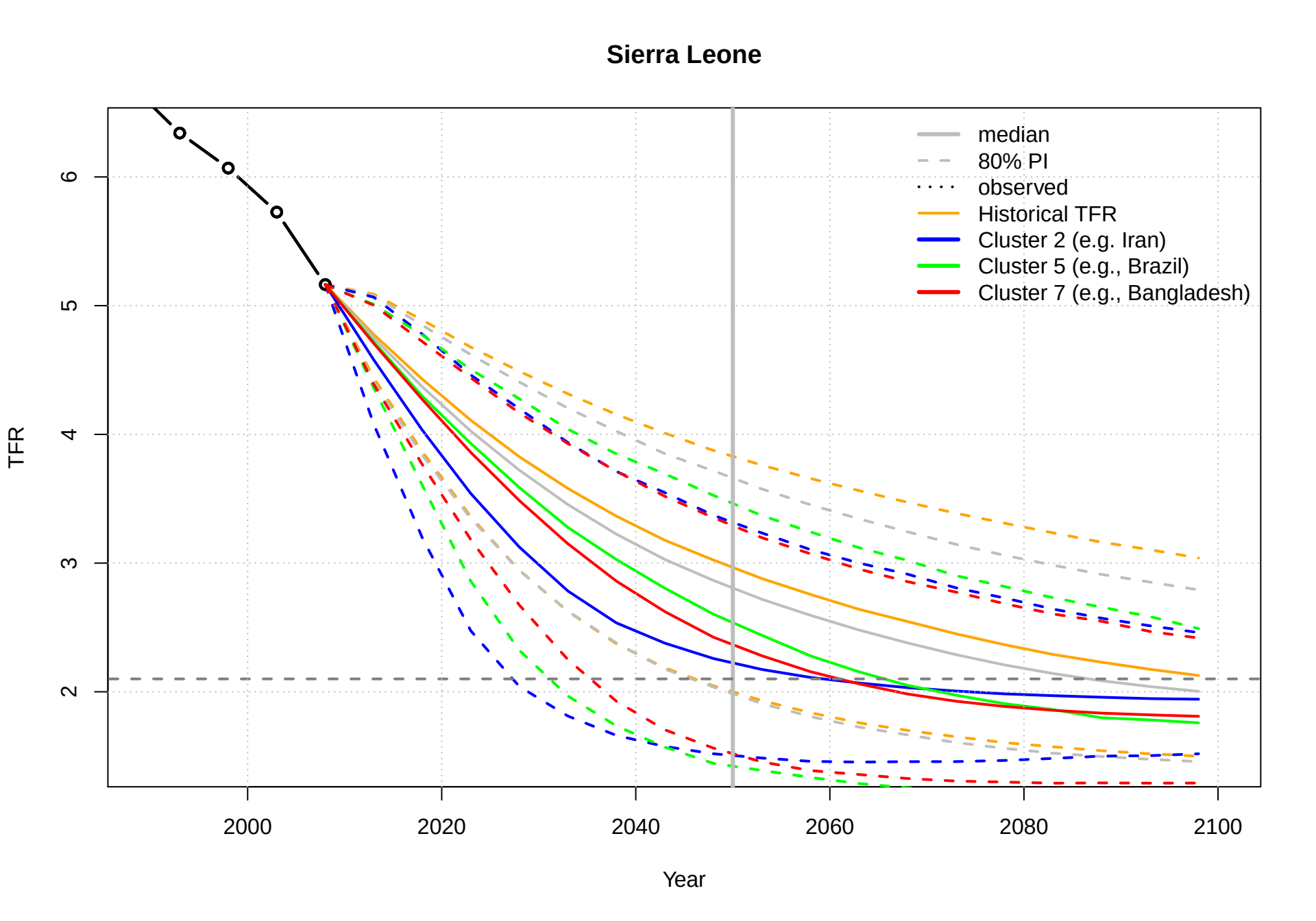

Reunion
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
1.4
1.6
1.8
2.0
2.2
2.4
2000
2020
2040
2060
2080
2100
Year

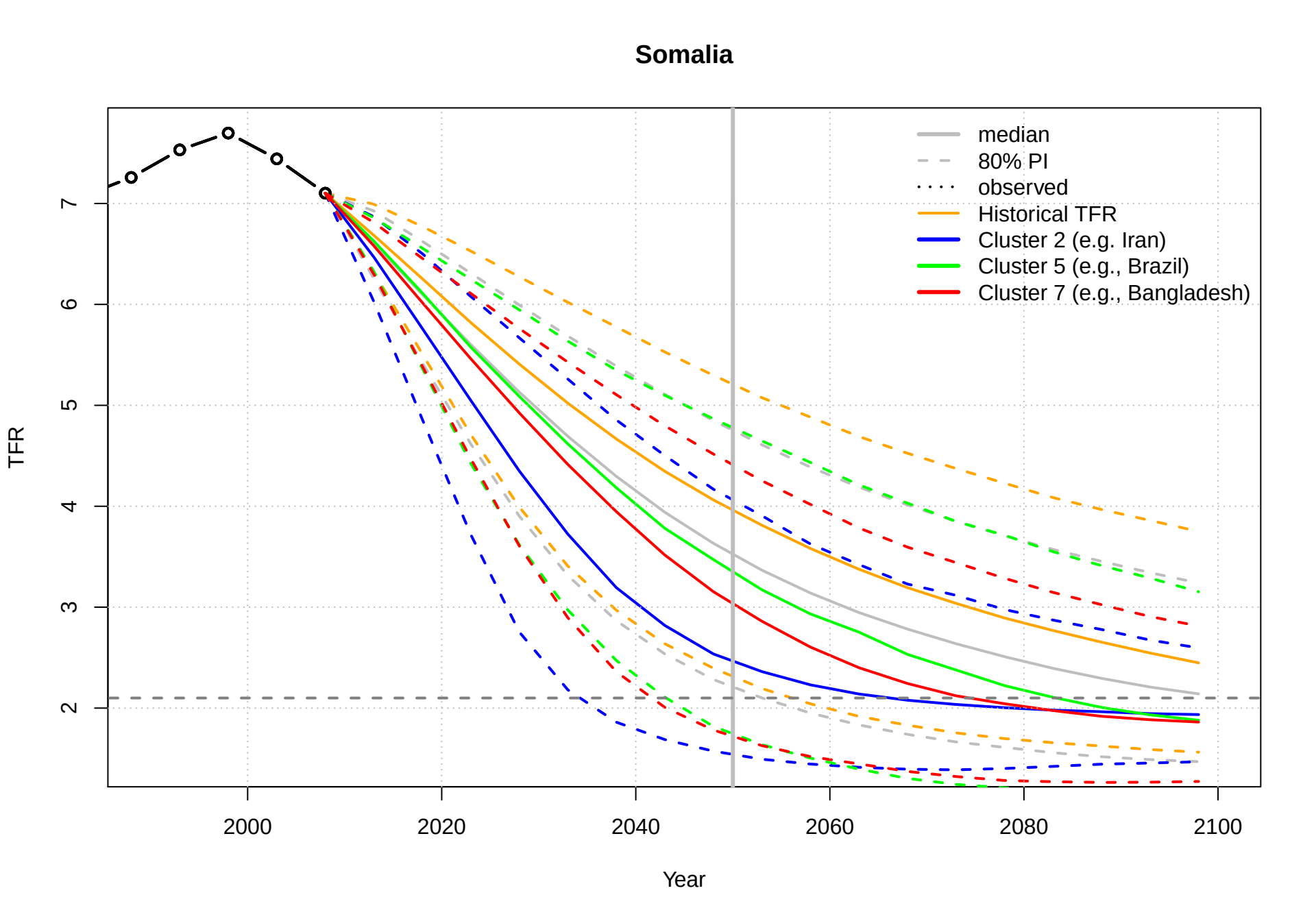

Rwanda
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

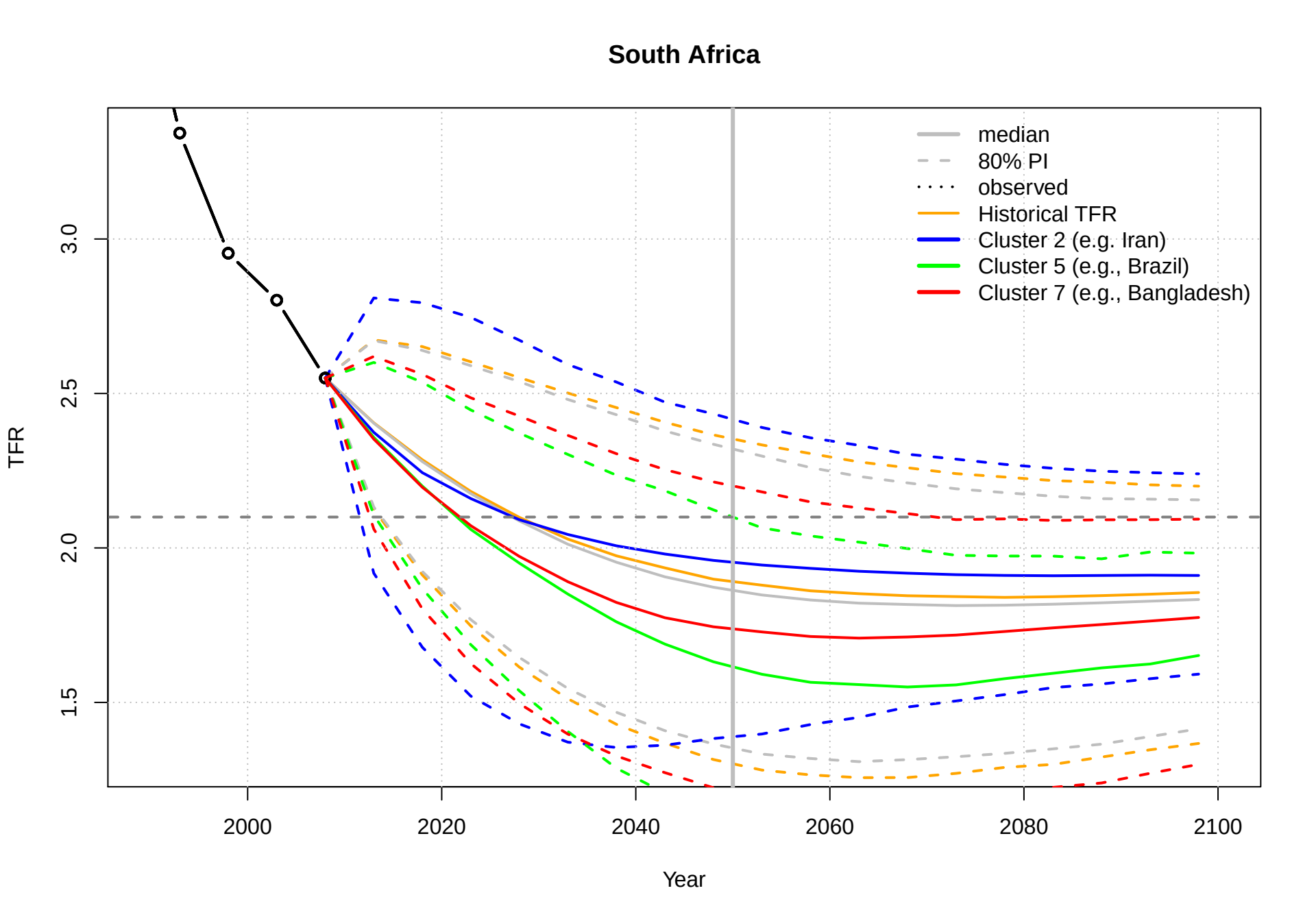

Sao Tome and Principe
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
2000
2020
2040
2060
2080
2100
Year

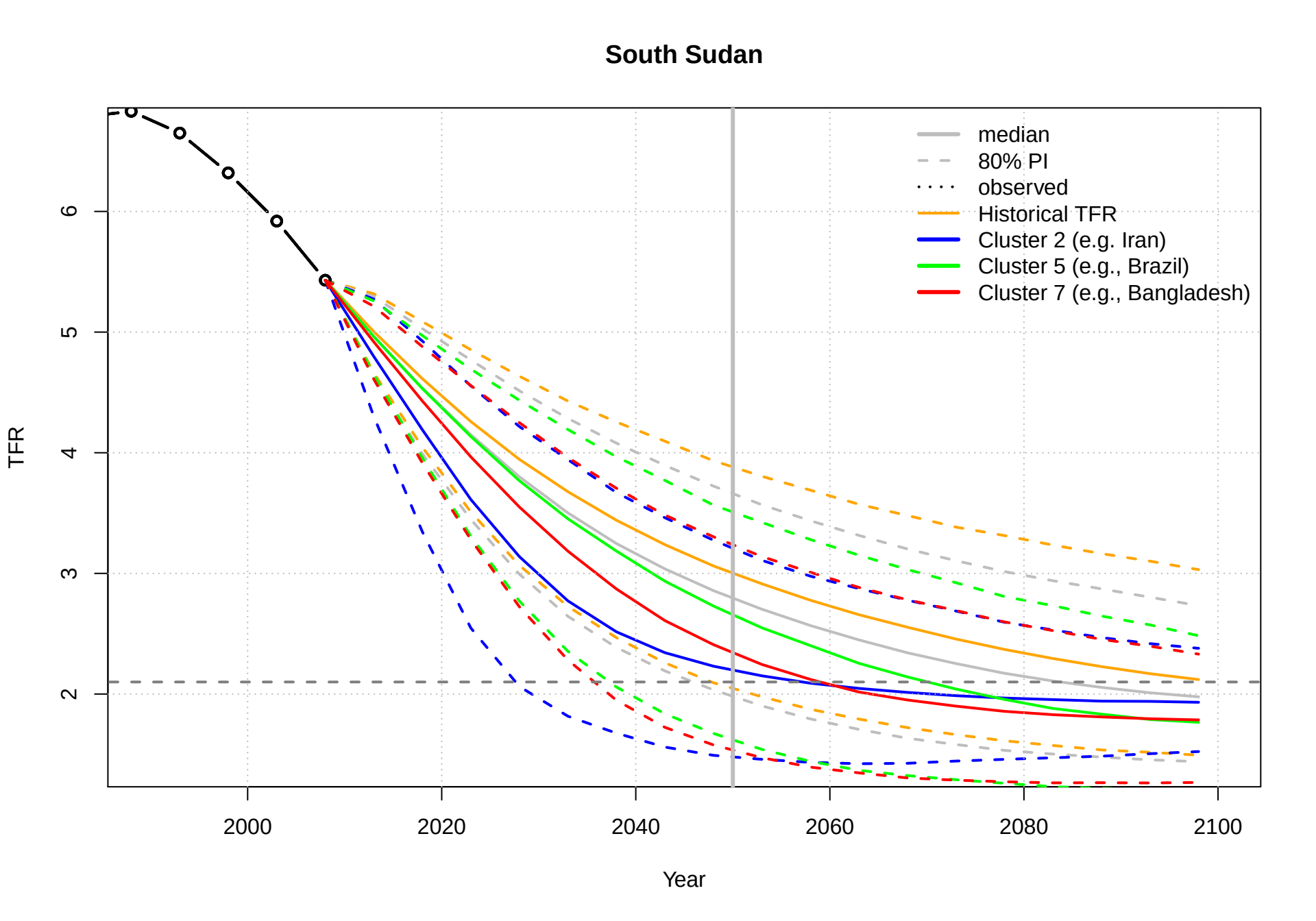

Senegal
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

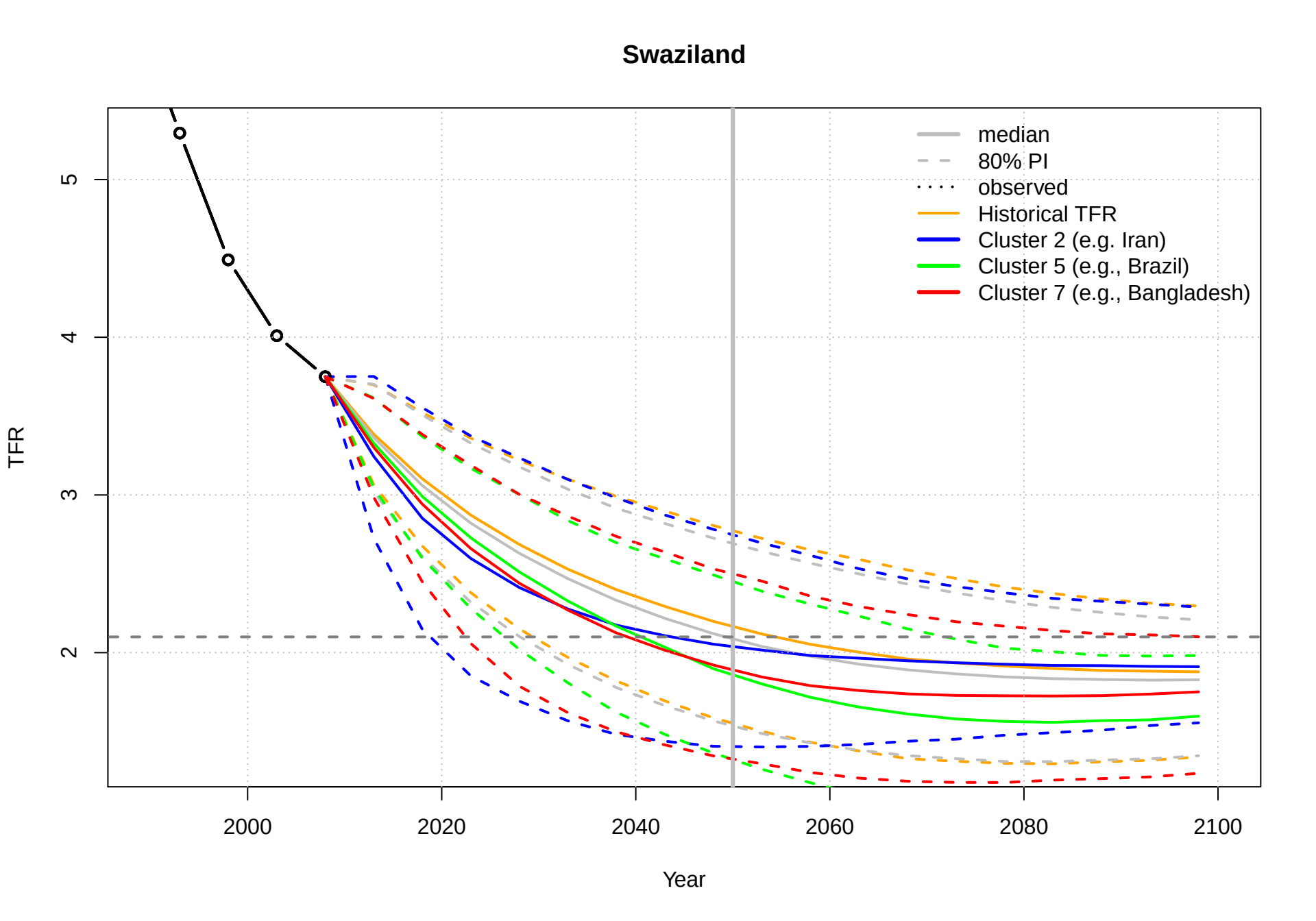

Seychelles
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2000
2020
2040
2060
2080
2100

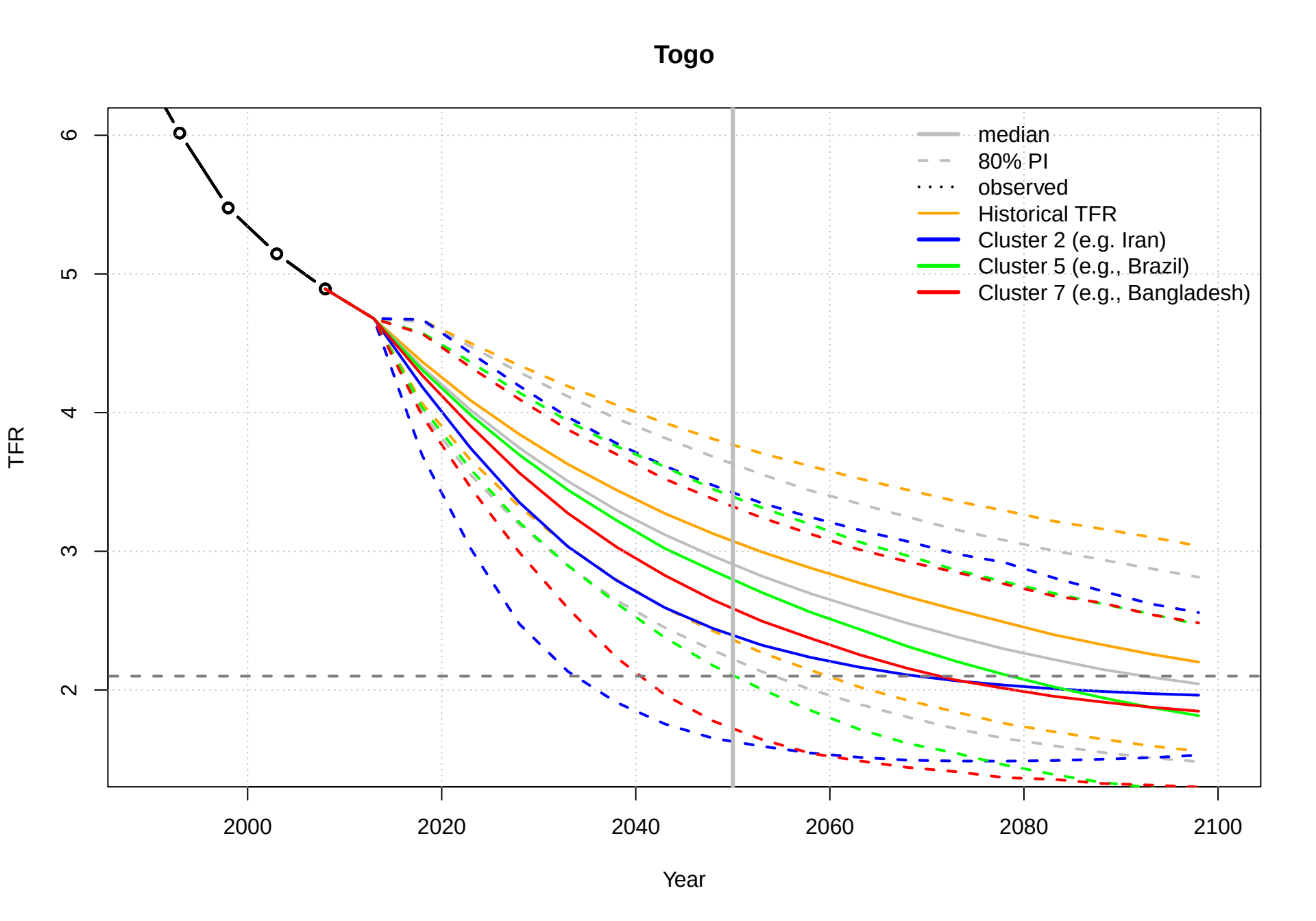

Sierra Leone
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

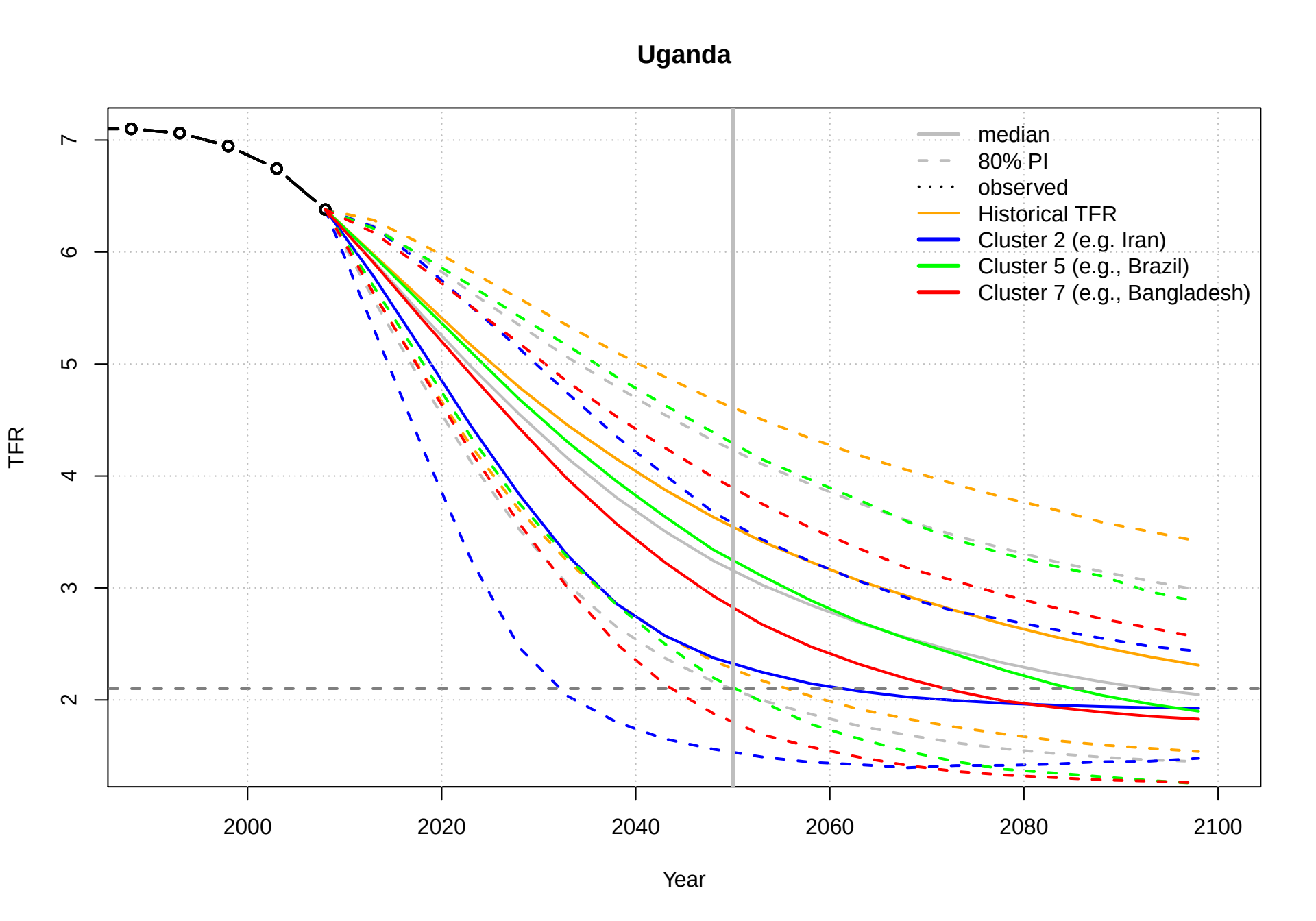

Somalia
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100
Year

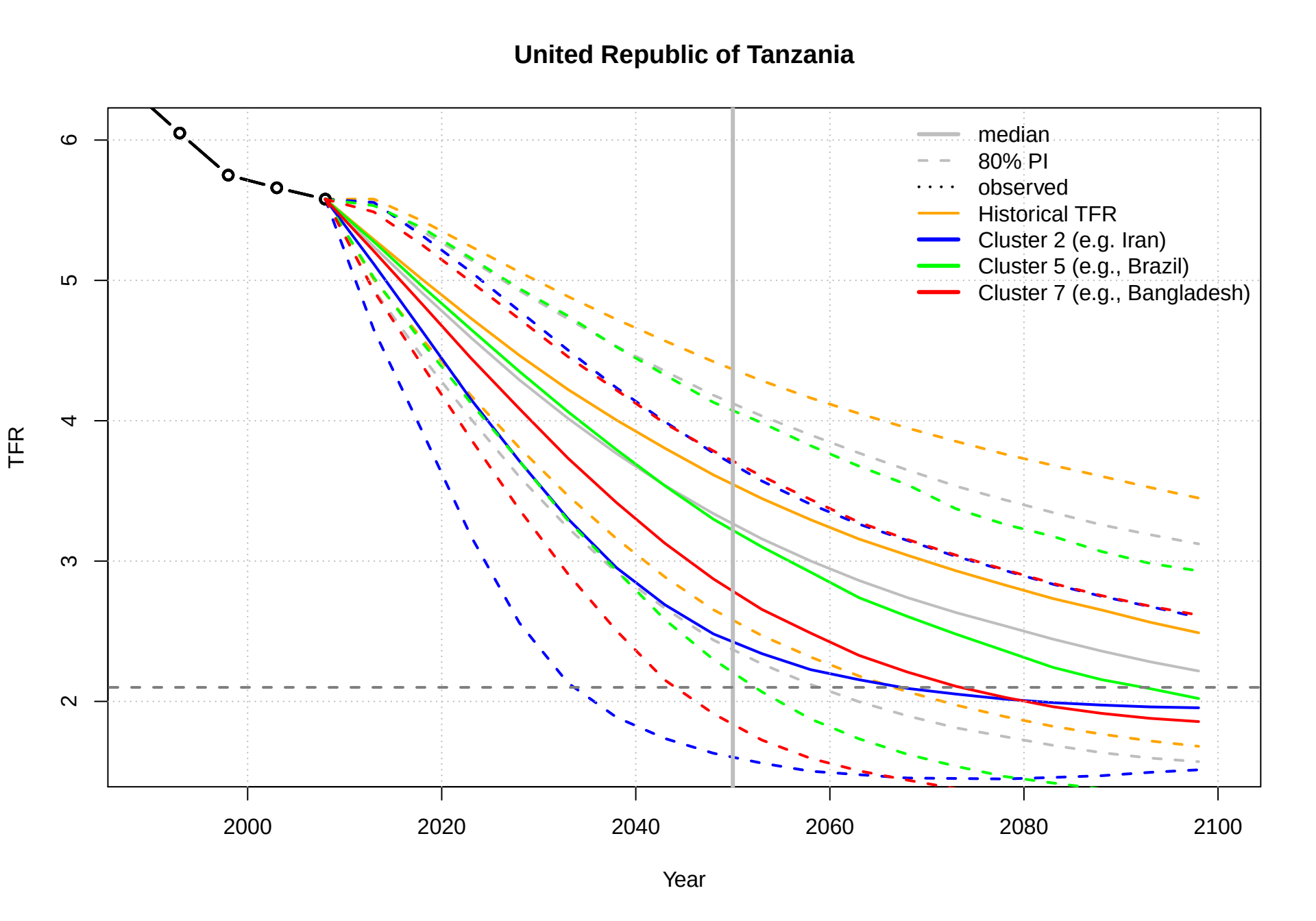

South Africa
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
3.0
2.5
2.0
1.5
2000
2020
2040
2060
2080
2100
Year

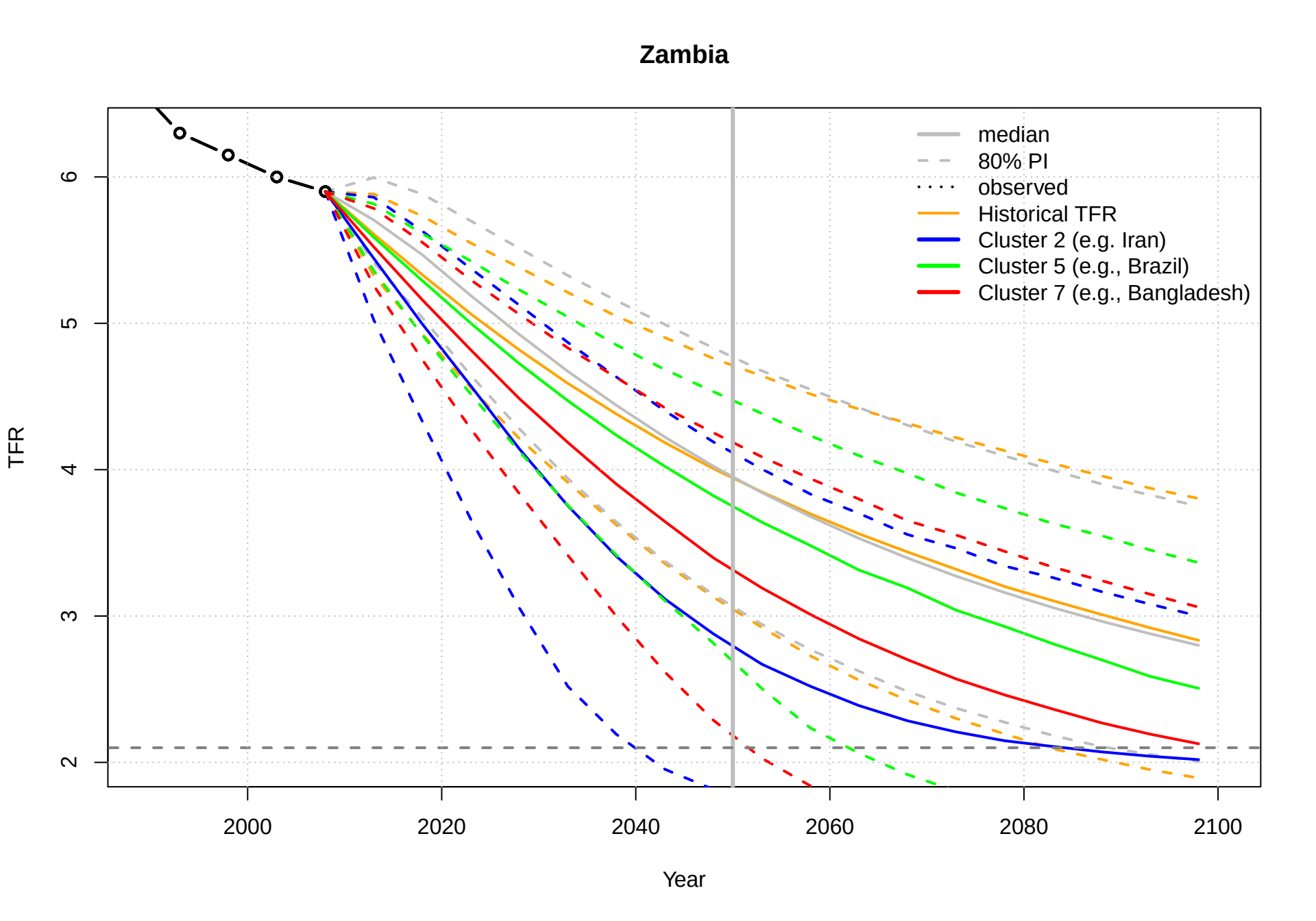

South Sudan
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

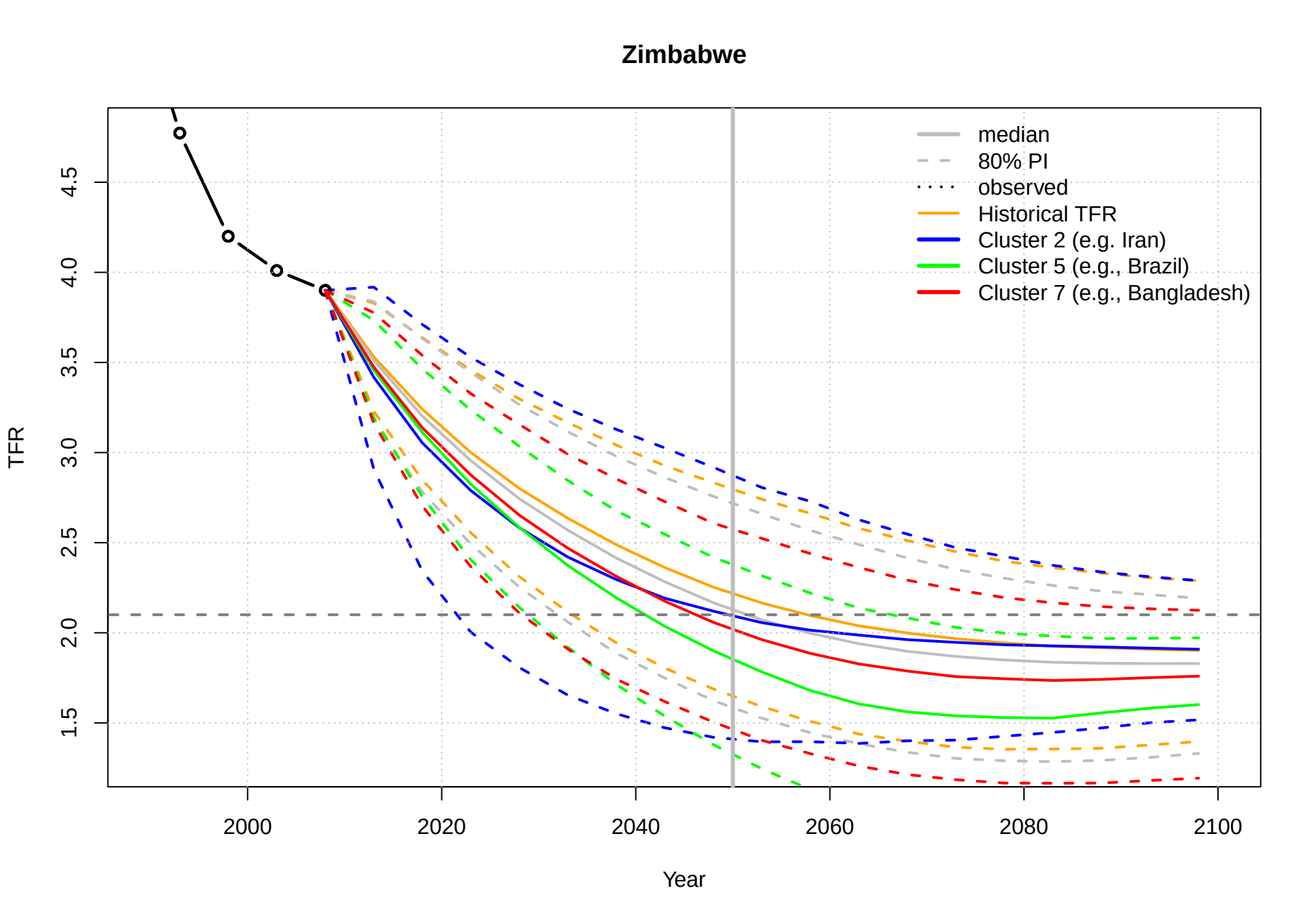

Swaziland
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
2000
2020
2040
2060
2080
2100
Year


Togo
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
6
2000
2020
2040
2060
2080
2100

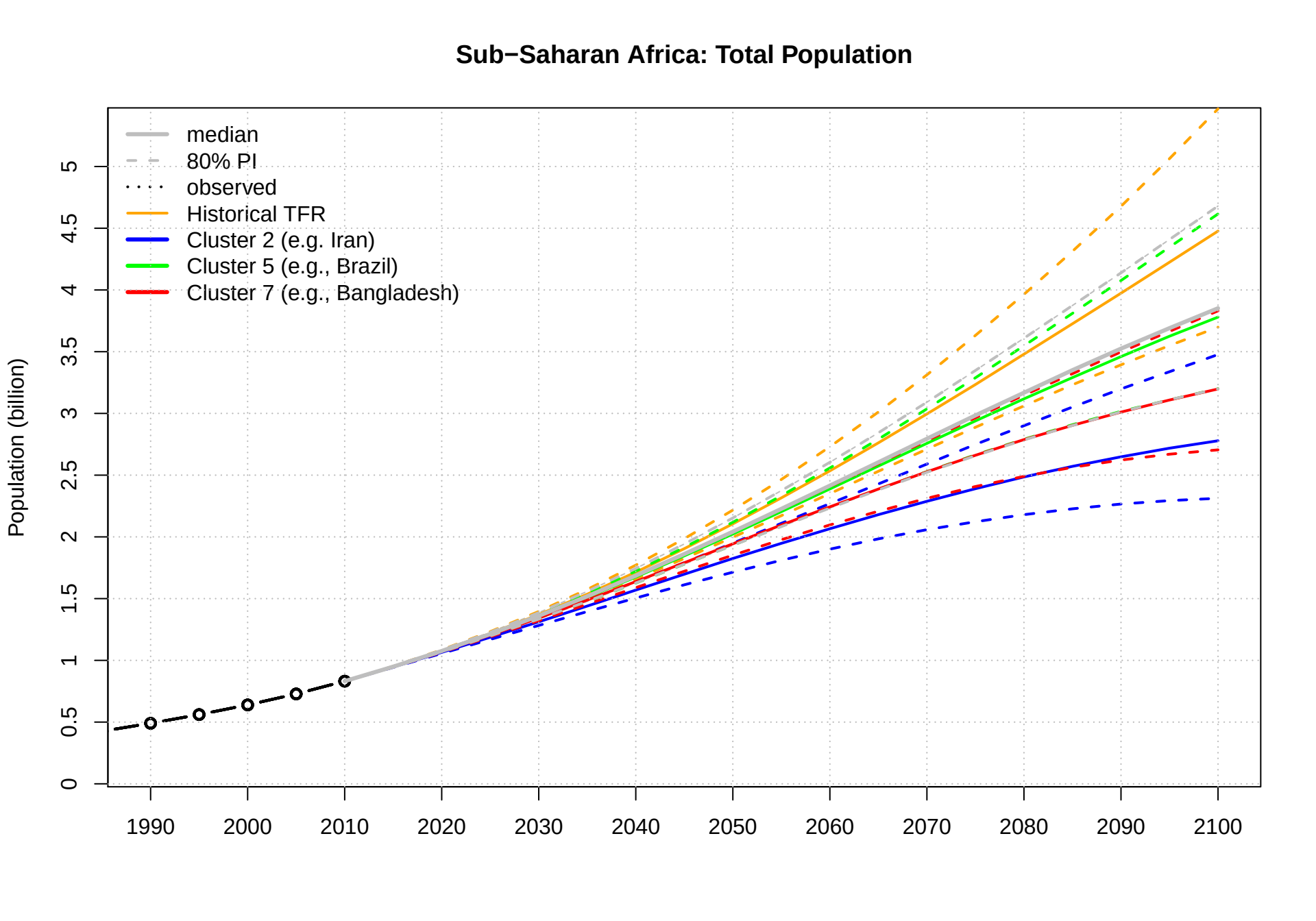

Uganda
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
7
2000
2020
2040
2060
2080
2100
Year

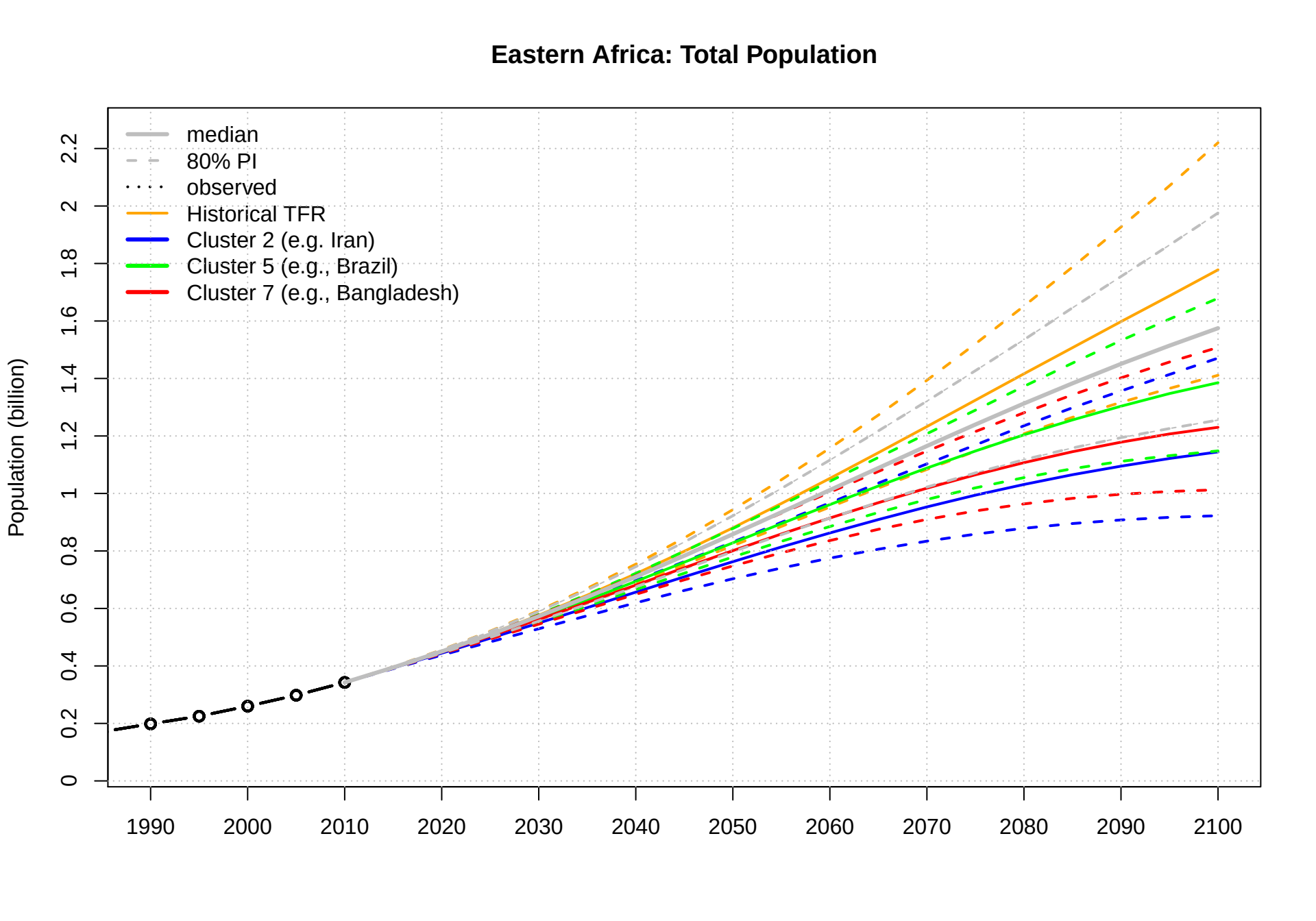

United Republic of Tanzania
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
Year
2
3
4
5
6
2000
2020
2040
2060
2080
2100

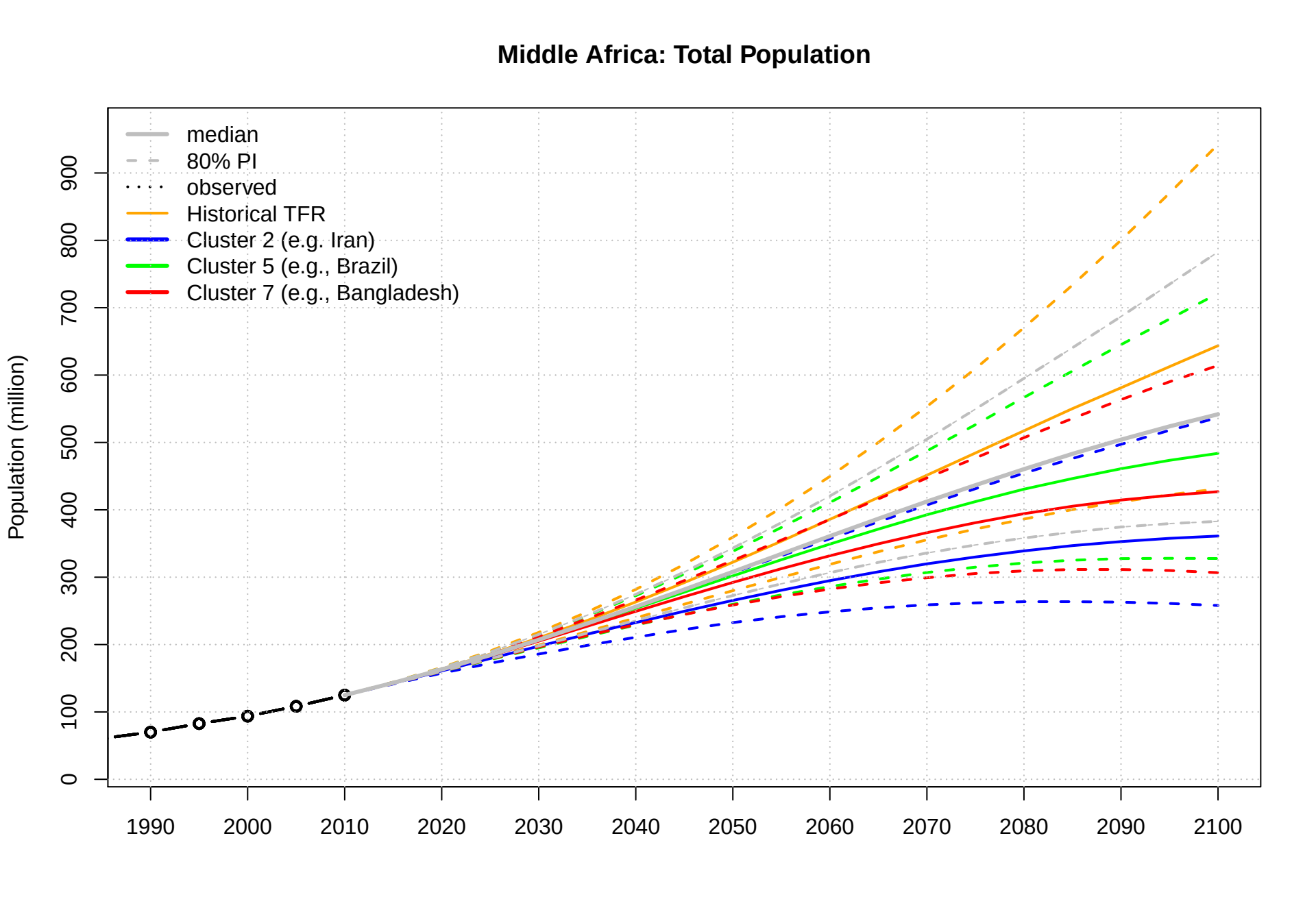

Zambia
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
2
3
4
5
6
2000
2020
2040
2060
2080
2100
Year

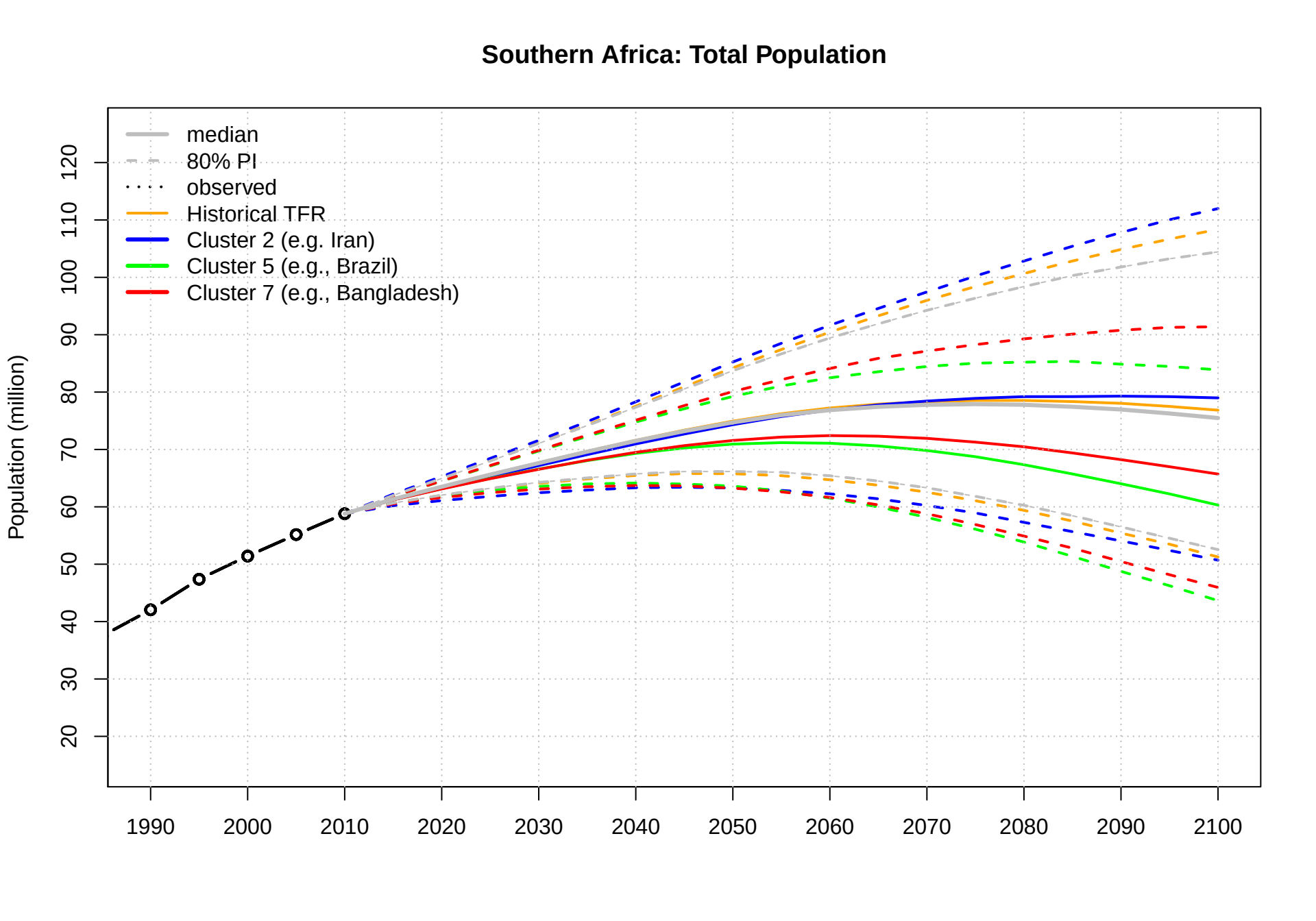

Zimbabwe
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
TFR
1.5
2.0
2.5
3.0
3.5
4.0
4.5
2000
2020
2040
2060
2080
2100
Year

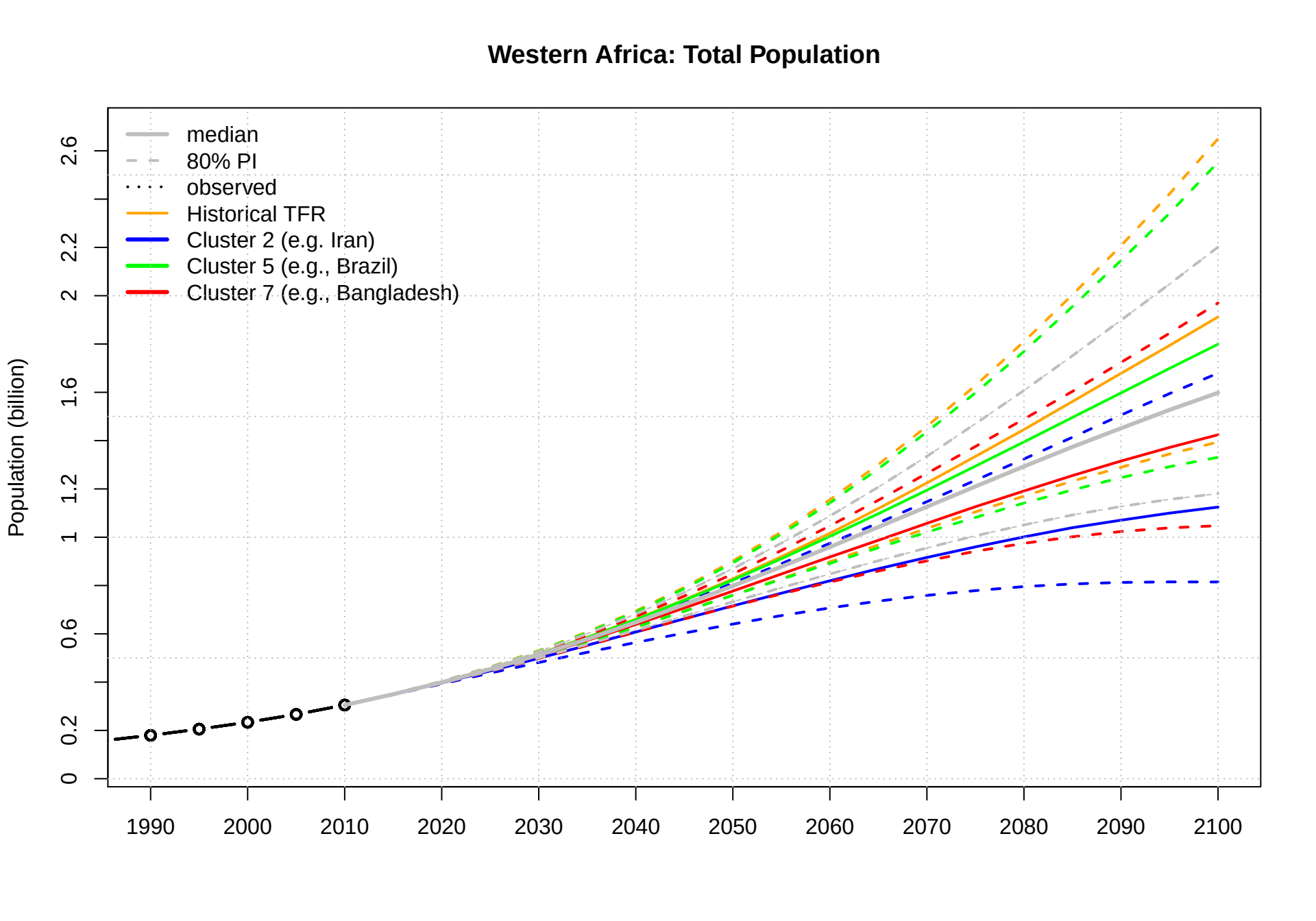
III. Probabilistic population projections median and 80 per cent prediction intervals) for five scenarios: baseline, historical, 2-“very fast-slow”, 5-“slow-steady” and 7-“slow-moderately fast” by region and country

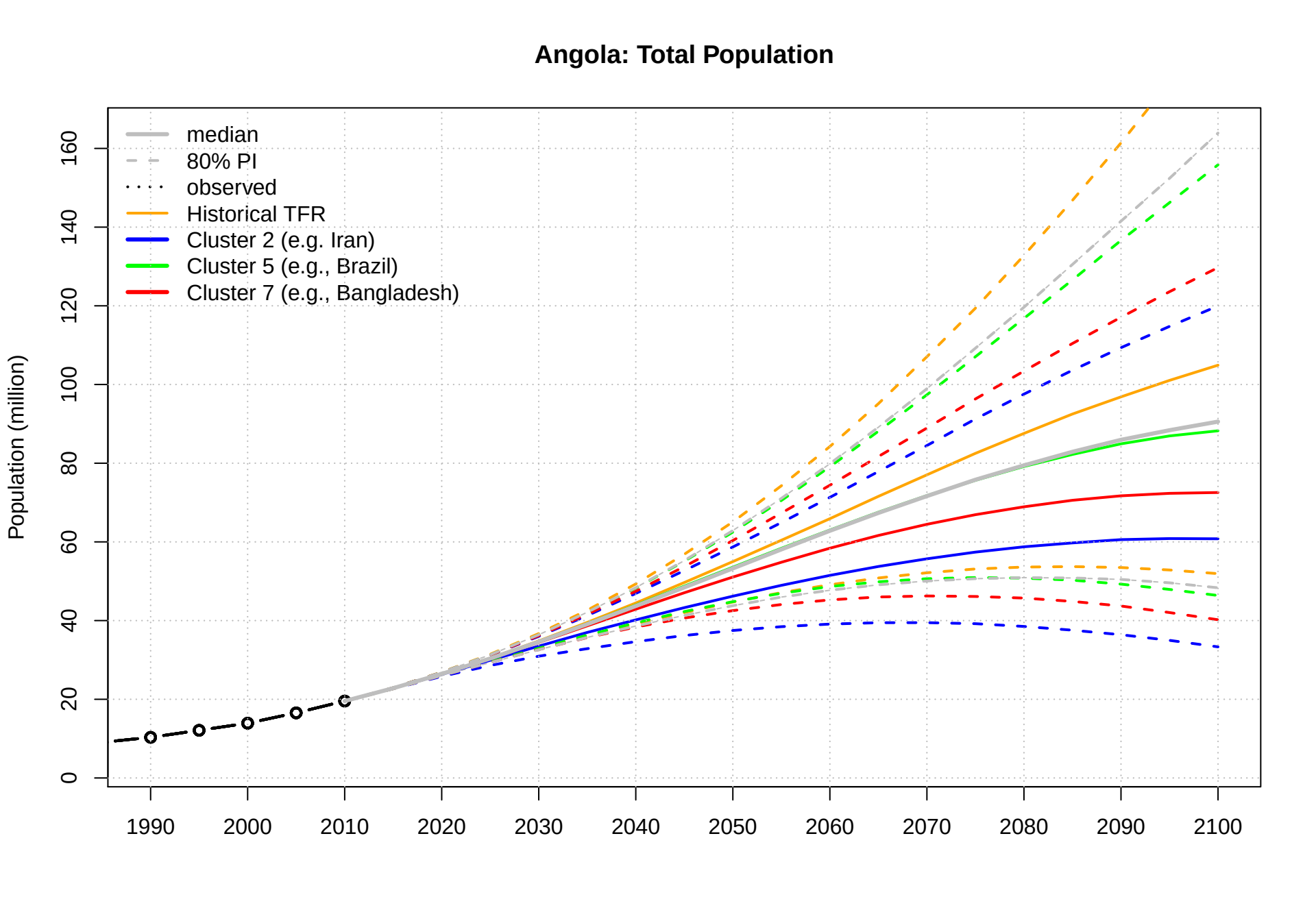

Sub−Saharan Africa: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (billion)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

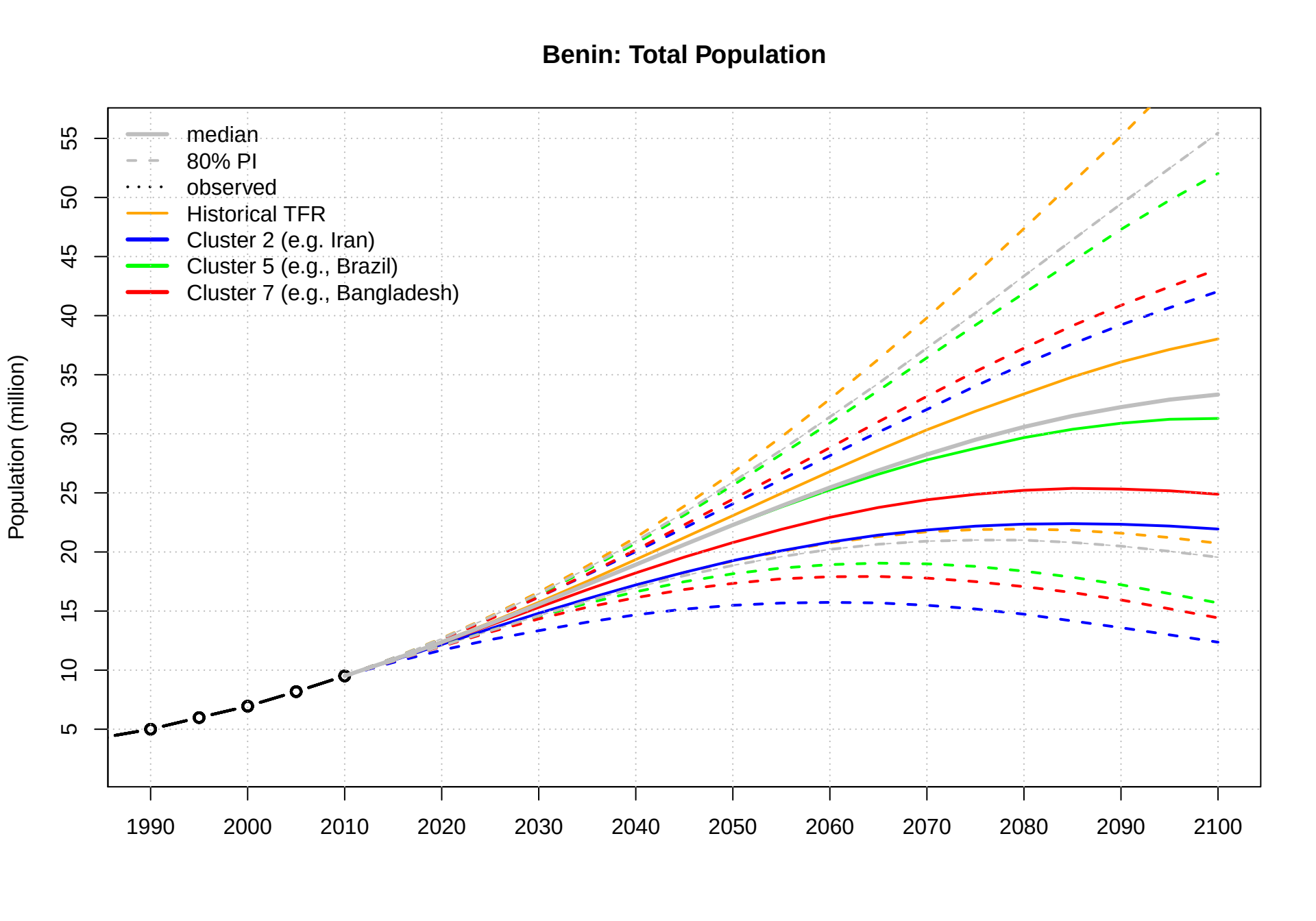

Eastern Africa: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (billion)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

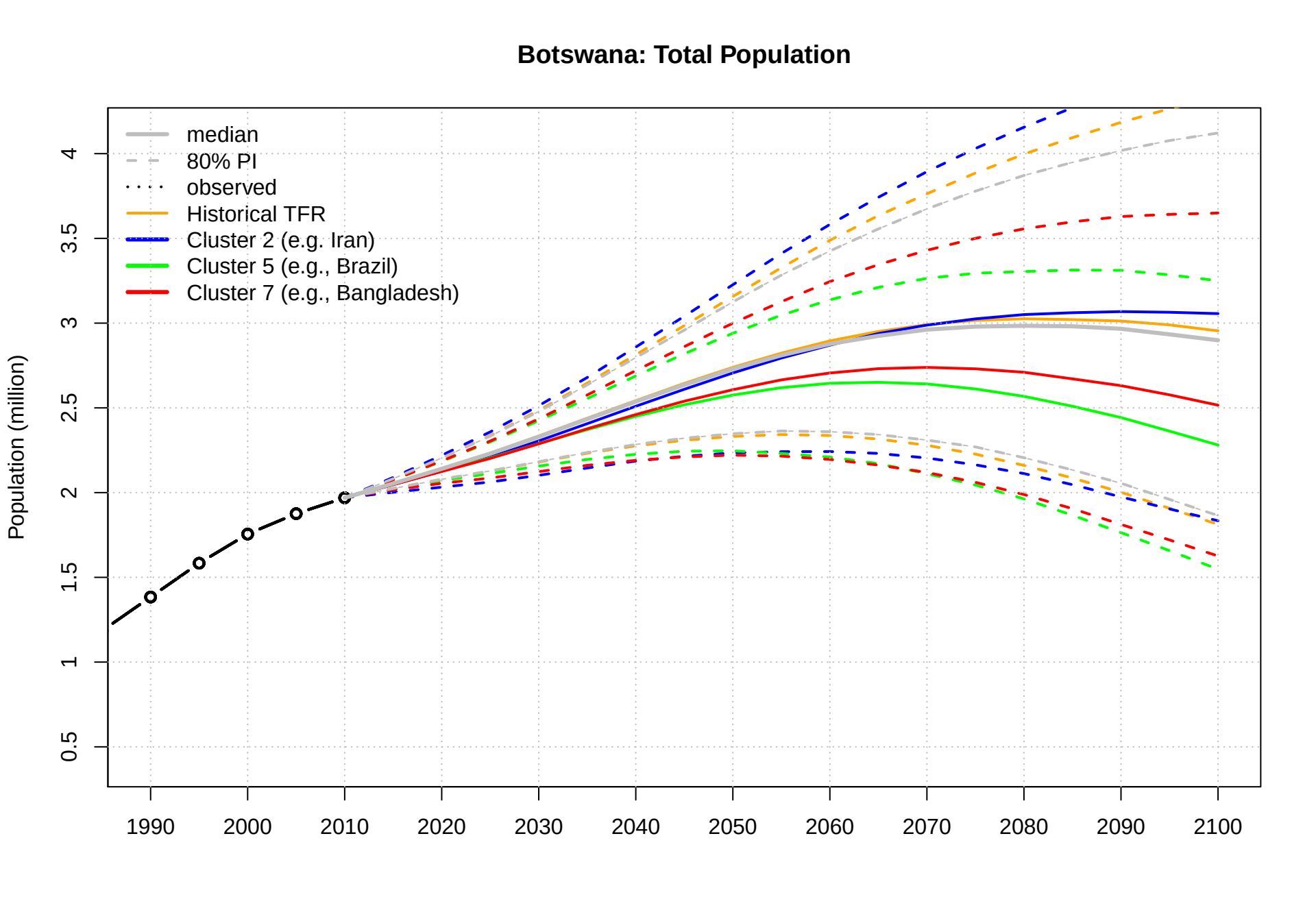

Middle Africa: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
100
200
300
400
500
600
700
800
900
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

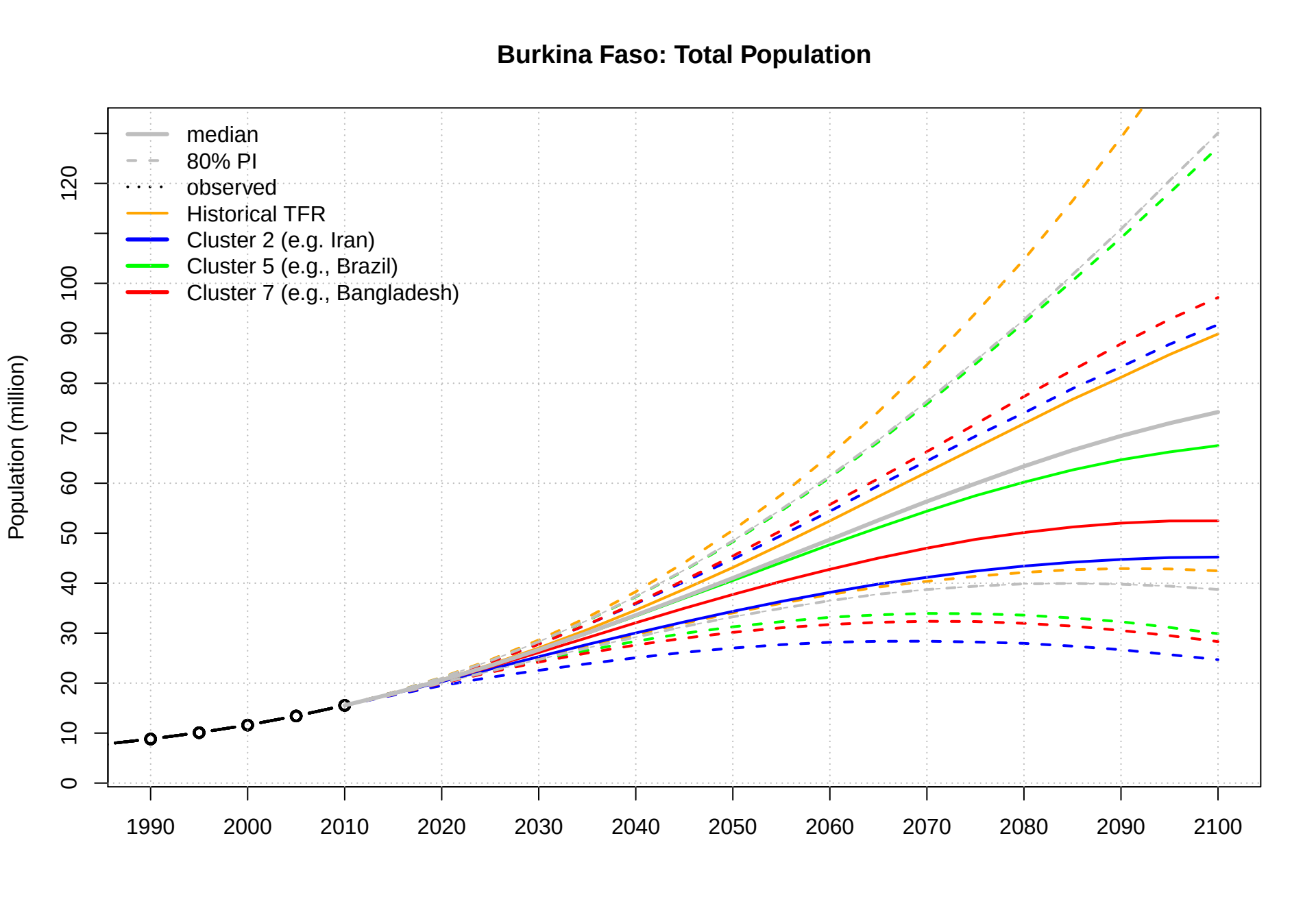

Southern Africa: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
20
30
40
50
60
70
80
90
100
110
120
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

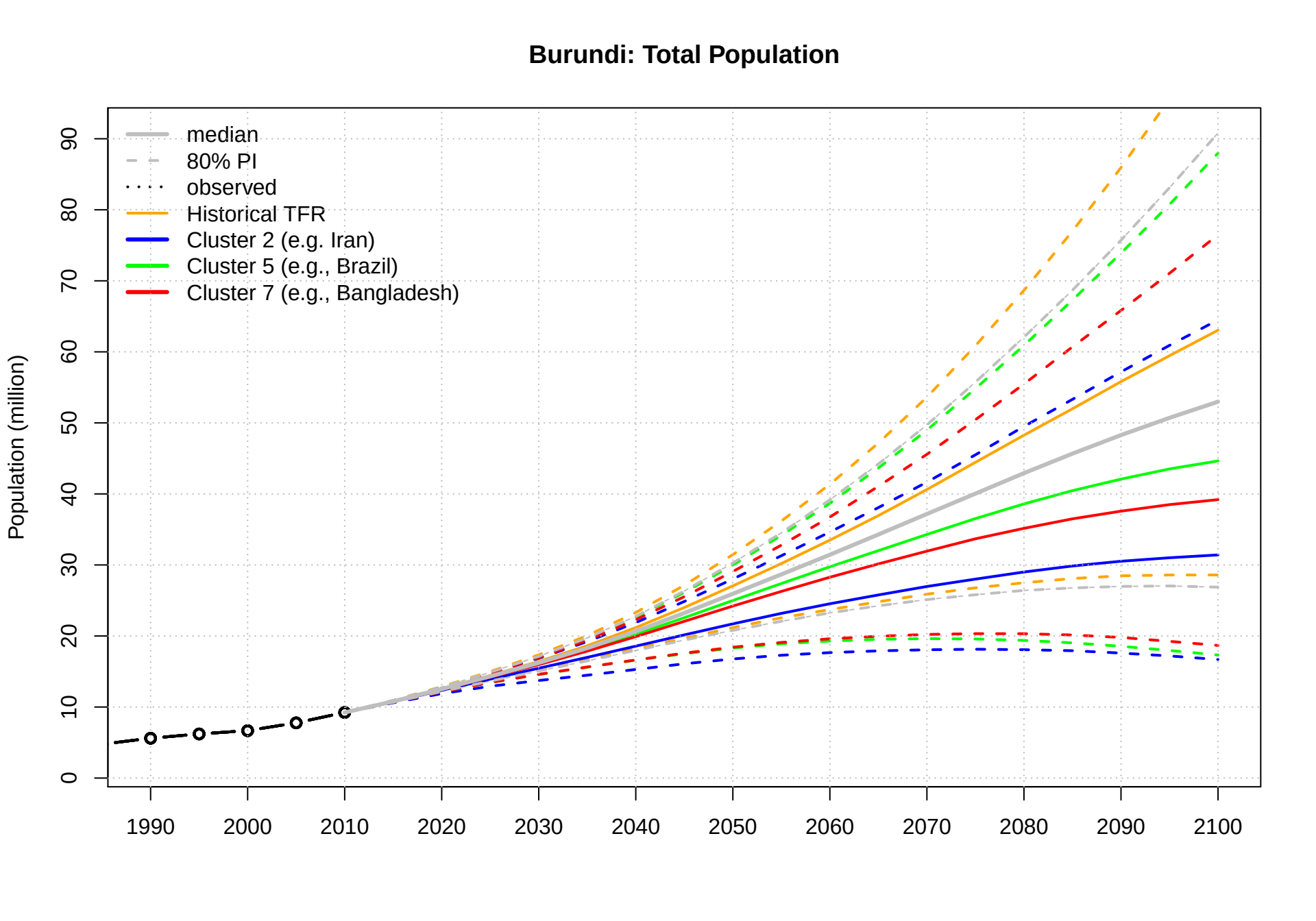

Western Africa: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (billion)
0
0.2
0.6
1
1.2
1.6
2
2.2
2.6
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

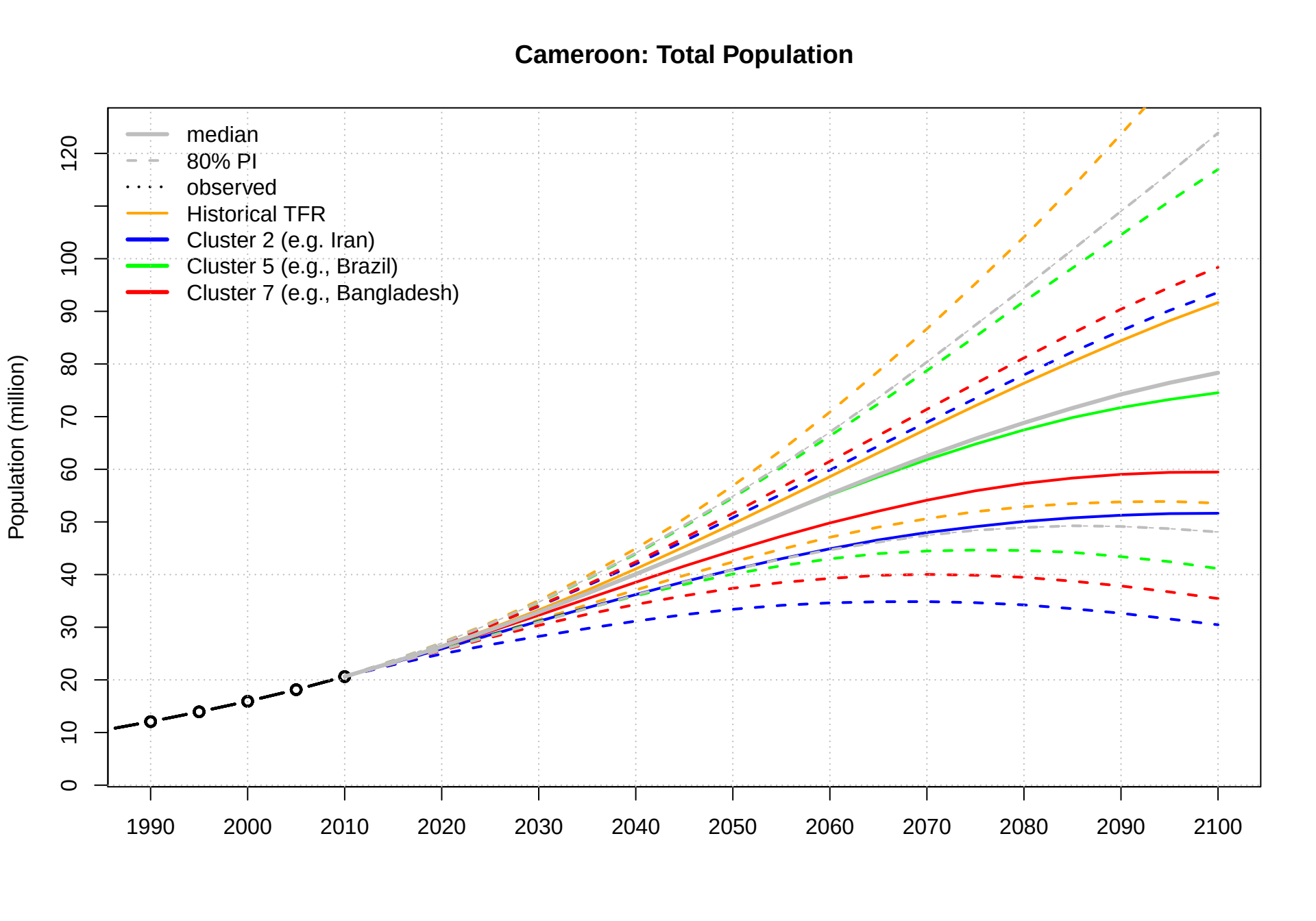

Angola: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
20
40
60
80
100
120
140
160
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

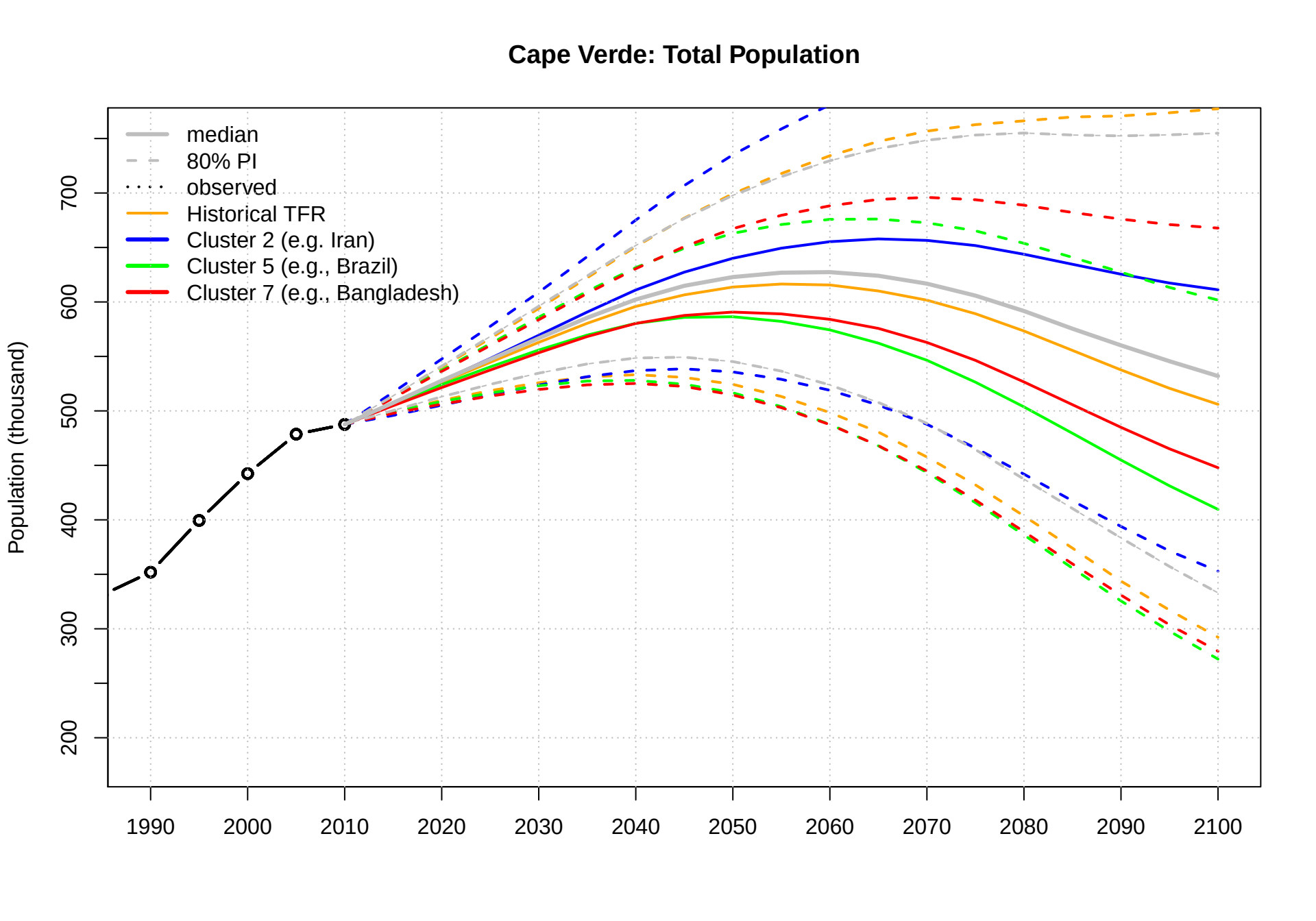

Benin: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
5
10
15
20
25
30
35
40
45
50
55
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

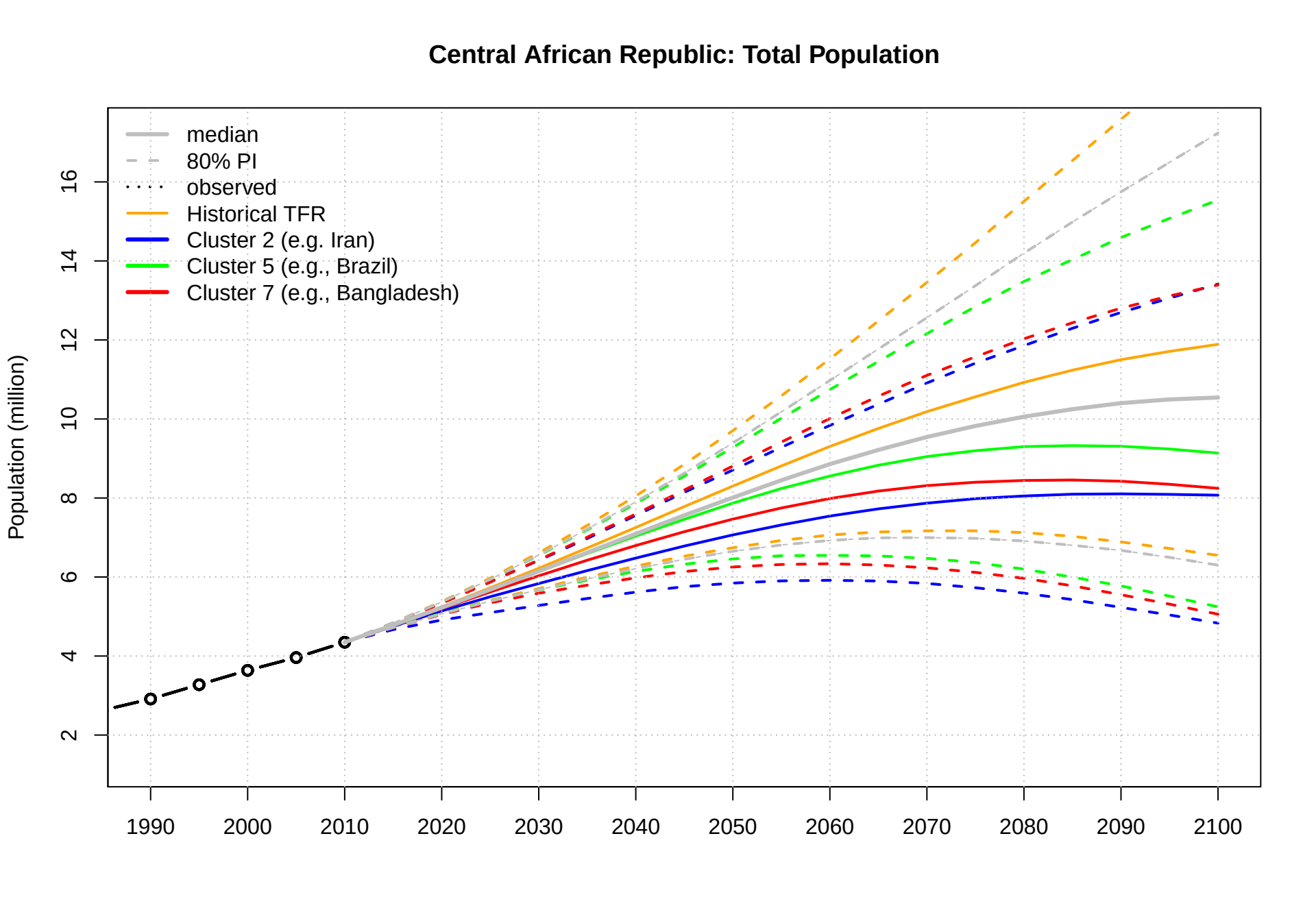

Botswana: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0.5
1
1.5
2
2.5
3
3.5
4
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

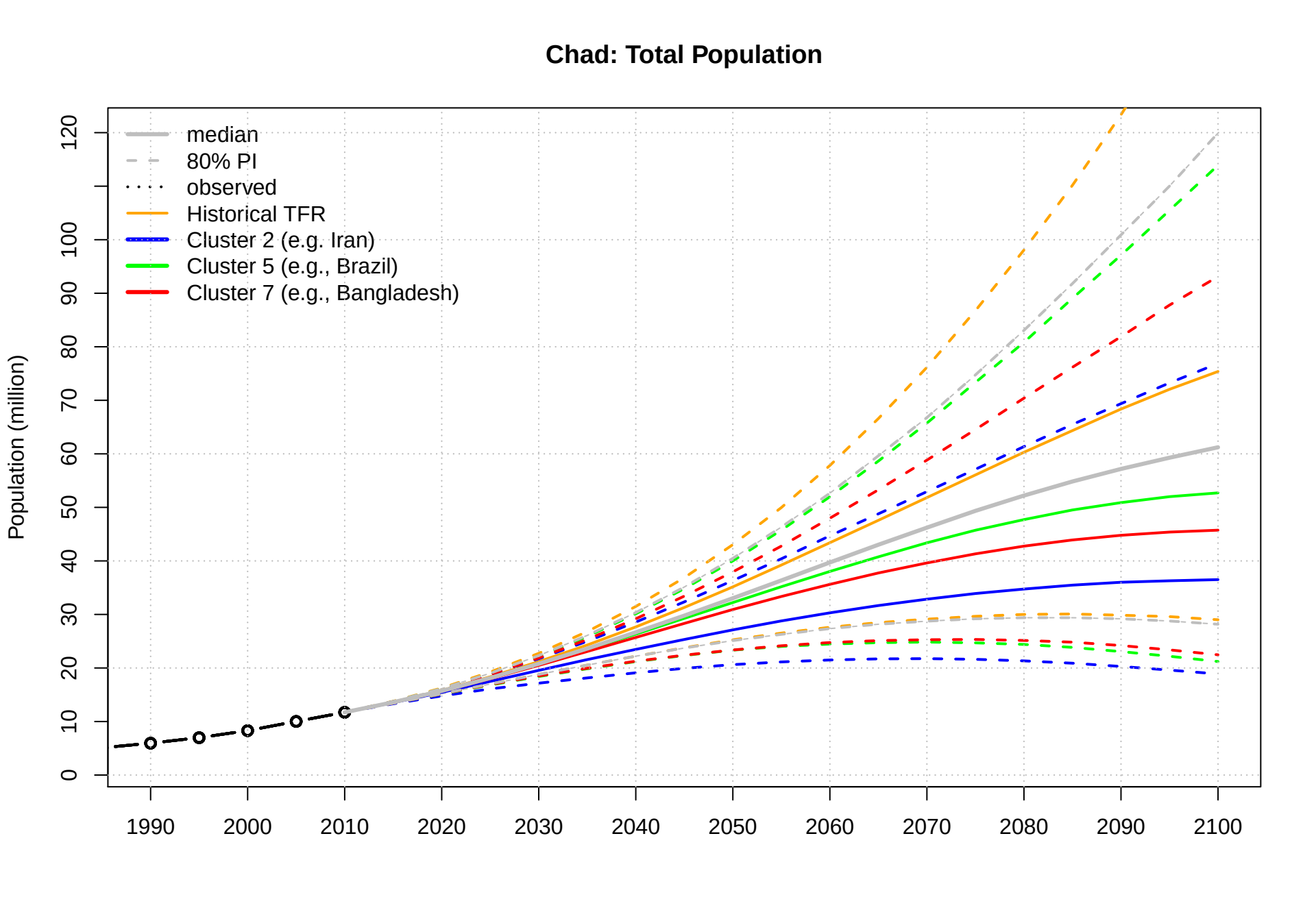

Burkina Faso: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
10
20
30
40
50
60
70
80
90
100
120
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

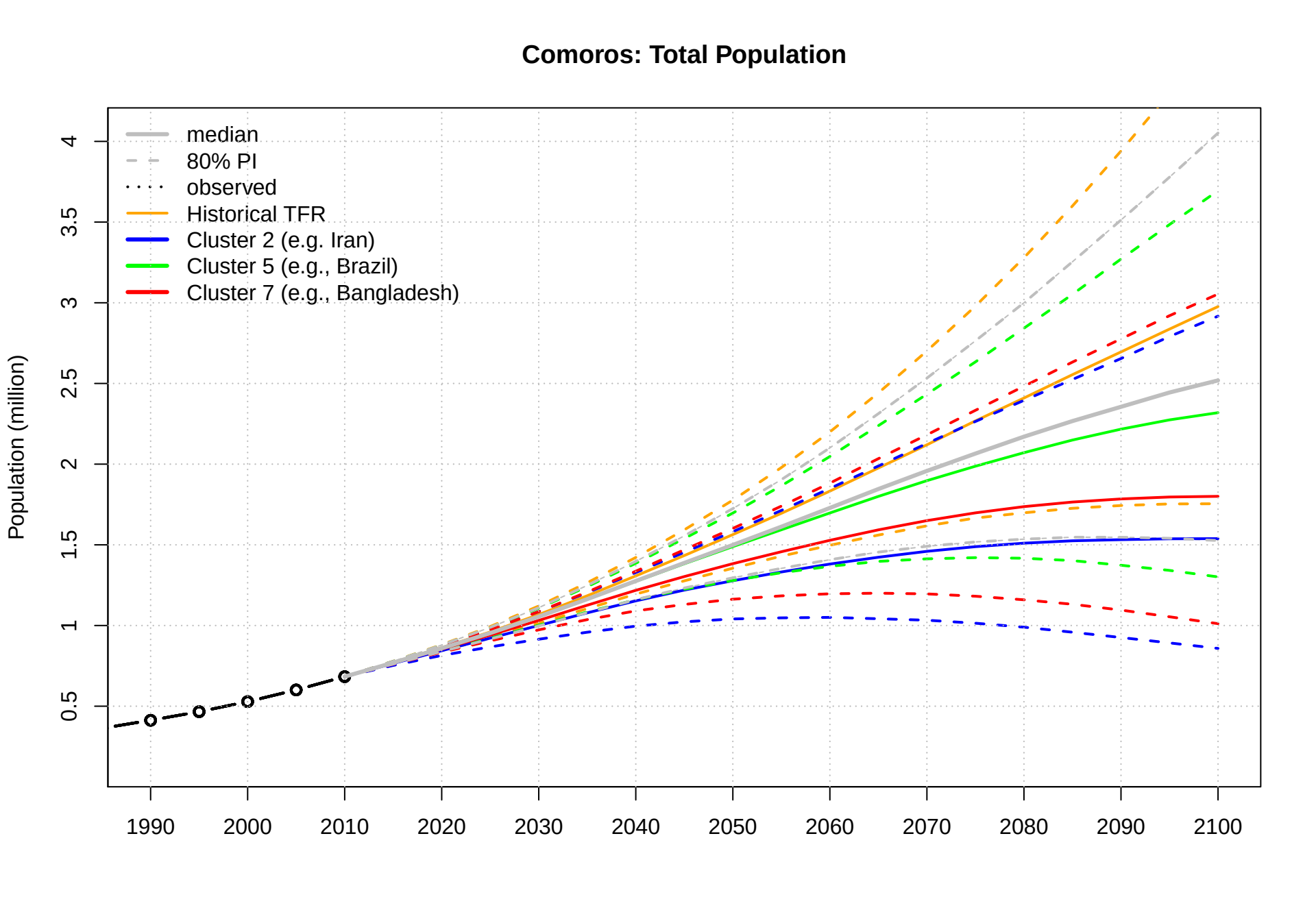

Burundi: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
10
20
30
40
50
60
70
80
90
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

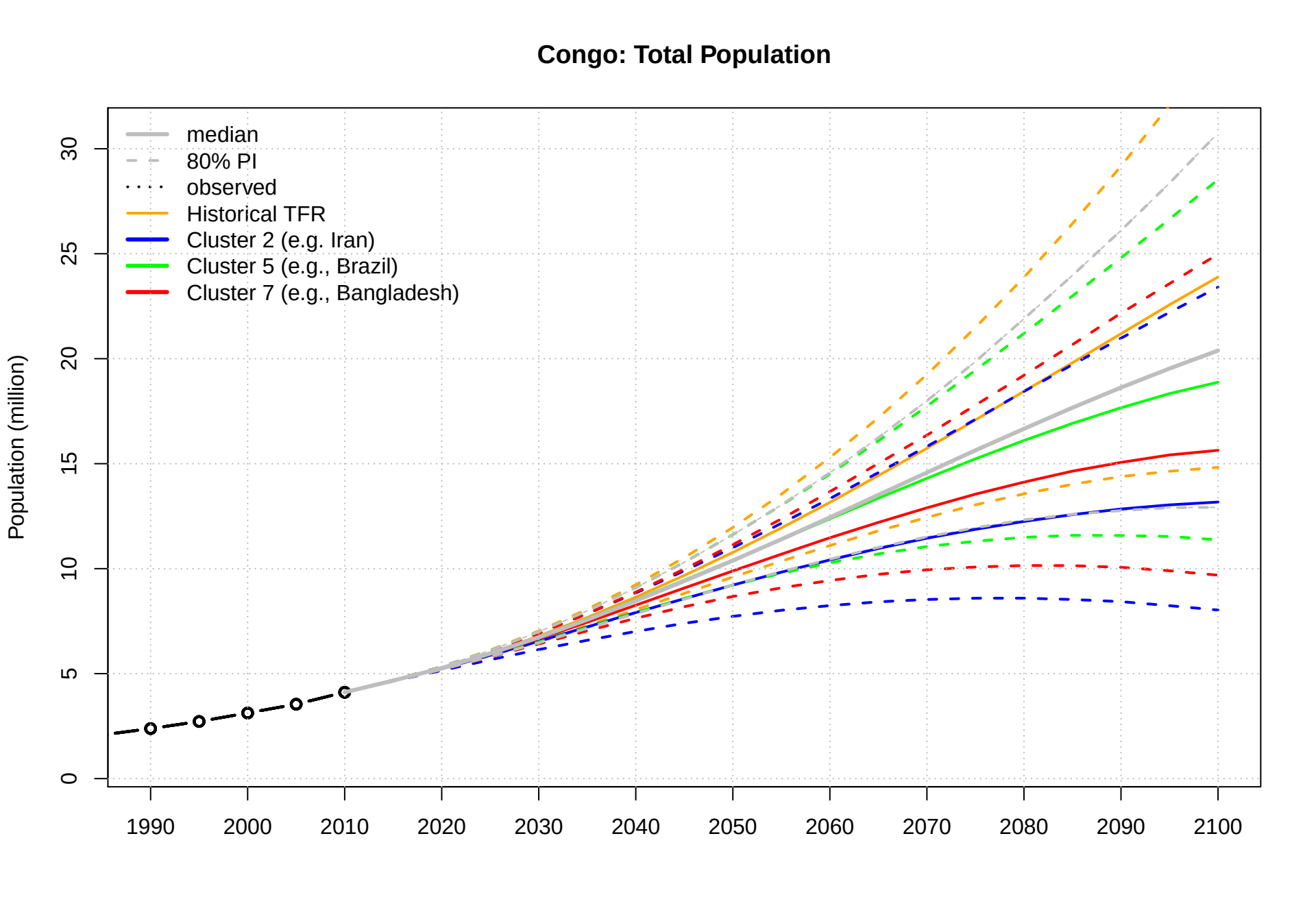

Cameroon: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
10
20
30
40
50
60
70
80
90
100
120
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

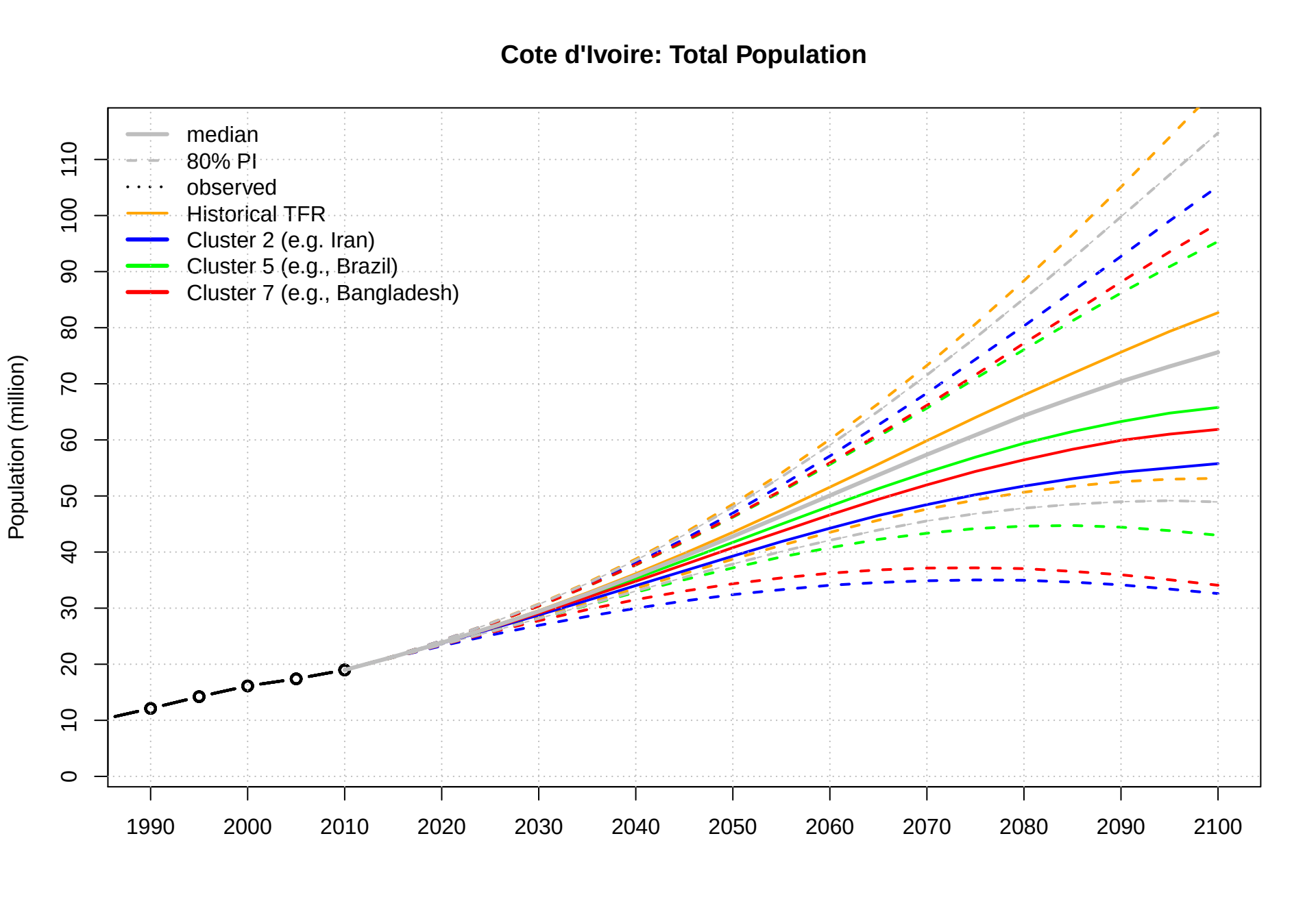

Cape Verde: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (thousand)
200
300
400
500
600
700
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

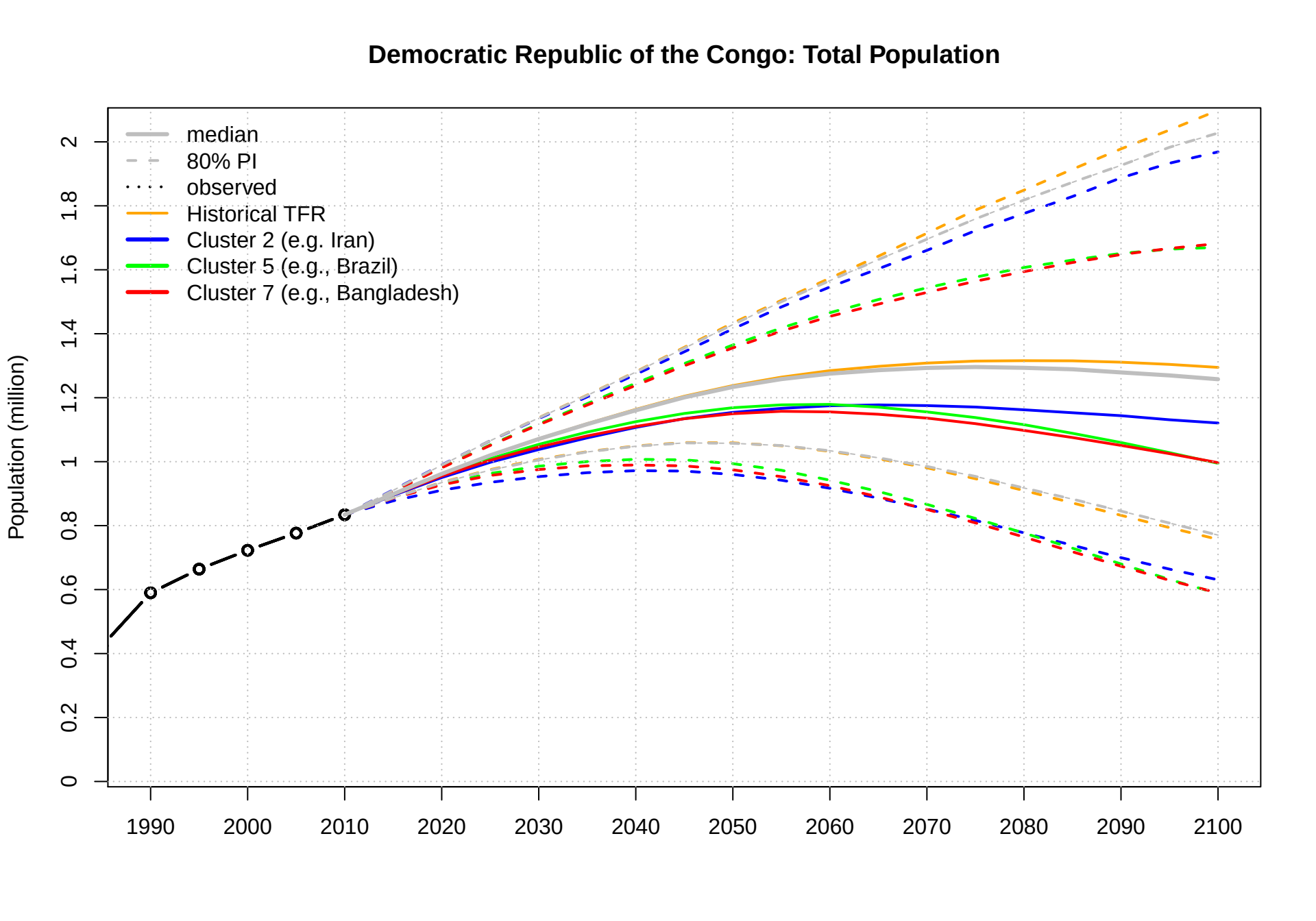

Central African Republic: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
2
4
6
8
10
12
14
16
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

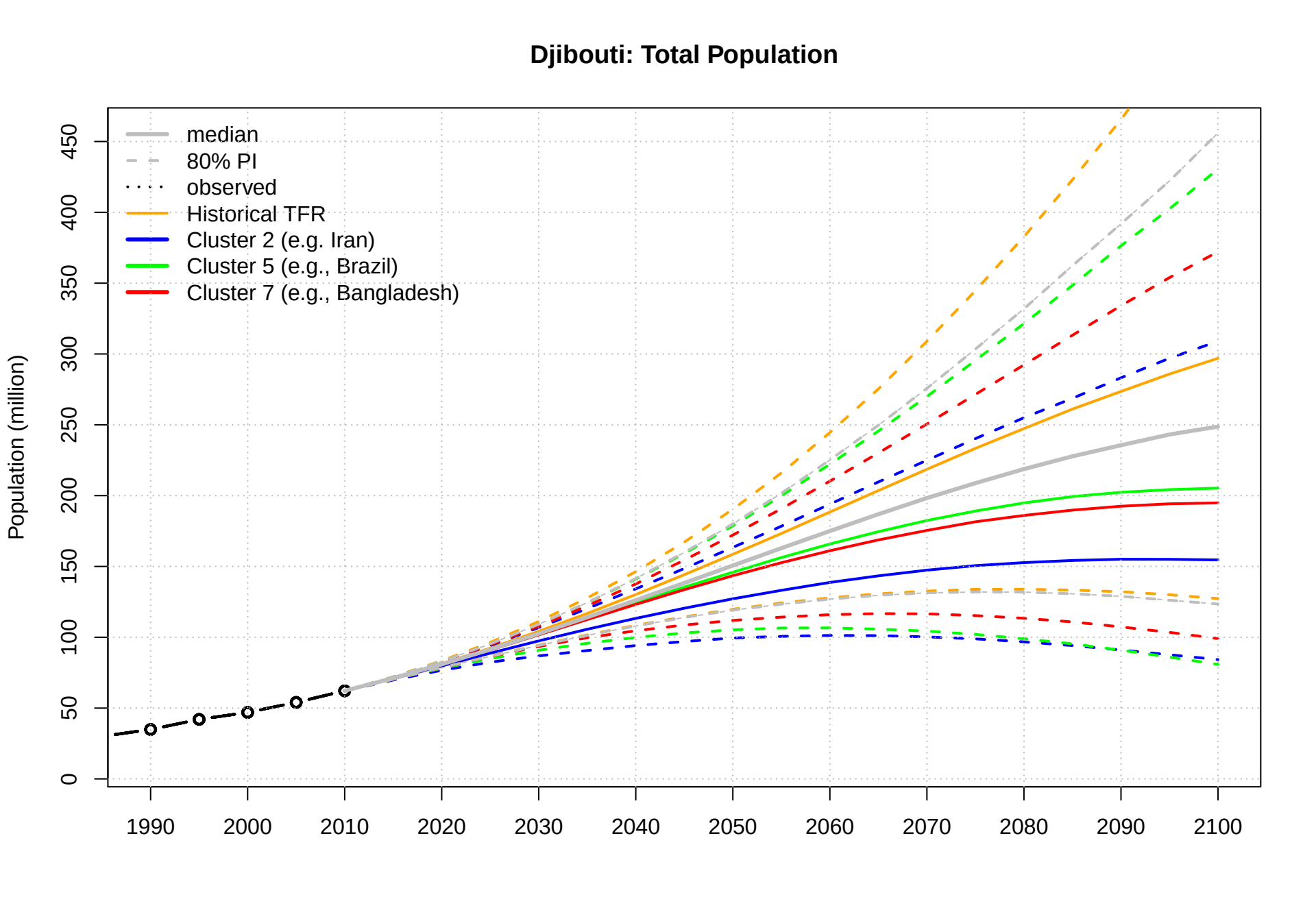

Chad: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
10
20
30
40
50
60
70
80
90
100
120
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

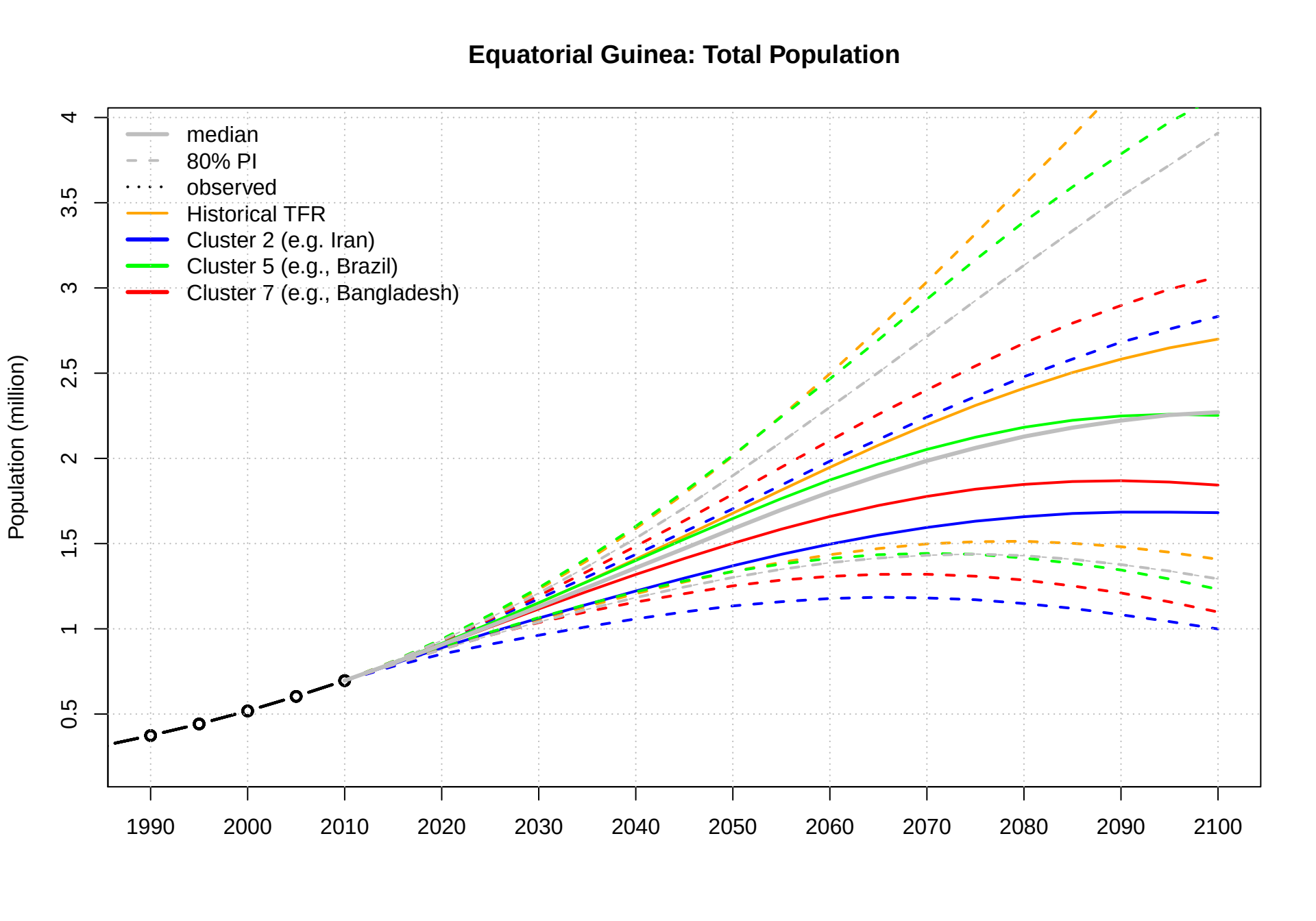

Comoros: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0.5
1
1.5
2
2.5
3
3.5
4
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

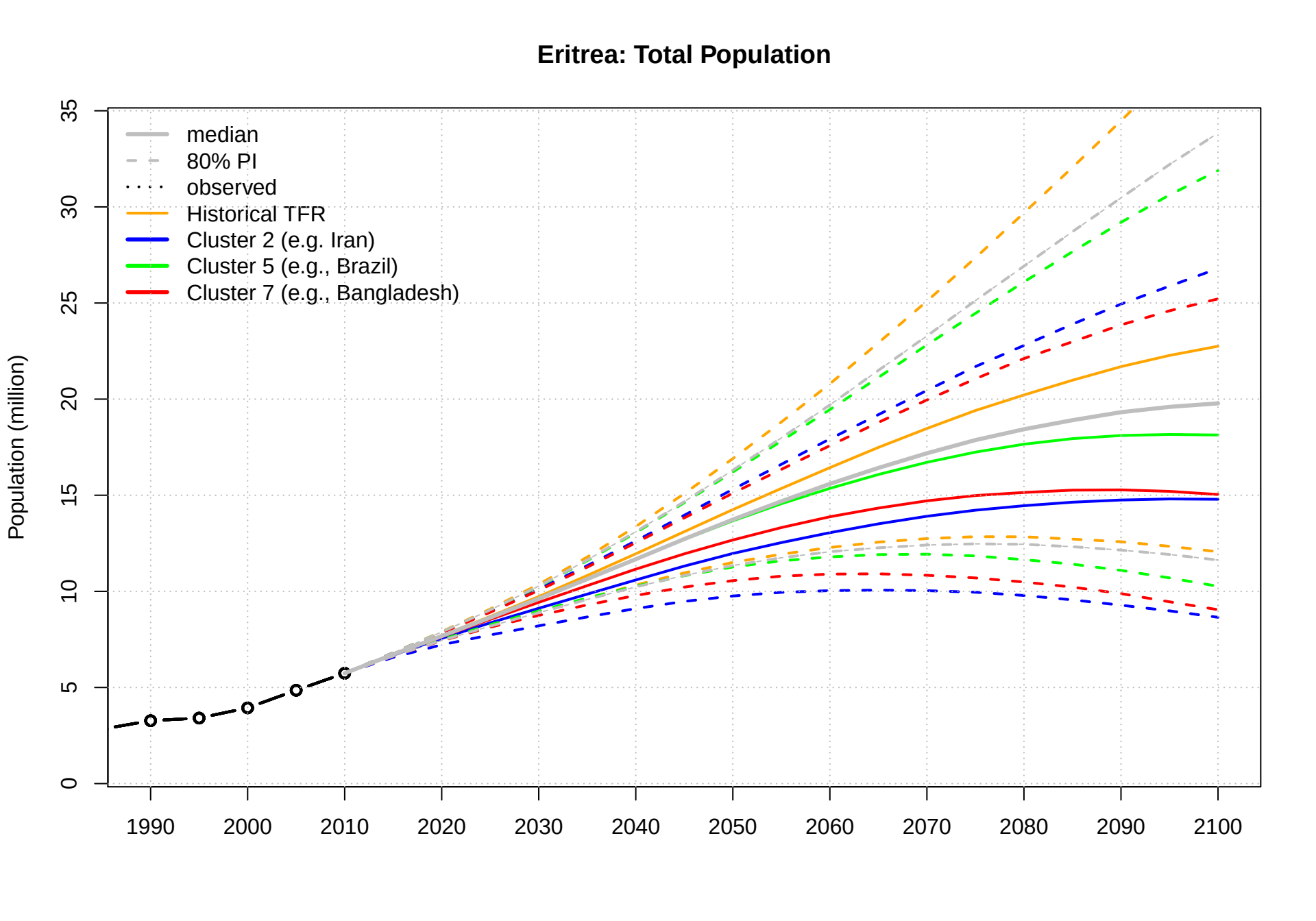

Congo: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
5
10
15
20
25
30
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

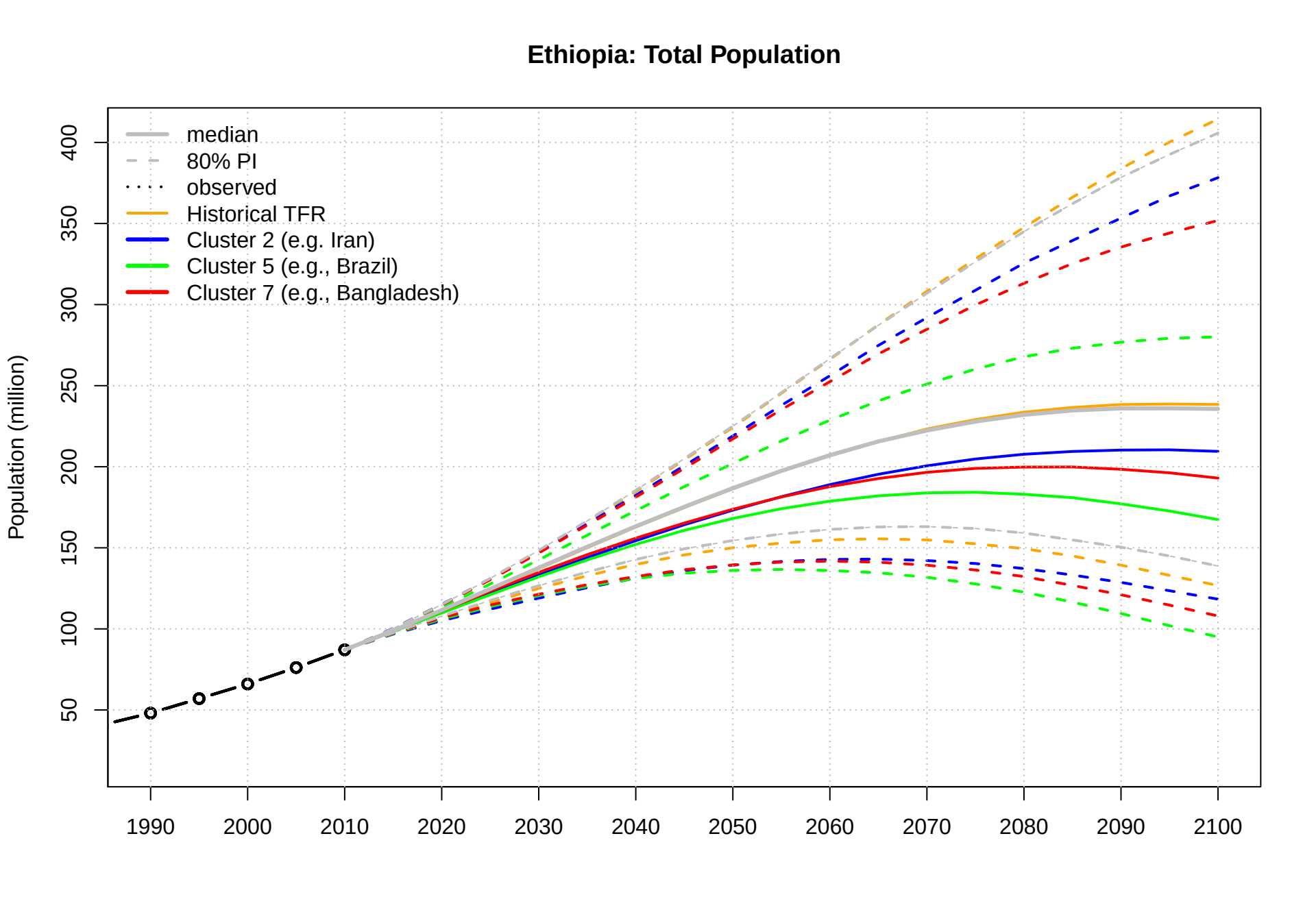

Cote d'Ivoire: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
10
20
30
40
50
60
70
80
90
100
110
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

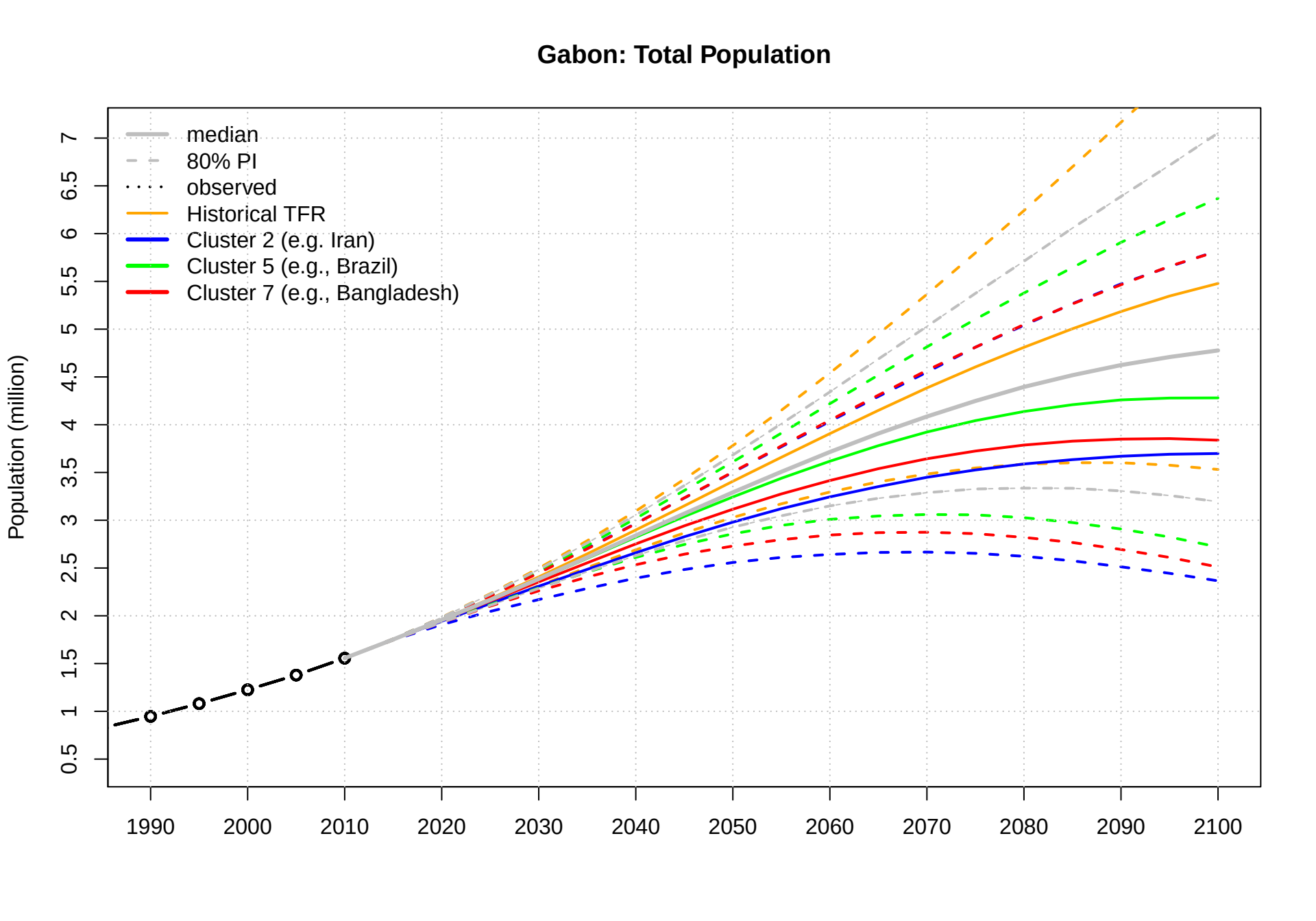

Democratic Republic of the Congo: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

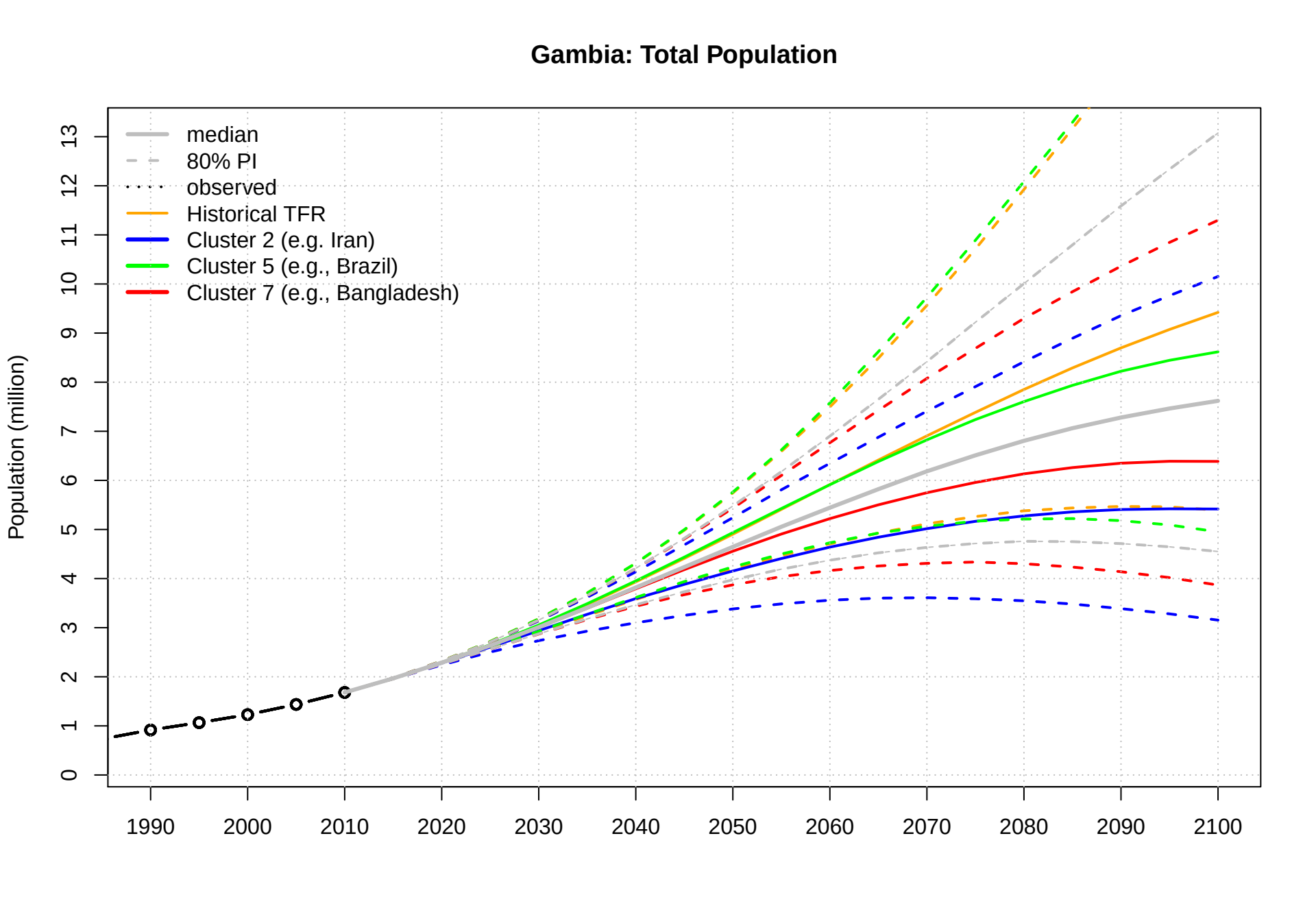

Djibouti: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
50
100
150
200
250
300
350
400
450
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

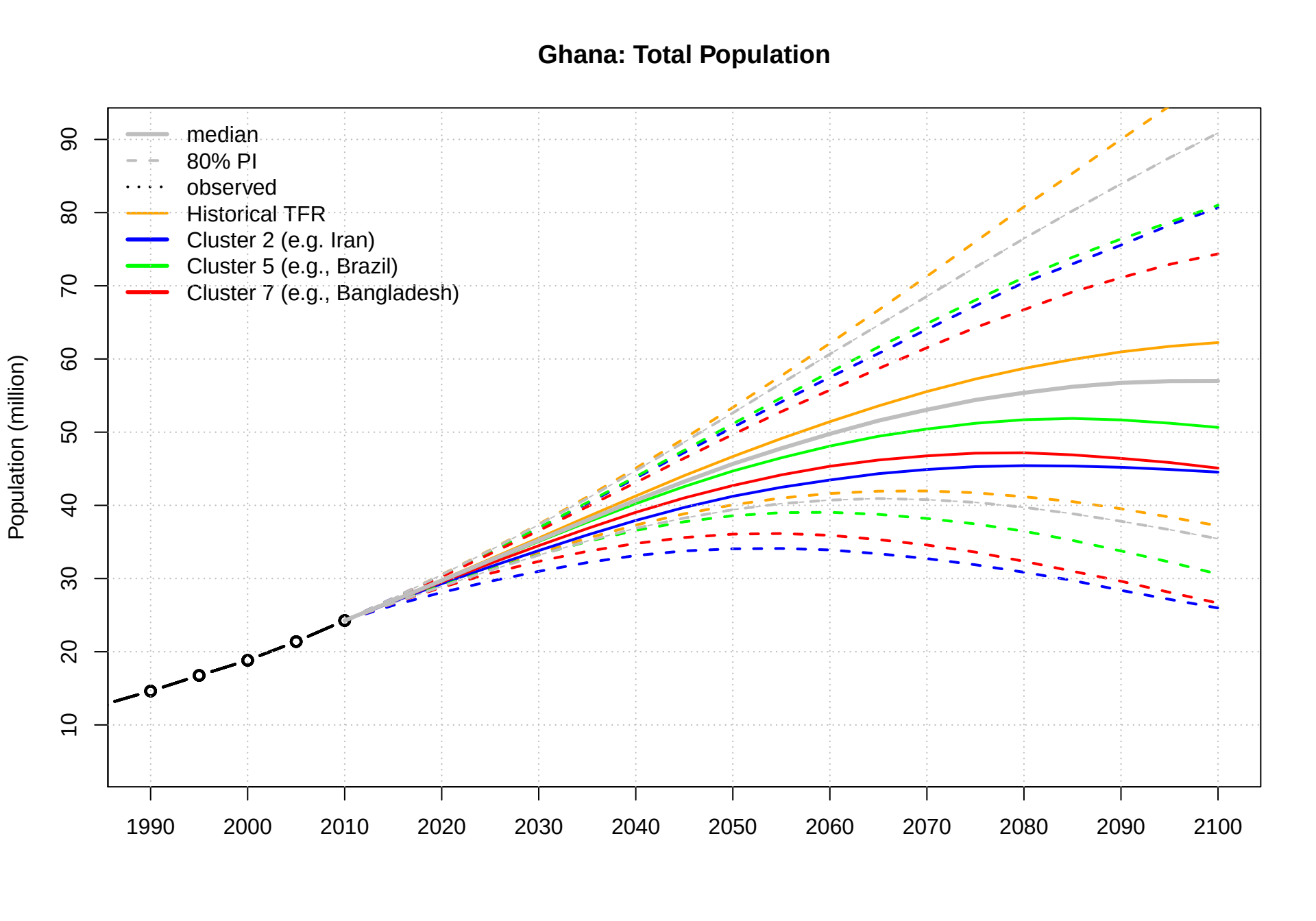

Equatorial Guinea: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0.5
1
1.5
2
2.5
3
3.5
4
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

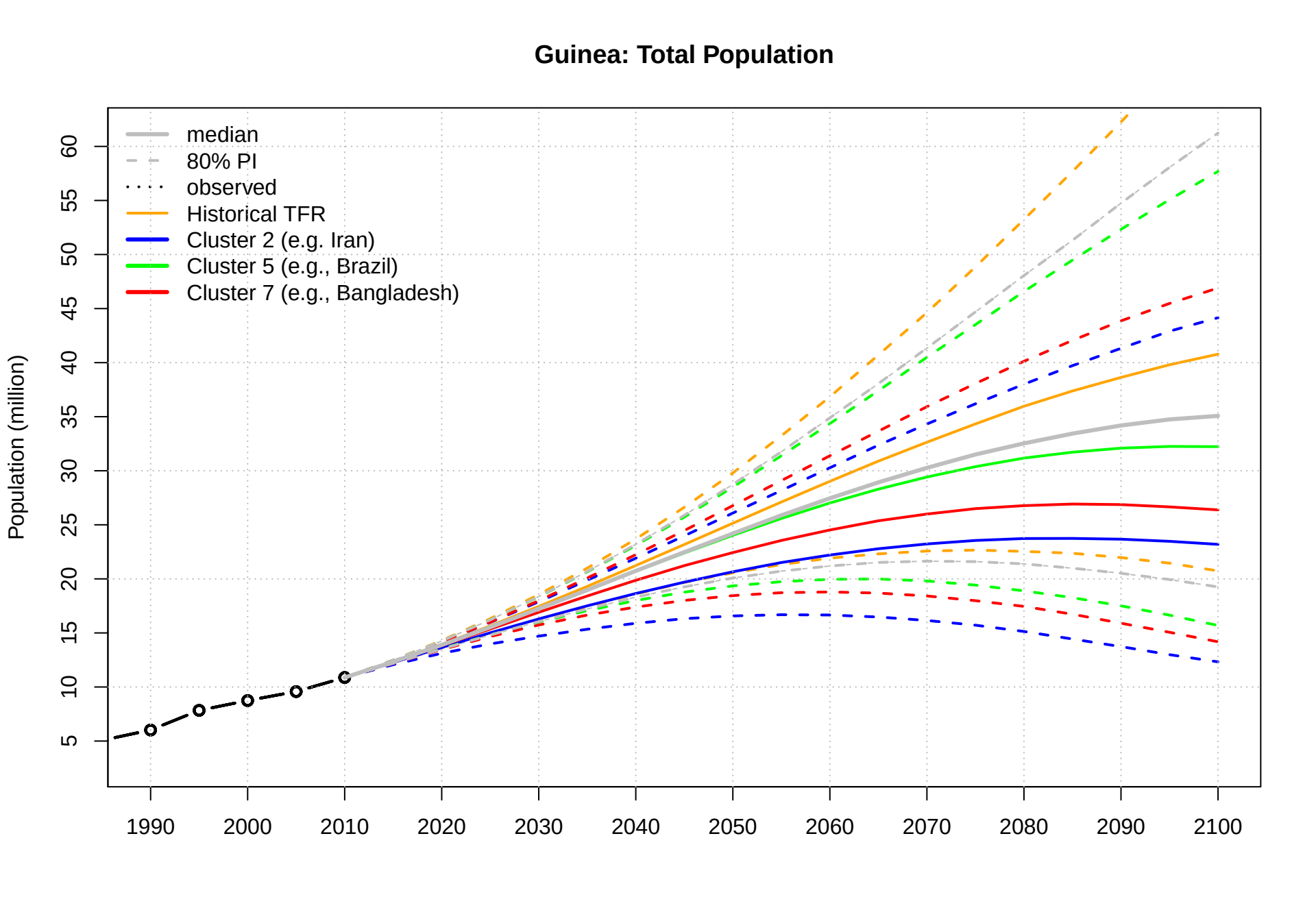

Eritrea: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
5
10
15
20
25
30
35
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

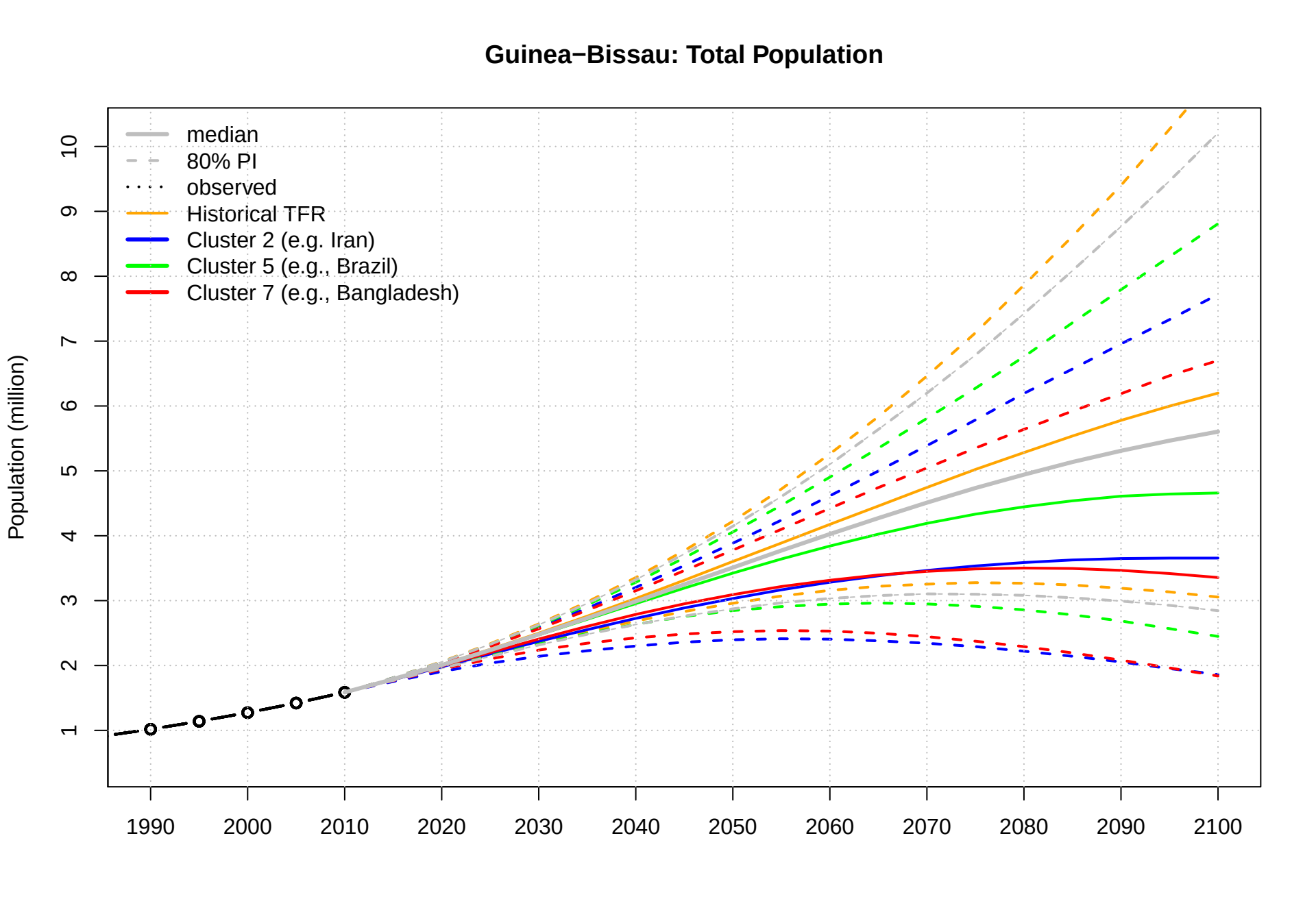

Ethiopia: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
50
100
150
200
250
300
350
400
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

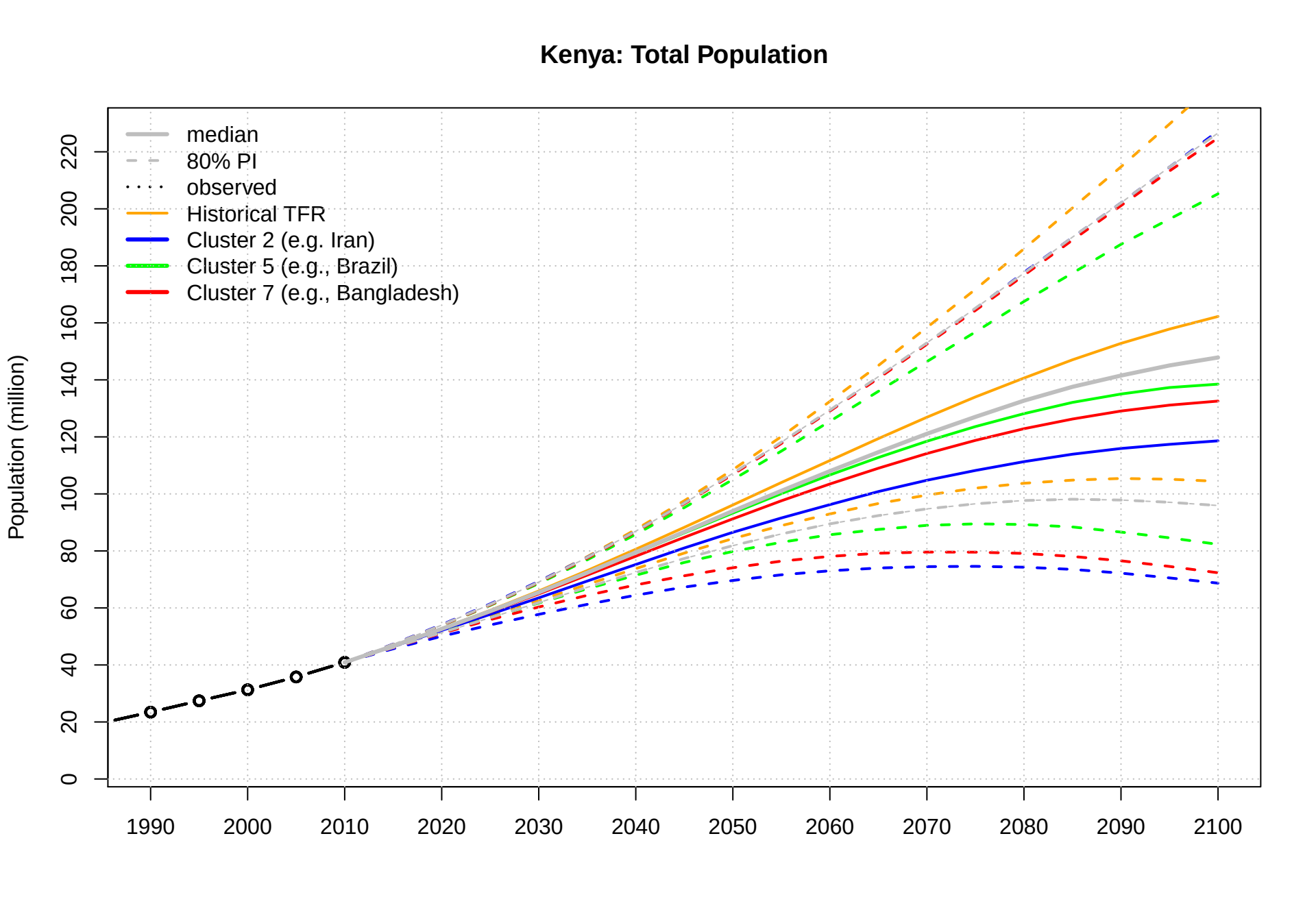

Gabon: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

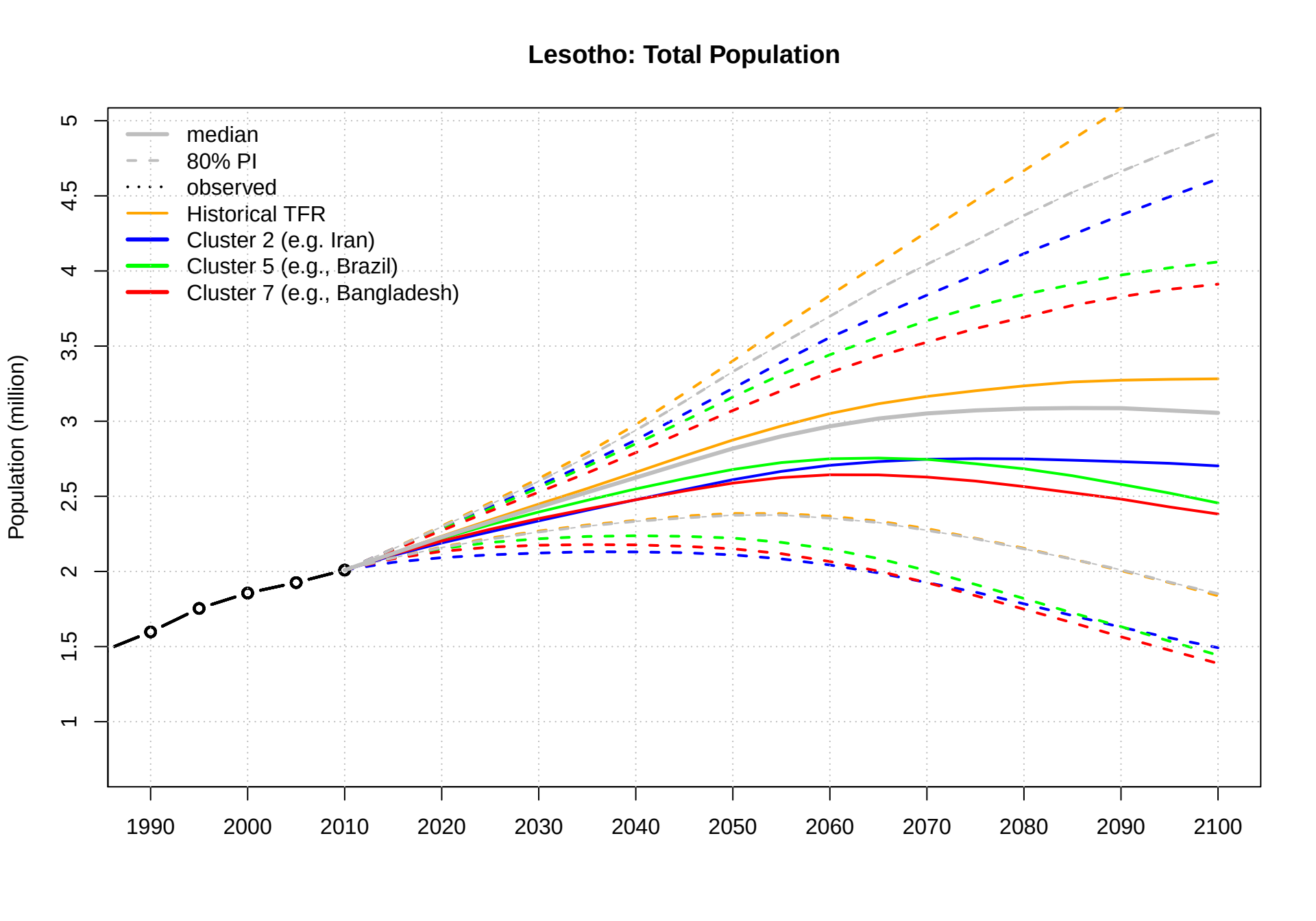

Gambia: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

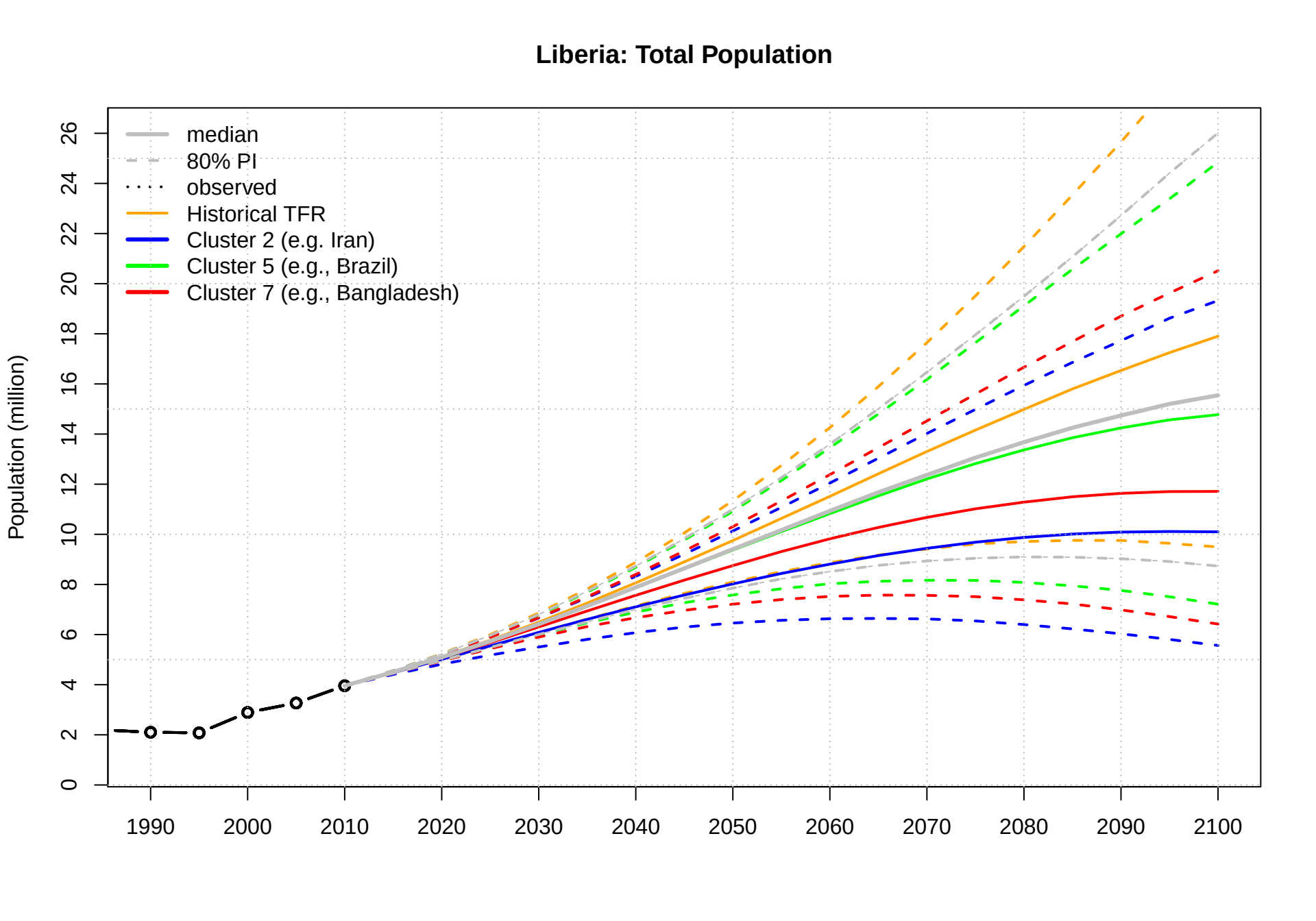

Ghana: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
10
20
30
40
50
60
70
80
90
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

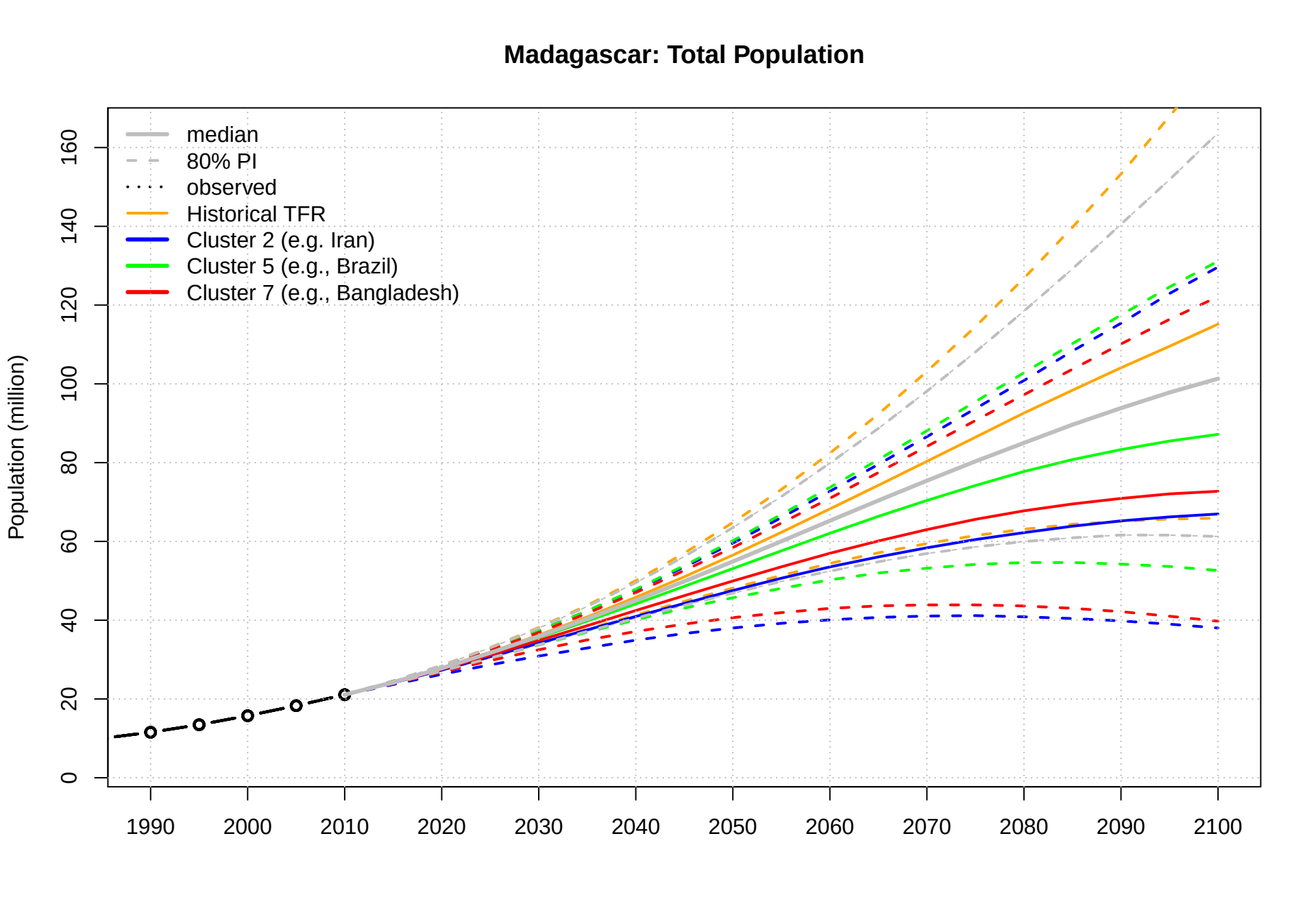

Guinea: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
5
10
15
20
25
30
35
40
45
50
55
60
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

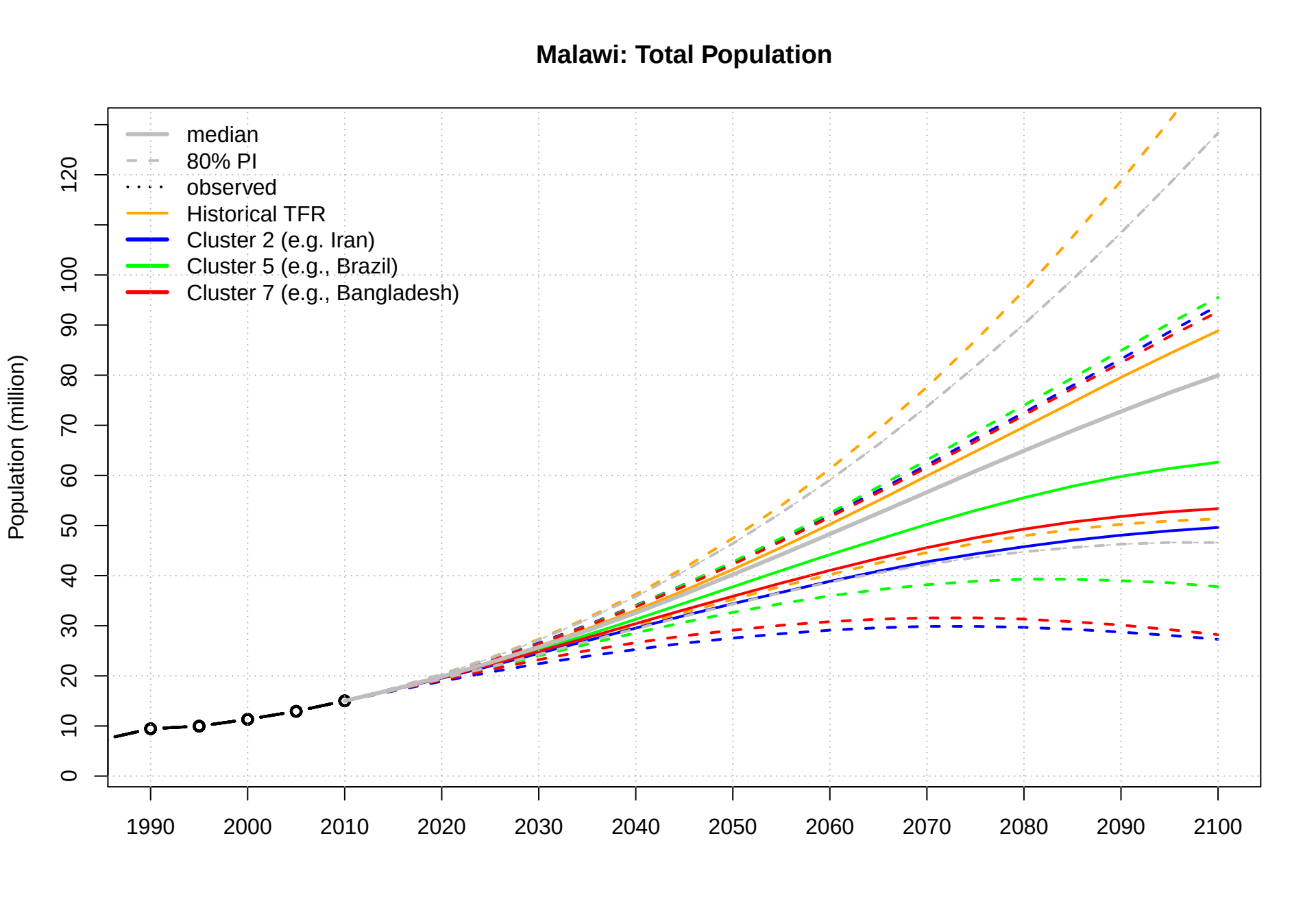

Guinea−Bissau: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
1
2
3
4
5
6
7
8
9
10
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

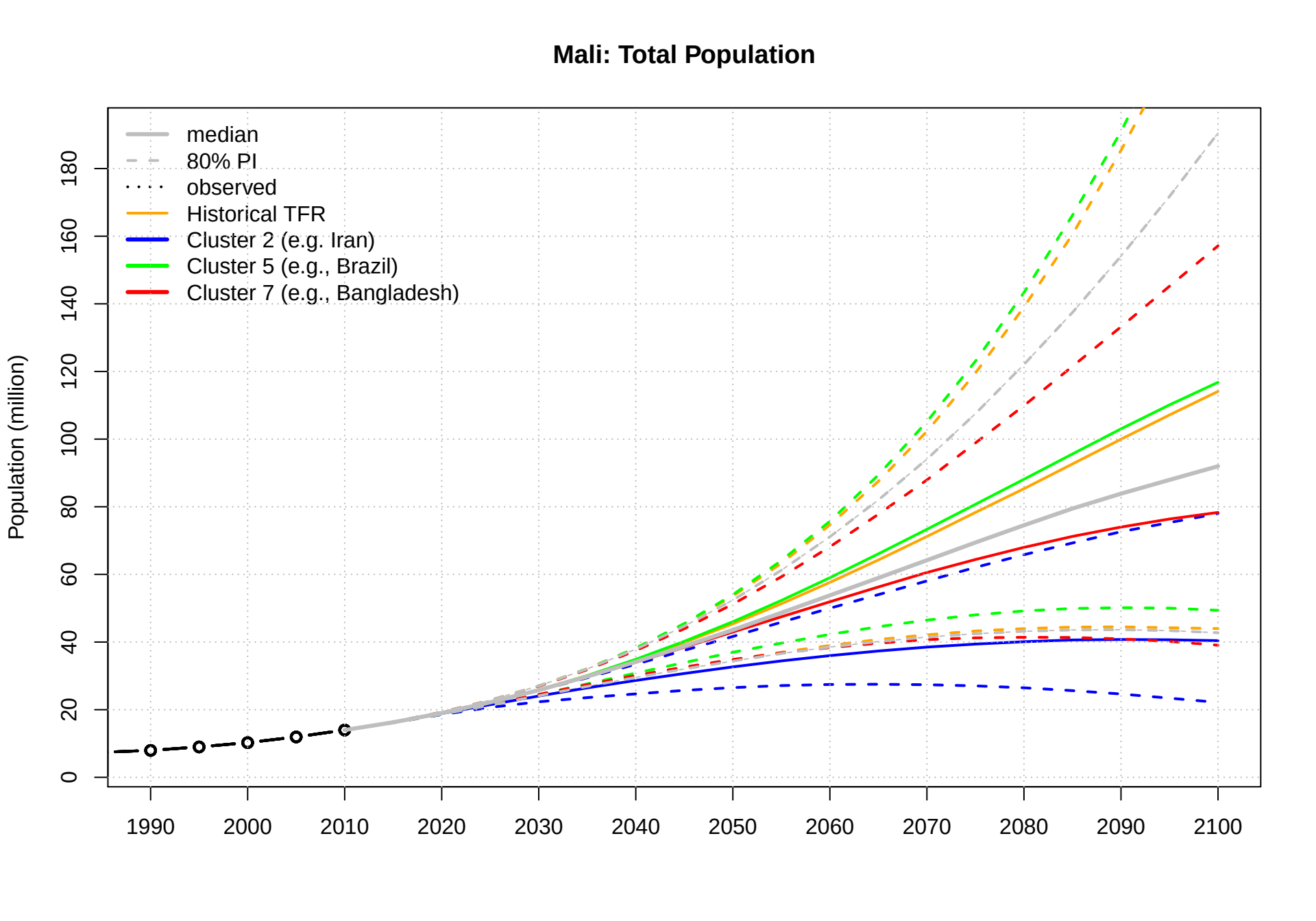

Kenya: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
20
40
60
80
100
120
140
160
180
200
220
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

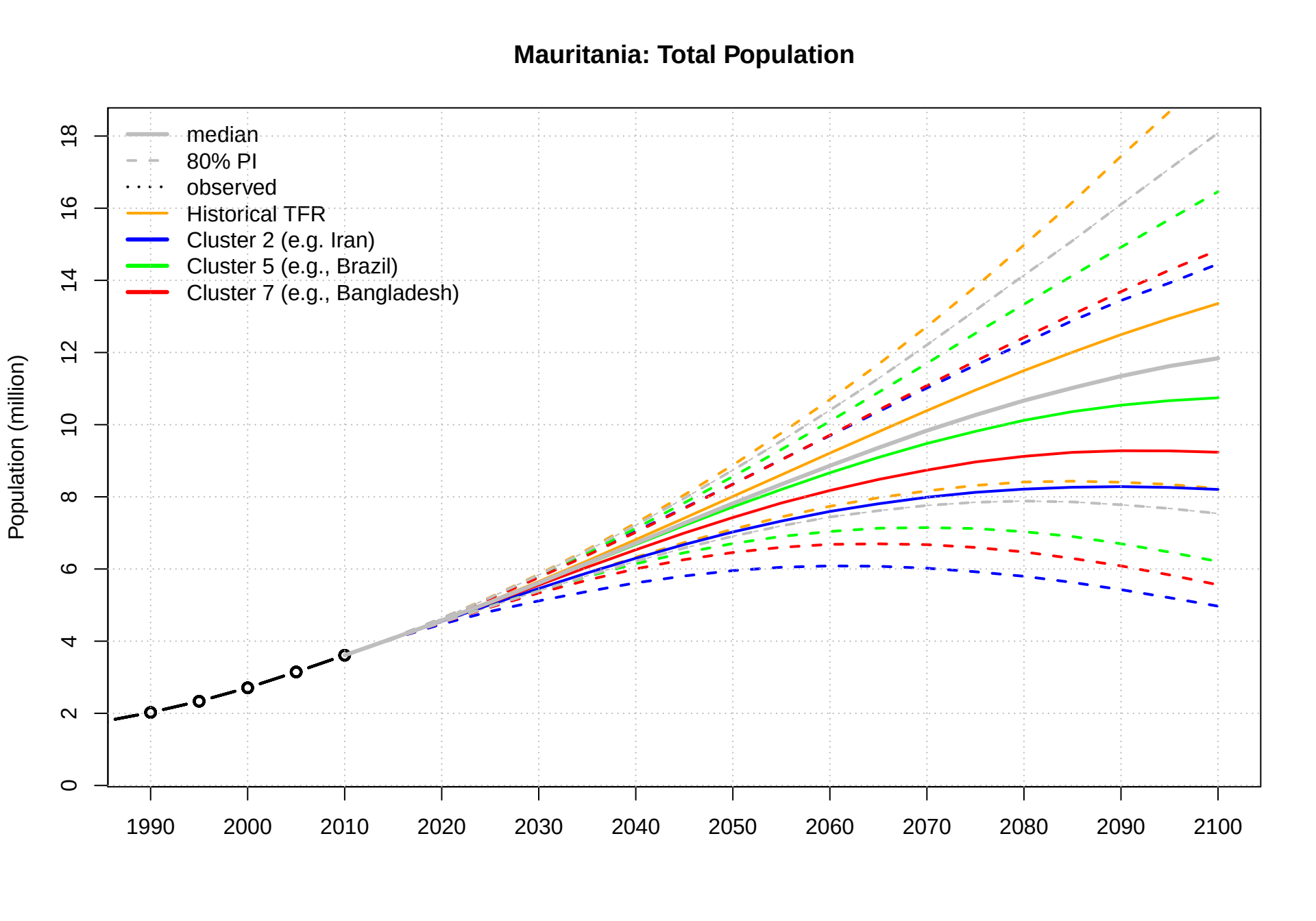

Lesotho: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
1
1.5
2
2.5
3
3.5
4
4.5
5
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

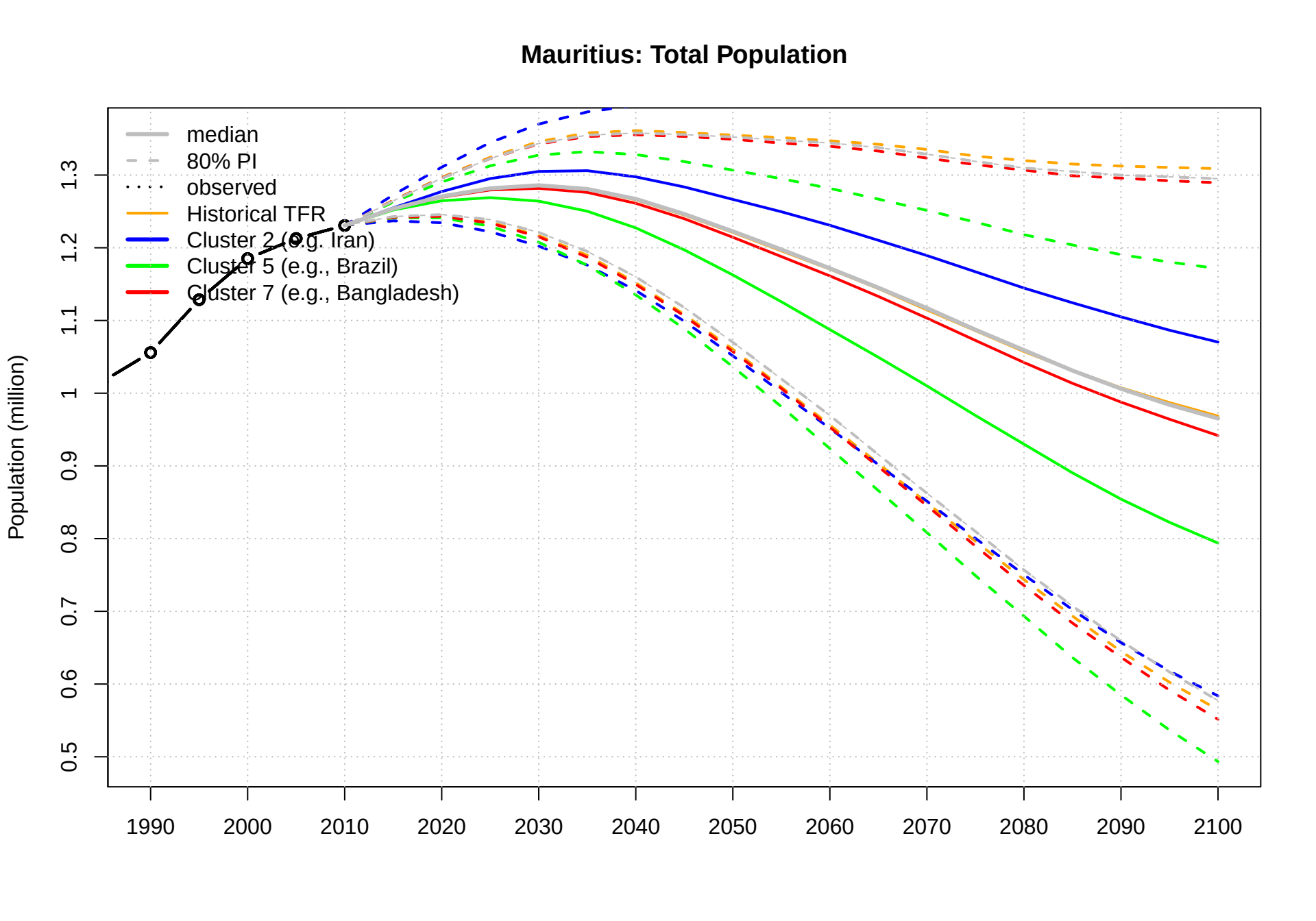

Liberia: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

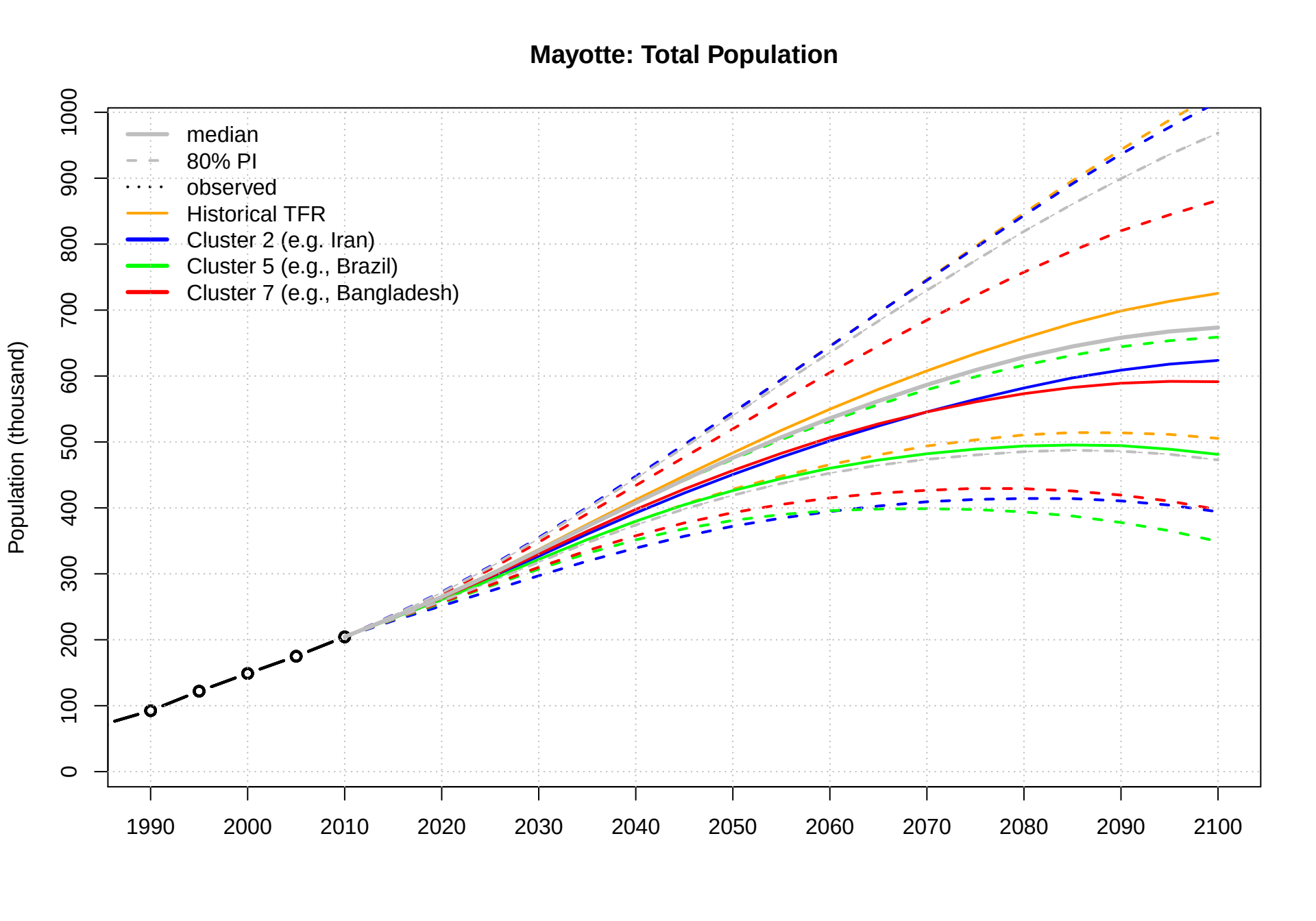

Madagascar: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
20
40
60
80
100
120
140
160
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

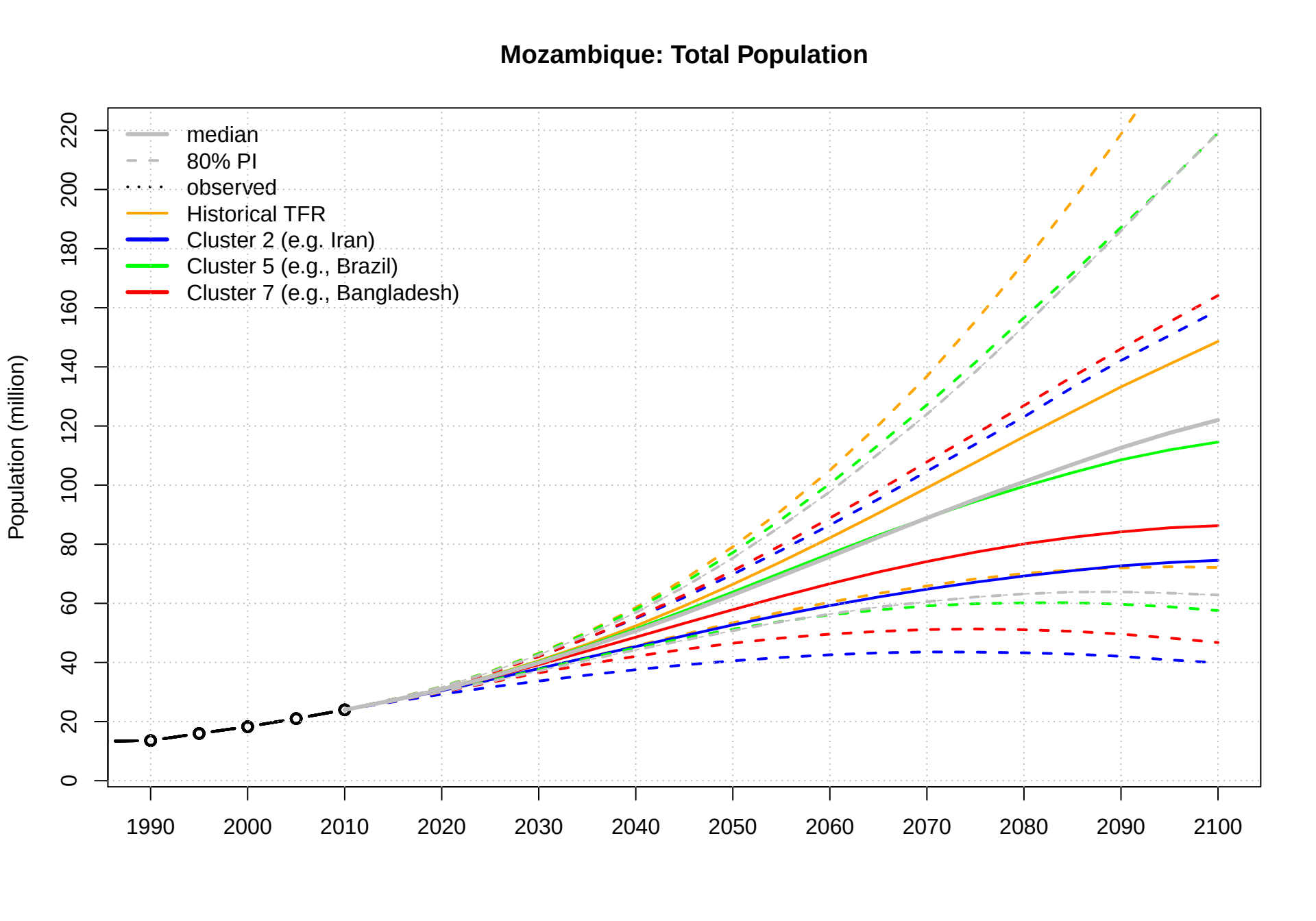

Malawi: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
10
20
30
40
50
60
70
80
90
100
120
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

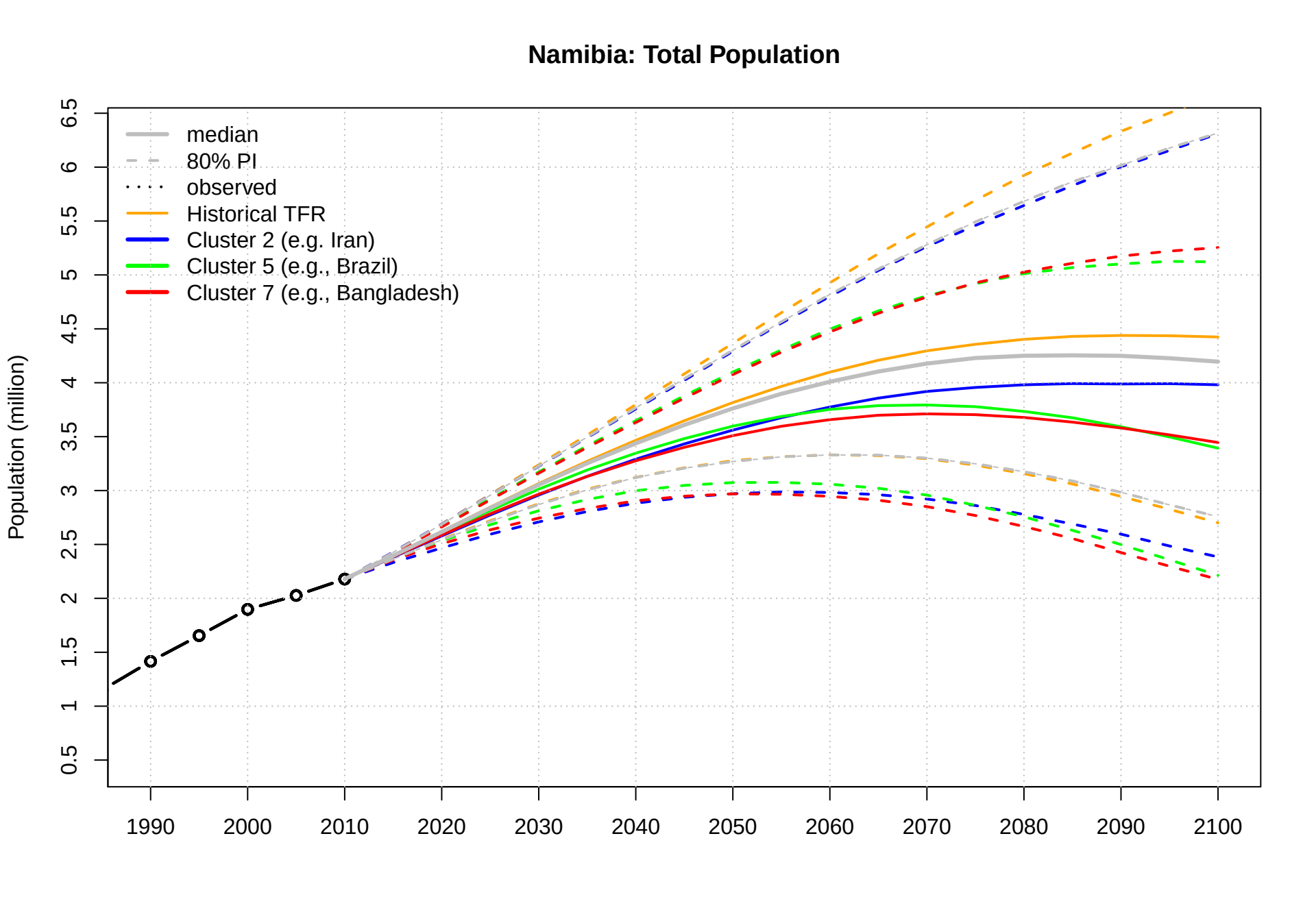

Mali: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
20
40
60
80
100
120
140
160
180
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

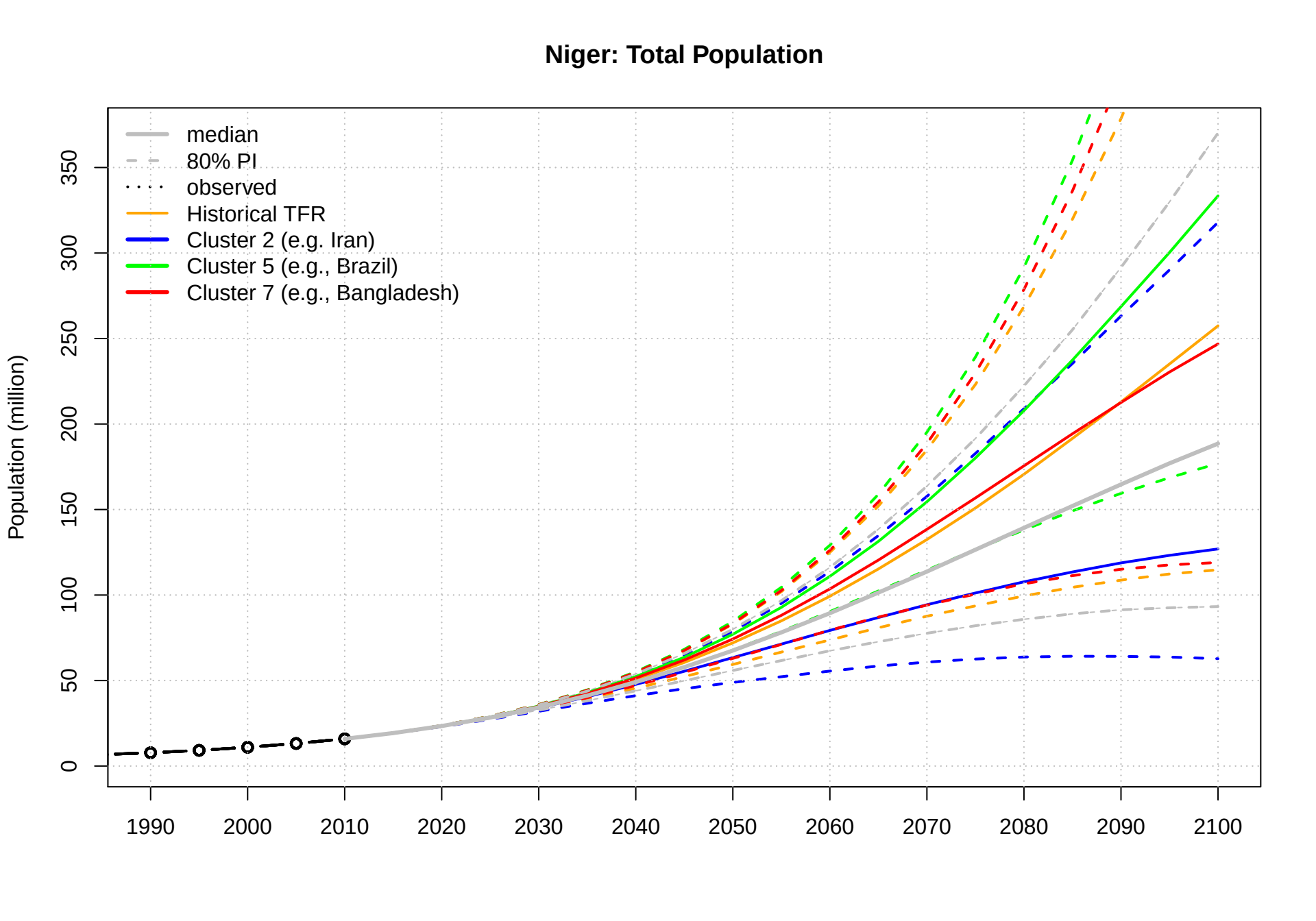

Mauritania: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
2
4
6
8
10
12
14
16
18
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

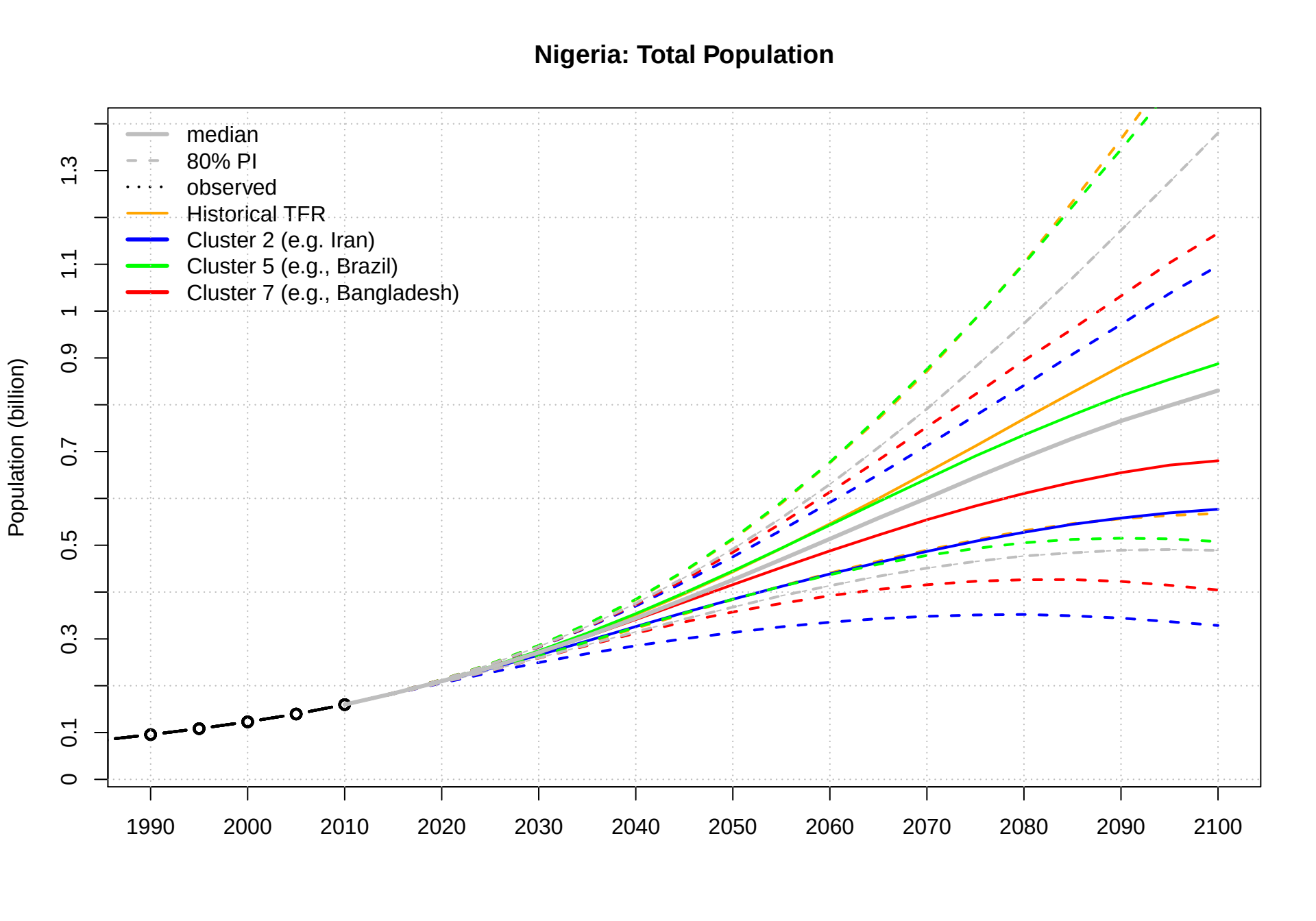

Mauritius: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

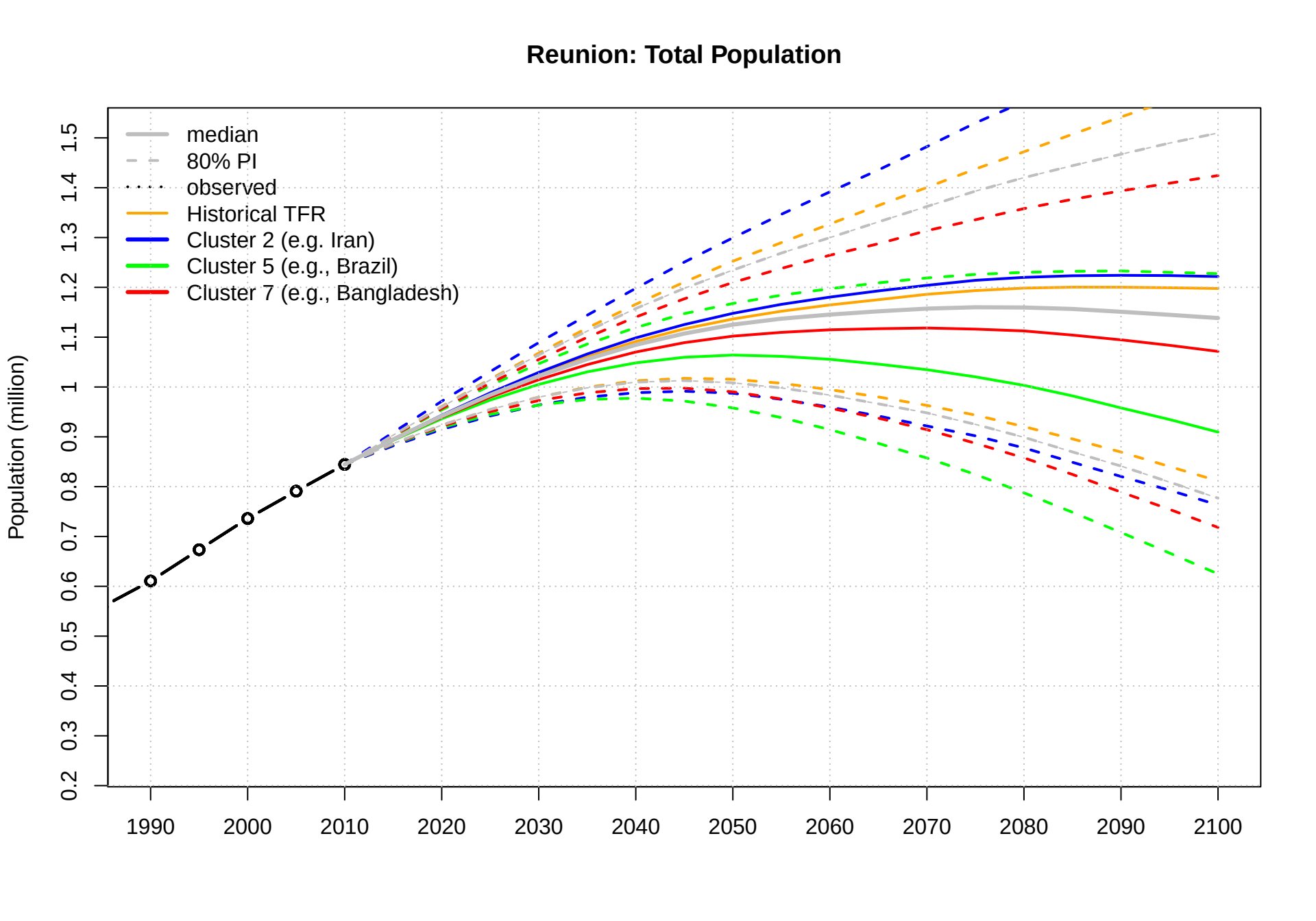

Mayotte: Total Population
Population (thousand)
0
100
200
300
400
500
600
700
800
900
1000
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)

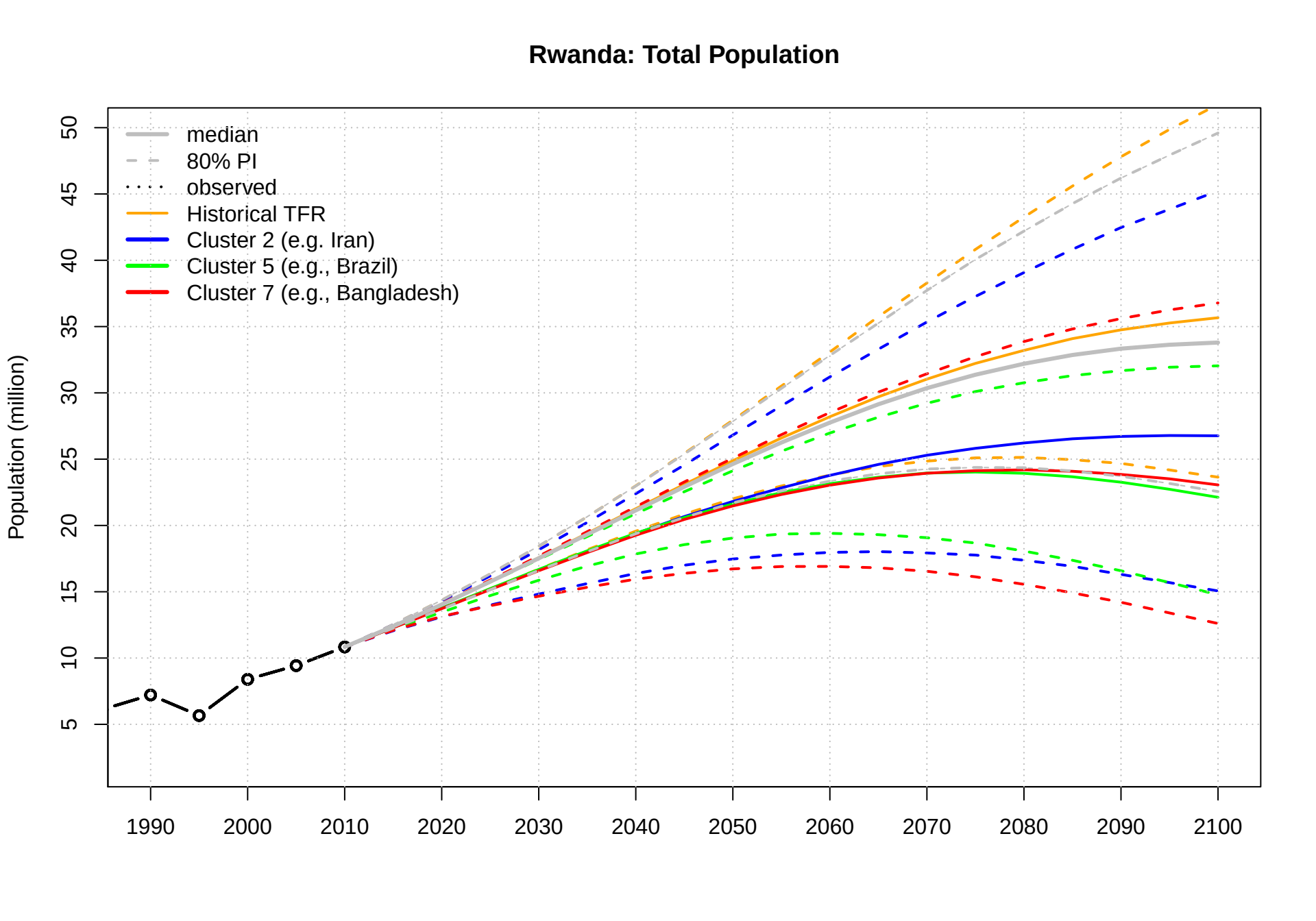

Mozambique: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
20
40
60
80
100
120
140
160
180
200
220
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

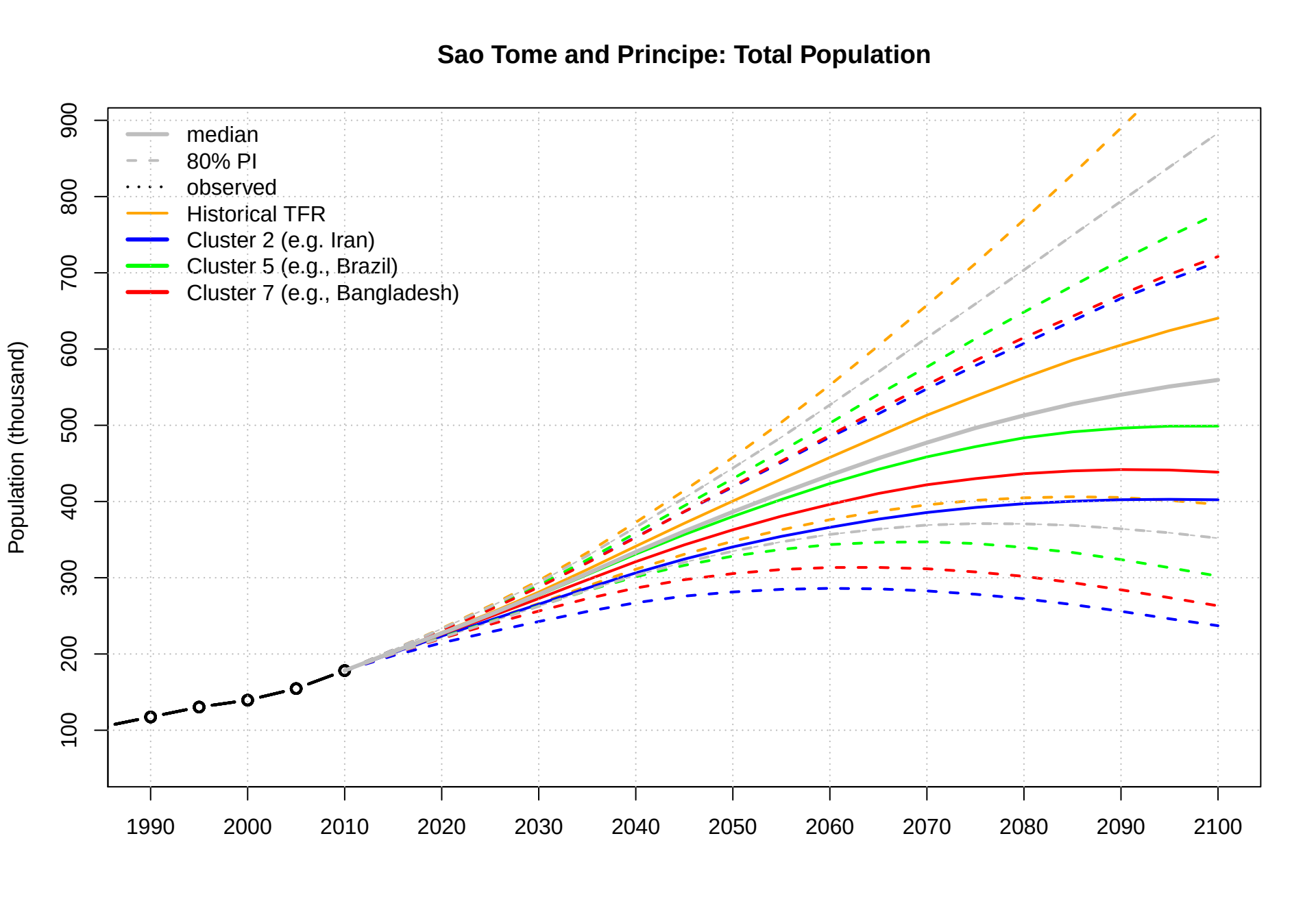

Namibia: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

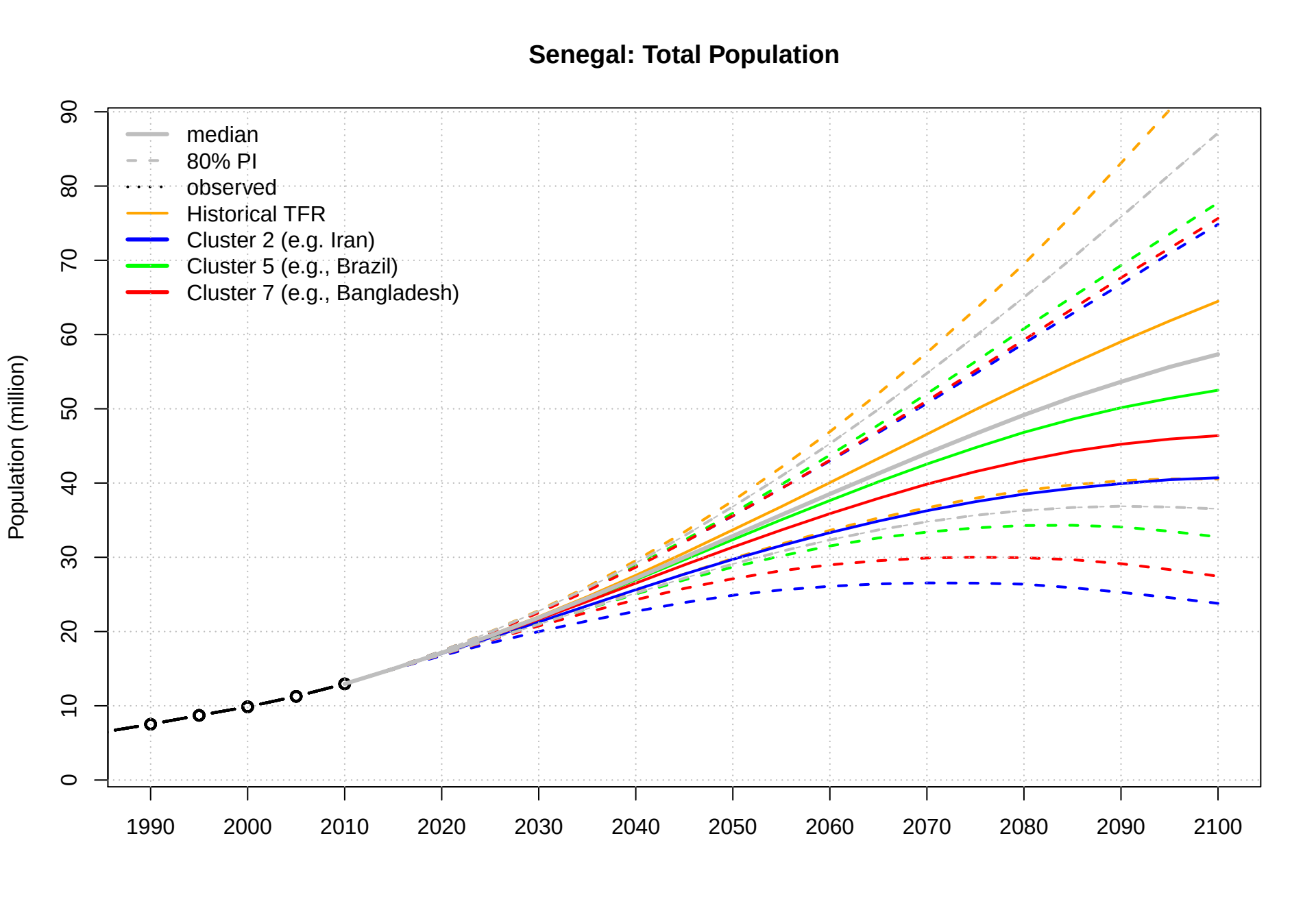

Niger: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
50
100
150
200
250
300
350
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

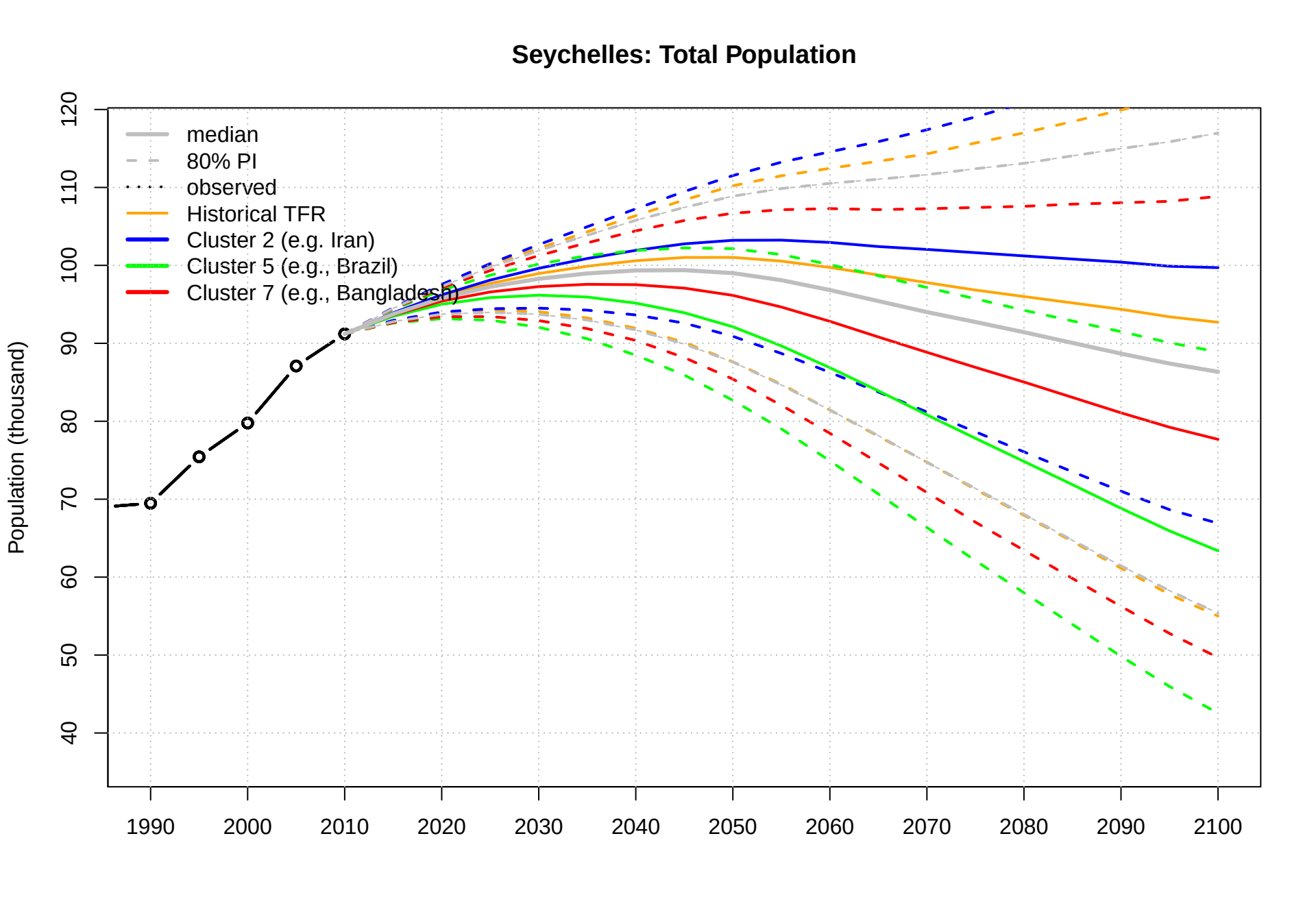

Nigeria: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (billion)
0
0.1
0.3
0.5
0.7
0.9
1
1.1
1.3
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

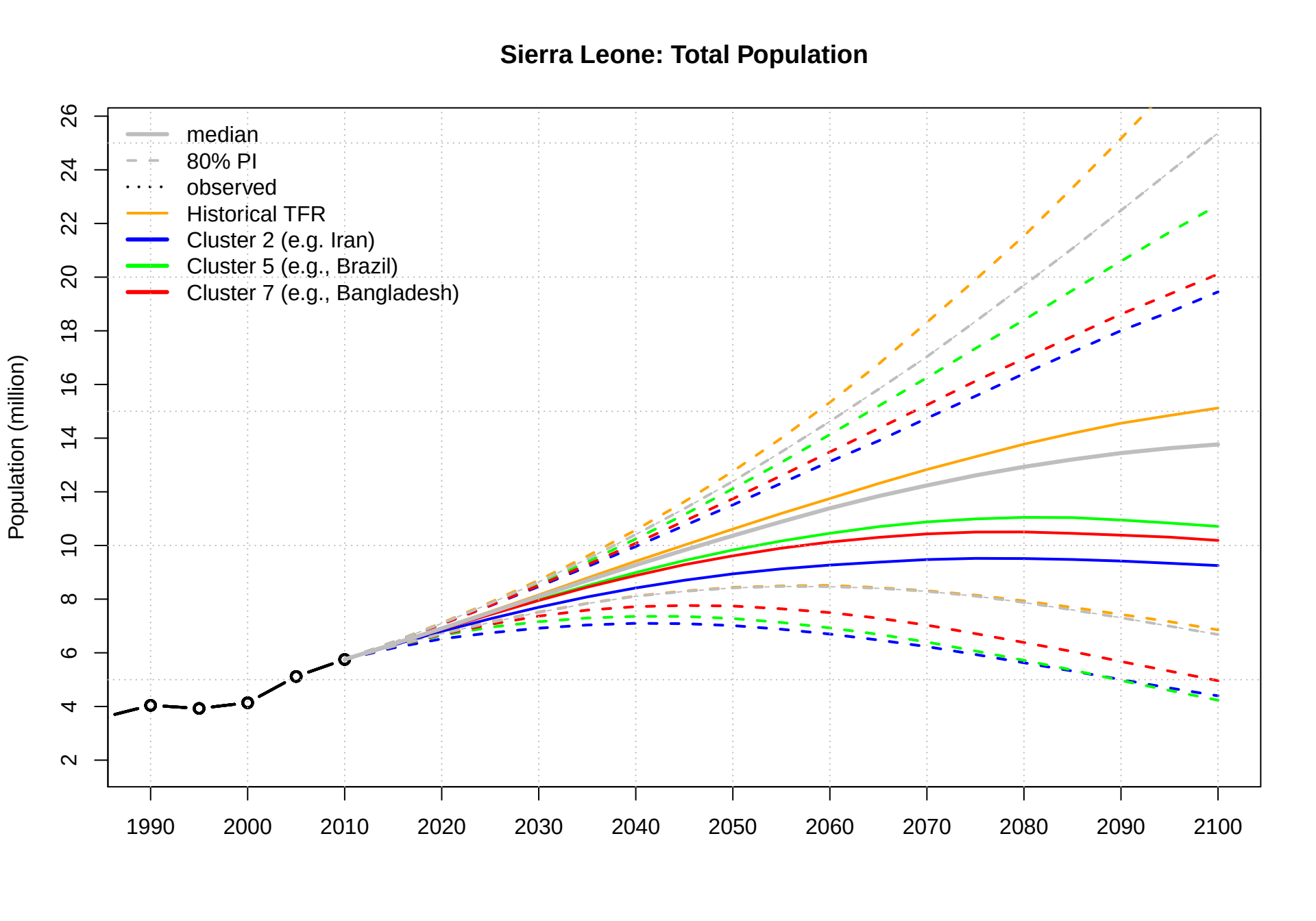

Reunion: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

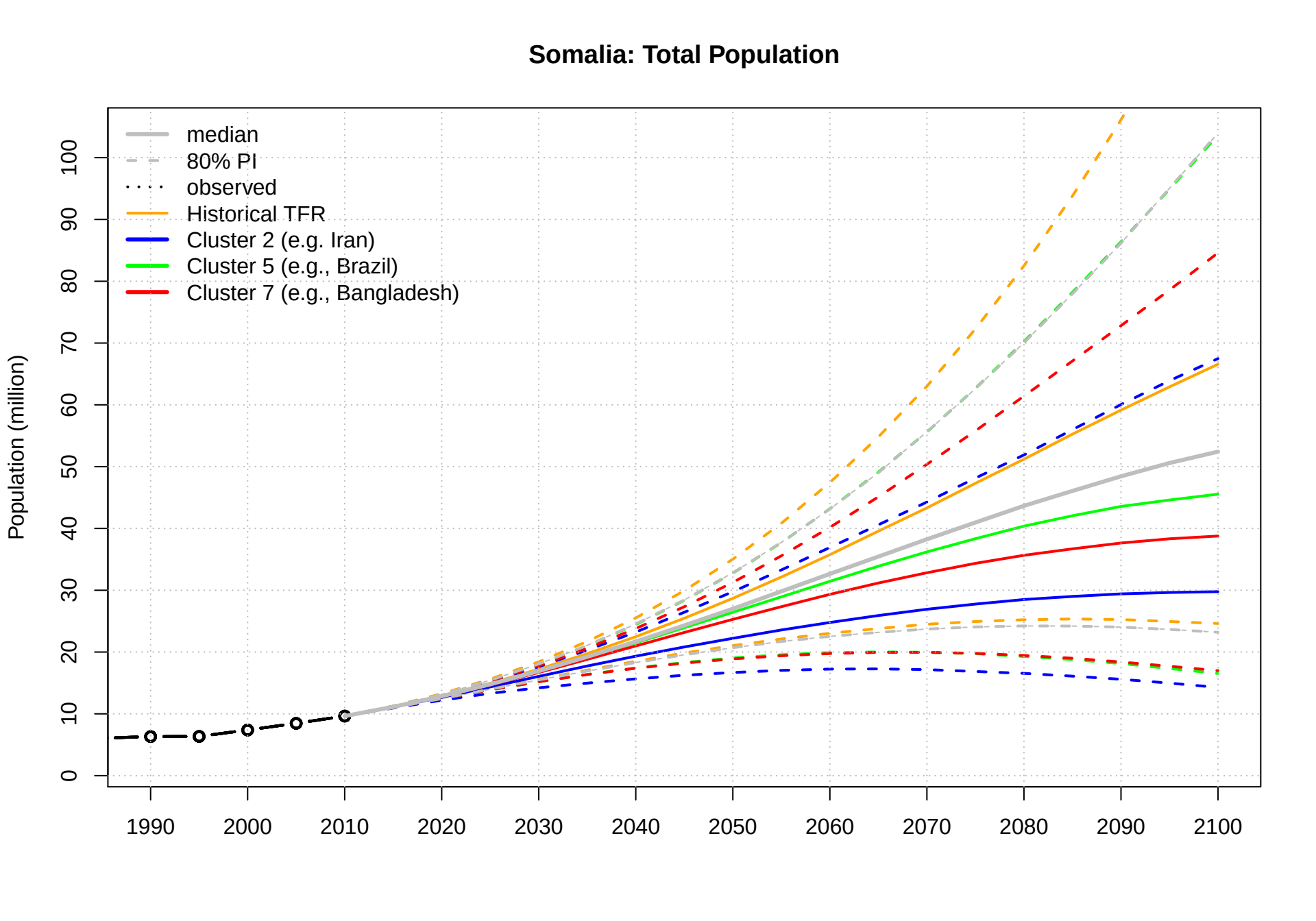

Rwanda: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
5
10
15
20
25
30
35
40
45
50
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

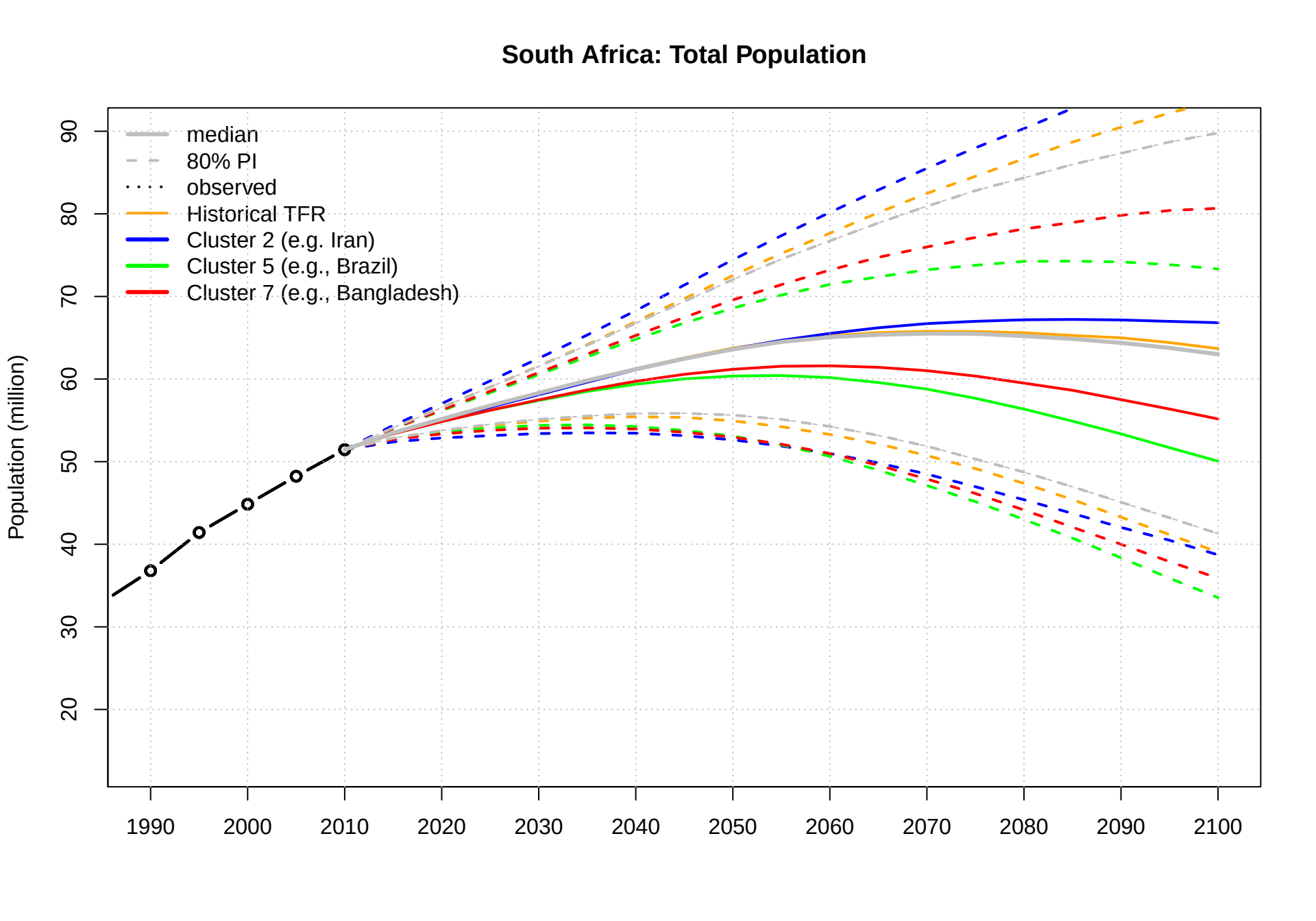

Sao Tome and Principe: Total Population
Population (thousand)
100
200
300
400
500
600
700
800
900
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)

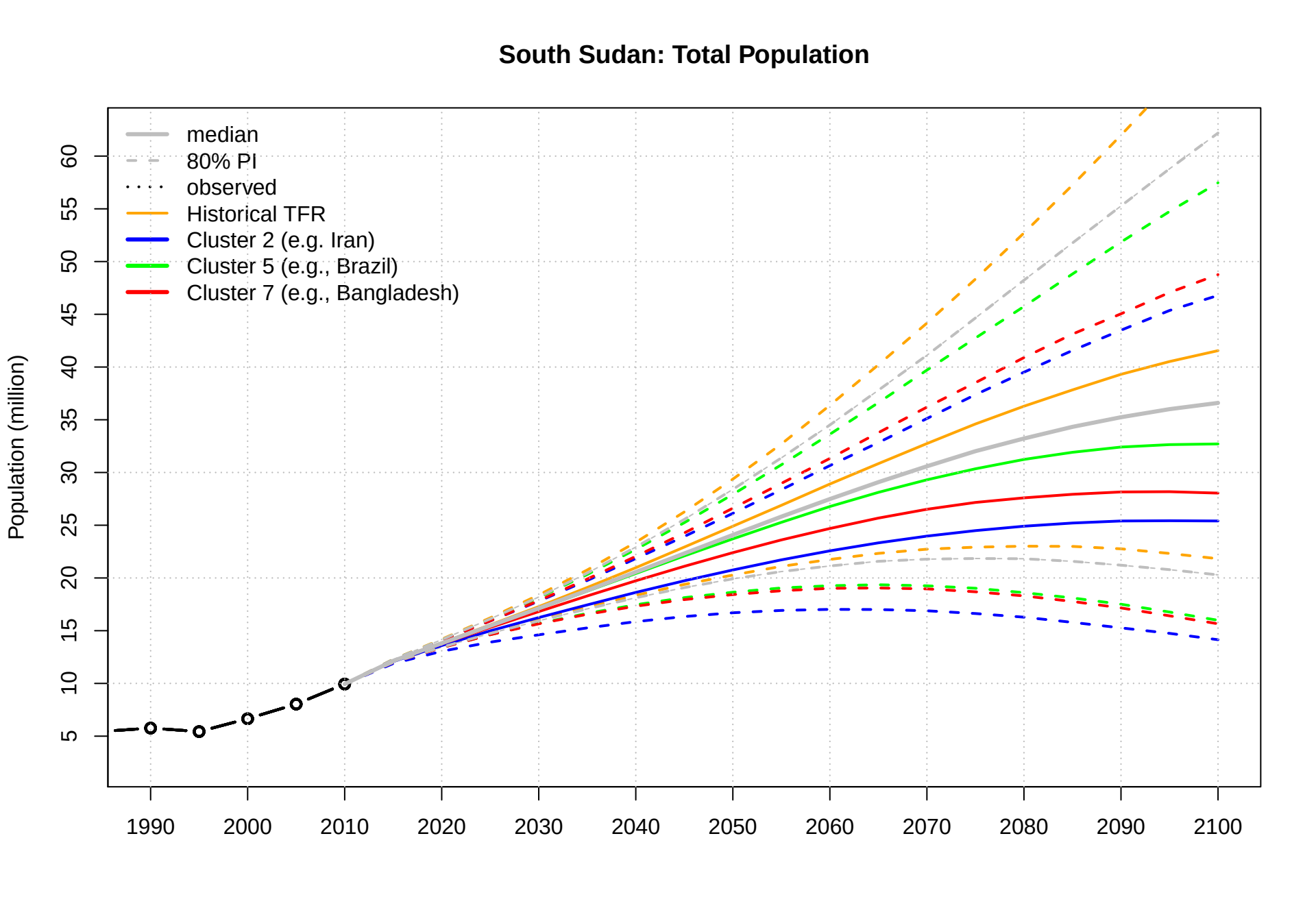

Senegal: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
10
20
30
40
50
60
70
80
90
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

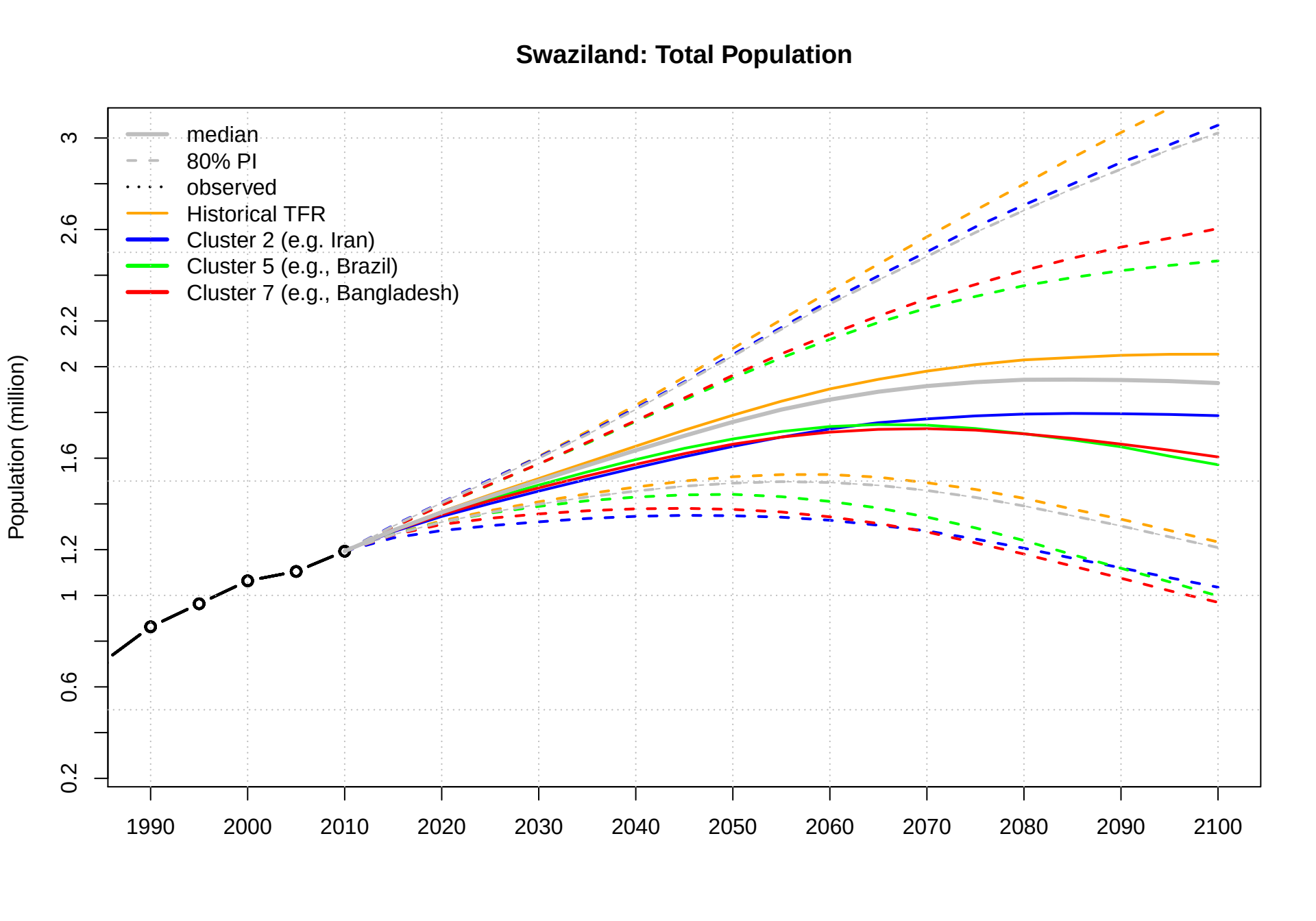

Seychelles: Total Population
Population (thousand)
40
50
60
70
80
90
100
110
120
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)

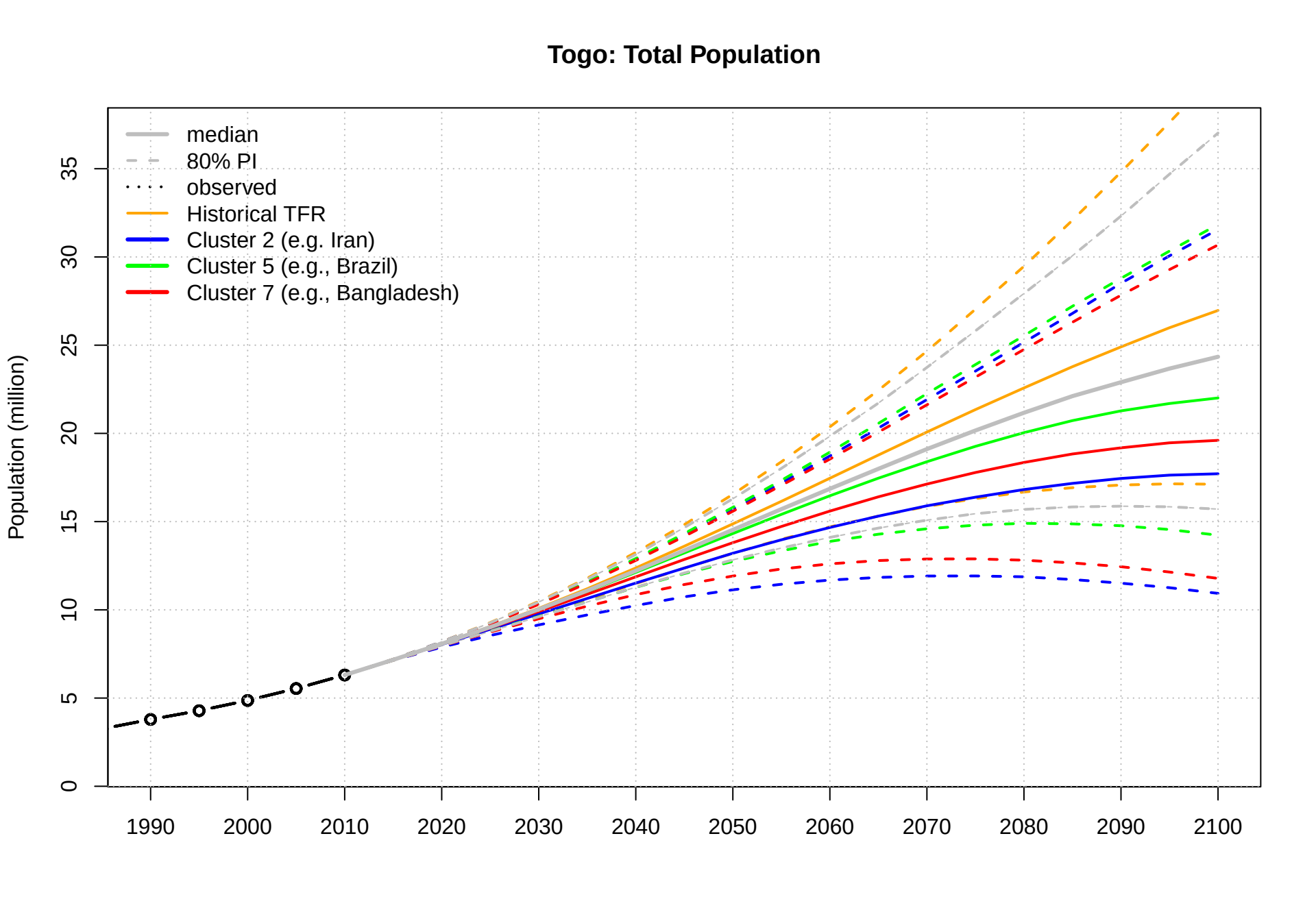

Sierra Leone: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
2
4
6
8
10
12
14
16
18
20
22
24
26
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

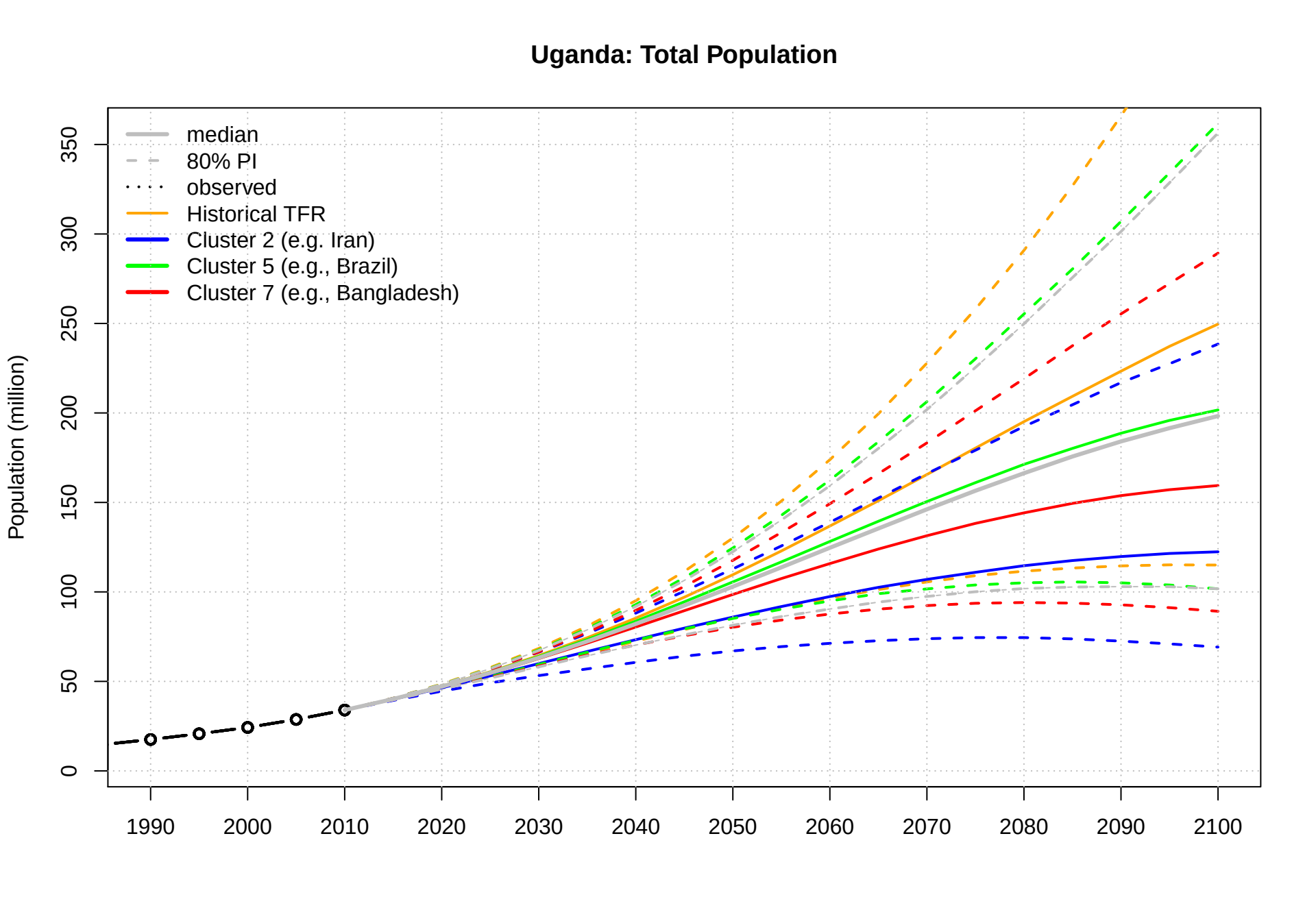

Somalia: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
10
20
30
40
50
60
70
80
90
100
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

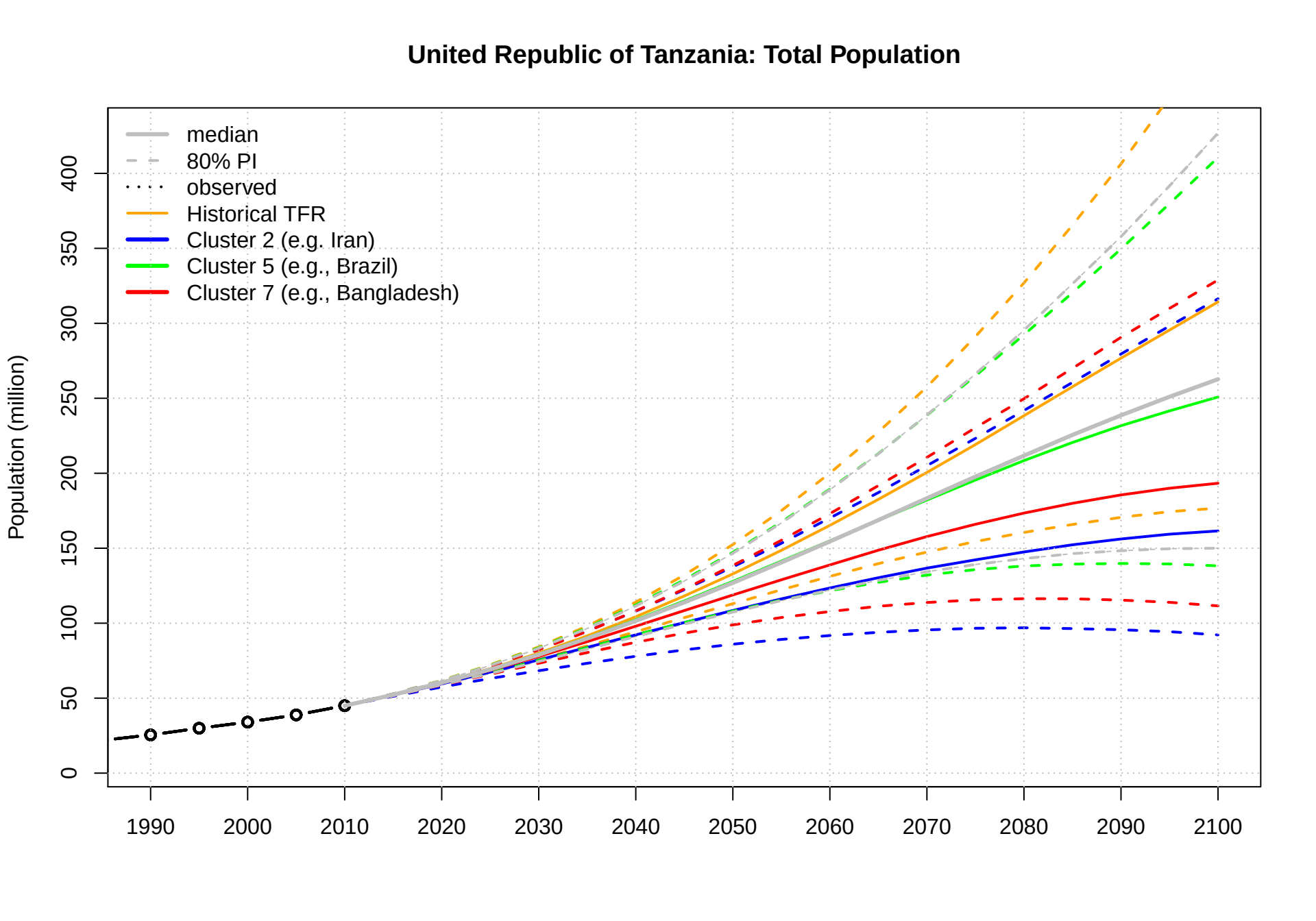

South Africa: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
20
30
40
50
60
70
80
90
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

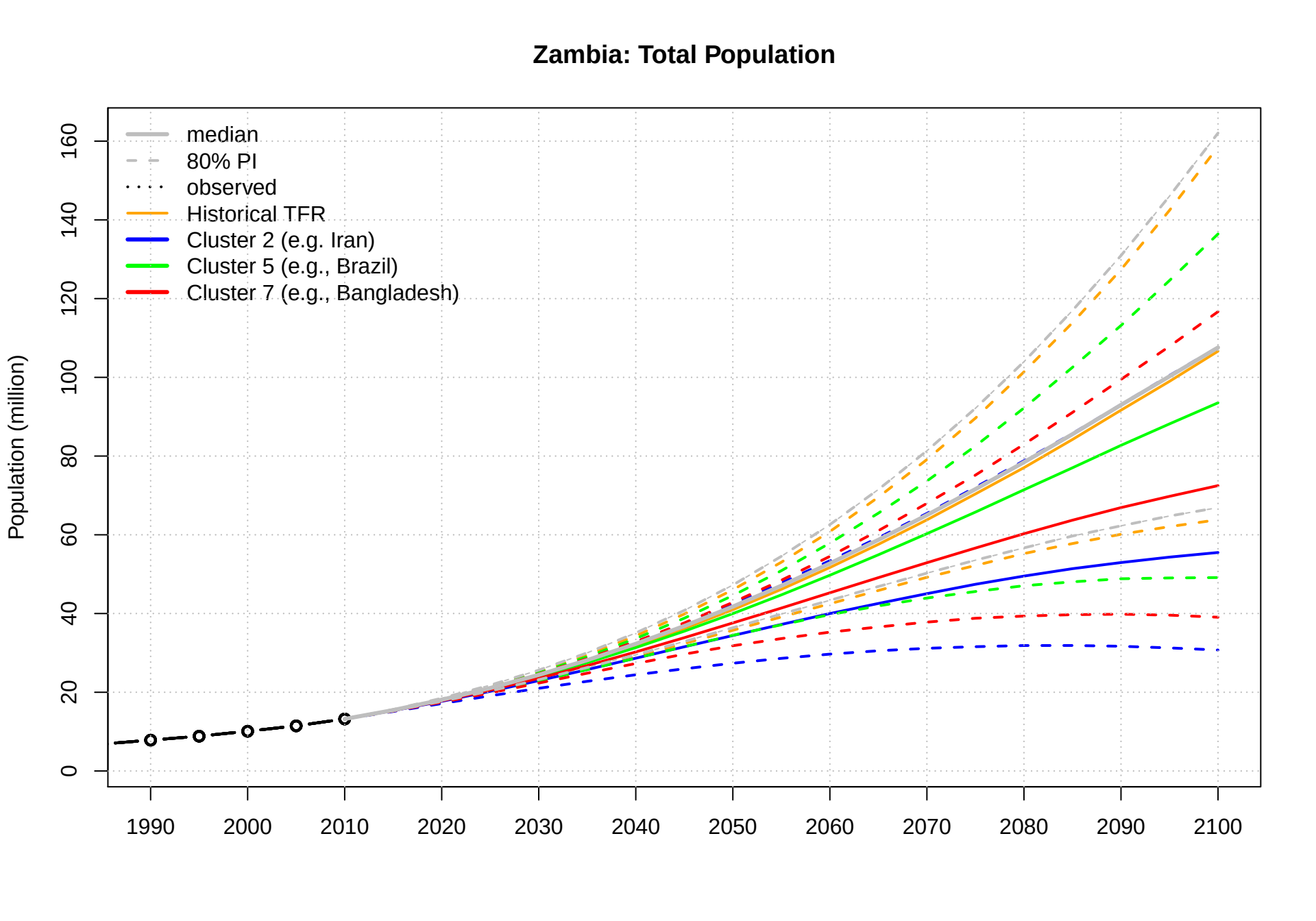

South Sudan: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
5
10
15
20
25
30
35
40
45
50
55
60
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

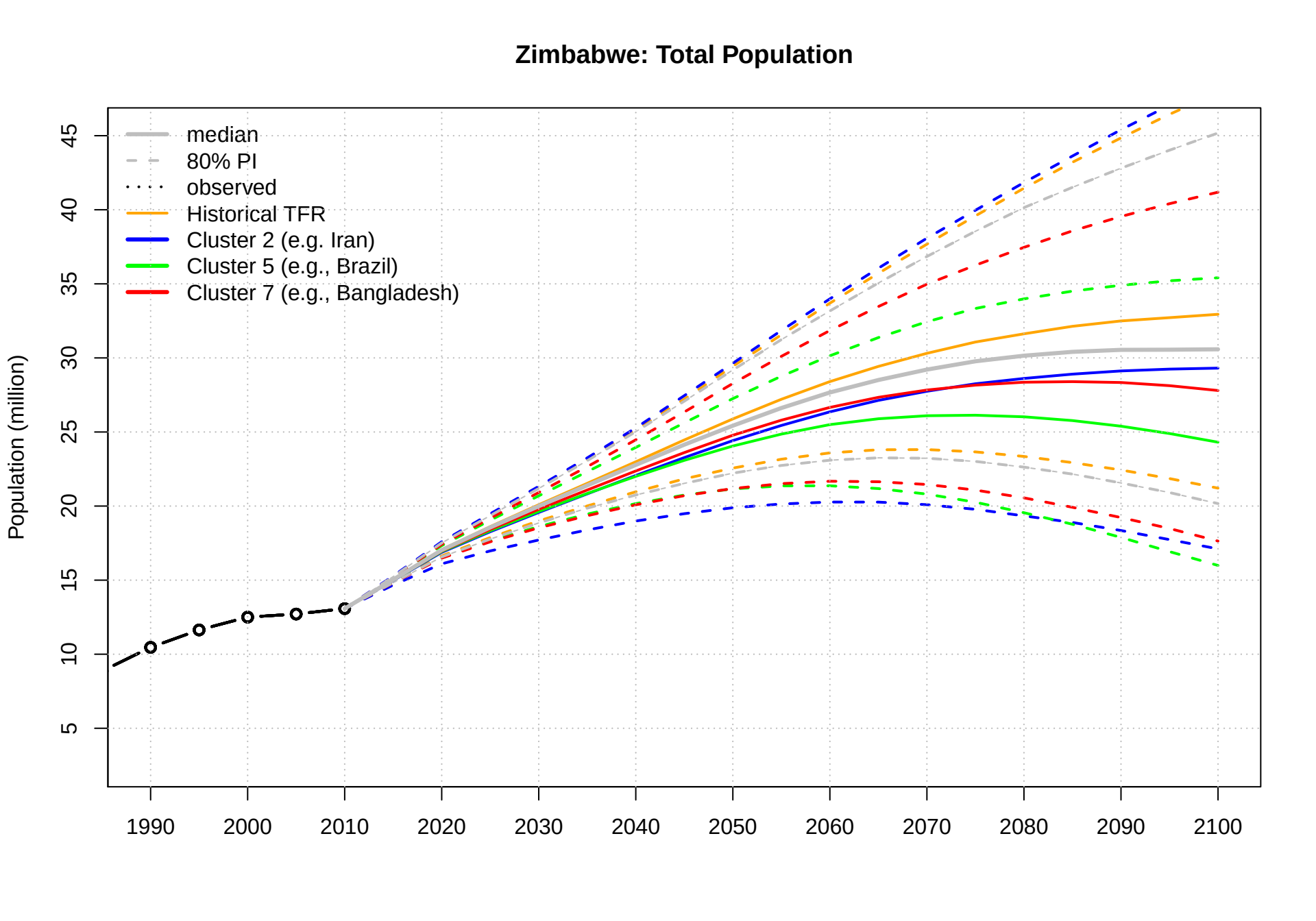

Swaziland: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0.2
0.6
1
1.2
1.6
2
2.2
2.6
3
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100


Togo: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
5
10
15
20
25
30
35
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100


Uganda: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
50
100
150
200
250
300
350
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100


United Republic of Tanzania: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
50
100
150
200
250
300
350
400
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100


Zambia: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
0
20
40
60
80
100
120
140
160
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100


Zimbabwe: Total Population
median
80% PI
observed
Historical TFR
Cluster 2 (e.g. Iran)
Cluster 5 (e.g., Brazil)
Cluster 7 (e.g., Bangladesh)
Population (million)
5
10
15
20
25
30
35
40
45
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100