

# WDA Discussion Paper

*On Demographic Challenges*

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## **Mitigation and Adaptation:** Analyzing and Shaping Demographic Change

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### **Content:**

1. Introduction
2. The Concept of Mitigation and Adaptation
3. Demographic Transition
4. Mitigation: Influencing the Determinants of Demographic Change
5. Adaptation: Coping with the Effects of Demographic Change
6. Policy Formulation



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## Contents

1. Introduction
2. The Concept of Mitigation and Adaptation
3. Demographic Transition
4. Mitigation: Influencing the Determinants of Demographic Change
5. Adaptation: Coping with the Effects of Demographic Change
6. Policy Formulation
7. Conclusion - References

## Abstract

Demography, the statistical study of human populations, has rapidly gained importance in recent political discussions, both in individual countries and multilateral institutions. Demographic data are an excellent starting point for policymaking because they allow for long-term and reliable projections. However, in most cases, demographic issues are addressed in a rather selective manner with a focus on individual topics such as pension systems, migration, or workforce development. A comprehensive view is rather rare. The lack of a holistic view and comprehensive policy approaches entail the risk of acting too late and inadequately to problems brought about by the consequences of demographic changes. The concept of mitigation and adaptation, developed and successfully applied in other fields, has great potential when applied to demographic issues. The concept does not explain demographic change, nor is it a generator of solutions. But it can form a useful framework and heuristic approach for understanding demographic change, classifying challenges, and deriving measures and policies. Precisely because the concept is not a closed model, it invites the consideration of research findings from very different fields.

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## About the WDA Forum

*As a Think Tank, the WDA Forum actively shapes the discussion on demographic topics. We work closely with the Institute of Insurance Economics at the University of St. Gallen as well as other educational and research institutions including the Harvard T.H. Chan School of Public Health in Boston, Stanford University in California, American Enterprise Institute in Washington/DC, Population and Ageing Centre at the University of New South Wales in Sydney, Fudan University in Shanghai, and Swissnex Network of Science and Technology.*

*The WDA Forum was founded in 2002 and is based in St. Gallen, Switzerland.*

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## 1. Introduction

Like climate change and digitalization, demographic change is one of the megatrends that will significantly affect all areas of life on the planet in the long term. However, policymaking in this area is still poorly developed. This neglect is not due to a lack of demographic knowledge or to insufficient scientific research. These are available on a large scale and of good quality.

The reasons for neglect are complex. Questionable pro-nativist policies have damaged the reputation of population policy and science. Some proposed solutions are controversial and politically contentious, at times to the point of being taboo. Indeed, this is also true for what gets identified as a problem in the first place. Religious beliefs play an important role as well. Because demographic issues are long term in nature and relate to the most personal aspects of life – birth and death – they have a hard time in the political process. Politicians usually think in terms of election cycles and predefined subject areas, but demographic change cannot be shaped this way.

In today's multilateral discussions, the focus is less on the longer-term development opportunities of countries and societies and much more on claiming individual rights. Such a one-sided focus – as important as the rights of individuals are – runs the risk that longer-term perspectives for society are neglected. This is true of, among others, the UN's Sustainable Development Goals (SDGs, Agenda 2030), the earlier Millennium Development Goals (MDGs), and the 1994 International Conference on Population and Development (ICPD), which was particularly important in the context of demography, with its Program of Action (UNFPA 2014).

All this makes it challenging to raise demographic issues in political discussions. As a result, the pressing problems from population trends intensify, and the burdens are transferred to future generations, who have increasingly less time to react effectively.

On the other hand, demographic analysis and forecasting tools have steadily improved over recent decades, and a lot of valuable knowledge has been acquired. Fortunately, there is no end in sight to this positive development. However, findings and tools are only of practical use if they find their way into political discussions, policy decisions and, finally, the implementation of concrete measures.

Mitigation and adaptation is a concept that is suitable for presenting larger contexts, classifying developments, and pointing to options for political action. There are two policy-relevant levels of intervention: Mitigation means acting on causes to avoid undesirable developments or damage; adaptation means limiting and managing unfavorable or difficult effects. The paired approach of mitigation and adaptation has proven useful in fields other than population science (law, epidemiology, risk management, climate policy, cybersecurity, etc.). It is worthwhile to evaluate this approach and consider its usefulness for demography.

To this end, the concept of mitigation and adaptation is briefly presented. Then, with the demographic transition model, it is linked to the determinants and impacts of demographic change. The demographic transition model does not cover all relevant aspects of demographic change, which include, for example, the spatial distribution of the population or changes in the composition of the population according to criteria other than age and gender, such as ethnicity, education, health, or wealth.

## 2. The Concept of Mitigation and Adaptation

Demographic developments can be addressed at two different levels. Mitigation targets the causes of demographic change. It is about influencing the determinants of demographic dynamics, i.e., fertility, mortality, and migration. The term mitigation originated in Anglo-Saxon criminal law and refers to factors that mitigate the severity of a crime or its punishment by making the defendant's behavior understandable. Today, the term is widely used and means diminution or avoidance.

In contrast, adaptation aims to manage – or learn to cope with – the consequences of demographic change. In general terms, adaptation means the adjustment of people to their social and physical environment. In the context of demographic development, it is about coping with phenomena such as the aging of a population, extreme urbanization, urban sprawl, etc., not by breaking the actual dynamics, but by seeking and implementing measures that lessen or counteract their negative effects.

Policy formulation in this approach is the design of appropriate mitigation and adaptation measures based on proven or innovative solutions using demographic knowledge and data.

Before elaborating further on the usefulness of the concept of mitigation and adaptation for population policies, it is worth pointing out some of the areas where they are being applied (regardless of what terminology is being used in those contexts).

In epidemiology or pandemic response, a mitigation and adaptation approach has long been in use. Mitigation measures contain the spread of a pathogen by reducing the number of new infections, thus avoiding overloading the health care system. Measures with this purpose include vaccinations, distance rules, masking requirements, hygiene measures, exit restrictions, reduction of contacts, isolation, and requirements to work from home. Adaptation measures, on the other hand, address the effects. These include medical treatment, care, and rehabilitation of the sick, the expansion of medical facilities, and measures to address the economic damage caused by the pandemic.

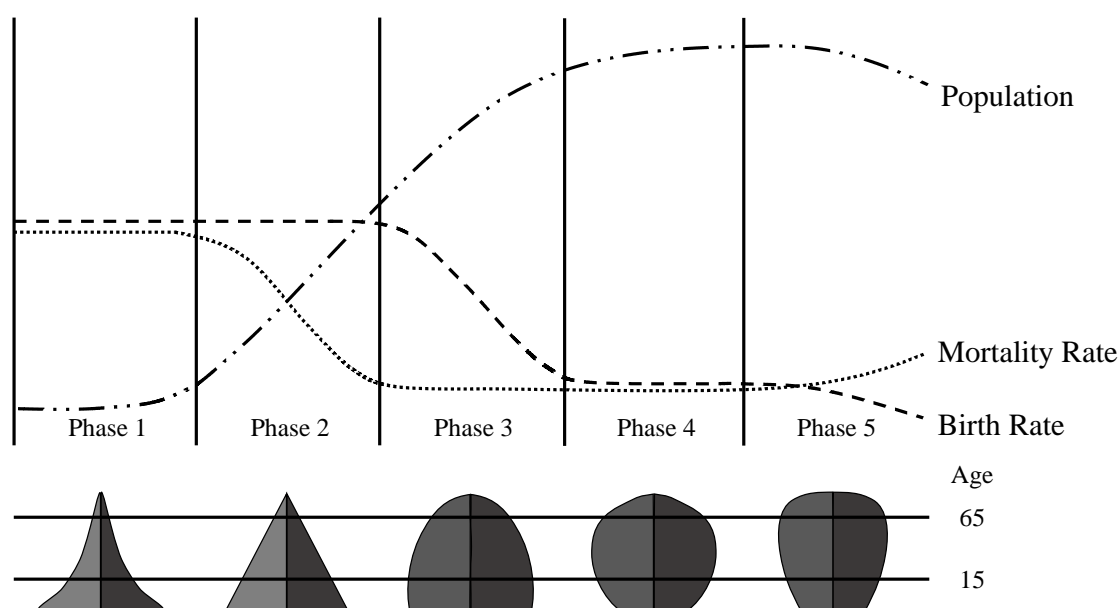
In climate policy, a distinction is made between mitigation and adaptation measures. Mitigation measures reduce greenhouse gas emissions by replacing fossil fuels in transport, industrial production, electricity generation, and the like. Adaptation measures, by contrast, deal with the consequences of climate change. These include the development of heat-resistant varieties for agricultural production, improving flood protection, or fighting against tropical diseases that spread with climate change. Adaptation measures usually do not reduce greenhouse gas emissions, but rather the harm they cause (Landauer 2012).

The concept of mitigation and adaptation are related to risk management, which is about avoiding and managing losses. In the insurance industry, the term risk mitigation is widespread. However, the division into mitigation and adaptation is not common. Risk management in areas such as supply chain management, cybersecurity, or financial risks is very much concerned with external influences over which there is little control. This is strikingly different from pandemics or climate change caused by human activities, where the risks and challenges arise endogenously, i.e., from developments in the system itself.

In the case of demographic change, there are similar interdependencies as in the cases of pandemics and climate change. It is not a matter of external impacts or shocks but of changes coming from within, which can be shaped by purposeful policies.

### 3. Demographic Transition

The demographic transition describes the typical course of population development from high birth and death rates, to low birth and death rates (Thompson 1930; Notestein 1945). It is a phenomenon that has been observed in all societies. Demographic transformation leads to different age pyramids in phases (as illustrated in Fig. 1) – from a very flat age pyramid with many young and few old people to an age pyramid in a columnar shape with a decreasing number of young people and a very large number of old people (Lee 2003; Dorbritz 2015). It is common to classify countries according to the phase of demographic transition they are in. The demographic transition has not stopped at the replacement level as originally envisaged by the theory. Instead, many countries experience below-replacement fertility for a prolonged time.



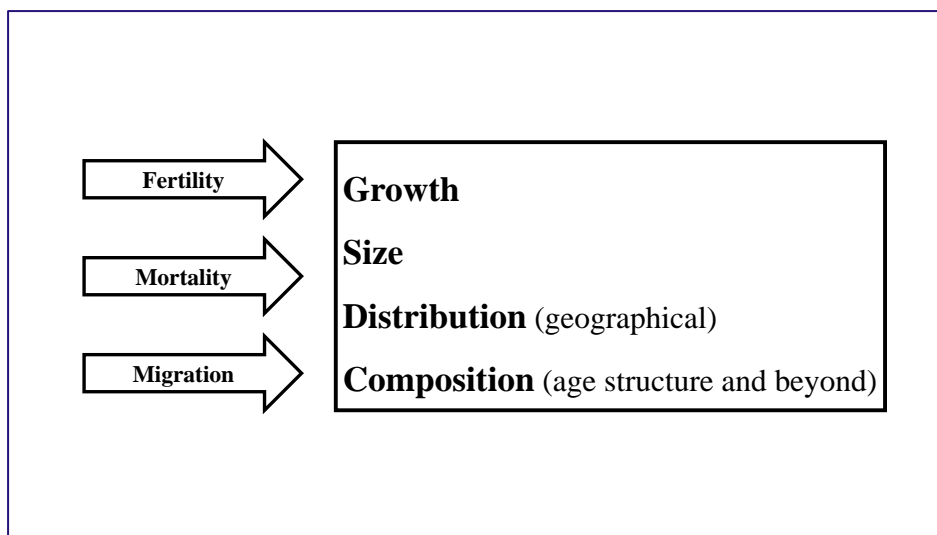
(Fig. 1) Change in age structure according to phases of demographic transition

The demographic transition model is quite old and has even older antecedents; scholars have repeatedly developed and refined it (Thompson 1930; Notestein 1945; Casetti 1968; Chesnais 1990; Kirk 1996; Handwerker 2019). It is an empirical observation rather than a theory in the classic scientific sense. It presents cause-and-effect relationships, but without explaining the changes of the crucial determinants of demographic development (fertility, morbidity) themselves. However, there is by no means a lack of explanatory approaches and studies on the changes in these determinants (Leeson 2014).

In each phase of the demographic transition, very different challenges arise for society in areas such as education, health care, social security, consumption, and the labor market (Cervellati et al. 2019). The course and speed of the demographic transition are also readily predictable in the longer term, although they differ from country to country. Therefore, it is

possible to anticipate and act on upcoming changes in a timely manner (Willekens 2015). This is the real potential of demography and the conclusions that can be drawn from it.

The change in the age structure as it results from demographic change is extraordinarily significant. However, it is not the only effect of demographic change. Demographic change is much more complex. The box on the right in Fig. 2 schematically shows other possible dimensions, namely the dynamics of population growth, the numerical size of the population, its geographical distribution, and the change of its composition beyond age structure.



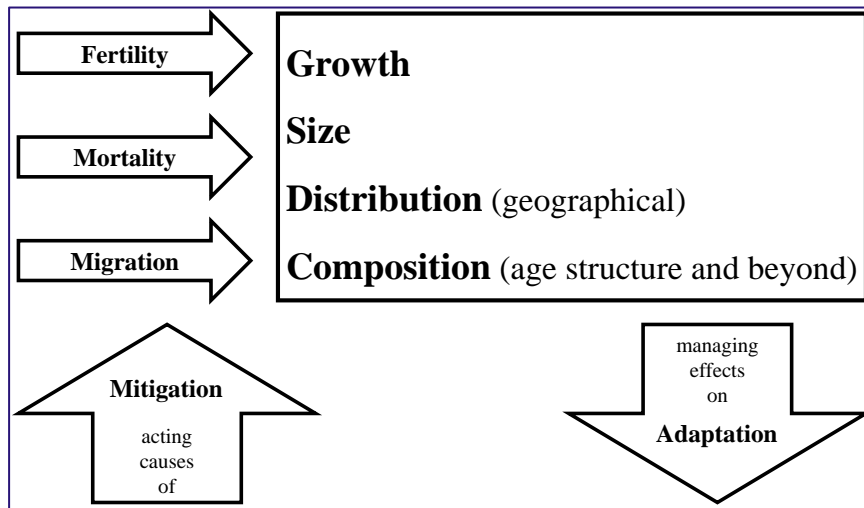
(Fig. 2) Demographic transformation beyond changes in the age structure

To be able to design comprehensive and differentiated policies, it is necessary, on the one hand, to extend the classic model of demographic transition with its clear focus on the age pyramid to include additional aspects. On the other hand, it is important, both in the analysis and in the design of concrete measures, not to limit oneself to demographic variables alone. It is precisely this openness of demography to other scientific disciplines that is one of its great strengths when it comes to policy formulation.

#### **4. Mitigation: Influencing the Determinants of Demographic Change**

How can the determinants of demographic change be acted upon (see Fig. 3)?

Nation states are the primary actors in population policies. They have extensive experience with measures to influence fertility and migration (May 2012) and they also have ample experience influencing mortality through public health policies. Often, national governments are supported by bilateral and multilateral development agencies. However, it should also be noted that it is by no means easy to influence the determinants of demographic development and that corresponding programs have been and are exposed to criticism.



(Fig. 3) Demographic transformation: mitigation and adaptation

## Fertility

Fertility is the birth rate (number of live births) of a population within a given period. Fertility in the demographic sense does not refer to the basic reproductive capacity, as in biology or other disciplines, but to the births that occurred (Pritchett & Summers 1994). Because different population groups tend to have different fertility, fertility affects not only the size and age structure of the population, but also the composition of the population, for example, by ethnicity or religious affiliation. Regional differences in fertility may also have implications for the geographic distribution of the population (Morgan & Hagewen 2005).

Human fertility has been an exceptionally large subject of research during the past several decades. Nevertheless, research has not produced a unified interpretation of fertility or a unified explanation of how fertility changes. Thus, there are not only an extraordinarily large number of explanations, but also an extraordinarily diverse array of them. This also leads to correspondingly different policy recommendations (Bock 2002; Ehmer et al. 2011; Herzer 2012). The approaches range from microeconomic and behavioral science models to explanations based on different institutional frameworks, cultural conditions, and societal values, or to attributing the change in fertility to access to contraceptives and sex education (Morgan & Hagewen 2005). There is no monocausal explanation.

Having children is the decision of individuals. Because it has important societal implications, this decision has long been influenced by government measures, including: (1) reproductive health information; (2) legislation and regulation; (3) value formulation; (4) tax incentives; and (5) subsidies and public services (May 2012).

The effectiveness of many of these government measures is disputed. The actual decline in the number of children certainly depends significantly on changes in lifestyle (for example, urban families tend to be smaller) and people's economic and social prospects. The introduction of an old-age pension system was one of the biggest factors in reducing fertility in many European countries, since people became much less dependent on children to take care of them in old age (Cigno 1992). It is also obvious that ideological views, as well as

religious and cultural values, play a major role in this area and have an influence on people's behavior (Fernández & Fogli 2006, 2009).

Since the work of Thomas Malthus, the relationship between fertility (number of children) and poverty has been a central topic of demographic studies. In developing countries with large numbers of children and often precarious employment opportunities, reducing the number of children is often seen as the key to overcoming poverty. Overall, however, the possibilities for controlling this in the short term are modest, except perhaps through a policy of improving girls' access to education, which leads to later marriage and a lower number of children. Accordingly, this aspect is also important in international frameworks such as the UN's Sustainable Development Goals (UN Women 2018). This example shows that many policies and developments that affect fertility have a different primary objective, while affecting fertility is a second-order effect.

Effective measures to increase fertility in order to boost the national workforce or to counteract population aging are even more difficult to broach and are often politically controversial. Many states have designed pro-natalist policies, from Fascist Italy, Nazi Germany, and Romania under Ceaușescu, to Sweden in the 1930s or France in the 19th century. The Chinese one-, two-, and three-child policies are also illustrative examples (Thompson 2022), and there is no shortage of others (Demeny 1986).

There is no canonized catalog of measures to influence fertility, nor would it make sense to develop such a catalog. The starting point must be careful analyses of cases before intelligently incorporating established and new research findings to design policies for specific national and regional contexts.

## **Mortality**

Mortality is the frequency of deaths within a population over a given period. Like fertility, it influences population size and population growth (Uhlenberg 2005).

Longevity is determined by socioeconomic factors, lifestyle, education, medical care, genetic conditions, and environmental factors, but also by individual autonomy and social inclusion, which confers meaningfulness into old age (GLC/WDA 2022; Lancaster 2012). Public health policy is all about mortality reduction. Like fertility, mortality is a complex and heavily researched area.

Measures to reduce infant mortality, improve diets, and enhance medical care, to name just a few, affect mortality and increase longevity. Such measures are not driven by the intention to change the population structure, but rather with general welfare in mind. Socially difficult outcomes of population change like aging must largely be dealt with by adaptation measures, as it is highly unethical to attempt to reduce longevity.

## **Migration**

Migration is the movement of people from one place to another with the intention of settling temporarily or permanently in the new place. Depending on the location in question, a distinction is made between immigration (inward) and emigration (outward). Migration changes the population structure and affects the growth, size, composition, and



geographic distribution of the population – both in the country of origin and the country of destination. Migration is a complex social, economic, and cultural phenomenon, involving multiple push and pull factors that interact in complicated ways (Brown et al. 2019).

Of the three determinants of demography (fertility, mortality, and migration), migration is the most difficult to forecast, measure, and explain. Migration depends heavily on decisions by individuals driven by the economic and political environment and not only by demographic factors. Internal migration continues to play a significant role in many countries. Migration not only changes population structures but can also affect other demographic determinants (White & Lindstrom 2019), for instance if the migrating population has different fertility or mortality rates from the population that is resident in the countries of origin or destination.

Global migratory movements have increased sharply if we look back at the last century. There are 281 million migrants worldwide (IOM 2022). While this is only 3.6% of the world's population, migration has nevertheless a significant geopolitical impact (Brown & Bean 2005; Abel & Sander 2014). Migration can have positive effects, but it can also lead to tensions and conflicts. The public debate about migration and migration policy is delicate in many countries. Not surprisingly migration is a highly researched area as well (von Beyme 2020).

Mitigation measures regarding migration are particularly difficult and have often been marked by failure. Migration legislation and border controls can hardly manage global migration flows effectively. The various measures to influence the push and pull factors of irregular migration tend to look like a patchwork. Some measures may even be unintentionally counterproductive. Improved education and training in migrants' countries of origin, for example, do not necessarily lead to better opportunities in the local labor market, but can instead incentivize and facilitate irregular migration to more prosperous economies (Clemens 2014). For these and other reasons, there are virtually no alternatives to cooperative approaches such as those suggested by the UN Global Compact for Migration (Newland 2018).

In conclusion, it can be said that the possibilities for influencing the determinants of demographic change – fertility, mortality, migration – are not short term. The effect of mitigation on population size, growth, and composition will only have effects in a few decades' time at best. Mitigation is therefore undertaken to alter expected demographic trajectories in the future; long-term population projections are useful not as predictions but as likely scenarios that may lead countries to adopt mitigation politics to achieve a different desired outcome.

## **5. Adaptation: Coping with the Effects of Demographic Change**

The effects of demographic change can be classified in very different ways and the most appropriate classification can vary depending on the country or region. It makes sense to start by identifying topic areas and then consider adaptation measures (see Fig. 3).

## **Age Structure**

The changing age structure is the most significant impact of demographic change. It is not only at the center of the demographic transition model, but also at the center of political debates. The two extreme manifestations are the so-called “youth bulge,” i.e., the far disproportionate growth of young, employable people on the one hand, and at the other end of the spectrum, aging, i.e., the sharp increase in the proportion of old people (GLC/WDA 2022).

The first type is characteristic of many countries in Africa and other developing countries. For the foreseeable future, African societies will remain enormously young, allowing them to achieve a so-called demographic dividend if they reduce their fertility (Groth & May 2017). The demographic dividend refers to the economic growth potential associated with the change in a population’s age structure, when the size of the working-age population (aged 15 to 64 years) exceeds that of the non-working-age, or dependent, population (aged under 14 years, and 65 and older). Its time window is limited. In recent decades, Asian countries have shown how a demographic dividend can be successfully exploited. However, capitalizing on a demographic dividend does not happen by itself; preconditions must be met to take full advantage of the opportunity. Reliable institutions, and investments in education and health care, are necessary to ensure the labor force is productive, as is a willingness to rethink outdated values. Key factors are, above all, jobs in sufficient quantity and quality, but also advantageous trade relations at regional and international levels (Groth & Dahinden 2020).

At the other end of the demographic spectrum are aging societies with high longevity, which today are found particularly pronounced in Europe and Southeast Asia (GLC/WDA 2022). Their older age structure will require far-reaching adjustments in areas such as old-age provision, continuing education, and health. It is about much more than financial challenges and burden sharing. It is about new lifestyles, reshaping the labor market, and ultimately fundamentally changing how value is created and distributed in a society (Sakamoto & Powers 2019; Richter 2014). Market mechanisms are very important, but without the right framework, they will not lead to the desired outcomes, in part because existing legal norms and institutions have come into being in a society with different demographic conditions. Innovations in areas as diverse as health, housing, mobility, and education are particularly important in this phase of demographic transition (Kohlbacher & Herstatt 2008; Lutz et al. 2008).

## **Population Growth and Decline**

Population growth and decline is of great consequence, not least regarding the profound effects on the consumer goods and services market and the investment market. Rapid changes can require major adjustments in a short period of time, which can be very challenging. For example, infrastructure and government services could come under strain, and the natural environment could be affected by an increase in the demand for resources. The political system may come under pressure and eventually reach its limit in keeping pace with population increase or decline. Rapid population growth typically also puts great

pressure on existing social lifestyles and can bring about a violent shift in values and culture, accompanied by social unrest and political tensions (Goldstone 2016). All these processes require political responses. Nigeria is an impressive example: an annual population growth of almost 2.5% means a doubling of the population in less than 30 years, with all the consequences that entails. Countries with aging and declining populations will also face increasing challenges in the decades ahead (GLC/WDA 2022).

### **Population Size**

The numerical size of the population is a factor with its own significance and is not merely the byproduct of demographic change. It deserves attention and should not remain unexamined as is too often the case.

It is not uncommon for states to measure themselves by the size of their population and derive power claims from it (Goldstone et al. 2012). According to UN projections, India will replace China as the most populous country within a decade, and by the end of the century Nigeria could have more inhabitants than China. Such demographic shifts will affect international relations and the global economy. The absolute size of the population on the territory of a state or in a region also has a striking effect on the use of natural resources (Lupi & Marsiglio 2021).

### **Spatial Distribution of the Population**

Demographic change can significantly determine the distribution of population in a country and region. It comes not as a surprise that the spatial distribution of population as an effect of demographic change has for long been an important area of policy measures and research (Chenal 2016; Guest & Brown 2019). It includes questions about the settlement pattern of a specific country or region but also of the whole planet. It includes aspects such as urbanization, suburbanization, or deurbanization, with the associated challenges for public policies. In 1950, less than a third of the world's population lived in cities; in 2007, half of all people were already city dwellers; in 2050, seven billion of the expected global population of about ten billion will live in cities. Those moving to urban areas hope to find better job opportunities and infrastructure, better education, and leisure facilities. Population growth plays a key role in this movement of people; however, there are also other drivers for the geographic concentration of populations, such as economic development, environmental issues, and so forth (Guest & Brown 2019).

### **Population Composition**

The demographic transition model describes the change in the age structure of society that arises from long-term declines in fertility and mortality. In multicultural societies, not all ethno-cultural groups have the same fertility and mortality. Therefore, there are shifts between these groups with important political consequences. Not only differential fertility and mortality, but also migration affects population composition (and spatial distribution). A well-known and often-studied example is Lebanon, where the proportional distribution of political offices is still based on religious affiliations as recorded in the 1932 census, which

no longer reflects contemporary realities. Not every change in the composition of society can be conclusively derived from demographic determinants. Changes in the socioeconomic structure of the population, for example, often have economic and political causes (Sakamoto & Powers 2019).

Demographic changes can lead to disintegration, social fragmentation that excludes certain population groups, and social polarization. Striking examples of this are poorly integrated immigrant populations or marginalized ethno-cultural or social groups. Integration measures can achieve or maintain sustainable social relationships. Integration reduces the social distance between social groups and leads to a greater convergence of values and views, without the identity of individual groups having to disappear. In addition to demographic change, there are many other causes that call for integration measures, often interacting with demographic changes. Strong economic growth, for example, can dissolve social ties and create social tensions. Social integration is an extremely broad field. It will not be addressed here. It matters that relevant knowledge and experience be considered when designing adaptation measures for demographic change.

## **6. Policy Formulation**

Successful policymaking requires analysis, but also the ability to be systematic in designing strategies. It is a process that steers society onto sustainable paths with the involvement of the population concerned.

### **Demographic Assessment**

To move from selective measures to a more comprehensive policy, a demographic analysis is important as a starting point. This involves questions such as: Where are we in demographic terms? Where are we heading?

The reliability of demographic projections depends heavily on the time period, the topic, the regional reference chosen, and the data available. In general, time periods beyond 20 years have a considerable probability of error. They are only of limited use as a basis for science-based policy advice. Mortality and fertility are more stable and are therefore easier to model, whereas migration is less so.

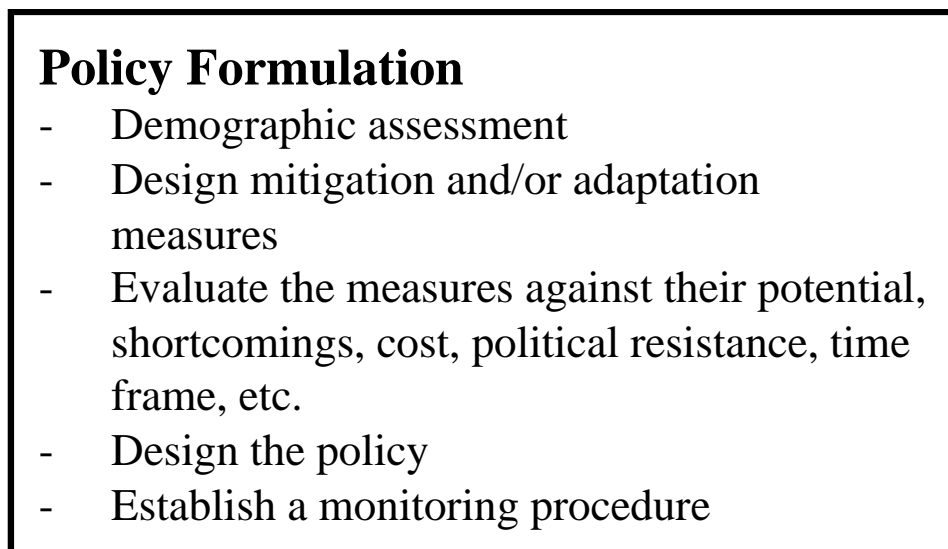
Unexpected external shocks occur unpredictably but regularly and lead to sometimes significant deviations from projections. The smaller the regional reference, the greater the probability of error. For many countries and regions, but also for some topics, the quality and quantity of data remain unsatisfactory.

Overall, however, the available data have improved considerably, and methodological knowledge has grown enormously. Demographic statements have therefore become much more reliable in the recent past. But how can these higher quality data be successfully incorporated into scientific policy advice?

## Policy Choices

Perhaps the most crucial step in policy formulation is the setting of objectives about what to aim for and/or what to avoid. This is ultimately a matter of policy choice, which is driven by complex historical, cultural, and social conditions and values.

The most creative and difficult part of policy formulation is identifying and designing mitigation and adaptation measures that support and implement the overarching policy goals. It is the area where the extensive data and research material gets a special role, but also where political processes (politics) are crucial.



(Fig. 4) Template for policy formulation

Mitigation and adaptation measures must be designed, evaluated, and implemented against the background of actual social, political, legal, and cultural conditions. Only to a very limited extent can they be derived from other contexts and experience, and from abstract considerations. New policies and individual measures may require comprehensive rethinking, for example in the fields of migration policy or the reorganization of the stages of life. If those aspects are not considered from the outset and if broad social support is not sought, it will not be possible to achieve ambitious goals.

Bundled as a policy, the chosen measures must be evaluated again. It is a matter of assessing their potential, their possible shortcomings, their financial and non-monetary cost, the political resistance they may trigger, timing, etc. Finally, it is a matter of deciding and communicating the policy in an appropriate form.

In order to succeed, it is crucial to continue to monitor the situation (both the outcomes of the measures and the underlying reasoning on which the policies are based), and to make adjustments if necessary – to the measures or even to the objectives that have been set.

Fig. 4 offers a template that summarizes these considerations.

## **Policy Advice**

Policy advice in the field of demography is a field with great prospects, but there are obstacles. Sound, high-quality policy advice is difficult in many respects because different expectations and paradigms must be reconciled. Policymakers expect clear, concise, action-oriented statements. These need to be made quickly – despite a lack of knowledge in many cases. Science, on the other hand, is often characterized by contradictory findings, a long time to obtain research results, and often little focus on practical relevance.

Better policy advice requires a better understanding of expectations and viewpoints. Science should strive more for comprehensibility and practical relevance, and politics should develop more understanding in dealing with ambiguity. In addition, it seems appropriate to further develop the interface through new communication formats. The guiding principle could be less information and more dialogue. It also seems important to increase the diversity of perspectives. Different disciplines and schools of thought generate a wider range of perspectives and thus generally facilitate a more comprehensive and differentiated picture of reality.

## **7. Conclusion**

Demographic change is one of the most important megatrends on the planet. Demography provides analytical tools and concepts to help us manage and adapt to the impact of demographic change. The toolbox exists, but it is underused and often misused.

The concept of mitigation and adaptation can forge a useful approach to move from scientific knowledge to policy action. This approach organizes the challenges and makes them visible. It makes options for action understandable and is suitable for bringing science and politics together.

Demographic change is tangible in numbers and data. Solutions must be based on these figures and not on subjective assessments and perceptions that are too often shaped by dogmas and unquestioned paradigms.

It is a matter of urgency to use this knowledge – the toolbox of demographic analysis and policy experience – and to use it now. This is even more important than further broadening and deepening knowledge. Inaction has great costs, not only for present generations but especially for the future ones.

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