

# Krisztina Losonc

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## 7. Climate change impacts on migration and labour market

### 7.1 Introduction<sup>31</sup>

Floods, droughts and monsoons have always disturbed human settlements, but there are more settlements now and more people in the world. Therefore, if a natural disaster happens, more will suffer than ever before. Moreover, climate in the past several decades has been greatly degraded by anthropogenic activity. In some cases, the chain of causality of human influence on the climate is direct and unambiguous (e.g. the effects of irrigation on local humidity), though there are instances where it is less clear. Presently, the scientific consensus (IPCC, 2007) on climate change is that human activity is very likely the cause for the rapid increase of global average temperatures, more generally known as global warming (see Appendix 1).

The thorough climate change report of the Intergovernmental Panel on Climate Change<sup>32</sup> (IPCC, 2007) points out that in the last few years, the increase in global average air and ocean temperatures, the widespread melting of snow and ice, and the rising global average sea level was noticed (see Appendix 2). According to the IPCC study, human influences have *very likely* contributed to the rise of sea level during the latter half of the 20<sup>th</sup> century; have *likely* increased temperatures of extreme hot nights, cold nights and cold days; have *more likely than not* increased risk of heat waves, areas affected by drought since the 1970s and the frequency of heavy precipitation events.

Winds have changed in both hemispheres – especially those blowing from the west. This ominous sign means that weather fronts and weather patterns are less stable, which points to the unknown risks involved. Since scientists are not able to determine the “elasticity” of such weather patterns or winds, it is hard to predict where the border line lies for the global wind system, or how much change it could

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<sup>31</sup> The author was supported by TAMOP-4.2.1.B-09/1/KMR-2010-0005 project in the research for this paper.

<sup>32</sup> The Intergovernmental Panel on Climate Change (IPCC) was jointly established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change.

tolerate until it suffers irreversible damage. To my very best knowledge, scientists are not investigating the possible consequences of a change in the global wind system or the Thermohaline circulation (i.e. the redistribution of heat by carrying out a very slow and extremely deep movement of water in the oceans of the world).

According to a reader's letter sent to the editor of The New York Times online<sup>33</sup>, there are two physical findings that stand out from climate change facts: firstly, in the last 50 years the world ocean has accumulated 22 times as much heat as has the atmosphere (data provided by the National Oceanic and Atmospheric Administration of the Department of Commerce). Secondly, it is this repository of heat — through processes like evaporation and ocean overturning — that drives the changes in weather we are experiencing: heavier precipitation events, sequences of large storms, bitter cold spells, and prolonged droughts in some regions. If the environment degrading human activity does not take a radical turn toward a greatly eco-friendly way of production, the number of natural disasters and nature-related problems are very likely to increase.

For the next two decades, a warming of about 0.2°C per decade is projected for a range of emission scenarios created by the IPCC. Even if the concentration of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected (IPCC, 2007). The Copenhagen Climate Summit of the United Nations, held in December 2009, was a failure. It was considered by the press a “disarray”<sup>34</sup> with a “weak” and “wishy-washy” declaration<sup>35</sup>. The developed and developing countries could not form a strong political cooperation to decrease the pollution of the environment and to initiate the transformation of present economies into sustainable ones. It is improbable that in the near future a climate agreement will be formed partly because of the economic crisis. As a consequence, the concentration of greenhouse gases cannot be held constant at year 2000 levels. Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21<sup>st</sup> century that would *very likely* be larger than those observed during the 20<sup>th</sup> century (IPCC, 2007).

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<sup>33</sup> Paul R. Epstein wrote the letter to the editor titled *Climate Change Facts*, as a reaction to article of The New York Times online. He is a doctor and an associate director at the Center for Health and the Global Environment, Harvard Medical School. The letter was published on February 13, 2010. Available online at <http://www.nytimes.com/2010/02/14/opinion/14climate.html>.

<sup>34</sup> John Vidal (December 8, 2009), *Copenhagen climate summit in disarray after 'Danish text' leak*, guardian.co.uk. Available online at <http://www.guardian.co.uk/environment/2009/dec/08/copenhagen-climate-summit-disarray-danish-text>.

<sup>35</sup> Ians (December 18, 2009), *Last day of Copenhagen summit, hope fizzling out*, IBN Live online. Available online at <http://ibnlive.in.com/news/last-day-of-copenhagen-summit-hope-fizzling-out/107355-11.html>.

## 7.2 The scenarios

The long-term nature and uncertainty of climate change and its driving forces require scenarios that extend to the end of the 21<sup>st</sup> century. **Scenarios are alternative images of how the future might unfold.** They are appropriate tools to analyze the influence of driving forces of, for example, future emission outcomes, and they help us assess the associated uncertainties. Scenarios assist climate change analysis, too, including climate modelling and the assessment of impacts, adaptation, and mitigation. In 2000, the Intergovernmental Panel on Climate Change accepted a new Special Report on Emissions Scenarios (SRES scenarios), which cover most of the main driving forces of future emissions, from demographic to technological developments and international cooperation. In the next chapter, these complex SRES scenarios will be developed further and their migration implications discussed. This subsection, on the other hand, only introduces a short description of each of the four SRES scenarios and demonstrates their forecasts of average global temperature and sea level rise. However, the possibility that any single emissions path will occur as described in the scenarios is highly uncertain.

The set of SRES emissions scenarios is based on an extensive assessment of the literature, several alternative modelling approaches, and an “open process” that was solicited by the wide participation and feedbacks of several environment groups and individuals. None of the scenarios in the set includes any future policies that explicitly address climate change, although all scenarios necessarily encompass various policies of other types (IPCC, 2000).

Four different narrative storylines were developed from the four scenario families to consistently describe the relationship between emission driving forces and their evolution and add context to scenario quantification. Each storyline represents different demographic, social, economic, technological, and environmental developments, which may be viewed positively by some people and negatively by others. The description of the four SRES scenario families<sup>36</sup> is the following:

- **A1<sup>37</sup> – A more integrated world:** characterized by rapid economic growth and quick spread of new and efficient technologies. It represents a convergent world where income and way of life converge between regions and where there are

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<sup>36</sup> The Special Report on Emissions Scenarios (2000) consists of four scenario families. Only the A1 scenario family has subgroups. All in all, there are 40 alternative SRES scenarios within the four scenario families. It is not the intention of the author to go into such detail, thus this paper only deals with the four basic SRES family scenarios even when mentioning “scenario” instead of “scenario family”.

<sup>37</sup> Only the A1 scenario has subgroups. They are the following: A1FI with an emphasis on fossil-fuels; A1B with a balanced emphasis on all energy sources; and A1T with an emphasis on non-fossil energy sources.

extensive social and cultural interactions worldwide. The global population will reach 9 billion in 2050 and then gradually decline.

- **A2 – A more divided world:** characterized by independently operating, self-reliant nations, regionally oriented economic development, and continuously increasing population. There are slower and more fragmented technological changes and improvements to per capita income.
- **B1 – A more integrated and more ecologically friendly world:** represents the emphasis on global solutions to economic, social and environmental stability. In this scenario, economic growth is rapid as in A1, but with rapid changes towards a service and information economy. Its population is rising to 9 billion in 2050 and then declining as in A1. There are reductions in material intensity and an introduction of clean and resource efficient technologies.
- **B2 – A more divided but more ecologically friendly world:** there is an emphasis on local rather than global solutions to economic, social and environmental stability. It has a continuously increasing population, but at a slower rate than in A2. This scenario has intermediate levels of economic development and it is characterized by a less rapid and a more fragmented technological change than in A1 and B1.

**Table 1** Projected global average surface warming and sea level rise at the end of the 21<sup>st</sup> century

Case	Temperature change (°C at 2090-2099 relative to 1980-1999) <sup>a), b)</sup>		Sea level rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	<i>Likely</i> range	Model-based range excluding future rapid dynamical changes in ice flow
Constant year 2000 Concentration <sup>b)</sup>	0.6	0.3 - 0.9	Not available
B1 scenario	1.8	1.1 - 2.9	0.18 - 0.38
A1T scenario	2.4	1.4 - 3.8	0.20 - 0.45
B2 scenario	2.4	1.4 - 3.8	0.20 - 0.43
A1B scenario	2.8	1.7 - 4.4	0.21 - 0.48
A2 scenario	3.4	2.0 - 5.4	0.23 - 0.51
A1FI scenario	4.0	2.4 - 6.4	0.26 - 0.59

Notes: a) Temperatures are assessed best estimates and likely uncertain from a hierarchy of models of varying complexity as well as observation constraints. b) Year 2000 constant composition is derived from Atmosphere-Ocean General Circulation Models (AOGCMs) only. c) All scenarios above are six SRES marker scenarios. Approximately CO<sub>2</sub>-eq concentrations corresponding to the computed radiative forcing due to anthropogenic GHGs and aerosols in 2100 for the SRES B1, A1T, B2, A1B, A2 and A1FI illustrative marker scenarios are about 600, 700, 800, 850, 1250 and 1550ppm, respectively. d) Temperature changes are expressed as the difference from the period 1990-1999. To express the change relative to the period 1850-1899 add 0.5°C.

Source: (IPCC, 2007)

It is important to note that the SRES scenarios are intended to exclude catastrophic futures, though such catastrophic futures feature prominently in the literature. They typically involve large-scale environmental or economic collapses, and extrapolate current unfavorable conditions and trends in many regions (IPCC, 2000).

The above table summarizes the global average surface warming and sea level rise projected by the four SRES scenarios (A1B, A2, B1, and B2). It shows that **climate change in the 21<sup>st</sup> century largely depends on the main energy resources people will be consuming until then and the level of international political cooperation**. In a more integrated and ecologically friendly world (B1), global average surface temperature is supposed to increase only by 1.8°C and the sea level is forecasted to rise by 28 centimeters on average between 2090 and 2099 relative to 1980-1999. This is the best case scenario from environmental perspectives. The worst case scenario is the more divided world, A2. Here, global average surface temperature is supposed to increase by as much as 3.4°C and the sea level is forecasted to rise by 37 centimeters on average between 2090 and 2099 relative to 1980-1999.

These numbers are serious if we consider the results of an environmental study (McGranahan, 2007) published in the *Environment and Urbanization* journal. The study states that **there are about 634 million people living in low-elevation areas**<sup>38</sup> and two-thirds of the world's largest cities<sup>39</sup> are at least partially in these low areas. The number of people under the threat of possible floods is expected to rise further due to the growth of population and increasing urbanization. The ten countries having the most people in low coastal areas are China, India, Bangladesh, Vietnam, Indonesia, Japan, Egypt, United States, Thailand, and the Philippines. The countries with the largest share of their populations living in low-elevation areas are the Bahamas, Suriname, the Netherlands, Vietnam, Guyana, Bangladesh, Djibouti, Belize, Egypt, and Gambia. These are the biggest source countries for future (environmental) migration.

The Special Report on Emissions Scenarios excluded future rapid dynamical changes in the ice flow. Internalizing the fact that global warming may cause large parts of the ice sheets of Greenland and Antarctica (holding the world's largest reservoirs of fresh water) to melt, the future seems even darker. Water expands as it warms, and even a temperature rise of a few degrees can raise sea levels and produce changes in ocean currents and acidity. This way global warming might destroy entire ecosystems and island communities. Furthermore, since the snow that fell in Antarctica has

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<sup>38</sup> In this particular study, low-elevation areas were defined as places along the coast that are less than 10 meters above sea level. Overall, this zone covers 2% of the world's land area but contains 10% of the world's population and 13% of the world's urban population. On average, the Least Developed Countries have a higher share of their population living in the zone (14%) than do OECD countries (10%).

<sup>39</sup> In the study all the cities with more than five million people are considered to be among the world's largest cities.

never melted for millions of years, the melting ice will probably set free air bubbles containing different chemicals that were trapped in the layers of ice for many years.

In 2000, the Intergovernmental Panel on Climate Change (IPCC) published its Third Assessment Report with a new set of emissions scenarios, called the Special Report on Emissions Scenarios (SRES). These scenarios project emissions for the major greenhouse gases, ozone precursor gases, and sulfate aerosol emissions, as well as land-use changes for the 21<sup>st</sup> century. The IPCC Special Report on Emissions Scenarios (IPCC, 2000) was issued by GRID-Arendal, an official collaborator of the United Nations Environment Program (UNEP). The report overviews the scenario literature, analyses different demographic, technological, social and economic driving forces, and describes the four scenario families in detail. Six different modelling groups volunteered to participate in the formation and development of the scenarios from three different continents (Europe, North America, and Japan) ensuring the diversity of methodological approaches. Also, due to open process, scientists worldwide had access to the research in progress and sent their feedbacks which contributed to the professionalism of the final outcome. The SRES framework has become a reference document for modelling the human dimensions component of impacts assessment (Gewin, 2002).

The main aim of the report was to describe the range of possible future emissions by 2100, but its scenarios are also based on concrete demographic, economic, and technological calculus, thus they truly describe the possible future alternatives of humanity in the next century. The scenarios are so detailed and multidimensional that they can be easily treated as global scenarios. Nevertheless, the environment together with available energy sources certainly shapes our future, so it should not be a doubted basis for individual scenario building.<sup>40</sup>

The beginning of the report highlights the large uncertainty in the scenario literature. These uncertainties range from inadequate scientific understanding of the problems, data gaps or lack of data, and inherent uncertainties of future events in general. As a consequence, not one or two but more alternative scenarios had to be developed. The final scenarios cover a wide range of driving forces from demographic to social and economic developments, and they encompass a wide range of future greenhouse gas (GHG) emissions. They are representative of a broad range of scenarios found in the scenario literature, but they are not directly based on any particular published scenario taxonomy or set of scenarios (IPCC, 2000).

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<sup>40</sup> The Special Report on Emissions Scenarios (2000) consists of four scenario families. Only the A1 scenario family has subgroups. All in all, there are 40 alternative SRES scenarios within the four scenario families. The author does not intend to go into too much detail, thus this paper only uses the main characteristics of the four scenario families. For the sake of simplicity, “scenario families” mean the same as “scenarios” in this paper.

The four SRES scenarios differ in how global regions interrelate, how new technologies diffuse, how regional economic activities evolve, how protection of local and regional environments is implemented, and how demographic structure changes. The Special Report on Emissions Scenarios (IPCC, 2000) has a “quantitative” storyline which includes various political, social, cultural, and educational conditions (e.g. type of governance, social structure, and educational level) though often these conditions are hard to be defined in strictly quantitative terms. Nevertheless, they participate in complex cause-and-effect relationships with quantitative emission drivers (e.g. economic activities, population levels, energy consumption). Their explicit inclusion in the scenario development process made scenarios more “plausible” and “believable”.

Each of the four SRES scenario families includes a descriptive part (“storyline”) and a number of alternative interpretations and quantifications of each storyline. The storylines describe a demographic, social, economic, technological, and policy future; consequently, they occupy a multidimensional space. All of them describe dynamic changes and transitions in generally different directions. They have features that can be interpreted as positive or negative, and their assumptions should be viewed with an “open mind”. The storylines do not include specific climate-change policies, but they do include numerous other socio-economic developments and non-climate environmental policies (IPCC, 2000).

The authors of the Special Report on Emissions Scenarios have not given “normal” names to the SRES scenarios in order to avoid unintentional connotations that could have breached their neutrality – they have named them: A1, A2, B1 and B2. It is easy to remember the basic characteristics of the four scenarios if the two most important dimensions of the scenarios are remembered. One is the global/regional dimension, and the other the economic/environmental dimension. The next table demonstrates that if we join “economic” with “A” and “global” with “1”, we get the A1 scenario which describes a highly globalised future with economic performance in its focus. This logic eases the understanding of further scenario comparisons.

**Table 2** Summary of the two main dimensions of the four SRES scenario families

	<b>Economic</b>	<b>Environmental</b>
<b>Global</b>	A1	B1
<b>Regional</b>	A2	B2

*Source:* IPCC, (2000)

Initially, all scenarios were characterized by two quantitative “targets”, namely global population and global gross domestic product (GDP) by 2100. These quantitative targets were harmonized data not projected by the IPCC but a result of a consensus process among the SRES authors (Gaffin, 2004). The targets guided the subsequent quantification of the SRES scenarios with different model approaches. The following table shows an overview on the specific numbers:

**Table 3** The quantitative targets of the SRES scenarios by 2100

	<b>A1</b>	<b>A2</b>	<b>B1</b>	<b>B2</b>
<b>Global population target</b>	7 billion	15 billion	7 billion	10 billion
<b>Global GDP target in 1990 US dollars</b>	US\$ 550 trillion	US\$ 250 trillion	US\$ 350 trillion	US\$ 250 trillion

Source: IPCC (2000)

We can see from the table above that while the globalised and economic performance focused scenario A1 predicts the highest global GDP target and the lowest global population target by 2100, the regionally divided and economic performance focused scenario A2 foresees the lowest global GDP target with the highest global population target. Scenarios B1 and B2, both representing eco-friendly futures, are in between these two “extremities”. Appendix 13 demonstrates the characteristics of each storyline briefly by presenting them in the form of hexagons that portray, among other things, the values for the two main driving forces (population and economic growth). Furthermore, the following table summarizes the main driving forces of the different scenarios:

**Table 4** Summary of the driving forces of the four SRES scenario families

	<b>A1</b>	<b>A2</b>	<b>B1</b>	<b>B2</b>
<b>Population growth</b>	low	high	low	medium
<b>GDP growth</b>	very high	medium	high	medium
<b>Energy use</b>	very high	high	low	medium
<b>Technology change</b>	rapid	slow	medium	medium
<b>Technology base</b>	A1C – coal A1G – oil, gas A1B – balanced A1T – non-fossils	regional	efficiency and dematerialization	“dynamics as usual”

Source: IPCC (2000)



The *Climate of the future* subsection of this chapter has already advanced a brief overview on the basic characteristics of the four SRES scenario families, and it is this chapter that deals with the different SRES scenarios in detail. The following sections first describe the SRES scenarios one by one, according to the report they were published, and then the scenarios are reconstructed through the author's additional trains of thought, which concentrate on the implications of the scenario on the future migration of people. The latter will be summarized in the end of this chapter.

### **7.3 Scenario A1 – A more integrated world**

The storyline of the first scenario shows a highly globalised world focusing on economic performance in the first place. Firstly, the scenario will be illustrated according to its original description in the IPCC Special Report on Emissions Scenarios (2000). Secondly, parallel to its further development, the migration implications of the scenario in question will be expounded.

#### ***Description of scenario A1***

This scenario undergoes a rapid and successful economic development where regional average income per capita converges. The transition to economic convergence results from progress in communication technology and transport, shifts in national policies on immigration and education, as well as firm international cooperation in the field of national and international development of institutions, which enhance productivity growth and technology diffusion. The current distinctions between “poor” and “rich” countries will eventually dissolve.

The primary dynamics of scenario A1 is market-based solutions and high rates of investment, especially in education, technology and innovation both at national and international levels. Business is dominated by American/European entrepreneurial culture with progress-oriented perspective. In some examples of this type of scenario, high economic growth leads to shifts of economic power from traditional core countries to the current economic “periphery”. In that case, Chinese and Indian entrepreneurial will be dominant. Households pile up savings and develop a commitment to education and lifelong learning. High mobility of people, goods, technology and ideas, as well as liberalized trade markets, and rising income levels characterize this globalised world. High incomes also precipitate into high car ownership, expansive suburbia, and dense national and international transport networks.

Low mortality and low fertility in the A1 scenario family shows how demographic and economic trends are closely linked, since affluence is correlated with longevity and small families. Global population grows to some 9 billion by 2050 and declines to about 7 billion by 2100. Though average age increases, economic needs of retired people will be met by private pension systems.

The global economy expands at an average annual rate of about 3 % to 2100, reaching around US\$ 550 trillion<sup>41</sup>, whilst global average income per capita reaches about US\$ 21,000 by 2050. Despite this world being far from problem free (e.g. wealthy communities might face problems of social exclusion), we can conclude that the high average level of income per capita contributes to an improvement in the overall health and social conditions of the people.

In this scenario, family energy and mineral resources are abundant. This is so thanks to the rapid technical progress reducing the resources needed to produce a certain level of output and increasing the economically recoverable reserves. The energy use per unit of GDP (final energy intensity) will decrease at an average annual rate of 1.3 %. Technological development “releases” natural resources currently devoted to supplying human needs for other purposes. The idea of environmental quality changes in this storyline from the emphasis on “conservation” of nature to active “management” of natural and environmental services. This increases ecologic “flexibility”.

The several subgroups of the A1 scenario family reveal the uncertainty regarding the type of the possible ruling energy source. In this rapidly changing world, some scenarios evolve along a carbon-intensive energy path consistent with the present development strategy of countries with abundant domestic coal resources. Other scenario groups build up their economy on oil and natural-gas resources in the long run. The third group predicts a shift toward renewable and nuclear energy sources. Finally, the fourth group assumes a balanced mix of technologies and supply sources with technology improvements. The latter scenario assumes no single source of energy as overly dominant.

### ***Description of scenario A1 and the analysis of its implications on migration***

The economic performance focused scenario A1 projects the highest global GDP target by 2100. Its development is mostly based on advances in transport and communication technology. The globalized world further strengthens and develops international institutions, enlarging their scope of authority. It is possible that by

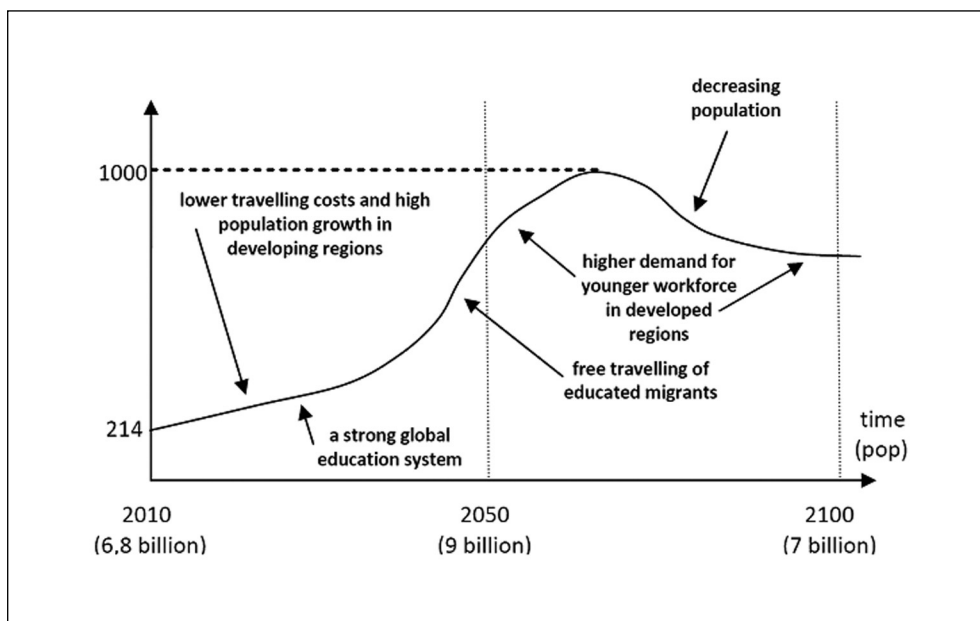
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<sup>41</sup> All dollar amounts herein are expressed in 1990 dollars, unless stated otherwise

2100 nation states lose their territory-based sovereignty; due to the high mobility of masses citizenship loses its value; and a global government is established to deal with the greater international issues.

Everyday people live in large urbanized areas with dense national and international transport routes. They live in a market-base economy and a globalized society. They are aware of the fact that every human being is equal and their only way to live a decent life is to achieve high level education. This way they can earn enough and put aside for their elder years. Due to advanced technology in health care and developed medical science, patients are easily cured and are able to live a longer and healthier life than today. Small families with one or no children are common, as government policies favor a decreasing global population trend. People are surrounded by an individualistic global culture, where ones family roots do not matter only the person's capabilities and educational background. The different languages slowly disappear and only one remains: English or Chinese.

**Figure 1** Dynamics of migration in scenario A1



Source: author

In the beginning, as population increases mostly in developing regions and the price of travelling starts to drop, masses of people will start migrating: first to the closest urbanized cities, then to developed regions. As local national and political

tensions tone down and local infrastructure is built up, there will be few obstacles left for companies to erect factories, and invest in local agriculture (more people with bigger budget demand more healthy food for which new territories need to be cultivated). The bigger urbanized world requires more energy and no matter which will be used in great majority (coal, oil and gas, renewable with nuclear energy, or a balanced mix of these), the developing countries rich in energy will obtain the attention of energy producing companies, thus earning external investments for the country's development and the increase in the domestic average level of per capita income.

The mobility of people increases greatly due to advanced and dense transport facilities. Just as governments and international institutions realize that the best way to decrease the gap between the affluent and the poor of the world is to enhance local education and create a strong international educational net which arms each student with enough opportunities to find a good job and live a decent life. Asylum applications and illegal migration will decline globally, and legal migration will change in character. A typical migrant will have a good educational background, capable of speaking English or Chinese, and will represent a good workforce for companies all over the world. It might as well happen, that the global government later orders all the basic telecommunication and traveling services to be free of charge, this way, too, contributing to higher economic performance.

The global government will support and sponsor primary, secondary and higher education and research in less developed countries until the community develops to a level where no additional support will be needed. As a consequence, the current distinctions between "poor" and "rich" countries will eventually dissolve and less people will strive for leaving as they find enough opportunities in their home region, too. Nevertheless, the slowly aging population of the western world will create a great demand for young employees coming from the developing world. This too, contributes to higher migration in the world.

#### **7.4 Scenario A2 - A more divided world**

The storyline of scenario A2 shows a divided world, where the different regions concentrate on the substantiation of a self-reliant economy with their own energy and food resources. Firstly, the scenario will be illustrated according to its original description in the IPCC Special Report on Emissions Scenarios (2000). Secondly, parallel to its further development, the migration implications of the scenario in question will be expounded.

### *Description of scenario A2*

The A2 scenario family represents a heterogeneous world. Compared to the A1 storyline, it is characterized by lower trade flows, relatively slow capital stock turnover, and slower technological change. It consolidates into a number of economic regions which are self-sustainable in terms of resources. Economic growth is irregular. The income gap between developing and presently industrialized parts of the world does not narrow, unlike in scenarios A1 and B1.

The A2 world has less international cooperation. Technology diffuses more slowly because people, ideas, and capital are less mobile. International disparities in efficiency, as well as income per capita are for the most part maintained or increased in absolute terms. Fertility rates decline relatively slowly due to the emphasis on family and community life, which makes the A2 population the largest among the storylines (15 billion by 2100).

Relative to other storylines, global average per capita income is low in this scenario, reaching about US\$ 7200 per capita by 2050 and US\$ 16,000 in 2100. Global GDP reaches about US\$ 250 trillion by 2100. Technological change in scenario A2 is also more diverse than that in A1. It is faster than average in some regions and slower in others, as the industry adjusts to local resource endowments, culture, and education levels. Resource intensive economies will be only developed in regions with abundant energy and mineral resources. Countries poor in resources through technological innovation improve resource efficiency and make use of substitute inputs. They place a priority on minimizing import dependence. High-income but resource-poor regions orient toward advanced renewable or nuclear technologies, while resource-rich regions with low-income generally rely on older fossil technologies. In this scenario, final energy intensities decline with a pace of 0.5 to 0.7 % per year.

Social and political structures diversify in the A2 world, with some regions moving toward stronger welfare systems and reduced income inequality, and others towards a more diverse income distribution and leaner government. Due to substantial food requirements, research and innovation in the A2 world is mainly directed toward agricultural output. The attention given to potential environmental damage is not uniform across regions and global environmental concerns are relatively weak. Strengthening protectionist trade blocks could slow down economic growth and there is a likelihood that regional spheres of influence will develop.

The authors of the IPCC report (2000) emphasize the neutrality of each storyline, involving scenario A2. All can have their positive and negative sides. Scenario A2, for example, has an increasing tendency toward cultural pluralism and the acceptance of diversity and basic differences.

### ***Description of scenario A2 and the analysis of its implications on migration***

Though the second scenario is focused mostly on economic performance, because it is regionally divided, it can only accomplish one of the lowest global GDP targets by 2100. The division of the world is so deep-rooted in this scenario that the different regions concentrate on self-sustainability only. This already predicts that in this scenario global mobility will be much lower than in the previous one.

The fraction of different regions in the future, according to this scenario, can be triggered off by several possible causes. The most likely cause is the inflammation of the present division between the developed and the developing world parallel with the strong isolation and protectionist policy of the affluent part of the world. If the developed countries continue to exploit the environmental resources and human capital of the developing world without investing in local economies and infrastructure, and they refuse to admit the growing number of refugees and migrants from these parts of the world (as another way of alleviating poverty in developing countries), it is possible that the world will be divided into two parts: the “rich” and the “poor”.

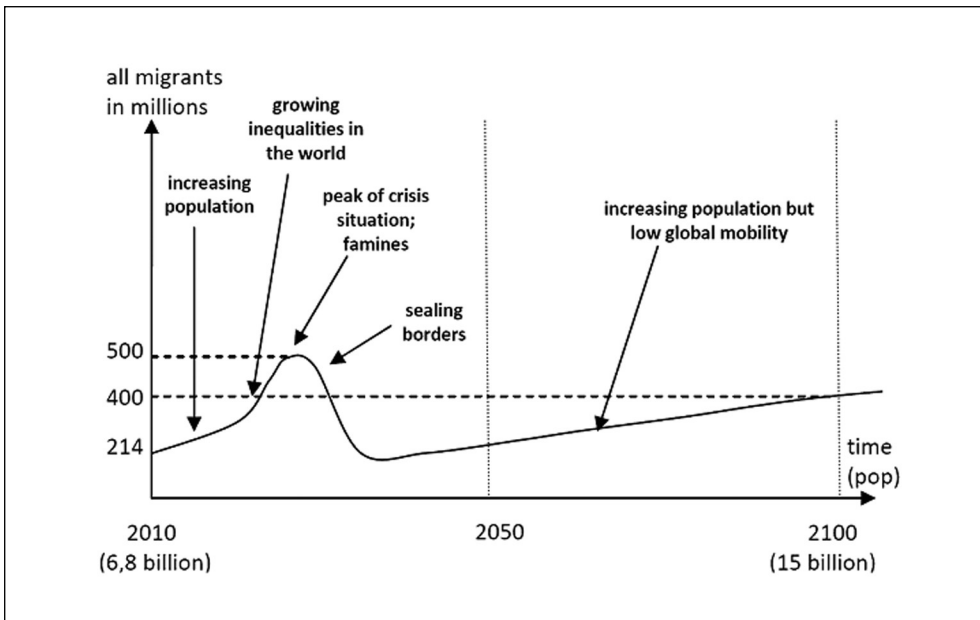
The population of the South rises sharply and there will be more and more migrants moving to the North. Due to intensifying conflicts within the population of the developed world between the newcomer immigrants and the locals, the developing world might take over and/or destroy the valuable assets of Western multinational companies on its territory to put an end to the exploitation of its resources. As a response, the developed world might totally seal its borders not letting anything or anybody through. A strong and deep-rooted conflict arises that is unlikely to result in war, but which creates two different worlds in one.

The reason why this cause of division is the most probable is that being a developed country or a developing/underdeveloped country is easily connected to a larger territory or continent. For instance, North America and Europe would represent the North and all the others the South which could naturally further divide into sub-groups according to sub-dimensions, too. Other causes of division could be religion and culture, or according to Huntington (1996), conflicts between civilizations may as well determine the geo-political future of the world.

The main dimension of scenario A2 is that it is about a divided world, though the reason for this division is rather marginal. It is about a closed world where communication between the different regions is undesirable and rare. As the previously well functioning system of global division of labor ceases to exist, nation states might fall in a crisis; they fail to fulfill their original roles as a state. These roles are taken over

by local communities in developing regions and other forms of organizations, such as city-states in developed regions. International cooperation transforms into inter-territorial or interregional cooperation. International institutions disappear. Possibly global cyberspace will devolve into several regional internet networks accessible only from the actual region.

**Figure 2** Dynamics of migration in scenario A2



Source: author

Regions and countries will self-organize and local communities will be the main, most basic and cohesive cell of less developed regions. People might as well be organized into modern clans as they realize that cooperation with the group is their only chance for survival. Family and social relationships bare great value for the individual in this scenario. Clans or groups of people will cooperate and organize the life of the community. Through division of labor, these communities would coordinate and rationalize food and energy production, infrastructure building, health care, education, and so on. Since family connections are of great importance for the people, there might be a possibility for the clans or groups of people in less developed regions to take up matriarchy. The priority of a woman led community is the security of the offspring and the group. It is less likely for women to engage

in a conflict or war than for men, so for the sake of peace between groups of people who all share harsh survival life conditions it is healthier to let women decide about politics.

Developed regions have many cities and urbanized areas. These regions will supposedly have a serious crisis when food disappears from the shelves of shops and supermarkets and urban citizens massively migrate from big cities to the suburbs and villages where they might find food. This chaos will be dealt with by the government or the military but it should not last long. Through serious research and technology development, people will find new ways to feed the urban population. With the establishment of a complex control system, order and discipline can be sustained in cities, too; however, it is more probable that the urban population of the world will migrate to yet unpopulated areas close to other communities. Once equilibrium is reached after the transition, global peace will be self-sustained thanks to the family-oriented local communities.

Technology development is the slowest in A2 compared to other scenarios, but it is a priority. Efficiency is weak because people, ideas and capital are almost immobile in this world, thus the fruitful cooperation of scientists coming from different cultures and circumstances is missing. On the other hand, population is rising (especially in developing regions) and all people have to be fed properly. There is a great urge in local communities to survive, thus they need to find ways to provide enough for all members. Food production is one of the main driving forces of technology development, but people also need to find ways to develop high-tech agriculture (if they have little territory as Japan), new energy sources or technology (if the territory is weak in natural energy sources or the contamination of the air or sea is too high), and strong infrastructure (if natural disasters are common in the region). Local communities living in territories with abundant natural resources will obviously evolve more resource-intensive economies, while those with less will find alternative ways and methods to compensate for it.

Scenario A2 envisages a great transformation of the world as we know now. Regional division creates a heterogenic world with many local communities and city-states which are characterized by different mixes of religion, culture, races and language. First, regional borderlines will be prohibited to cross and international transport will cease to exist. Second, masses of people will migrate until they settle down and form self-sustainable local communities.



## **7.5 Scenario B1 - A more integrated and more ecologically friendly world**

The storyline of scenario B1 represents an eco-friendly future and an integrated and convergent global world. International cooperation and sustainable development are key features of this future. Firstly, the scenario will be illustrated according to its original description in the IPCC Special Report on Emissions Scenarios (2000). Secondly, parallel to its further development, the migration implications of the scenario in question will be expounded.

### ***Description of the B1 scenario***

The primary characteristics of scenario B1 are a high level of environmental and social consciousness and a globally consistent approach to sustainable development. Governments, businesses, the media, and the public pay increased attention to the environmental and social aspects of development. Simultaneously, technological change plays an important role.

Economic development is balanced in the scenario and income distribution is more and more equitable through time. It describes a fast-changing and convergent world; nevertheless, the priorities differ from the ones found in A1. Whereas the A1 world invests its gains primarily in economic growth, the B1 world invests a large part of its gains in improving the effectiveness of resource use, social institutions, equity, and environmental protection.

Social exclusion on the basis of poverty is prevented by a strong welfare net. However, in some regions people may not conform to the main environmental and social intentions of the majority. World markets and economic efficiency may be adversely affected by high taxation levels and massive income redistribution.

An increase in resource efficiency is a major factor in achieving the goals stated above. Incentive systems and advances in international institutions promote the diffusion of cleaner technology. New organizational measures are adopted to reduce material wastage by maximizing reuse and recycling. This, together with technical and other organizational changes contributes to high levels of energy saving, and reductions in pollution. As a by-product, labor productivity improves.

Global population reaches 9 billion by 2050 and declines to about 7 billion by 2100. Though demographic transition to low mortality and fertility occurs at the same pace as in the A1 scenario, it happens for a different reason: it is motivated environmental and social concerns. This world has high levels of economic activity, and makes significant progress toward international and national income equali-

ty. Global income per capita averages US\$ 13,000 in 2050 and global GDP reaches about US\$ 350 trillion by 2100. As the emphasis on material goods is less and resource prices are increased by environmental taxation, more income is spent on services than on material goods. Quality becomes more important than quantity.

The B1 storyline sees a relatively flexible transition to alternative energy systems as conventional oil and gas resources decline. There is an extensive use of natural and unconventional gas during transition period, but the major push is toward post-fossil technologies, driven in large part by environmental concerns. Environmental quality is high due to high environmental consciousness and institutional effectiveness. Most potentially negative environmental aspects of rapid development are effectively dealt with on local, national, and international levels. Cities are compact, suburban developments controlled. Infrastructure is designed for public and non-motorized transport. Low-input and low-impact agriculture contributes to high food prices with less daily meat consumption per person than in scenario A1.

### ***Description of scenario B1 and the analysis of its implications on migration***

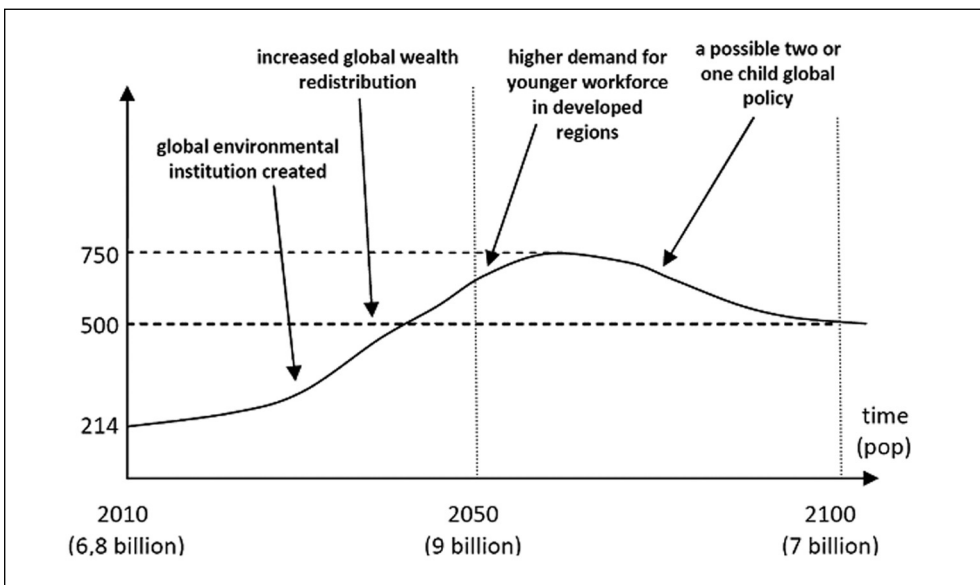
The trigger of scenario B1 is the awakening communal responsibility of humans. People start seeing the evidence of accelerated environment depletion around them (e.g. deforestation, soil depletion, over-fishing, and global and regional pollution) and they decide not to follow the same path. They kickoff local civil movements to promote an eco-friendly economy and lifestyle and they engage in the work of international environmental organizations, such as Greenpeace. The internet and the media contribute to the quick spread of this eco-movement and in the end it becomes a global priority to restore and preserve natural resources.

The popularity of national green parties start to grow in an increased scale among locals and they start to gain majority in national parliaments. For the purpose of conducting such a world-changing mission, serious political, social, and financial support is needed. The strengthened social awareness of environmental problems and the strong will to take action grows, and finally it appears on the global "circus floor". First, politicians and capitalists are forced to take action by the public, than they simply realize their potential individual gains in this trend that greatly stimulates economic growth.

As this issue represents a possible threat to the future of humanity (because the final degradation of nature can seriously damage the quality of life on Earth) the national governments within the institutional framework of the United Nations decide that stronger international cooperation is needed in order to achieve specific results. A global institution is established with supranational authority to decide

upon a global environmental policy. It builds up a complex plan to transform the world into an eco-friendly and sustainable one. It will levy a global tax on every person in the world, the amount of which will depend on the assigned development level of the country they are residents of. It will be the task of national governments to collect this tax together with the traditional national taxes. This way the capital needed to finance the transformation process will be secured step by step. The global institution will create ways to restore depleted natural resources and to save species that are on the verge of extinction; furthermore, it will command the public sector and urge big multinational companies to invest in technology development in order to find new and environment friendly ways of human lifestyle. Creating this new eco-friendly and sustainable world economy becomes a task that will unite people from all over the world. A new global economic “order” will be created.

**Figure 3** Dynamics of migration in scenario B1



Source: author

Conventional cities will be transformed into compact smaller ones designed for public and non-motorized transport, with suburban developments tightly controlled. Traditional means of transport will be replaced by new technology based no-emission vehicles, motorcycles and airplanes (powered by electricity, hydrogen, or nuclear energy etc).

Economic growth will be fuelled by new green technologies entering the market and the push of their obligatory usage in both public and private sphere. As a consequence, this world will undergo rapid changes in global economic structures. People will get accustomed to the new lifestyle where quality is more important than quantity, where natural resources are distributed in a more egalitarian way, where the basic needs of each person are fulfilled and children get free and compulsory education. The B1 storyline is the opposite of the A1 storyline, which foresees a materialistic consumer society where the individual is in the centre of attention.

The storyline of scenario B1 is characterized by high taxes and an increased level of global wealth redistribution. As fast population growth, especially in the developing and underdeveloped regions, represent a threat to the sustainable capacity of the environment, the supranational global institution might introduce a two or one-child policy in the world parallel to providing the basic needs for those in need. This also explains the low population growth of this scenario. A reformed primary education system, which is the same all over the world, represents one of the milestone projects of this global institution because it plans to educate the future generations in a right way so that after the few decades of transition, the created eco-friendly world order will be sustained.

Since this storyline is about a highly globalized world, the migration and the movement of people will be common through border lines and it will reach a medium level compared to other scenarios. As the reformed educational background will provide the migrants with the most important capabilities and language knowledge (English), they will not represent a heavy weight on the receiving community's social system. The development of infrastructure and travelling system based on green technology will further enhance global migration. Furthermore, the slowly aging population of the western world will create a great demand for young employees coming from the developing world. This too, contributes to higher migration in the world.

## **7.6 Scenario B2 - A more divided but more ecologically friendly world**

The storyline of scenario B2 represents an eco-friendly future in a regionally divided and fragmented global world. Environmentally aware citizens and community-based solutions are the key features of this storyline. Firstly, the scenario will be illustrated according to its original description in the IPCC Special Report on Emissions Scenarios (2000). Secondly, parallel to its further development, the migration implications of the scenario in question will be expounded.

### ***Description of scenario B2***

The B2 storyline represents a world which is one of increased concern for environmental, social and economic sustainability. Government policies and business strategies at the national and local levels are increasingly influenced by environmentally aware citizens, with a trend toward local self-reliance and stronger communities. International institutions lose their importance. Local and regional decision-making institutions take the lead instead. Community-based social solutions and technical successes endorse the priorities of this storyline: human welfare, equality, and environmental protection. The storyline of scenario B2 appears to be consistent with current institutional frameworks in the world and current technology dynamics. However, it is characterized by a relatively slow rate of development.

The widely pursued education and welfare programs reduce mortality and fertility to a lesser extent. The population reaches about 10 billion people by 2100 which is consistent with the United Nations projections. Income per capita grows at an intermediate rate, and it reaches about US\$ 12,000 by 2050. By 2100 the global economy might expand to reach US\$ 250 trillion. Income differences decrease internationally, although not as rapidly as in more globalized storylines. Through the development of stronger community-support networks, local inequities are reduced considerably.

Educational levels rise in average and they promote development and environmental protection – the latter being the only truly international common priority in the B2 storyline. Nevertheless, people do not intend to address global environmental challenges in the first place. They prefer to create strategies to address environmental challenges at the local and regional levels, thus these being more successful, too. It is difficult for governments to design and implement agreements that combine global environmental protection, even when this could be associated with mutual economic benefits.

The B2 storyline represents an especially prosperous climate for community initiative and social innovation – particularly in view of high educational levels. Technological frontiers are pushed less than they are in A1 and B1 scenarios, and innovations are also regionally more heterogeneous. Investment in research and development about energy declines globally. Regions with high economic growth and limited natural sources place an emphasis on technology development and bilateral cooperation, while regions that are abundant in natural resources do not engage in technology development at such a scale. Therefore, technical change is uneven. The energy intensity of GDP declines at about 1 % per year, in line with the average historical experience since 1800.

Community innovation puts a particular emphasis on urban and transport infrastructure and it decreases the level of car dependence and urban sprawl. People aim

at food self-reliance so they try to consume more and more local products. Countries with high population densities have dietary patterns with less meat.

Depending on the availability of natural resources, energy systems differ from region to region. In some, the need to use energy more efficiently (due to the lack of natural resources) spurs the development of less carbon-intensive technologies. A gradual transition occurs towards non-fossil energy resources in world energy supply, though the energy system remains a predominantly hydrocarbon-based system until 2100.

### ***Description of scenario B2 and the analysis of its implications on migration***

The trigger of the B2 storyline is the same as of B1: people realize the high level of environment depletion locally and they start off community initiatives to deal with the problems locally. The great difference between the two scenarios is that while in the B1 world this bottom up initiative grows into a supranational global institution dealing with environmental sustainability, the B2 world remains fragmented and its citizens and international politics do not seek a global solution. The B2 storyline is the continuation of the present. It is characterized by the cooperation of (nation) states and a weak international framework. The slowest economic growth compared to other scenarios and its medium level yet uneven population growth ensures that countries evade stronger forms of international cooperation. Substantial steps towards economic, social and environmental sustainability are taken at community level.

The more a territory is hit by the effects of global warming (e.g. deforestation, soil depletion, over-fishing, and global and regional pollution), the more the people living there will become concerned about their environment and about the future of their children. It can be foreseen that the citizens of small coastal and island countries, economies dependent on fishing or on agriculture will be the first to seriously deal with the environmental issue. It is unlikely that now developed countries will take their share of responsibility for the effects of global warming, but it is possible that the developed private sector will step by step realize the potential profit in eco-friendly products due to the growing demand of the global market. Nevertheless, big multinational companies are likely to use their lobby force in the public sector to slow down the introduction of eco-friendly measures. The reason for this is that not letting the (former) product life cycles to evolve in the market and reach the maturity and decline phase<sup>42</sup>, and the reorganization of the production lines for the new

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<sup>42</sup> The phases of product life cycle are the following: development, introduction, growth, maturity and decline. The development of a product is considered profitable if it goes through all the five life cycles.

products based on different technologies both represent a great financial burden for multinational companies. Thus it will not be the private sector to lead environmental friendly technological change but community initiatives.

The B2 storyline has a weak international institutional framework which is more like a camouflage as these institutions are not given sufficient power and authority to implement decrees at national levels. Representatives from mostly all governments around the world do not reach a compromise due to their stubborn attitude and will not give in. As the uncooperative attitude becomes the attitude of most countries on the global political arena, the groups of issues the international institutions engage in decrease to a single one: environmental protection. This theme remains the one which loosely but surely keeps alive international political cooperation.

The regionally divided world of scenario B2 is based upon the strong and cohesive communities of environmentally aware citizens. The aging/growing population, health care, pension system etc. begin to represent a growing burden for governments all over the world and the welfare system might fall in crisis as well. Not only international cooperation but also problem-solving ambitions at a national level fail, too, due to weak economic ambient. This is the reason why local communities become the basis of this scenario.

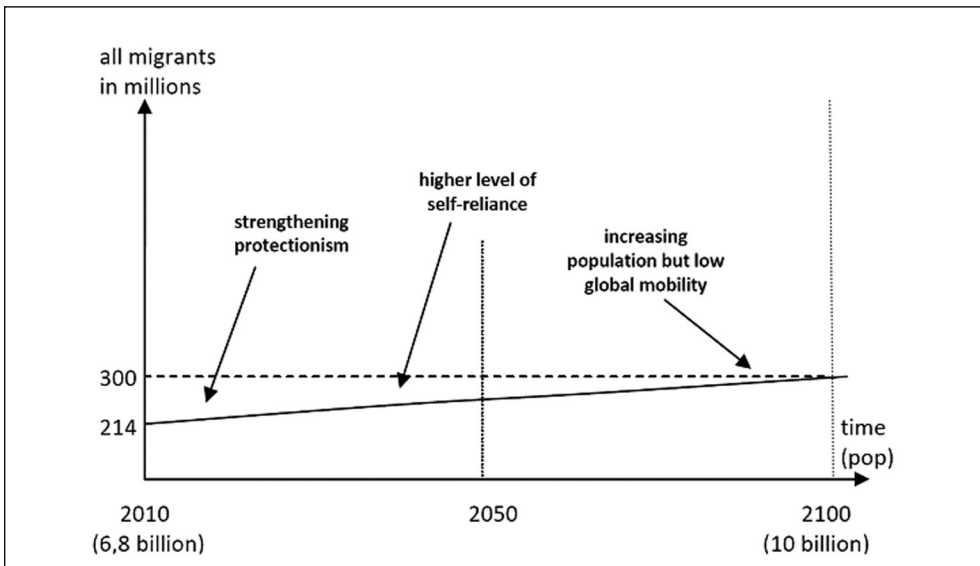
Ideas, innovation, capital, and people will become less mobile globally because of the divided nature of this scenario. The globally slower economic growth and the failure of international cooperation result in countries closing up their borders towards most migrants and asylum seekers. It is probable that illegal migration will increase and more and more environmental migrants will appear due to the more frequent environmental disasters.

The uncooperative and sometimes violent global environment forces countries to create self-reliant economies and minimize import dependency. Technology improvement is slow due to ideas, innovation, capital, and people being less mobile globally. Local communities adopt a proactive approach to their unique local problems: in the beginning, -small-step innovations mostly come from the society and not the public or private sector. Bigger communities (cities) mostly in now developed countries are transformed as urban transport is modernized to be more eco-friendly and sustainable. Communities realize their vulnerability and dependence so they determine to reform themselves to be self-reliant (on food and energy) in an environmentally friendly way, if possible. The education system gets a lot of attention everywhere.

This divided world can evolve in positive and negative ways: it can be a world where governments are able to implement reforms to fight the economic, social and

environmental problems coming in the future, or it can be a world where governments turn out to be inadequate as they postpone cardinal reforms and decisions too much. Naturally, the outcome depends on how each country will handle the problems in a bad economic situation.

**Figure 4** Dynamics of migration in scenario B2



Source: author

## 7.7 Scenario summaries

We can lay down the following observations: both of the two globalized worlds (A1 and B1) are having high economic and low population growth; the two fragmented worlds (A2 and B2) are characterized only by slow or medium technology change; the first scenario (A1) has the highest economic growth together with rapid technology change but one of the lowest population growth rates. Moreover, even an environmentally friendly world (B1) can reach high economic growth.

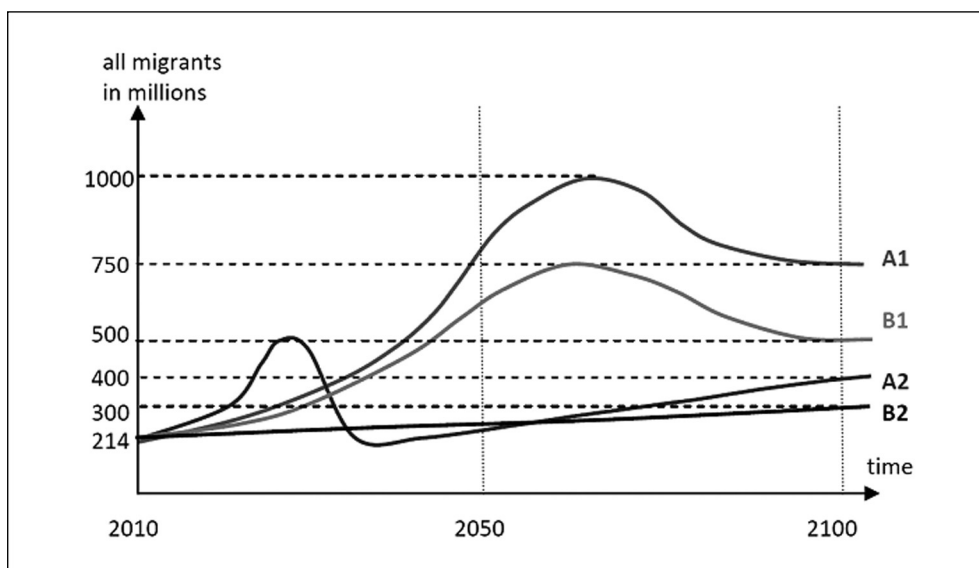
This section demonstrates a comparison between the different migration trends of each scenario. It disregards migration within countries and it pays attention only to international migration (both legal and illegal) with all asylum seekers, economic migrants, environmental migrants, tourists etc. – as long as they cross borders. The international migration identified here are not quantified because of (1) the high



uncertainty that lies behind forecasting for the next 100 years, (2) the complexity of the six models used in the original scenario building (apart from them being unavailable for the author), and (3) because sometimes less information is more useful.

The comparison of the different migration trends is based on four elements: the two main dimensions of the scenarios mentioned in the beginning of this chapter, the respective population growth rates, and the author's reconstructed storylines. The two main dimensions of the scenarios are the global-regional dimension, and the economic-environmental dimension. The following figure represents the international migration forecast for each of the four scenarios.

**Figure 5** Dynamics of migration in all scenarios



Source: author

Scenarios A1 and B1 reach higher migration levels in the long run because they represent a globalized world with less international barriers and more international mobility possibilities for people. Though both have low population growth levels and they reach a target of 7 billion people by 2100, their migration trend is different. According to the storyline of A1, it reaches the highest economic growth level from all scenarios based on rapid technology change. Furthermore, in both cases, the advanced and dense transport facilities allow travelling costs to decrease greatly. The globally but gradually introduced modern education system in scenario A1—which puts an emphasis on the international exchange of students—also contributes

to higher migration levels. Scenario B1 has a high GDP growth rate but because it characterizes a more environmental friendly world (which means that the prices of natural resources are increased artificially to a high level), it can accomplish only a medium rate of technology change. However, after the global economy “greens out” totally (it runs on unlimited natural resources, for example wind or solar energy), and this green technology slowly diffuses to all regions in the world, the growth rate of international migration will decrease. Due to population decrease after 2050, the levels of migration will fall in both scenarios. Also, we could suppose that an aging population is less mobile compared to a young population.

Scenarios A2 and B2 reach lower migration levels in the long run because they represent a regionally divided world with limited or sometimes “forbidden” international movement. Thus, international mobility possibilities are small. However, these two scenarios, too, have different migration trend lines. While the total number of migrating people in scenario A2 reaches a peak very fast compared to other scenarios, the migration trend of scenario B2 shows the same trend of slow international mobility in the long run. The answer to this difference can be found by studying their storylines. Scenario B2 is the one most similar to the world today: the level of international cooperation is low and international migration is restricted. If this migration policy remains the general policy for most of the countries, than even with 10 billion people by 2100, migration patterns will not change much – i.e. international migrants as a percentage of the global population will decrease, which is in line with the divided and protectionist nature of this scenario. What is more, with more people in the world who can afford overseas transport, migration policies will also have to be stricter than they are today. It is probable that illegal migration will increase and that more and more environmental migrants will appear due to the more frequent environmental problems and disasters.

The migration trend line of scenario A2 shows a steep pump out in the beginning of the period studied. It portrays the “crisis” between the developed and the developing world caused by the protectionist policies of the affluent part of the world. The exploited developing world bans natural resource allocation and trade with the dependent developed world. Due to this, a chaos situation evolves detailed in the storyline. Later, this mass movement of people will level off and the average level of global migration will be fuelled just as in scenario B2. The only difference being that scenario B2 will hold two thirds of the population of scenario A2 by 2100 (10 billion and 15 billion respectively). This explains that there are more migrants foreseen in the latter storyline.

The possibility of these four scenarios has not yet been discussed. Globalization is a far reaching trend in history; we could even say that apart from some exceptions, globalization characterized the last few centuries of humanity and it grows at an

accelerated pace. This is the reason why this chapter claims that the two globalized versions of the scenarios, A1 and B1, have a higher possibility of coming true than the two other scenarios about regionally divided and heterogeneous worlds, A2 and B2. Unless, a disturbing and trend-breaking event happens that has a bigger impact than the two world wars –since even after the world wars the political segmentation of the world was able to dissolve.

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