Chapter 2
Risks to Human and Environmental Security, Well-Being and Welfare: What are the 'Right' Indicators, How Are They Measured and Why Are They Only Rarely Used to Guide Policies?

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Abstract This work starts with the classification of different forms of individual and systemic risks and their basic measurement. Thereafter, perceptions and attitudes towards risks will be analyzed. Reasons for the over- or underestimation of risks, basic risk behavior (risk seeking versus risk avoiding personalities and strategies) as well as recommendations to overcome possible misperceptions will be forwarded. The actual problems of non-sustainable development in the world are partially due to ill-conceptualized and misleading indicators for risks. The Gross Domestic Product (GDP) is used as one key objective for government policies in nearly all countries. Its deficiencies are well known and scientific consensus exists that other indicators are needed. Such sets of sustainability-oriented indicators and conformingly derived proposals for change exist since many years and will be resumed. Reasons why these indicators are only rarely used in official politics need to be discussed: errors, scandals, biased approaches ('wishful thinking'), complex models, false forecasts or simply missing knowledge about the future and bad data analysis. Examples from economy, ecology and demography are presented. Measures needed to overcome at least some of these deficiencies will be proposed claiming for risk management systems, robust decision making, and ethical principles guiding individual and collective behavior.

Keywords Risks · Well-being · Climate change · Forecasts · Scenarios

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1 Classification and Measurement of Risks

This work starts with the classification of the different forms of individual and systemic risks and their basic measurement. Thus, the first question to be asked is 'what can happen?'; the second 'what is the probability of the risk?'; and the third question concerns the possible effects of a risk or the gravity of the risk.

1.1 The Different Types of Risks

Probably the word 'risk' was created in ancient times when ships crossed the Mediterranean Sea. The Latin word 'resecum' means the cliff that has to be avoided when sailing on the sea. Probably one of the first certificates of insurance covered maritime risks (Nguyen and Romeike 2013:51). In common language, there is no fundamental difference made between the terms 'risk', 'hazard', and 'uncertainty'.

However, science in general, and statistics in particular, mean by 'uncertainty' events without being able to indicate the probability of the event. Events where such a probability exists are called 'risks'. While uncertainty and risk are neutral terms with possible positive or negative outcomes, 'hazard' characterizes the danger of an event or an object having negative effects (i.e. a substance causing cancer). As the calculation of probabilities is based on the frequency of past events, the derived probability for future events is only reliable if there are no fundamental changes in factors influencing or controlling events (e.g. the probability of heavy rainfalls or floods may increase due to climate change making past counts obsolete). Thus, it would be from a terminological point of view more appropriate to use the term 'uncertainties' instead of 'risks'. Being scientifically very correct would mean to reserve the term 'risks' to lotteries and games with clear rules where, by means of mathematical probability analysis, in fact probabilities are valid. However, many areas in practice show sufficient regularities (e.g. in biology, medicine, agriculture, and sports) that justify the (prudent!) use of past frequencies of events for calculating probabilities and confidence intervals for future events (see Sect. 1.2). Therefore, mostly in this chapter, the term 'risk' in the sense of possible, but 'uncertain events' will be applied in accordance with common language and the topic of this volume.

In this chapter, it will be argued from a human anthropocentric perspective. It does not deal with risks to other species or nature, however not excluding ecological aspects as biodiversity that are considered to be important also for humans and their survival.

Literature contains voluminous catalogues of risks in different areas. Useful classifications might be the separation of natural and manmade risks on the one hand, and individual and collective/systemic risks on the other hand. Natural risks comprise earthquakes, tsunamis, volcano eruption, sun-activity, meteorites, floods, droughts, weather anomalies like El Niño, etc. Manmade risks, probably much more frequent, include political, ecological, technical, health, economic, financial,

demographical, social, personal security, gender and privacy risks, risks to justice, risks for minorities and others (Proske 2008; Renn 2014).

Some of these risks are caused by individual behavior (as smoking or obesity), others by the behavior of groups of humans or the setting of society (collective or systemic risks). Also, the effects of risks are either borne by individuals, groups of people, nations or even the whole mankind. A further distinction might be made according to the gravity of the risk from influencing mostly the comfortableness of one or a few people (i.e. noise in the neighborhood of wind turbines, airfields or factories) to affecting the future welfare and well-being of whole nations or mankind (climate change, biodiversity…).

1.2 The Probability of a Risk

After having answered the question 'what event or risk can happen', the next question to ask is 'how high is the probability or chance that a risk comes true'. For many events or risks, statistical information is available based on the frequency of events or calculations (Gigerenzer 2013; Gigerenzer 2014; Proske 2008; Renn 2014). However, a possible and rather common misunderstanding of such statistical data is – especially concerning man-made risks – that for example a very low risk for instance of a nuclear meltdown means that such an event will practically never take place in human's lifetime. The catastrophes of Chernobyl and Fukushima within a period of 25 years only show that such calculations might be wrong and misleading. Also, the fact that it took nearly 200 years between two very big earthquakes in Haiti does not exclude the possibility that there will be an earthquake in Haiti in the near future, thus justifying – eventually – even rather costly preventive measures or construction standards.

1.3 The Effects and Measurement of Risks

After knowing the possible events, respectively risks and their probability, the negative and/or positive effects of such events must be estimated, if possible and calculated in monetary or other concrete terms. Basically, the questions asked are: 'What is at risk and how big are the possible damages and losses?'. Standard financial analysis proposes the concept of actuarial expectations or values where the probability of an event is multiplied by its possible monetary positive or negative effect and summed up for all possible events. Respective values are used in cost-benefit analysis discounting future payments and earnings into net present values. Thus, the gravity of a risk can be measured and precautionary expenses can be evaluated. However, such calculations are rather inappropriate when dealing with human life, injuries or biodiversity. In those cases, other methods and indicators are requested as for example absolute life expectancy, days of lost life expectancy, mortality,

number of years of ‘healthy’ life, quality adjusted life years, number of species at risk of extinction, etc. Especially the mortality indicator is widely used for measuring the risk exposure of different activities or events. Proske (2008:177–180) has established a very detailed catalogue of about 150 situations/events or risks ranging from the mortality of a new born in Mali which was about 10% in 2004 p.a. until the chance being killed by a meteorite (6× 10–11 p.a.). For illustrating certain risks, the indicator ‘days of lost life expectancy’ is also very impressive: according to Proske (2008:234), alcoholism costs 4000 days and poverty in France between 2555 and 3650 days. Not very convincingly – because positive health effects are not counted – jogging takes 50 days and hiking 0,9 days.

If human life is threatened, the upper tolerated limit of a risk per year, the so-called de minimis risk, for a breakdown of any kind of buildings or other technical devices usually is defined as 10–6 (Proske 2008:188). As the exposure time to a certain risk is quite different, the so-called ‘fatal accident rate’ calculates the risk assuming an identical exposure time. For example, the risk of a jockey to have a serious, even deadly accident is rather high, but the time he is riding the horse is very short, thus leading to a still acceptable fatal accident rate.

Risks of groups of people are called ‘collective’ risks. For example, the number of people being killed in a plane crash is usually bigger than in a car crash. The concept of cumulative F-N-diagrams gives an idea of risks of different events, and was widely used in designing and comparing technical devices including nuclear reactors (Proske 2008).

Even if risks are evaluated by indicators like mortality, cost considerations come into the focus of decision makers when deciding about preventive measures (i.e. appropriate construction methods regarding the prevention of earthquakes versus financing of development activities).

2 Perceptions and Attitudes Towards Risks

Perceptions and attitudes towards risks will be analyzed as they vary considerably on the individual and on the systemic level. Reasons for the over- or underestimation of risks, basic risk behavior (risk seeking versus risk avoiding personalities and strategies), as well as recommendations to overcome possible misperceptions, will be forwarded.

As was discussed above in different areas of science and practice, the term ‘risk’ is defined quite differently, usually with negative connotations as fear, danger or the (mostly unknown) probability of loss or damage, but also positive meanings as ‘opportunity’, ‘chances’ or ‘adventure’, nicely expressed by the slogan ‘no risk – no fun’ of mostly young and hedonistic people (Nguyen and Romeike 2013). Not only in the Middle Ages, risk and adventure were considered by parts of the population as a mean to increase honor and self-esteem (for example when knights were fighting against each other for winning the hearts of beautiful ladies). It seems to me that

modern followers or adepts of these medieval knights can be found easily nowadays in international politics.

Risks are quite often perceived differently from one person to another. For example, some kinds of acoustic waves might be classified by one individual as noise, and by somebody else as music, wind turbines as positive instruments to fight against climate change or a risk to the natural environment and as bird killers.

Risk attitude depends on the possibility to decide on risk exposure: voluntarily people take and accept rather high individual risks (e.g. in sports or when smoking), but are much more sensitive about collective risks (Proske 2008). According to Renn (2014), individual risks are influenced to 2/3 by individual behavior and 1/3 by the environment. People generally underestimate systemic risks, for example financial crisis, migration, and climate change effects.

People overestimate the capability to deal with risk (for example car drivers, where a very big majority thinks that they are better drivers than the average driver) combined with the underestimation of individual risks (e.g. concerning exposure to accidents and diseases) and overestimation of collective completely or nearly completely uncontrollable natural or other risks (tornados, flooding, contaminated 'poisoned' food, risk of vaccination). However, this doesn't necessarily influence the behavior of people: regions with natural hazards (e.g. California with its high risk of earthquakes) are very much appreciated by people as working and living environment (Proske 2008). People ignore such risks because social risks (like losing a job, income or friends) strongly influence the decisions of people rather than very abstract natural risks.

Basic individual alternatives in dealing with risks are (Nguyen and Romeike 2013): acceptance (e.g. not changing driving style); avoidance (not driving with cars); reduction (driving prudently); limitation of possible damage (using a car that protects passengers); and transfer of risks to others (car and health insurance).

Risk reduction measures (e.g. better roads) do not necessarily lead to a lower rate of accidents as people adapt their behavior and e.g. drive faster on roads or drive faster in winter due to ABS[1] (Schmidt-Bleek 2014; Paech 2013).

The perception of risks depends heavily on the presence of the risk in the media. For example, at the beginning of the century the fear of the 'Creutzfeld-Jacob' disease due to beef consumption was shared by many people and governments. Imports of meat were blocked between many countries. However, in Europe only 150 people died from this 'Mad Cows Disease' within 10 years, approximately the same number dying from drinking perfumed lamp oil (Gigerenzer 2014:300). Another example of a problematic perception of risk is even more alarming: after the terrorist attack on the twin towers on September 11, 2001, many Americans (and not only Americans!) were afraid of flying, and decided to take instead the car as transport medium. According to Gigerenzer (2014:22), this decision produced very probably 1.600 additional deaths because taking a car is much more risky and causes more accidents and higher mortality rates than going by plane.

[1] ABS is the acronym of the German word 'Antiblockiersystem'.

Also, the time since the last accident of the same type counts. The perception of the risk diminishes as longer as a disaster attributed to a certain risk took place (Proske 2008:174).

On one hand, it seems natural that individuals and humanity try to minimize risks. On the other hand, taking risks is the very essence of an individual's life when choosing a partner, selecting a job, developing hobbies or investing money. Also, societies as a whole took big risks in the past – unaware of consequences and the gravity of their decisions – as they developed nuclear reactors or even conventional coal industries. Up to now, probably many more people died in coal mines and from the induced air pollution than from nuclear energy, but the potential and fear of much bigger catastrophes with nuclear reactors than thermal power plants motivated the German government to close down the nuclear reactors rather quickly, but only in the medium future, conventional thermal power plants will follow.

From the perspective of climate change, the whole process of industrialization can be seen as a very risky endeavor producing more and more greenhouse gases each year, demonstrated by the annual report of the World Meteorological Organization (WMO) on greenhouse gas concentrations (WMO 2015b). However, this process has led to huge improvements in the living conditions of many people as measured by conventional indicators, thriving development all over the world to new records and motivating the countries of the Southern hemisphere to copy the industrialization and modernization process of the so-called 'developed' countries. As the thriving factor of this development is the desire to achieve well-being and welfare everywhere, indexes and indicators for measuring well-being and welfare, but also the risks to human and environmental security, will be discussed in the next section.

3 Indexes and Indicators for Human and Environmental Security Well-Being and Welfare

The actual problems of non-sustainable development in the world are partially due to ill-conceptualized and misleading indexes and indicators measuring human objectives. For example, in conventional economic theory and politics Gross Domestic Product (GDP) is still used as a proxy for welfare (3.1). Sets of sustainability oriented indicators and conformingly derived proposals for change exist since many years and will be discussed (3.2).

3.1 The Gross Domestic Product

A negative or only small growth rate of the GDP per capita, respectively the Gross National Income (GNI) per capita, is still seen as a major risk for welfare, and therefore GDP/GNI is used as one key objective for government policies in nearly all

countries. Its deficiencies are well known. Some of them are (Diefenbacher and Zieschank 2011:13ff):

- Many products are not accounted for as part of GDP such as domestic labor, activities of volunteers, black market or informal market activities.
- Costs are accounted for goods or services – as in the case of expenditures for hospitals, prisons or defense – disregarding the fact that these costs are the result of accidents, diseases, crime, wars, etc. that in general cause a lower welfare for the big majority of the population.
- Long-term effects of economic activities, as the use of raw material and effects of climate change, are not considered. Implicitly, it is taken for granted that scarcity of resources and negative environmental effects will result in price increases of scarce and polluting material, thus leading to their replacement or at least more efficient usage. The price evolution of raw materials shows clearly that market mechanisms are not working in this sense. Also, efficiency gains are often outweighed by rebound effects, for example lower consumption of fuel stimulates sales of Sport Utility Vehicle (SUV) with a quite high consumption (Paech 2013).
- The (unequal) distribution of income, fortune and welfare is not taken into account by the GDP concept neither within nations nor between them. To compensate the unequal distribution and satisfy poorer sections of an economy, growth of the GDP is necessary as a vehicle for generating a 'trickling down effect' of income, and thus reducing poverty. However, the result of this process is often an even more unequal distribution.
- The growth rate of the GDP is by itself problematic in a finite world. For example, the mathematical effect of a constant growth rate of 3% is equal to a doubling of GDP within 23.5 years. The actual growth rate goals, and also the real growth rates in many developing and emerging countries, were at least in the past much higher (common political strategies suggest that this is also necessary for reducing poverty – see above). As a consequence, huge ecological, social, economic, and also political problems have evolved in many countries. After the financial crisis, many countries have stimulated growth of the GDP by deficit spending programs for generating demand, thus increasing public debts to very high levels. This raises doubts if those levels are still sustainable or will lead at least in some cases (the case of Greece for example) to bankruptcy of whole states.

So, the growth ideology has been criticized heavily asking for a more balanced growth or even replacing 'quantitative' non-sustainable growth (this means GDP growth) by 'qualitative' growth with a constant or even decreasing GDP where economies are restructured for becoming sustainable (Miegel 2011). Alternative indicators were proposed for example by the Stiglitz-Sen-Fitoussi Commission appointed by the French government. They presented their report in 2010 suggesting that indicators and indexes should cover the following domains: material living standards (income, wealth), health, education, personal activities, political voice and governance, social relationships, and environmental sustainability (Stiglitz

et al. 2010). Such indicators exist in the framework of the so-called happiness indicators which will be introduced and discussed in the next section.

3.2 *Gross National Happiness, Human Development, Legatum Prosperity and Happy Planet Index*

Many different alternative indicators have been developed since 1970 when Bhutan introduced its first Gross National Happiness indicator (GNH) (Centre for Bhutan Studies and GNH Research 2015). Recently, other countries followed Bhutan and created their own indexes, e.g. the Canadian index of well-being (2011) (University of Waterloo 2015), the Australian unity wellbeing index (Australian Unity 2015), and the United Kingdom (UK) national well-being index (2014) (Office for National Statistics 2015; Self 2014). The advantage of the national indexes is that they can be tailored ideally for the local situation reflecting cultural, ethnical or even religious characteristics. The disadvantage is the non-comparability on the international level.

Thus, in this analysis the objective is to present and discuss three international indexes: Human Development Index (HDI) (UNDP 2015a); Happy Planet Index (HPI) (Centre for Well-being at NEF 2015); and Legatum Prosperity Index (LPI) (Legatum Institute 2015). These indexes represent rather different approaches and illustrate the different dimensions of happiness on the international level. There are many more other indexes with more or less the same objective, but also very different approaches like the OECD Better Life Index (2011)[2], World Happiness Report (2012)[3], and the Quality of Life Index[4].

This rather big confusing number of different happiness measurement approaches is similar to other domains, as poverty analysis, where at least seven different concepts are used by statistical authorities in one country (Benin), leading often to logically non-convincing results (Sommer et al. 2013, 2014) (see below). The same might be true for the happiness indicators where the results are presented in the form of rankings of the rated countries (Table 2.1)[5].

As can be seen in Table 2.2, there is a very strong correlation between GNI and HDI. Probably not much astonishingly, it can be concluded that high income countries are also those with a rather long mean period of schooling and high life expectancies, the opposite being true for the countries with a low GNI. The same is true for the LPI, only to a slightly lower extent.

More astonishingly, the correlation between HDI and LPI is also very high (0,929). Taking into account the fact that LPI is calculated from 89 indicators and

[2] http://www.oecdbetterlifeindex.org/.

[3] http://worldhappiness.report/.

[4] http://www.numbeo.com/quality-of-life/rankings_by_country.jsp

[5] The detailed calculation of the correlation of these rankings can be forwarded by the author to everybody on demand.

Table 2.1 HDI, HPI and LPI

Index	Human development index (HDI)	Happy planet index (HPI)	Legatum prosperity index (LPI)
First year	1990	2006	2010
Domains	economy, health, education	health, well-Being environment	prosperity, economy, entrepreneurship and opportunity, governance, Education, health, personal freedom, social capital, safety and security
Indicators	GDP / capita, Life expectancy, mean years of schooling, average years of schooling	Life expectancy, experienced well-being, ecological footprint.	89 variables out of 200 were selected
Organization	UNDP	New Economics Foundation	Legatum Institute
Weighting method	Geometric mean of normalized indices for each of the three dimensions,	Individual formula: footnote (b)	Weights were determined by regression analysis at the start (2010)
Data sources	UNDP Human Development Report, UNESCO	Gallup World Poll, UNDP Human Development Report 2011, WWF	Official sources and "commercial providers", details not provided
Number of countries	185	151	142
Gender issues	No	No	–
Sources	http://hdr.undp.org/en/content/human-development-index-hdi	http://www.happyplanetindex.org/about/	http://www.prosperity.com
Time series analysis	Yes	No	No
Normalization of variables / sub-indicators	All: upper and lower limits defined by UNDP Footnote (a) GNI: logarithm of income, to reflect the diminishing importance of income with increasing GNI	Footnote (b)	Variables are standardized by subtracting value from the mean and dividing by the standard deviation.
Latest update	2013	2012, Footprint 2007 Footnote (c)	2013

[a]Reference values: life expectancy: lower limit: 20 and upper limit: 85 years; mean years of schooling 18, average years of schooling: 15, GNI: upper limit 75.000 USD, lower limit: 100 USD

[b]Complete calculation of HPI: Happy Planet Index $= \Omega \frac{(\text{Ladder of life} + \alpha\,\text{Life expectancy}) - \pi}{(\text{Ecological Footprint} + \beta)}$

where: $\alpha = 2.93$, $\pi = 4.38$, $\beta = 73.35$, $\Omega = 0.60$, Ladder of Life (individual subjective classification from 1 to 10): researched by surveys from the Gallup Institute: http://www.happyplanetindex.org/assets/happy-planetindex-report.pdf

[c]Newest footprint data (2011): http://www.footprintnetwork.org/ecological_footprint_nations/

Table 2.2 Correlations between GNI, HDI, HPI, LPI and ecological footprint

	HDI	HPI	LPI	Ecological footprint
GNI	0,968	0,258	0,894	−0,884
HDI		0,332	0,929	−0,863
HPI			0,328	−0,001
LPI				−0,846

Table 2.3 HDI time series of selected countries

Growth rank	HDI rank	Country	1980	1990	2013	Growth rate
1	136	Cambodia	0,251	0,403	0,584	2,59%
2	169	Afghanistan	0,230	0,296	0,468	2,18%
3	176	Mali	0,208	0,232	0,407	2,06%
7	91	China	0,423	0,502	0,719	1,62%
16	129	Morocco	0,399	0,459	0,617	1,33%
69	6	Germany	0,739	0,782	0,911	0,64%
73	20	France	0,722	0,779	0,884	0,62%
131	5	USA	0,825	0,858	0,914	0,31%
132	57	Russia		0,729	0,778	0,28%
139	133	Tajikistan		0,610	0,607	−0,02%

Data source: UNDP (2015a)

HDI only from 4, this shows that indeed life expectancy, mean years of schooling and GNI are decisive factors for happiness (as measured by LPI). A detailed cluster analysis study by Otoiu et al. (2014:581) reveals that the best explanatory variables, that is the indicators with the strongest influence on happiness indexes are: CO_2 emissions per capita; GNI per capita; life expectancy at birth; mean years of schooling; total participation rates; share of fossil fuels; income Gini coefficient; and well-being.

On the other hand, the correlations between HPI and HDI are rather small. Also the correlations between HPI and LPI and HPI and GNI are low. This is due to the influence of the ecological footprint that is strongly negatively correlated to GNI: the richer the country the higher the footprint.

As HPI and ecological footprints are practically not correlated, the message of the HPI is not so clear. Rich countries reach medium ranks while medium countries as Costa Rica and Vietnam reach the highest ranks due to their lower footprints. Countries with lower ranks in HDI normally don't change their low positions due to low sub-indicators for wellbeing and for life expectancy.

It results from the discussion that HDI together with the ecological footprint are theoretically the best indexes and indicators for describing the situation of a country[6]. The HDI indicator allows intertemporal comparisons of countries (Table 2.3),

[6] As the latest available ecological footprint indicator dates from 2007 with an update in 2010, it is proposed to replace this indicator by an indicator measuring the CO2 emissions. Both indicators are strongly correlated.

Table 2.4 Comparison of seven selected countries

	Germany	Saudi Arabia	Russia	Costa Rica	South Africa	Vietnam	Morocco
HDI rank	6	34	57	68	118	121	129
GNI per cap.	43,049	52,109	22,617	13,012	11,788	4892	6905
Male life expectancy	78,3	73,9	61,8	77,8	54,7	71,3	69,1
Femal life expectancy	83,1	77,6	74,4	82,2	58,8	80,5	72,7
Adult literacy rate		87,2	99,7	96,3	93	93,4	67,1
Under 5 mortality	3	7	9	9	33	18	27
Obesity	14,7			8,1	19,2	4,4	10,7
Overall life satisfaction index	6,7	6,5	5,6	7,3	5,1	5,5	5
Footprint (2010?)	4,57	3,99	4,40	2,52	2,59	1,39	1,32
Female participation rate	53,5	18,2	57,0	46,4	44,2	72,8	43,0

Data sources: UNDP (2015a) and Statistisches Bundesamt (2014)

as well as comparisons across countries (Table 2.4). Probably not very astonishingly, developing and emerging countries are showing the highest annual growth rates. However, at least in the case of Afghanistan, this might be a rather unsustainable situation produced by the support of the allies due to the war against the Taliban. Also, the situation in Mali is not stable as it is still under attack of terrorists. Probably more astonishingly, the USA and Russia are nearly at the end of the ranking showing only half of the growth rate of Germany and France.

The comparison of seven very different countries from Germany to Morocco (Table 2.4) reveals that countries may show very different performances. Sometimes high GNI per capita hides shortages and deficiencies in other areas: Saudi Arabia with one of the highest GNI per capita in the world has a very low female labor participation rate and a lower literacy rate than South Africa. Only in South Africa, male life expectancy is lower than in Russia. Overall life satisfaction in Costa Rica is significantly higher than in Germany with less than one third of the German GNI per capita and similar life expectancies. Morocco shows only slightly lower values of the life satisfaction index than countries like South Africa and Russia with 50% or less of the footprint of South Africa and Russia.

In general, the detailed comparison of countries shows that high ranks in GNI do not necessarily mean higher life standards of the population: multiple reasons from gender issues to human rights and freedom of speech would probably motivate many people to live in Costa Rica (HDI rank 68) or in Morocco (rank 129) than in Saudi Arabia (rank 34). Thus, indexes as HDI, LPI and others implicitly hide tradeoffs between important aspects. The same happens when methods like cost-benefit analysis are used to support decision makers in ecological decision-making. Implicitly, such methods apply equal weightings for different costs and benefit items. Thus, a tradeoff between nature and social and economic aspects take place. For example, the loss of biodiversity that is the threat of extinction of species is

accepted in exchange for increased agricultural production or measures against climate change like increased biogas production[7]. Such an approach means always applying a weak instead of a strong concept of sustainability where for example biodiversity or other social or ecological values must be protected and tradeoffs are not allowed.

If composite indexes like HDI are used, distribution effects (who has to bear the costs? who will get the benefits?), human security, empowerment, gender issues, regional, ethnical or local differences are not considered.

4 Why Politicians Still Use the GDP-Concept and Mistrust Science

Reasons why HPI and LPI indexes are often neglected in politics need to be discussed. Also, it should be investigated which indexes or indicators additionally to GDP/GNI are really used and why they are used.

4.1 Measurement Problems and Interpretation of Data

The great diversity of approaches reflects different perceptions of the world and its values by the index users. But, as shown in the previous section, HDI and LPI are closely correlated and they are also strongly correlated with GDP (Table 2.2). It follows that the error of using for example, the HDI instead of the LPI will not result in big differences. Even the GDP/GNI are rather strongly correlated with HDI and LPI. However, there are exceptions (as the case of Saudi Arabia shows) from this rule that were analyzed above. Thus, in summary the mistake of continuing to use GDP, instead of for example HDI, might be acceptable for a politician preparing economic programs and for investors deciding on fund applications.

However, there are some other problems with indexes and indicators: the values of – for example GDP – are frequently revised ex post. These revisions, due to statistical errors and corrections, reached in the case of Germany a magnitude between −1.0 and 0.9 percent points for specific years even quite some time later than the first values were published (Döhrn 2014:34).

Also, the magnitude of growth rates of GDP is a highly political and economic issue demonstrated by the Chinese GDP growth rates. The suspicion that China falsifies growth rates has a long tradition and continued until recently. In an article published by the Economist (2015), it was noted that: “all seems a little too perfect to be true. The Chinese government set a growth target of ‘about 7%’ this year. And

[7] In cost-benefit analysis also problematic discounting of future benefits and costs when calculating net present value takes place: for justifying discounting, it is implicitly assumed that in the future technological progress will solve problems, higher incomes will make it easier to bear costs.

for a second consecutive quarter, despite ample evidence of stress in its industrial sector, it managed to hit that right on its head". Thus, doubts that the data were 'smoothed' or even 'fabricated' are openly expressed. In its article, the Economist concludes that the first alternative is more likely, referring to examples from the past when China most probably underestimated intentionally the GDP growth rate for political reasons. The theory of 'smoothing' is supported by the fact that the Chinese government propagates actually a new target for economic growth of about 6.5% instead of 7%. So the publications earlier this year might be seen as a preparation of the market for the new target.

The same problem of uncertainties about actual figures can be observed with demographic data. In 2006, a (worst case) scenario was presented where the German population would decrease from about 82 million (2002) to roughly 62 million until 2050 (Schwägerl 2015). The resulting demographic gap alarmed the German public and was widely discussed by many authors (Birg 2005; Schirrmacher 2006). The tendency of a shrinking and older population seemed to be confirmed when officially the population number in Germany was reduced to 80.2 million (Census 2011). In the census 2011, it was found out that the resident's registration offices contained 1.5 million only nominal citizens (Statistische Ämter des Bundes und der Länder 2014; Der Spiegel 2013).

Due to the influx of many foreigners – 860.000 migrants from Non-EU-countries arrived in 2015 (plus 382.500 migrants from EU-countries) (Bundesamt für Migration und Flüchtlinge 2016) – the German government changed its projections for the coming years and expects actually 300.000 migrants per year until 2030 instead of 100.000 until recently. As a result, it is estimated that the German population will not shrink, but increase until 2030 and will only decrease afterwards (Creutzburg 2015; Schwägerl 2015).

In other countries like Nigeria, an ethnically and religiously very diverse country, the census is an even more political issue than in Germany since it has links with the borders of electoral districts and the composition of parliament. In the past most probably, the outcome of the census was frequently falsified leaving many doubts about the actual number of people living in Nigeria (Odunfa 2006; Population Reference Bureau 2006). Even officially, it was acknowledged: "the usual problems of under-coverage common to most censuses are compounded by those of over-counting, as states, ethnic groups, and religions compete for demographically based claims on power and resources" (Population Council 2007:206).

For checking especially urban population figures in West Africa, the French development agency (AFD) commanded the so-called 'Africapolis' study (AFD undated, 2011). By using satellite imaginary complimentary to census data, the study found out that especially in Nigeria, but also in other West African countries, the number of urban population is considerably smaller as assumed until now by the census. The results of the Africapolis methodology for Nigeria demonstrate that many settlements have either scarcely grown since the 1960s or were simply grossly over-estimated at that point. Astonishingly, it was found that the populations of nearly half of the smaller urban settlements assessed via their methodology were less than those recorded in the 1963 census (Potts 2012). "At the national level, the

outcome of the Africapolis re-evaluation of the 2006 census in Nigeria is that its urbanization level is 30%. Yet the UN Department for Economic and Social Affairs reported a level of 49% in 2006" (Potts 2012:1386). Thus, a very critical view must be observed on statistical data produced by national statistical offices, especially in developing countries.

Also, a research we have undertaken in the Republic of Benin revealed many inconsistencies. For example, the incidence of income poverty in Benin in 2011 for households under three persons is published as 1.0%, that is to say almost zero, while non-monetary poverty in the same group is 39.6% (Sommer et al. 2013). Therefore, despite many efforts and initiatives in the past for improving the performance of statistical offices, much needs to be done to improve data quality. This might be often difficult or impossible on account of political motives. The reason for at least some of these errors may be even sometimes simple calculation errors, facts that even happen to very prominent scientists working in prominent universities and financed by prominent institutions like the IMF. One of the IMF's most prominent researchers, Reinhart and Rogoff (Chief Economist of the IMF between 2001 and 2003), committed obviously such (EXCEL) errors when calculating the threshold for country's debt ratios (Reinhart and Rogoff 2009). Especially, they tried to analyze the problem of how (higher) debt ratios might influence economic performance. Their results were understood especially by conservative politicians all over the world that there exists a threshold of 90% debt ratio to GDP from whereon GDP growth suffers from higher debts.

Herndon et al. (2013) found out, when replicating Reinhart and Rogoff's analysis, that coding errors, selective exclusion of available data, and unconventional weighting of summary statistics lead to serious errors that inaccurately represent the relationship between public debt and GDP growth among 20 advanced economies in the post-war period. Their finding is that when properly calculated, the average real GDP growth rate for countries carrying a public-debt-to-GDP ratio of over 90 percent is actually 2.2 percent, not 0.1 percent as published in Reinhart and Rogoff (2009). According to Herndon et al. (2013), differences in average GDP growth in the categories 30–60 percent, 60–90 percent, and 90–120 percent cannot be statistically distinguished. The Journal Newyorker asked thereafter: "after this new fiasco, how seriously should we take any economist's policy prescriptions, especially ones that are seized upon by politicians with agendas of their own?" (Cassidy 2013). However, this result should not be misunderstood: according to the German institute for economic research (Deutsches Institut für Wirtschaftsforschung, DIW), early indicators of the last financial crisis were high growth rates of credits in relation to GDP, and on the micro level high debt ratios and low equity ratios of the affected banks (Beck and Bremus 2014). Also, the example of Greece will probably show in future that it may be virtually impossible for this country to reduce its debt ratio to a sustainable level without debt reliefs.

In the case of the controversy on the debt threshold, calculation errors, and perhaps the misinterpretation of data, explain the deviations. In the case of 'Climategate' in November 2009, the email server of the Climate Research Unit of the University of East Anglia in the UK was hacked. This Unit is a member of the Intergovernmental

Panel on Climate Change (IPCC) and collaborating closely with the British National Weather Service. Especially, the emails of its Director Phil Jones contained rather problematic content, recommending for example manipulation of data. The report of an independent government committee found out later that there was at the end no manipulation of data. However, the very problematic communication policy only publishing affirmative data was heavily criticized (Fiaromonti 2014). Especially, the attempt to hide data from publication has to be considered an ethically very problematic behavior, because it provokes mistrust of people and politicians in the results of climate models and calculations. Probably, Climategate was one of the causes why the Copenhagen climate summit in 2009 failed.

In the climate change debate, another example of problems of really knowing 'the true and real' actual situation is the discussion about the so-called 'Climate Hiatus'. Climate Hiatus means the fact that according to many researchers and institutions, including IPCC (since 2013) and the British meteorology services, the temperature didn't increase as expected in the climate models during the last decade (Allan and Loeb 2015). IPCC states in its latest Summary report: "The rate of warming over the past 15 years (1998-2012; 0.05 [-0.05 to 0.15] °C per decade), which begins with a strong El Niño, is smaller than the rate calculated since 1951 (1951–2012; 0.12 [0.08 to 0.14] °C per decade)" (IPCC 2015). Another study summarizes: "despite ongoing increases in atmospheric greenhouse gases, the Earth's global average surface air temperature has remained more or less steady since 2001" (England et al. 2014:227). The IPCC forwards as an explanation "substantial decadal and inter-annual variability", and also the fact that "ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010 (high confidence), with only about 1% stored in the atmosphere" (IPCC 2015:3). Other possible explanations are forwarded in the literature, for example a "recent intensification of wind-driven circulation in the Pacific" (England et al. 2014:227).

The publication of a study in June 2015 claiming that there never was a global warming hiatus was under these circumstances a big surprise: "The apparent hiatus, first reported by the IPCC in 2013, resulted from a shift during the last couple of decades to greater use of buoys for measuring sea surface temperatures. Buoys tend to give cooler readings than measurements taken from ships" (EOS Earth and Space Science News 2015). It would mean that the measurements of world average temperature were wrong, measuring too high values in the past and too low values now. Thus, according to these researchers no climate hiatus exists! This finding would be perfectly in line with many other observations confirming climate change, from average regional temperatures beating 1 year after the other all time high records, sea level rising until natural disaster statistics and extreme events (IPCC 2015; WMO 2015a, 2015b; Munich Re 2015:58). On a worldwide scale, the year 2015 was the warmest year ever observed (NOAA National Centers for Environmental Information 2016).

As a result, we may conclude that there is quite often only a low confidence in statistics about 'facts' of the past because they are wrongly measured, falsified or manipulated, badly ascertained, respectively researched or misinterpreted. However,

Table 2.5 Comparison of naïve forecasts of the German GDP with official forecasts

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Score
Official forecast	1,7	1,5	1,2	1,4	2,2	0,2	1,2	2	0,8	1	
Reality	1,2	0,7	3,7	3,3	1,1	−5,1	4	3,3	0,7	0,4	
Naive forecast		1,2	0,7	3,7	3,3	1,1	−5,1	4	3,3	0,7	
Deviations											
Off. forecast – reality		0,8	−2,5	−1,9	1,1	5,3	−2,8	−1,3	0,1	0,6	5
Naive forecast - reality		0,5	−3	0,4	2,2	6,2	−9,1	0,7	2,6	0,3	4

Data source: Statista (2015)

indexes and indicators as GDP/GNI, population figures or CO_2 are not only analyzed for comparing a country with other countries or evaluating past successes in development, but also for deriving recommendations and planning or even 'knowing' the future.

4.2 Forecasts, Projections and Scenarios

All indexes show only past performances of countries, but don't help to produce forecasts that show how the indicators will develop in the future. For doing this, a lot of efforts were and still are regularly undertaken for knowing better future developments in many fields, especially economy, demography, and ecology.

4.2.1 Economic Forecasts: The Example of GDP

One of the key indicators in economy is still GDP/GNI. At least in the case of industrialized countries, as for example Germany, many institutes publish every year a series of forecasts for the next year. It begins with the IMF in September, followed by OECD, the Council of independent experts nominated by the German government, several research institutes, and at the end of January finally the last forecast is made public by the German government. The question is how reliable such forecasts are (Döhrn 2014). A very simple comparison of naïve and scientific forecast is reproduced in Table 2.5.

As can be seen in the time series of the years 2005–2013, official forecasts were in 5 years more precise than naïve forecasts; naïve forecasts were better in 4 years. The impression of the relatively weak quality of forecasts is partially confirmed by the literature. For example, the OECD has detected in its forecasts a positive bias, forecasting constantly better values as realized (Lewis and Pain 2015). Other authors found out an acceptable degree of precision of German GDP forecasts (Döhrn 2014), if the time horizon doesn't exceed very much 1 year. However, the (rather low) precision of GDP forecasts decreases rapidly for forecasts exceeding 1 year.

According to Dühr, the 70% confidence interval has a width of 4 percent points for such forecasts in the case of Germany. Also, Tol (2008) confirms that GDP forecasts exceeding 18 months are not reliable. Julio and Esperanza (2012) evaluated the forecast quality of GDP components and claimed, "the overall accuracy of component predictions…is substantially low, meaning that GDP forecasts are assembled with rather inaccurate component predictions". As expected, the lowest forecast quality occurred in the financial crisis. Ikka Korhonen (Bank of Finland) and Maria Ritola investigated the success of forecasting economic developments in major emerging markets and conclude: "our results suggest that relying on any one forecast methodology is not prudent" (Korhonen and Ritola 2014).

4.2.2 Population Projections

Concerning population forecasts, it has to be repeated that there are in certain countries, as Nigeria, high uncertainties about the correct actual figure. Thus, it is widely accepted that it is impossible to forecast the future population of a country or the world, but to do instead 'projections'. According to the Merriam-Webster Dictionary (2015), a projection is "an estimate of what might happen in the future based on what is happening now". According to the German Gabler's economic dictionary, projection is not like forecasts since it is based only on observations from the past and objective methods, but uses also subjective guesses for example by experts (Gabler's Wirtschaftslexikon 2015).

The UN has updated recently its so-called 'population estimates and projections' applying statistical methods. The United Nations Development Program (UNDP) projections for the world population vary between 7.3 billion (low variant) and 16.6 billion people (high variant) for the year 2100 with an 80% confidence interval between 9.6 and 12.3 billion people (UNDP 2015b). However, all projections start with the same values in the year 2015, not acknowledging any doubt on the measurement of the existing world population. So, in all projections a population of 182 million people for 2015 is supposed for Nigeria.

According to other demographers, the UN's projection exaggerates heavily. In an article at Global Environmental Change, Wolfgang Lutz and his colleagues at the International Institute for Applied Systems Analysis (IIASA) in Vienna, Austria, use a very different method – one that involves canvassing a large group of experts – to argue that population is likely to peak at 9.4 billion in 2075 and fall to just under 9 billion by 2100 (Samir and Lutz 2017; Kunzig 2014).

Another study provides simulations showing what global and regional population sizes would actually be if the rest of the world would have experienced similar population growth patterns as what was observed in Europe during the demographic transition. The implications of differences in population growth patterns are large. If Nigeria would have followed the French population trajectory, it would grow from 38 million in 1950 to only 72 million in 2100, while the UN projections suggest it would reach 914 million people by 2100. Thus, population growth is more influenced by cultural variations causing uneven growth rather than by any universal

population growth trajectories over the demographic transition (Skirbekk et al. 2015).

Therefore, the only possible conclusion of the different approaches from an observer's point of view and a concerned world citizen is that there is high uncertainty about future world population as well as national populations.

4.2.3 Climate Change Scenarios

Instead of projection in climate science, scenarios are widely used. Scenarios are descriptions of different plausible futures. According to Tol (2008:22), they combine "art and science". They are based on empirical regularities (as the assumption of dependencies between temperature and CO_2 levels) and theoretical understanding (the greenhouse effect). The basis of climate change scenarios are projections of emissions of greenhouse gases and their supposedly (close) correlation with average world temperature, sea level or other meteorological phenomena as the frequency of storms, droughts, floods, etc. For deriving the scenarios, assumptions must be made on the behavior of people, respectively socio-economic systems including population growth, technological progress and capital growth (Tol 2008:23). For Storch (2008:5), "scenarios are not predictions, but 'storyboards' (used usually for producing movies), a series of visions of futures which are possible, plausible, internally consistent but not necessarily probable". Even one might say the purpose of many scenarios is to motivate politicians to implement adequate measures that undesired scenarios become self-defying prophecies, that is they don't come true.

However, the IPCC scenarios are often presented in the form of forecasts. According to Tol (2008:18), "this mistake is often made by journalists and policy makers". But, "although scenarios cannot be falsified or validated, they can be tested against data nonetheless" (Tol 2008:32). Thus, if the temperature hiatus – if there exists any at all (!)– would continue for some years, the scenarios developed by the IPCC need to be adapted and the models 'calibrated'.

Last but not least, an important reason for politicians not following scientific recommendations is very often the complexity of the texts published by scientific bodies. An example is the Summary for Policy Makers (SPM) of the IPCC. A linguistic analysis of IPCC summaries for policymakers was undertaken recently by researchers from the university of Bonn in Germany that resulted in the evaluation that "IPCC SPMs clearly stand out in terms of low readability, which has remained relatively constant despite the IPCC's efforts to consolidate and readjust its communications policy" (Barkemeyer et al. 2015).

4.3 Data Politicians (and People) are Really Interested in

Beside GDP growth, unemployment and debt ratios, politicians are interested in data like polls (especially measuring their own popularity and of their parties!). Such data is provided worldwide by the Gallup[8] or many national institutes, researching the opinion of population or specific target groups. For example, since 1973 the EU publishes two times a year in spring and fall a survey in all member countries called 'Eurobarometer'. One standard question since the beginning is as follows: 'On the whole, are you satisfied with the life you lead?'. The possible answers are: very satisfied; fairly satisfied; not very satisfied; and not at all satisfied. Taking all countries together, about 80% of the EU citizens are very satisfied or fairly satisfied with no big variations in time since the last 40 years (European Commission 2015).

At the first glance, it seems that this result confirms the so-called set point theory in psychology that happiness and satisfaction are mostly constant factors in the life of a person and, as a consequence, also have characteristic values in specific countries. However, a more detailed analysis reveals that rather big deviations exist between countries which may be explained by national factors. But, there are also important fluctuations in time: between 2007 and 2014, the percentage of people satisfied with their life increased in Germany from 82% to 87%, and decreased in Italy from 76% to 63% and in Spain from 90% to 70%. It seems that the most important reason for these changes is the economic evolution in the Eurozone since 2009 (European Commission 2015).

The big problem with information contained in polls, GDP growth rates, and also well-being indicators is its short mindedness, which is the unwillingness to look or care about long-term implications. However, as these implications are highly uncertain, forecasts are impossible, communication policies are inappropriate, and scenarios are not sufficiently plausible or really understood or accepted by people and politicians, this attitude is perhaps understandable.

5 What Needs to be Done – Risk Management and How to Find the Right Decisions for Reaching Sustainability

Despite all problems of measuring, analyzing and forecasting indicators and risks, one of the most important risks is population growth, especially in poor countries. A growth rate of about 3% p.a. can still be observed in many sub-Saharan African countries. This rate means that the population will double within 23.5 years. High population growth provokes high economic growth necessary for reducing poverty, but also increases in resource consumption, pollution and CO2 production. Therefore, climate change, depletion of resources and migration will be intensified.

[8] http://www.gallup.com/home.aspx

Thus, the fight against population growth must become a priority, especially in Sub-Saharan Africa.

By using the words of Keynes (who meant them for defending his mostly short-term oriented economic policy proposals), there is only one certainty in life: 'in the long run we are all dead'. Not only for religious people and parents and grandparents caring for their children and grandchildren this doesn't mean that we should live following the principle 'après nous le deluge' ('after me, the deluge'). Since the Brundland Commission published its report 'Our common future' in 1987 defining 'sustainability' as "not compromising the ability of future generations to meet their own needs" (UN 1987), basically all nations accepted this principle.

Concerning short and medium term risks, risk management systems exist in many areas from fire brigades, medical care to management of any kind of disasters as accidents, floods, hurricanes or earthquakes. In all these areas, prevention plays nowadays an important role. It may reduce the risk to life dramatically as is shown by the low dead rates in countries having implemented adequate risk prevention measures (for example Japan and Chile regarding earthquakes). The development of risk management in organization is supported by principles and guidelines laid down in ISO 31000:2009: "It can be used by any organization regardless of its size, activity or sector. Using ISO 31000 can help organizations increase the likelihood of achieving objectives, improve the identification of opportunities and threats and effectively allocate and use resources for risk treatment" (ISO 2015). "Organizations using it can compare their risk management practices with an internationally recognized benchmark, providing sound principles for effective management and corporate governance" (ISO 2015).

These risk management systems are limited up to now to disasters and many types of prevention are only possible for rich countries. It may be hoped that the creation of additional funds may improve the situation of poorer countries. The actual behavior and mobilization of funds concerning refugees in Europe raise many doubts on the ability of the international community to increase solidarity. At the end, this is a question of ethical principles guiding individual as collective behavior including ethically sound scientific research.

One approach that is basically, and in general also accepted by many, is the robust decision making. Policy options must be identified to prevent unacceptable outcomes in as many scenarios as possible. In practice, it means realizing co-benefits in as many areas as possible like for example from poverty reduction to climate change.

6 Conclusion

As was shown previously, richer countries are in general also the happier countries. The indicators with the strongest influence on happiness are: CO_2 per capita; GNI / GDP per capita; life expectancy at birth; mean years of schooling; total participation rates; share of fossil fuels; income Gini coefficient; and well-being. This is

underlined by the fact that poor countries show in general a low performance in most if not all these areas. Thus, regarding the importance of CO2 per capita and resource consumption there seems to be no chance for sustainable development. However, the example of Costa Rica shows that alternatives are possible; people there have a higher score in life satisfaction than people of much richer countries as Saudi Arabia and even Germany.

Despite all uncertainties demonstrated above regarding the correct description and analysis of the actual situation, that is the selection of the 'right' indicators and the impossibility to forecast long-term developments, there are some fundamental robust strategies that should be promoted. These include the fight against high population growth rates, mainly in poor countries, the introduction of clean technologies and the promotion of a more dematerialized world by fostering the insight that happiness can (also) be reached when changing the actual patterns of consumption.

However, it should not be underestimated that there is a long way to go. Especially the following questions need to be answered when preparing and deciding about concrete measures for reducing risks to human and environmental security, well-being and welfare: How to define and achieve sustainable long-term solutions? How to change the individual perception of risks from short term to long term? How to develop better early warning systems? How to deal with worst-case scenarios? How to value non-monetary items (for example in the case of biodiversity)? And how to overcome free rider situations?

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