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An International Nutrition Index

Successes and Failures in Addressing Hunger and Malnutrition

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Contents

List of Tables:

List of Figures:

List of Boxes:

Abstract

At international conferences in the 90s, the international community reconfirmed the elimination of hunger and malnutrition as high priority. The Nutrition Index (NI) presented in this paper has been designed to assess the effectiveness of actions taken towards achieving this goal. The Nutrition Index reflects complementary dimensions of a country's nutrition situation by including the following indicators: 1) the percentage of undernourished in the population, 2) the prevalence of underweight in children under the age of five, and 3) the under-five-mortality rate, indicating the deadly synergy between inadequate food intake and unhealthy living conditions.

After data refinement and several estimation procedures to supplement lacking data, data availability permits NI calculation for the vast majority of developing countries and at different points in time (1981, 1992 and 1997). The NI serves as a comprehensive measure to analyse performance and trends in combating hunger and malnutrition in single countries and in regions. In North Africa and the Near East, as well as in Latin America and the Caribbean, a nearly satisfactory nutrition situation has been achieved. The nutrition situation is still bad in South Asia and no better than mixed in most of Southeast Asia, but very promising upward trends have been observed in this region since the beginning of the 80s. In large parts of Sub-Saharan Africa, the nutrition situation is bad or even extremely bad, and recent trends do not provide much scope for optimism either.

In further analyses, significant correlations between NI values and the prevalence of micro-nutrient deficiencies are found, and the tight connection of macroeconomic performance and people's ability to be free from hunger and malnutrition is demonstrated. In spite of this, the comparison of NI and GNP per capita also reveals that much economic scope for policies to relieve hunger and malnutrition still remains untapped in many countries. The Nutrition Index, in its function as an international monitoring tool, is hoped to make countries more accountable to their commitments and to help speeding up necessary nutritional improvements.

Kurzfassung

Auf den internationalen Konferenzen der 90er Jahre hat die internationale Gemeinschaft erneut bekräftigt, dass der Bekämpfung von Hunger und Mangelernährung hohe Priorität zukommen muss. Um die Wirksamkeit von Maßnahmen abzuschätzen, die zur Erreichung dieses Ziels ergriffen werden, wurde der hier vorgestellte Ernährungsindex (EI) entwickelt. Der Ernährungsindex spiegelt komplementäre Aspekte der Ernährungslage eines Landes wider, indem er folgende Indikatoren einschließt: 1.) den Prozentsatz der Unterernährten in der Bevölkerung, 2.) die Häufigkeit von Untergewicht bei Kindern unter fünf Jahren, und 3.) die Sterblichkeitsrate von Kindern unter fünf Jahren, die zu einem großen Teil das tödliche Zusammenwirken von unzureichender Nahrungsaufnahme und ungesunden Lebensbedingungen wiedergibt.

Nach Aufbereitung der Daten und der Ergänzung fehlender Daten durch Schätzungen reicht die Datenverfügbarkeit aus, um den Ernährungsindex für die große Mehrheit der Entwicklungsländer und verschiedene Zeitpunkte zu berechnen (1981, 1992 and 1997). Der EI dient als umfassendes Maß für die Analyse von Leistungen und Trends bei der Bekämpfung von Hunger und Mangelernährung in einzelnen Ländern und Gesamtregionen. Sowohl in Nordafrika und dem Nahen Osten, als auch in Lateinamerika und der Karibik wurde eine nahezu befriedigende Ernährungssituation erreicht. Die Ernährungslage in Südasien ist immer noch schlecht und im größten Teil Südostasiens allenfalls mittelmäßig, aber in dieser Region können seit Anfang der achtziger Jahre sehr vielversprechende Verbesserungstrends beobachtet werden. In weiten Teilen Afrikas südlich der Sahara ist die Ernährungslage schlecht oder sogar äußerst schlecht, und die jüngsten Trends geben ebenfalls nicht viel Anlass zum Optimismus.

In weiteren Analysen werden signifikante Korrelationen zwischen Ernährungsindexwerten und der Häufigkeit von Mikronährstoffmängeln festgestellt, und die enge Verbindung zwischen volkswirtschaftlicher Leistungsfähigkeit und der Möglichkeit der Menschen, ein von Hunger und Mangelernährung freies Leben zu führen, wird gezeigt. Nichtsdestotrotz offenbart der Vergleich von EI und BSP pro Kopf auch, dass in vielen Ländern ein großer wirtschaftlicher Spielraum ungenutzt geblieben ist, der für politische Maßnahmen zur Verringerung von Hunger und Mangelernährung eingesetzt werden könnte. Mit dem Ernährungsindex und seiner Funktion als internationalem Überwachungsinstrument verbindet sich die Hoffnung, dass Länder über die Einhaltung eingegangener Verpflichtungen Rechenschaft ablegen und dass notwendige Verbesserungen der Ernährungslage beschleunigt werden.

1 Introduction

Notable progress has been made in recent decades in combating hunger and malnutrition. Nevertheless, considering the goal of the United Nations' World Food Conference in 1974 - that 'no child should go to bed hungry' within a decade - the gap between vision and reality is striking: at the end of the 90s, about 800 million people in the developing world were suffering from hunger, that is, they could not meet their minimum dietary energy requirements (FAO 1999a). In 1995, 167 million children under five were malnourished as measured according to their weight for age, and even more – 206 million – showed signs of growth faltering, while 49 million were wasted (WHO 1997). About half of the 11.6 million deaths among children under five in 1995 in developing countries are estimated to be associated with malnutrition (Bailey et al. 1998). At least 40 million children in the developing world suffer from Vitamin A deficiency, and the dietary iodine supply of nearly one third of the world population is at risk (WHO/UNICEF/ICCIDD 1993; WHO/UNICEF 1995). Two billion people in both developed and developing countries are affected by iron deficiency (FAO/WHO 1992a). These figures indicate a largely unsatisfactory global nutrition situation and provide strong arguments for renewing national and international commitment to improve nutrition.

At the World Summit for Children in 1990, the International Conference on Nutrition in 1992 and the World Food Summit in 1996, the international community reconfirmed the elimination of hunger and malnutrition as priority of utmost importance (UNICEF 1990a; FAO/WHO 1992b; FAO 1998). To assess the effectiveness of actions taken by national governments, NGOs and the private sector towards achieving these goals and target scarce resources to the neediest, there is a need to quantify and continuously monitor changes in a country's or region's nutrition situation. First steps were taken by UN agencies concerned with nutrition: FAO, UNICEF and WHO, however, use different lead indicators for which they regularly collect and publish data. So far, there has been no widely accepted single, comprehensive measure for a country's or region's nutrition situation.

The Nutrition Index (NI) presented in this paper has been designed to fill this gap. The NI comprises the percentage of undernourished, the proportion of underweight children under five and the under-five-mortality rate. The combination of several indicators in one index has obvious advantages: in contrast to the multitude of single indicators that are currently used (and that have merits of their own), the NI allows for a quick international and intertemporal overview because of its condensed information content. The NI consists of indicators that reflect different, but complementary aspects of nutrition problems that should be viewed together.

In the following, the concept and theoretical underpinning of the Nutrition Index are presented first. In order to transparently derive the NI, methodology and data refinement procedures are described at length (chapter 3). Actual NI scores and outcomes of analyses with respect to micro-nutrient deficiencies and basic determinants are reflected in detail. The reader just interested in the results and their implications is referred to chapters 4 and 5. Here, the performance of each country in terms of overcoming hunger and malnutrition is presented and discussed. It is hoped that such information on success and failure stimulates renewed policy action in under-performing countries and continued attention to the problem in those countries which show a laudable track record.

2 The Concept of the Nutrition Index (NI)

The purpose of the NI is the quantitative description of a country's or region's nutrition situation. Prior to any actual index calculation, decisions have to be made about the set of indicators that are to be included in the index, and about the mode of aggregation. These decisions have to be taken with care, because the set of indicators used and their aggregation have a strong impact on resulting index values. The choice of indicators should be guided by an idea of how a good nutrition situation can be characterised. The following criteria are proposed here for the judgement of a country's nutrition situation: Vast majorities of the population, especially vulnerable groups like children,

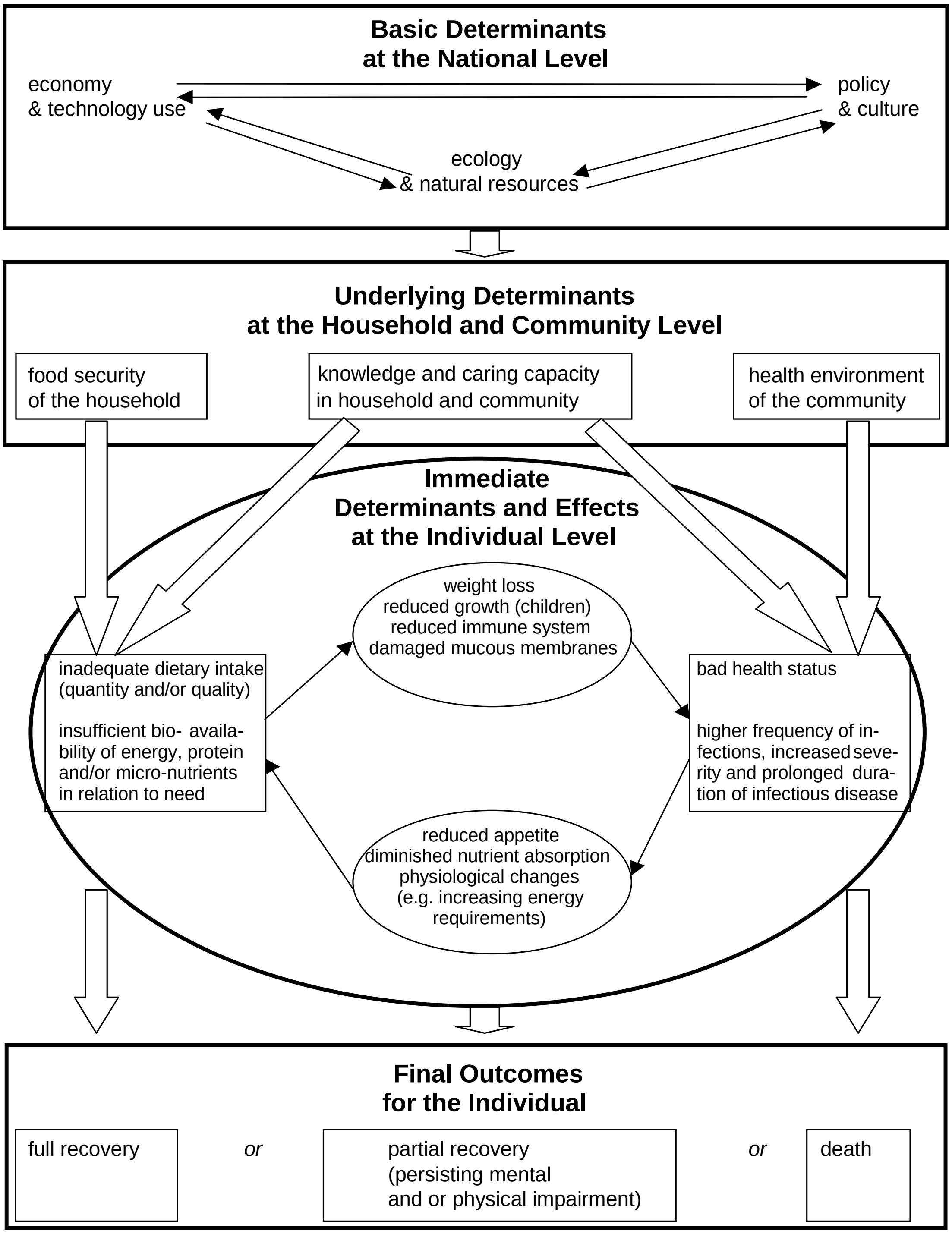
- are free from hunger (have adequate dietary energy supply);
- have good nutrition status (as measured by anthropometrics);
- and are safe from death caused directly or indirectly by malnutrition.

Clearly, the nutritional well-being of the individual is at the centre of this concept. Besides the definition of an adequate nutrition situation, a basic understanding of the interrelationship of the main variables expressed by specific indicators is needed for an informed choice of indicators (which is in fact limited by data availability). Furthermore, the analysis of factors such as economic performance and their effect on the nutrition situation requires a concept of the causal relationships and pathways. In the following, an appropriate conceptual framework is outlined on which the choice of indicators and mode of aggregation are based.

2.1 Conceptual Framework

The conceptual framework is presented in Figure 1. A distinction is made between three levels of causality corresponding to basic, underlying and immediate causes of hunger and malnutrition, and malnutrition-related deaths. In accordance with the above definition of an adequate nutrition situation, the focus is on immediate causes and effects at the individual level and the outcomes for individuals, though the pathways leading from basic to underlying and from underlying to immediate causes will be briefly described.

Figure 1: Determinants, Effects and Outcomes of Hunger and Malnutrition



Sources: adapted from UNICEF 1990b, Smith and Haddad 1999, von Braun et al. 1998, Tomkins and Watson 1989

The basic determinants of hunger and malnutrition at the national level relate to the interacting fields of economy and technology, policy and culture, ecology and natural resources: scarcity of natural resources, lack of technology and economic assets, market and policy failure (including violent political conflicts and discrimination) lead to low macro-economic performance. The result is widespread poverty, especially in the absence of mitigating social policies. Poverty seriously interferes with household food security and caring capacity[1] in the family and community, impedes investment in education and utilisation of health services. Furthermore, household food security is directly affected by the functioning of local markets, the use of technology in households (e.g. for food conservation), agro-ecological factors such as soil fertility and climate, and by policy measures such as food for work programs or food subsidies. The acquisition of knowledge is influenced by education policy and public health campaigns. Women's education and their caring capacity are frequently hampered by culturally embedded and politically reinforced discrimination. Time resources as another important factor for care-giving are determined by the workload and division of labour, available technologies (for example, firewood-saving stoves), natural resources (e.g. water) and cultural habits. Health environments are shaped by the safety of workplaces, natural conditions and policy outcomes like public investments in the provision of water, sanitation, health care and public health programs such as immunisation campaigns (von Braun et al. 1998; Smith and Haddad 1999).

The impact of the underlying determinants (household food security, knowledge and caring capacity, and health environments) on the immediate causes of dietary intake and health status is obvious: what kind of food, and how much, is accessible to an individual household member is determined by the availability of food in the household, by the recognition of own needs and the needs of others, and by the caring capacity of the family members responsible for food preparation and feeding of children. Knowledge, time and material resources other than food are necessary to care for oneself and others by preventing and curing infectious diseases (UNICEF 1990b). The exposition to pathogens and therefore probability of illness is partly a function of the health environment. Depending on the living conditions as determined by food security, knowledge, caring capacity and the health environment, the individual can get trapped in a vicious circle of inadequate dietary intake and bad health status. The starting point can be either energy, protein, and/or micro-nutrient intake falling beneath requirements, or infection and bad health status. The consequences of lack of dietary energy and protein and of the most prevalent micro-nutrient deficiencies[2] are shown in Table 1, with special reference to the effects mentioned in Figure 1. The consequence of acute insufficient dietary energy intake is reduced body mass (wasting). Moreover, chronic lack of dietary energy, protein and some micro-nutrient deficiencies cause growth faltering in children (stunting). Both wasting and stunting are reflected in low body weight with reference to a child's age (underweight). Other effects of dietary energy, protein and/or some micro-nutrient deficiencies are reduced functioning of the immuno system and damages to mucous

[1] The term 'caring capacity' is defined here as the amount of time, personal effort and material resources that can be mobilised for care-giving (adapted from Smith and Haddad 1999).

[2] Any of the listed nutrient deficiencies can be the single cause of the effects noted in the table, though in reality, multiple deficiencies with often fatal synergies are most prevalent.

membranes. Barriers against infection are no longer intact, and resistance to pathogens is weakened. The risk of viral and bacterial infections rises, and a bad nutrition status prior to infection prolongs the duration and aggravates the severity of the infectious disease. Loss of appetite is a frequent consequence of infection, which in turn reduces dietary intake. Physiological changes specific to many infectious diseases are energy-consuming fever and catabolism of body protein that enhance the need for dietary energy and protein (Tomkins and Watson 1989).

Table 1: Effects of the Most Prevalent Macro- and Micronutrient Deficiencies

Deficient Dietary Component	**Physiological Changes and Clinical Symptoms**				
	Weight Loss "wasting"	**Growth Faltering in Children "stunting"**	**Reduced Immuno Resistance**	**Damage in Mucous Membranes**	**Specific Symptoms**
Macronutrients					
Energy*	**X**	**X**	**X**		Muscular Atrophy
Protein*		**X**	**X**		Oedema
Micronutrients					
Vitamin A		**X**	**X**	**X**	Bitot's Spots, Blindness
Iron			**X**	**X**	Anaemia
Iodine		**X**			Goitre, Cretinism

* mostly energy and protein deficiency are combined, as the co-called Protein-Energy-Malnutrition (PEM)
Source: Biesalski 1995, Spittler et al. 1995, Barth et al. 1995, de Gruyter 1998

The final outcome for the human being depends on genuine individual factors, care, health and nutrition interventions from the outside, and on the intensity of adverse effects in the vicious circle. At best, the individual gains full recovery after some time of suffering. Partial recovery is another possible outcome; in this case reduced body size in adulthood and irreversible damage to mental capacity, blindness or other disabilities are a remaining characteristic of the person affected[3]. Premature death is the most serious outcome of the vicious circle (Pinstrup-Andersen et al. 1995).

The insights into the immediate causes, effects and final outcomes of hunger and malnutrition are integrated next into the choice of indicators.

[3] Of course, not only well-being, but also working and learning capacity are strongly affected by these impairments in present and later life. The formation of human capital, a driving force of economic growth, is on the long run impeded by the effects of malnutrition on human health. Therefore, another pathway leads from the vicious circle and its adverse final outcomes back to the „economy" as basic determinant, which is not depicted in Figure 1.

2.2 Choice of Indicators

The choice of indicators is guided by the concept of what constitutes an adequate nutrition situation and the framework just outlined. As the conceptual focus is on the nutritional well-being of the individual, the following indicators are selected:

- the percentage of undernourished as estimated by FAO, reflecting the share of the population with insufficient dietary energy intake,
- the percentage of underweight children under the age of five, indicating the proportion of children suffering from weight loss and/or reduced growth[4],
- the under-five-mortality rate, reflecting to a large extent the fatal consequence of the synergy between inadequate food intake and bad health environments.

A comparative characterisation of the three indicators is given in Table 2. It is obvious that they refer to different, but complementary aspects of a bad nutrition situation. A common feature can be seen in the fact that undernourishment, underweight in children and child mortality are more or less strongly associated with micro-nutrient deficiencies. Even though no indicator for vitamin or mineral deficiencies was included in the index due to insufficient data availability, the NI is likely to reflect the lack of micro-nutrients to a certain extent [5].

4 The anthropometric measure for underweight – low weight for age – is preferred to the other anthropometric indices (low height for age, that is stunting, and low weight for height, the so-called wasting) because it encompasses both chronic and acute malnutrition.

5 This assumption is empirically analysed in chapter 5 for iron, iodine and Vitamin A deficiencies.

Table 2: Comparison of Common Indicators for the Nutrition Situation

Criteria	Single Indicators for the Nutrition Situation		
	Percentage of Undernourished	**Percentage of Underweight Children**	**Under-Five-Mortality-Rate**
Aspect of Nutrition Problem	• inadequate dietary *energy* intake (“hunger”) • immediate cause of the vicious circle* and possible effect of infection • important, but narrow aspect of nutritional well-being indicated; not congruent with, but frequently associated with inadequacy of micro-nutrient intake • interaction of individual constitution, food intake, care and health environments not considered	• low body weight with reference to age (“malnutrition”) • cause and effect within, eventually final outcome of vicious circle* • broad aspects of nutritional well-being and nutrition status, outcomes of dietary energy, protein and micro-nutrient deficiencies and unhealthy living conditions captured • interaction of individual and external factors (food, care, health environments) reflected	• death in childhood (“mortality associated with malnutrition”) • possible final outcome of vicious circle* • central aspect of well-being described, to a large extent outcome of dietary energy intake, some micro-nutrient deficiencies and infection • interplay of individual resilience and external factors reflected, but other causes of death than starvation or its potentiating effects on mortality comprised
Reference Group	• whole population • comprehensive, but no respect to different vulnerability of population subgroups	• population subgroup: children under 5 • especially vulnerable group; serious and irreversible consequences of malnutrition on well-being, learning and working capacity	• population subgroup: children under 5 • especially vulnerable group, central role of nutrition for survival

.... / ....

Table 2 (continued): Comparison of Common Indicators for the Nutrition Situation

Criteria	Single Indicators for the Nutrition Situation		
	Percentage of Undernourished	**Percentage of Underweight Children**	**Under-Five-Mortality-Rate**
Consideration of Inequality	• inequality of inter-household food allocation within the population considered • no information about inequitable intra-household allocation included	• inequality of allocation of food and other resources primarily within the subgroup of children under five • hints at inter- and intra-household allocation of resources within the population	
Origin of Data	• estimates derived mainly from macro-data on distribution, production, trade and use of agricultural products	• nationally representative surveys as data sources, supplemented by estimates	• government statistics, representative surveys and partly estimates

*vicious circle of inadequate dietary intake and bad health, see Figure 1.
Source: Tomkins and Watson 1989; Svedberg 1998; UNICEF 1998; Biesalski et al. 1995

The combination of the percentage of undernourished, that refers to the population as a whole, and the two indicators relating to children under five has more advantages as concerns the resulting index: both the nutrition situation of the whole population and the effects of inadequate nutrition (and concurrent factors) on a physiologically and socially very vulnerable group are captured by the NI. Besides the fact that children's nutrition status deserves particular attention because malnutrition puts them at high risk of physical and mental impairment and death, relying on data about children is also justified from a methodological point of view: anthropometric data on children are favourable due to their international comparability. In contrast to the body size adults can reach, the growth potential of children under five most probably does not differ by ethnic origin (Svedberg 1998). Moreover, international data about the nutrition status of adults are not yet broadly available, whereas anthropometric data referring to children have been collected by WHO in a large, regularly updated database[6], so that data availability suggests their use[7]. A shortcoming of anthropometric indicators can be seen in the fact that they do not reveal the most tragic consequence of undernutrition: premature death. Equal levels of malnutrition in a country as measured by low weight for age can have quite different effects on the proportion of malnutrition-related deaths among children, depending on the overall level of child mortality (compare the example of Niger and Yemen described in Box 1). This disadvantage of the percentage of

[6] WHO 1997 or http://www.who.int/nutgrowthdb/.
[7] In contrast to this, mortality data are also available for the population as a whole, but mortality among adults varies to a larger extent according to factors that are not linked with nutrition (like lifestyles, hazardous occupations and active participation in wars). Due to this methodological reason, child mortality is preferred for the purpose of NI calculation.

underweight children is balanced by the inclusion of the under-five-mortality rate. Clearly, the mortality data comprise other causes of death than malnutrition, and the actual contribution of malnutrition to mortality is not easy to track, because the proximate cause of death is frequently an infectious disease (Pelletier et al. 1994). But about 54% of deaths among children under five in developing countries are estimated to be associated with malnutrition (Bailey et al. 1998).

Box 1: Malnutrition and Malnutrition-related Deaths in Children in Niger and Yemen

Anthropometric data do not tell the whole story about the tragedy of malnutrition. This is exemplified here for Niger and Yemen, where quite similar prevalences of underweight in children under five were found with 42.6% (in 1992) and 46.1% (in 1997), respectively.

Figures on the percentage of underweight children alone do not reveal the proportion of children dying due to the potentiating effect of malnutrition on disease, because this share depends on the overall mortality level. But the *relative contribution* of malnutrition to all causes of death varies independent of mortality levels according to the prevalence and severity of malnutrition. Based on this finding, the share of child deaths caused by the potentiating effect of malnutrition on disease can be roughly estimated with the prevalence of malnutrition as single input (Pelletier et al. 1994).

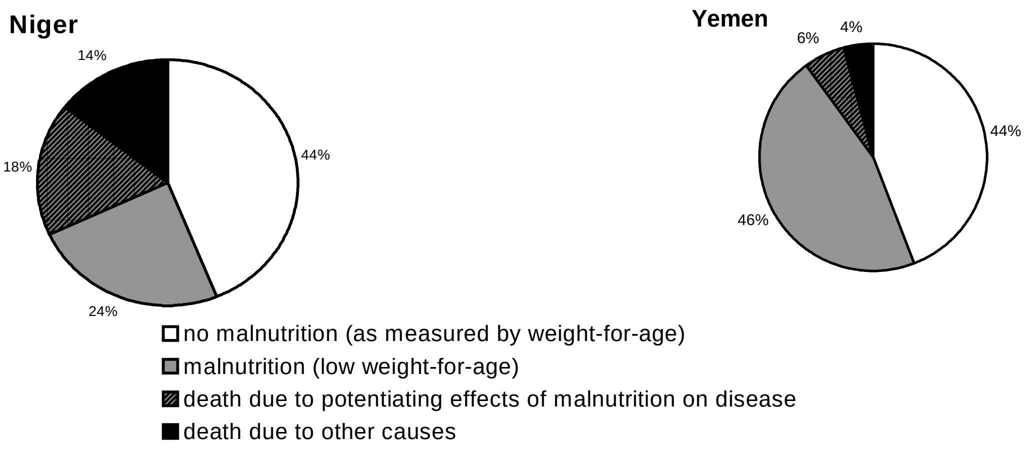
This methodology was applied to the anthropometric data from Niger and Yemen, and malnutrition could be estimated to contribute by about 55% and 58%, respectively, to child mortality. Taking into account the large divergence of child mortality levels in both countries – in Niger, 320 out of 1000 children die before their fifth birthday, but only 100 per 1000 in Yemen - the implications are quite different.

Though the follow-up of a cohort of children five years after birth would reveal that about 44% are alive and above the underweight cut-off in both countries, the fate of the rest is not the same. Whilst in Yemen, children's lives and health have been adversely affected by malnutrition in 52% of the initial cohort nearly five years later, the respective number is 42% in Niger. But in Niger, malnutrition has brought death to more than two fifths of this group, whereas this happened to only one ninth of these children in Yemen. In Niger, about 18 out of a cohort of 100 children are no longer alive five years after birth due to the potentiating effect of malnutrition on disease. In Yemen, only 6 out of 100 children have died from this cause. Therefore, in Niger, three times as many child fatalities are attributable to malnutrition than in Yemen (see the following charts).

…. / ….

Box 1 (continued): Malnutrition and Malnutrition-related Deaths in Children in Yemen

Though the anthropometric data suggest that the problem of malnutrition is slightly worse in Yemen, a look at malnutrition-related deaths does not confirm this notion. This provides strong arguments for integrating child mortality data in the Nutrition Index.



Note: Clearly, the percentage of underweight children is lower when it is referred to the whole cohort of children born five years ago instead to the surviving children only, as done in the nutrition surveys. Moreover, underweight prevalence reported for children at age four - taken as a proxy for underweight prevalence in children just before their fifth birthday - is lower than prevalence in all under-five-year olds in Niger and slightly higher in Yemen.

Data sources: Kourgueni, I. A., Garba, B., Barrère, B.: Enquête Démographique et de Santé, Niger 1992. Demographic and Health Surveys. Niamey, Niger and modifications as presented in WHO, 1999; Yemen democratic and maternal and child health survey 1997. Demographic and Health Surveys. Central Statistical Organization. Sana'a, Yemen, 1998, as presented in WHO, Global Database on Child Malnutrition, http://www.who.int/nutgrowthdb/; accessed March 2000

Another type of complementarity between the indicators selected for the NI exists with respect to the kind of inequality in resource allocation that is considered.[8] Differences between the indicators in the reflection of inter-household and intra-household allocation of food and other supplies are mainly rooted in the reference groups used and in the ways the data are derived. The primary source for the indicators referring to children are micro-data gained in representative surveys. FAO approaches the problem of quantifying undernourishment from the other side: macro-data like agricultural trade and production statistics and data or estimates about the national distribution of consumption are the point of departure. Concerns have been raised about the validity of these underlying data (Svedberg 1998). At least, errors in the underlying data are more likely to affect the absolute number of people estimated to be undernourished than the relative

[8] The consideration of inequality is of course limited in the undernourishment and underweight indicators, because undernourishment and underweight can vary gradually among individuals from severe to mild, but the data are derived by using cut-off points.

differences in the proportion of undernourished among countries or in succeeding periods of time; the latter are far more relevant for index calculation. On the other hand, the validity of the data about children is restricted by sampling and estimation errors, and, in the case of the under-five-mortality rate, partly dependent on the reliability of government statistics. Concerning data quality, there is certainly a lot of scope for improvement – but the assessment of the nutrition situation should not be postponed until perfect data with global coverage are available[9].

For the aggregation of the three indicators weighing factors have to be determined. Factor analysis was considered appropriate for the derivation of weights, because the relationships of the indicators suggest the existence of strong correlations, and because this technique allows the calculation of empirically founded weighing factors. The details concerning the aggregation of indicators are discussed in the next chapter together with other methodological issues, like data refinement and estimation procedures.

[9] Data availability and comparability problems are addressed in more detail in the next section.

3 Underlying Data and Methodology

Before calculating NI scores, problems of data availability and comparability have to be tackled, and the aggregation of indicators has to be performed. Faced by a lack of direct nutrition-related information in some countries, ancillary criteria are defined in order to identify countries that are main candidates for nutritional surveillance. Thereafter, data gaps are filled by own estimations and estimates from other sources as far as possible. Refinement procedures are applied to the anthropometric data and reference periods are fixed before the data can actually be used in factor analysis and for NI calculation. The methodologies used are outlined in the following.

3.1 Dealing with Problems of Data Availability and Comparability

The NI cannot be calculated for every nation and any point in time due to lack of data for some countries and years. Whereas annual data for the under-five-mortality rate of all countries in the world are generally available, data availability for the percentage of undernourished and the proportion of underweight children is quite limited. For industrialised countries, virtually no data about undernutrition exist. Nutritional surveillance is no priority in most developed countries, because wealth and well-established social safety nets have led to a good nutrition situation for the overall population. The efforts of data collection and monitoring should focus on states where considerable proportions of the population are still suffering from hunger and are physically and mentally affected by malnutrition, and these countries are the main candidates for the following estimation procedures designed to close data gaps.

Thus, a first step undertaken in the construction of the index is the division of countries into those with problems of undernutrition and those without them. For countries with lack of direct nutrition-related data, the under-five-mortality rate and average dietary energy intake can serve as auxiliary criteria. A look at available data for average dietary energy intake (mean 1995-97) and undernourishment (1995-97) reveals that in the range of more than 3,100 kcal per capita and day, less than 2.5% of the population are considered to be undernourished in most countries, that is, they fall into the „very low hunger category“ according to FAO (FAO 1999a)[10]. But taken as single auxiliary criterion, the national average of calorie consumption could easily conceal disparities in inter- and intra-household food allocation. Moreover, as has been outlined in the theoretical part, there is more to adequate nutrition than sufficient dietary energy intake. These facts are illustrated by the situation in some North African and Near Eastern countries - Egypt, Turkey and Syria - where average dietary energy intake even exceeds the mark of 3,100 kcal, whilst more than 10% of children under five are undernourished. At the same time, the under-five-

[10] Compare the model laid out in part 3.1.1: the predicted value for an average dietary intake of 3,100 kcal is 2.5% undernourished.

mortality rate in these three countries amounts to more than 30 per 1,000 and is therefore considerably larger than in countries that have equal or even lower calorie consumption, but have reached a higher stage of economic development. In Japan, for example, the average citizen consumes less than 3,000 kcal per day, but the under-five mortality rate is as low as 6 per thousand live births, and there is no reason to assume malnutrition problems in this highly industrialised country[11]. Therefore, the under-five-mortality rate and average dietary energy intake are taken together for a rough assessment of the severity of nutrition problems. A country is assigned to the group with no severe nutrition problems, if average dietary energy intake exceeds 2,900 kcal per capita and day *and* the under-five-mortality rate is below 15 per thousand. These criteria are quite stringent in order to make sure that no country with persisting undernutrition escapes nutritional surveillance[12]. Of course, there are borderline cases, and it is accepted that some countries with lacking data, where nutrition problems might actually be smaller than assumed, may be erroneously classified as „countries with severe nutrition problems“.

Estimating the percentage of undernourished for countries with probably severe nutrition problems, but missing data, is the next step.

3.1.1 Percentage of Undernourished People: Estimation Model

Estimates of undernourishment are based on 3-year periods and have been published for 1979-81, 1990-92 and 1995-97 for developing countries only (FAO 1999a). In spite of rising concern for the nutrition situation in parts of Eastern Europe and in the countries of the former Soviet Union, no country estimates of undernourishment have been published yet by FAO for this region. For the Eastern European and Central Asian region and a few developing countries with less than one million inhabitants, estimates were therefore generated by a simple model to complement the data set.

FAO arrives at its estimates of the percentage of undernourished by using the average dietary energy intake, the distribution of food consumption according to actual consumption or income data, and the average minimum dietary energy requirement. If all this information was available for every country, the data set needed for the calculation of the NI could be completed following the methodology used and published by FAO. In the absence of some of these data, linear regression (ordinary least squares, OLS) was chosen as technique to produce estimates that are as close to the FAO figures as possible. To permit estimates for the bulk of countries with missing data, care had to be taken in the selection of indicators entered as independent variables

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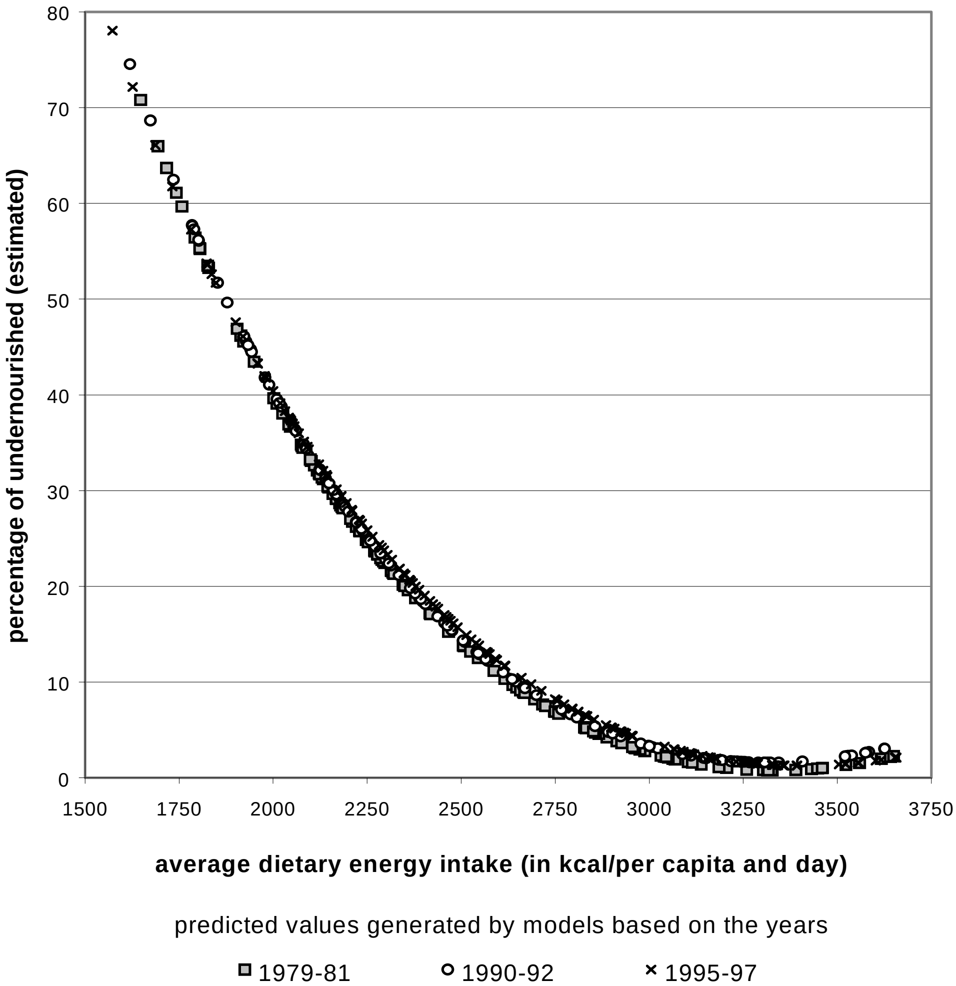
11 The latest nutrition survey in Japan has been conducted 20 years ago, in 1980, and the percentage of underweight children under five was no more than 3.1%.

12 Malaysia, Slovakia and Kuwait are odd cases that are included into the group with nutrition problems, though they meet the criteria: in Malaysia, underweight prevalence in children has been nearly 20% in 1995; in Kuwait, the percentage of undernourished is reported to be 3% for 1995-97, and for the preceding period 1990-92, 27% undernourished have been estimated; average calorie consumption in Slovakia has been only slightly higher than 2,900 in 1995-97 whilst the under-five-mortality rate (11 per 1000) exceeded the level in Western industrialised countries.

into the regression model, to make sure that lack of data for explaining variables would not limit the expansion of the data set[13]. Two readily and broadly available indicators likely to be strongly associated with the percentage of undernourished are GNP per capita and the average dietary energy consumption. Linear regressions were run with all possible combinations of these indicators, their logarithms and squares as independent variables (average values for the years 1995-97) and the percentage of undernourished as dependent variable (referring to the 1995-97 period). GNP per capita, its logarithm and square or combinations of these proved to be worse predictors than the variables derived from average dietary energy intake. Moreover, they had no additional explanatory power as against a set of the variables gained from dietary energy intake. The best fit, indicated by the highest adjusted R-square, was yielded by using a linear combination of the average dietary energy intake and its logarithm only. In a next step, regressions were run with the average dietary energy intake and its logarithm in the same way, but for different periods of time - with the variables referring to the years 1979-81 and 1990-92, respectively. The differences found between the coefficients in the three models that are based on different periods of time, and in the plots of the predicted values against the average dietary intake were marginal (see Figure 2).

[13] Whereas the average minimum dietary energy requirements could have been calculated in principle for all countries where the composition of the population by age and sex is known - but only with considerable effort in collecting these data and doing the computations - in many countries no data exist about the distribution of income and/or consumption. Therefore, average dietary energy requirements were omitted in the model, and data about food or income distribution could not be relied on, if the estimation model was to fulfil its purpose of enhancing data availability.

Figure 2: Comparison of Estimation Models Based on Different Periods of Time



Source: own calculation

To minimise the influence of random errors and to make sure that the final model is derived only from more recent data that are assumed to be of better quality than the 1979-1981 figures, country data for the years 1990-92 and 1995-97 were pooled for the final linear regression[14], again with the average dietary intake and its logarithm as independent variables and the percentage of undernourished according to FAO as dependent variable. The characteristics of this final model are shown in Table 3.

[14] This was done in such a manner that nearly every country in the data set was represented twice, that is by data from the 1990-92 *and* the 1995-97 period. No weighted regression technique was applied, but ordinary least squares, because 2 observations (1990-92 and 1995-97) were available for 98% of the countries in the sample and just 2 countries (2% of the sample) were represented only by one observation from 1995-97. Therefore, it is extremely unlikely that different numbers of data points might introduce a bias into the model.

Table 3: Model to Estimate the Percentage of Undernourished, Ordinary Least Squares (OLS)

Dependent variable:	percentage of undernourished
Independent variables:	average dietary energy intake (in kcal/per capita and day) logarithm of average dietary energy intake (in kcal/per capita and day)
Periods of time:	1990-92 and 1995-97, dependent and independent variables matched Data source: FAO 1999a and 1999b

Variables	Coefficients	T-statistics	Significance
Intercept	2426.57	30.28	0.0000
Average dietary energy intake	0.10	21.07	0.0000
Ln (average dietary energy intake)	-340.61	-28.88	0.0000
Number of observations	192		
Multiple R	0.986		
R-squared, adjusted	0.971		
Standard error	2.90		
F statistic	3234.55		0.0000
Durbin-Watson statistic	1.96		

Note: Significance is two-tailed for both F and T-statistics
Source: own calculation

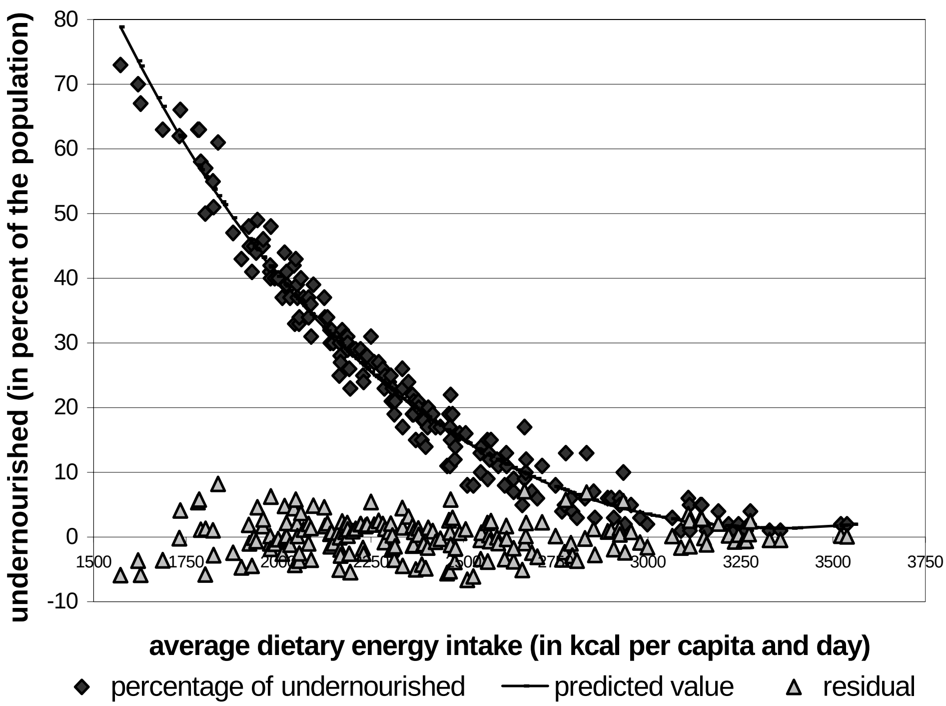
The significance of the overall model and of the singular coefficients and the constant proved to be very high, which is demonstrated by the significance levels given in Table 3. The probabilities that the whole model is invalid or that any of the coefficients or the constant is zero amounts to less than 0.005% [15]. Average dietary intake and its logarithm, chosen as independent variables, predict 97% of the variation of the dependent variable (percentage of undernourished), which means that the model has an excellent goodness of fit. Of course, this is not surprising, given the fact that FAO derives the percentage of undernourished inter alia from average dietary intake and assumes a log-linear distribution of calorie consumption. The residuals produced by the model can be explained by the impact of specific countries' food distribution data differing from the standard log-linear distribution on the percentage of undernourished and by the variation of average minimum dietary energy requirements. Though, as the residuals vary between a minimum of –6.6 and a maximum of 8.2, and the standard error is only 2.9, the influence of the latter factors is quite small.

[15] The Durbin-Watson statistic indicates the absence of auto-correlation – of course, auto-correlation is not expected to be a problem, because the model is based on cross section data with two observations per country. In this case, the Durbin-Watson statistic gives evidence that the model is not wrongly specified in terms of variable selection and functional form.

If the predicted values were used for the aggregation of indicators instead of the actual figures published by FAO, the error introduced into the NI would be less than one percentage point for 73% of the countries in the sample (this is the case for all residuals smaller than 3, see also derivation of weights in this chapter - the percentage of undernourished accounts for one third of the NI).

The percentage of the undernourished as resulting from the model, the FAO figures and the residuals are plotted against the average dietary energy intake in Figure 3. The upward slope between 3360 and 3600 kcal per capita and day is likely to be a bias introduced by the fact that cultural traditions in some Near Eastern states like Turkey foster a high calorie intake at a moderate level of development while social inequalities persist.

Figure 3: Percentage of Undernourished, Actual and Predicted Values and Residuals Plotted Against Dietary Energy Intake, Model with Pooled Data Set (1990-92 and 1995-97)



Source: own calculation

In contrast to that, in a country like Korea, traditional dietary patterns tend to keep calorie consumption at 3,155 kcal per capita and day (in 1997) - a level that is still relatively modest taking into account Korea’s economic development - while the percentage of undernourished is very low, partly due to a well performing social system. Consequently, the model designed here should not be used to estimate the percentage of undernourished for developed countries with high calorie intake, because the results would be affected by the distortion of the predicted values in the upward slope. The predicted values for countries with a calorie consumption over 3,300 kcal per capita and day are irrelevant here anyway. After all, the original data set was supplemented by own estimates for 27 countries that were generated by the model and for 16 of these countries the estimates entered the NI. A complete list of countries with the percentage of undernourished given by FAO and the supplementary own estimates can be found in Table A–1 in the appendix.

3.1.2 Percentage of Underweight Children: Estimates and Data Refinement

The most serious data availability and comparability problems exist for the anthropometric data that were taken from the WHO's regularly updated database (WHO 1997 and 1999) and, for the period before 1993, partly from data by the International Food Policy Research Institute (IFPRI) published in the Second Report on the World Nutrition Situation (UN ACC/SCN 1993). The main problem is that the nationally representative surveys these data are drawn from are conducted irregularly, and that for some countries, no data are available at all. The data set for underweight children was therefore supplemented by estimates published by UN ACC/SCN in 1993. Care was taken not to include estimated figures that showed an obvious misfit with existing data, e.g. predicted values with residuals of 10 and more. No estimates of the proportion of underweight children are available so far for the more recent years 1993 to 1998, but fortunately, a great number of surveys providing up-to-date information have been done in this period.

Besides the limited availability of data for given periods of time, another problem is posed by the fact that the anthropometric data reported in the nutrition surveys refer to different age groups of children (though the most frequently surveyed group are children under five years). The prevalence of underweight varies between groups of children at different age. For example, nutrition status is usually quite good up to an age of half a year, but dramatic deteriorations can be observed after the weaning phase due to inadequate dietary composition and feeding practices. For this reason, the comparison of the prevalence of underweight in children under five years in one country with the prevalence found for the age group 0.25-<3 years in another country, for example, may overestimate the relative severity of malnutrition in the latter. Similarly, the intertemporal comparability of survey results based on different age groups can be affected (the left side of Table 4 shows the age groups used in the surveys that served as data sources for the NI and their share in the overall number of surveys).

This problem can be taken into account by multiplying the data referring to age groups other than the under-fives with corresponding correction factors, as done in the Second World Report on the Nutrition Situation (UN ACC/SCN 1993)[16]. For the purpose of calculating the Nutrition Index, the corrected data as given in the UN ACC/SCN report for the period before 1993 were adopted in this study, ensuring consistency with the estimates taken from the same publication. To improve data consistency over time and internationally, new factors were calculated from existing surveys for which malnutrition prevalence was reported separately for different age groups. In the selection of nationally representative nutrition surveys for this

[16] As these factors are found to be different for each country and level of malnutrition, it is not clear how their numerical values have been determined.

purpose, preference was given to countries with nutrition problems where underweight prevalence has also been reported for other age-groups than the under-five-year-olds. Special emphasis in this group was put on surveys from countries where proportions of underweight children higher than 6% are known. The latter selection criterion takes into account that errors introduced into the NI by data referring to the „wrong“ age group might be the larger in absolute terms the higher the underweight prevalence is[17], with larger distortions of the NI scores as a result.

Table 4: Frequency Distribution of Reference Age Groups Before and After Conversion of Malnutrition Prevalence (in Age Groups Different from 0 - < 5 Years) into the Prevalence in Under-Five-Year-Olds

Reference Age Group	Before Correction *		After Correction **	
	Number of Surveys	**Percentage of Surveys**	**Number of Surveys**	**Percentage of Surveys**
other than 0 - < 5 years				
0 - < 3 years	18	10.4	12	6.9
0.25 - < 3 years	6	3.5	1	0.6
0 - < 4 years	4	2.3	0	0.0
0.25 - < 4 years	1	0.6	0	0.0
0.25 - < 5 years	4	2.3	2	1.2
0.5 - < 5 years	11	6.4	0	0.0
0 - < 6 years	5	2.9	0	0.0
0.5 - < 6 years	2	1.2	0	0.0
1 - < 6 years	1	0.6	0	0.0
1 - < 7 years	1	0.6	1	0.6
all other than 0 - < 5 years	**53**	**30.6**	**16**	**9.2**
0 - < 5 years	**120**	**69.4**	**157**	**90.8**
All age groups	**173**	**100.0**	**173**	**100.0**

* as reported in the nutrition surveys (WHO 1997 and 1999; UN ACC/SCN 1993).

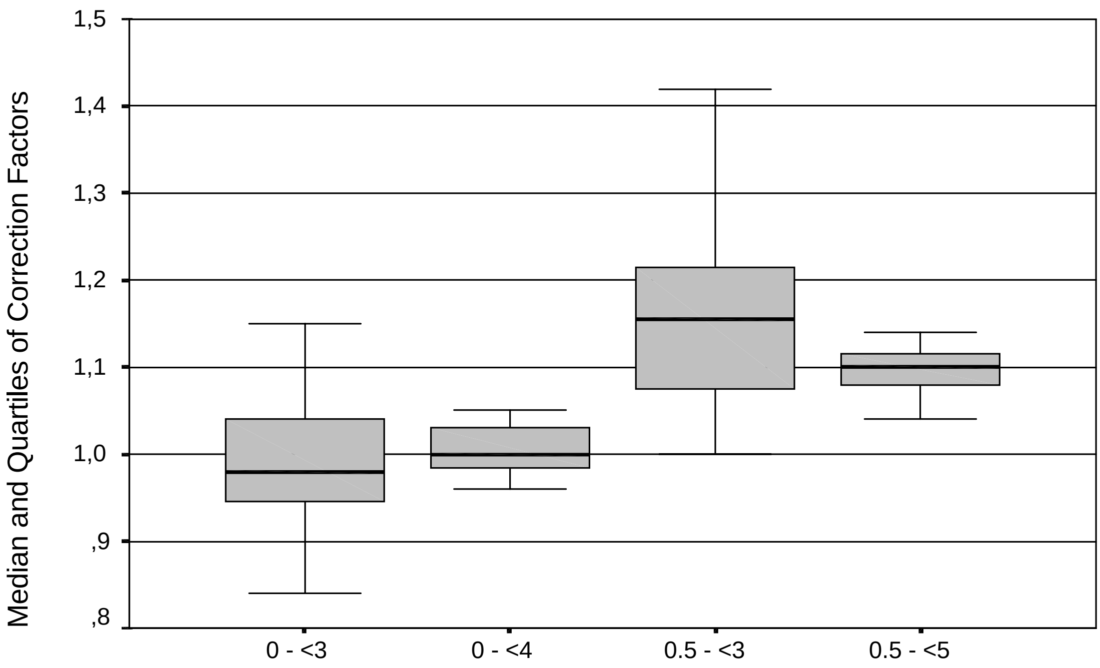
** surveys where no correction factor was applied, because prevalence in the respective age group proved to be close to identical with prevalence in under-five-year-olds, were attributed to the 0 - < 5 years group.

Source: own calculation

[17] In the Second Report on the World Nutrition Situation, the factors are reported to be in the range of 1.01 to 1.30. For an underweight prevalence of 6%, errors below 0.9 points can be expected.

The correction factors for a specific country and survey were obtained by dividing the underweight prevalences for the age groups in question (0 – under 3 years, 0.5 – under 3 years, 0 – under 4 years, and 0.5 – under 5 years) by the prevalence reported for all under-fives[18]. The box-plots in Figure 4 show the range, median and quartiles of correction factors found for different age groups. Evidently, the variation of factors among countries is high for the two age groups of under-three-year-olds (0-3 years and 0.5-3 years) and very low for the under-four-year-olds and the 0.5- <5 group.

Figure 4: Box-Plots of Correction Factors (Prevalence of Malnutrition in Indicated Age Group Divided by Prevalence in all Under-Five-Year-Olds)

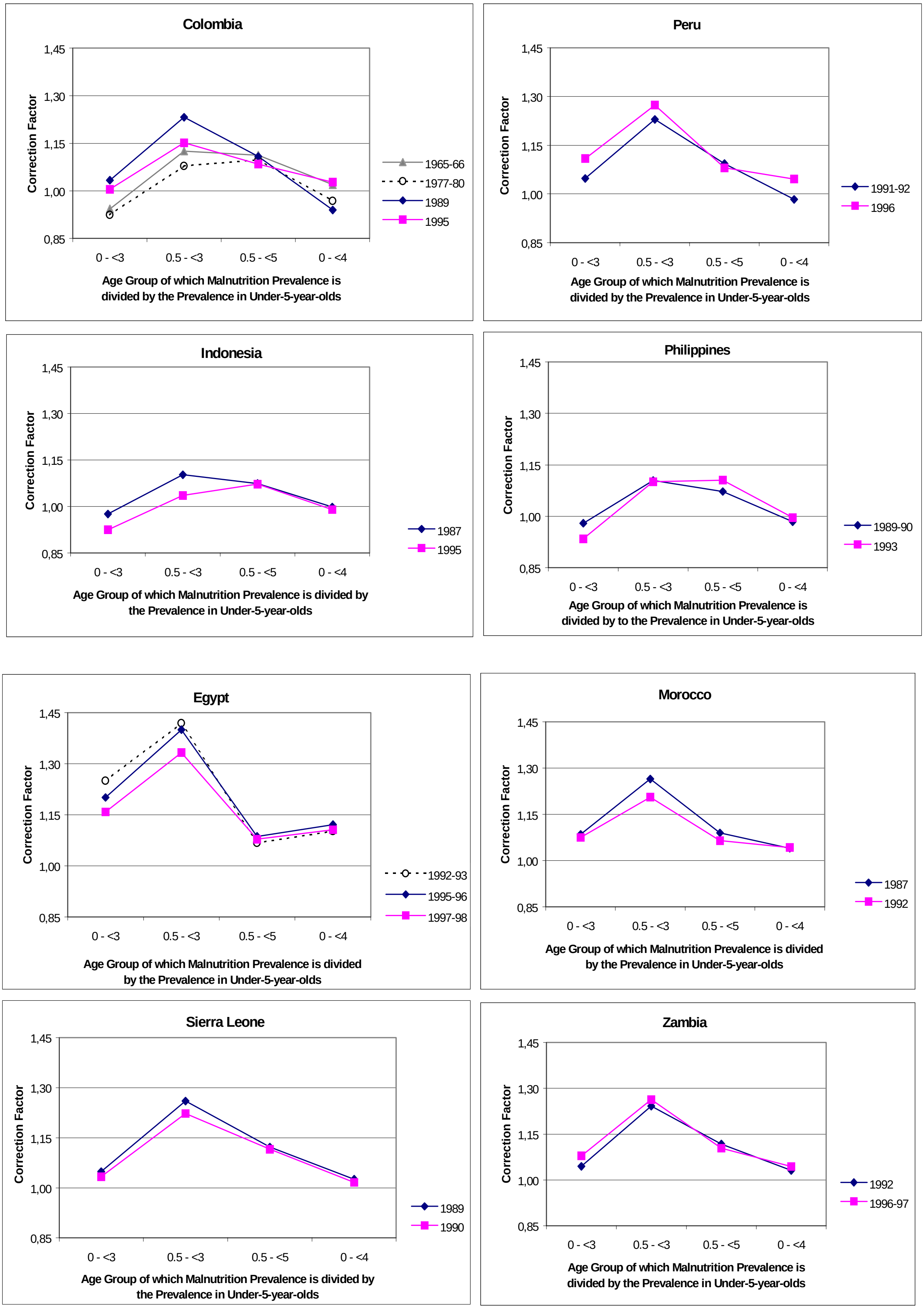


Source: own calculation

Correction factor patterns prove to be astonishingly stable over time for a given country, at least for countries where nutrition surveys are available for several years. A small time series of factors could be calculated for these countries (compare Figure 5 and Table A-2 in the appendix, that also reveal regional peculiarities of the South and Southeast Asian region).

[18] The prevalence of malnutrition in the under-three-year-olds, for example, is usually not directly indicated in the data source, but could be calculated by aggregating the prevalences in the 0 - <0.5, 0.5 - <1, 1 - <2 and 2 - <3 age groups (weighing the percentage of underweight children with the sample size in each age group).

Figure 5: Change of Correction Factors over Time, Country Cases



Source: own calculation

In conclusion, the procedure described below was followed to improve data consistency:

- No correction factors were applied to data referring to the under-four age group, because the mean value of correction factors turned out to be one and the standard deviation proved to be very low, making it unlikely that large deviations from the underweight prevalence in under-fives might occur.
- Correction factors were always applied to data referring to the 0.5– <5 group, because the calculated factors showed to be consistently greater than one with low standard deviation. In cases where a correction factor could be derived for the same country at a different point in time, this factor was used. If this was not possible due to lack of data, the average value of factors from countries of the same region was taken. Where neither factors for the respective country nor for its region could be calculated, the average of all factors was chosen (only in one case, for the Azerbaijan data).
- Taking into account the high variation of correction factors for the 0–<3 and 0.5-3 age group even within regions and their average value of one, only factors derived from data for the same country were applied to avoid the enlargement of an existing bias with the real, yet unknown prevalence among under-fives[19]. Therefore, correction was impossible for some countries, which does not necessarily mean that the underweight prevalence finally used for NI calculation deviates from the real prevalence among under-five-year-olds (because the unknown correction factor could also be exactly or nearly one).
- For some countries, anthropometric data referred to the 0.5–< 6 age group. In this case, first the prevalences for the 0.5–<5 age group were calculated from the age-specific prevalences reported in the survey. Then, the correction factor for this group was applied to estimate the probable under-five prevalence. Differences found between prevalences in the under-five and under-six age group were so small that adjustment was considered unnecessary.

After this data refinement, more than 90% percent of the survey data expressed the underweight prevalence in the under-five age group (see Table 4, right side).

3.1.3 Reference Periods for the Indicators Constituting the NI

Gaps in available data could be filled and international comparability was improved by estimation and refinement procedures. Nevertheless, the data on undernourishment and the anthropometric data cannot be matched perfectly because they do not refer to the same years. In particular, the anthropometric data are spread over a wide time range. Therefore, anthropometric data for NI calculation cannot be drawn from one year, but the latest available information out of a fixed period of time has to be used. Justification can be found in the fact that quick changes in the

19 Correction was omitted if the correction factor found for a specific country was in the range of 0.95 – 1.05.

percentage of underweight children rarely occur. There is, so to say, a built-in lag in this indicator: partly due to the fact that the eldest children in the sample are usually nearly five years old, and their weight for age is not only determined by current conditions, but also the outcome of their nutrition situation since and even before birth. Moreover, some factors that have been identified as relevant for children's nutrition status – for example female education and access to safe water (Smith and Haddad 1999) – surely require long-term investments before showing an impact on a nation-wide level.

There is also empirical evidence for only slow changes in underweight prevalence (compare WHO 1997, pp. 40-42, where countries with more than one nutrition survey in the 1965-97 period are listed, together with the year of survey, reported prevalence and annual change rates for the time between the surveys). About 65% of the reported annual change rates are in the range of –1 to +1% points, and nearly 80% in the range of –1.5 to +1.5 % points. Only 7% of all observed change rates – a total of six cases - amount to an absolute value of more than 4% points per year. In this context, it should be noted that in five out of the six cases with relatively high annual change rates, these rates have been calculated from data out of surveys that were completed in subsequent years. Because inevitable measurement and sampling errors gain the more influence on calculated annual change rates the shorter the time period between the surveys is, these five rates are likely to be more distorted by random errors than the change rates computed from surveys with larger time intervals[20].

Taking into consideration that annual change rates in underweight prevalence are quite small for the majority of countries, six-year-periods have been chosen as reference periods, from which the latest available information about underweight prevalence in children was included into the NI. Furthermore, the bulk of data, including the estimates, refer to the more recent years in these periods (compare Figure A-1 in the appendix), e.g. more than three quarters of the data collected in the 1993-1998 period are from the years 1995-1998. Therefore, the latest information from 1993-1998 is considered approximately representative for the year 1997, for example. Similarly, the percentage of undernourished referring to 1995-1997 is indicative for the year 1997. The under-five-mortality rate has been directly taken from 1997. The complete listing of time ranges or years the single indicators and the respective NIs refer to is found in Table 5.

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[20] The following fact is in favour of this assumption: in all three out of the five countries for which more than one annual change rate could be calculated, the trends computed before or after the one-year-period with a change rate above 4% points go into the opposite direction (as indicated by the opposite sign of the change rate).

Table 5: Time Ranges for NI Calculation

Reference Year of the NI	Corresponding Reference Years and Periods of the NI Components
NI 1981	Undernourished 1979-1981 Underweight children, data from most recent survey in 1977-1982 [1] Under-five-mortality rate 1980
NI 1992	Undernourished 1990-92 Underweight children, data from most recent survey in 1987-1992 [1] Under-five-mortality rate 1992 [3]
NI 1997	Undernourished 1995-97 Underweight children, data from most recent survey in 1993-1998 [1] Under-five-mortality rate 1997

[1] The year of survey completion is defined as the „reference year“ here.
[3] For some small countries – Comoros, Djibouti, the Gambia, Guyana, and Swaziland – data for 1992 were not available and data from 1993 were taken instead.

Apparently, the time intervals between the reference periods for data about undernourishment entered into the NI 1981, 1992 and 1997 are equal for all countries, and the same applies to the under-five-mortality-rate[21]. In contrast to this, the intervals between the survey data on malnutrition included into the NIs differ among countries. This can be seen as a problem for the interpretation of intertemporal changes in NI scores. The interval between the underweight data used for the NI 1992 and 1997 may in some extreme cases only be one year for some countries and up to 10 years for others. The expected average interval is about six years, and 10 years between the data of the 1977-82 and 1987-92 reference periods. The actual time intervals between the nutrition survey data and estimates were analysed: the average of the intervals derived from the data in the reference periods for the NI 1992 and 1997 amounted to 5.2, and the mean of the corresponding intervals referring to the NI 1981 and 1992 was 9.9. The standard deviations both amounted to 1.8. Indeed, maximum and minimum values of 10 years and one year, respectively, were observed for the intervals between underweight data in the 1987-92 and 1993-1998 periods, but they applied only to three out of 65 countries, and 83% of intervals were found in the quite reasonable range of seven to three years. Similarly, the extreme values of intervals calculated for the data from 1977-82 and 1987-92 were found to be five and 13.5 years, but again, about 80% of the intervals were in a quite sensible range between eight and twelve years.

As a concluding remark it can be stated that the problem of differing time intervals for the underweight data exists and is not yet resolved, but that the magnitude of the problem is not large with respect to the NI’s validity – partially due to the attenuating effect of constant time intervals for the other two indicators. Solutions for the problem can be expected from a higher frequency of nutrition surveys and more reliable prediction models in the future.

[21] With the negligible exception of the five countries mentioned in Table 5, for which the under-five-mortality data of 1993 were used.

3.2 Aggregation of Indicators

Different subsets of the total data were subjected to factor analysis, with estimates for the percentage of the undernourished and the estimates for underweight children one time included and another time excluded, and comprising data from several periods of time (1977-1982, 1987-92, 1993-98, 1987-98, e.g.). Weights were found to be quite stable at 0.32, 0.33 and 0.35 for underweight children, undernourishment and child mortality, respectively. Because data availability and reliability are better in more recent periods, the statistics and derived weights shown here are based on a combined data set for the 1987-1998 period. Statistics drawn from factor analysis are shown in Table 6, including the correlation coefficients of the variables they are based on, and their one-tailed significance (estimates of undernourishment and underweight children included).

Table 6: Statistics of Factor Analysis

Correlation Coefficients			
	Under-5-Mortality Rate	**Undernourished (in %)**	**Underweight Children (in %)**
Under-5-Mortality Rate	1	-	-
Undernourished	0.68 *	1	-
Underweight Children	0.62 *	0.54 *	1

* Coefficients are significant at the 0.001 percent level

Anti-Image Correlation Matrix			
	Under-5-Mortality Rate	**Undernourished (in %)**	**Underweight Children (in %)**
Under-5-Mortality Rate	0.66	-	-
Undernourished	-0.52	0.70	-
Underweight Children	-0.41	-0.21	0.76

Notes: Measures of Sampling Adequacy (MSA) for Variables are printed on the diagonal. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.702

…. / ….

Table 6 (continued): Statistics of Factor Analysis

Factor Statistics			
	Eigenvalue	**Percentage of Variance**	**Cumulated Percentage**
Factor 1	2.23	74.2	74.2
Factor 2	0.47	15.6	89.8
Factor 3	0.31	10.2	100.0

Notes: Only Factor 1 was finally extracted by Principal component Analysis (criterion: eigenvalue > 1)

Final Statistics for Variables			
	Communality	**Factor Score**	**Derived Weight ***
Under-5-Mortality Rate	0.80	0.89	0.35
Undernourished	0.74	0.86	0.33
Underweight Children	0.69	0.83	0.32

* Formula for Derivation: Weight for Variable x = Factor Score of Variable x / (Sum of all Factor Scores)

Source: own calculation

The correlations between the variables are highly significant and in the range of medium to high. The Kaiser-Meyer-Olkin measure of sampling adequacy is 0.70 for the selected variables and therefore falls into the category that is usually classified as „middling" or „quite good". Measures of sampling adequacy for single variables that are given on the diagonal of the anti-image correlation matrix indicate that all three indicators are well-suited for a common factor analysis. Principal components analysis extracted one factor that accounted for 74.2 % percent of variation. Factor scores obtained for the indicators were divided by their sum in order to normalise the sum of weights to one.

The final formula for the calculation of the NI is as follows:

NI = 0.32*(100 – CUW) + 0.33*(100 – PUN) + 0.35*(100 – CM)

with NI: Nutrition Index
CUW: percentage of children underweight
PUN: percentage of the population undernourished
CM: percentage of children dying before age five

The better the nutrition situation, the more the index approximates its theoretical maximal score of 100. The theoretical minimum value of zero is never reached, because this would indicate that all children died before their fifth birthday, that the whole population was undernourished and that 100% percent of children were underweight. This scenario is extremely unlikely.

Scaling could be applied especially to the under-five-mortality-rate, where the extreme values (1000 per 1000 or 0 per 1000) are not realistic. But any scaling – and the omission of scaling alike – is arbitrary[22]. For the sake of simplicity, scaling was therefore omitted.

With this formula and the refined and supplemented data set at hand, Nutrition Index scores can finally be calculated.

[22] Furthermore, a comparison of the rankings of countries based on preliminary indices with different degrees of scaling showed only slight differences.

4 Nutrition Index: Ranking and Trends

NI scores are used in the following to set up a ranking of countries and to graphically illustrate the world nutrition situation in a map. Furthermore, they are found to be helpful in showing trends in the nutrition situation of countries and regions.

4.1 Ranking and Mapping of Countries

The ranking of countries according to their Nutrition Index score is shown in Table 7, with the best performers on top of the list. In the world map depicted in Figure 6, countries with NI 1997 are represented (NI 1992 for those where the NI 1997 could not yet be computed).

Countries that have experienced long-lasting violent conflicts affecting the infrastructure and productive base of the economy have very low NI scores, indicating a miserable nutrition situation. This holds true especially for Ethiopia, Eritrea, Mozambique (until 1992), Somalia and Afghanistan.

Also, the connection of low economic performance and a desolate nutrition situation can be seen in the ranking: especially the poorest African nations are found at the bottom. The concentration of severe nutrition problems in very poor Sub-Saharan African countries is also shown on the world map. Rising incomes are likely to lead to an improved nutrition situation, but underinvestment in nutrition, on the other hand, may keep productivity low. The relation of GNP and NI scores is more closely investigated in the last part of this chapter.

The ranking of countries within regions is discussed together with the development of NI values over time in the next section.

Table 7: International Nutrition Index (NI) – Ranking of Countries

NI Rank	Country	Nutrition Index (NI) 1981	1992	1997
1	Argentina	97,1	98,0	**98,22**
2	Kuwait	94,2	89,0	**98,01**
3	Yugoslavia[1]*	..	..	**97,74**
4	Chile	96,1	96,1	**97,64**
5	Libya	93,4	94,9	**97,29**
6	Lebanon	91,5	95,1	**97,09**
7	Jordan	..	95,7	**96,54**
8	Uruguay	95,5	94,6	**96,54**
9	Russian Federation	..	..	**96,45**
10	Romania	..	**96,08**	..
11	Cuba	95,4	**95,97**	..
12	Costa Rica	94,4	96,7	**95,88**
13	Tunisia	91,0	95,1	**95,64**
14	Kazakstan	..	..	**94,88**
15	Fiji	..	..	**94,62**
16	Turkey	90,2	93,0	**94,44**
17	Syria	91,3	94,0	**94,39**
18	Croatia	..	..	**94,01**
19	South Africa	..	..	**93,74**
20	Saudi-Arabia	91,1	**93,65**	..
21	Brasilia	89,6	91,3	**93,34**
22	Morocco	86,3	**93,25**	..
23	Trinidad and Tobago	93,8	**93,16**	..
24	Algeria*	86,2	93,0	**92,89**
25	Jamaica	93,0	94,1	**92,72**
26	Mexico*	90,2	**92,69**	..
27	Venezuela	93,9	93,9	**92,54**
28	Malaysia	87,7	90,2	**92,52**
29	Mauritius	86,3	91,8	**92,45**
30	Egypt	86,3	93,3	**92,38**
31	Colombia*	88,6	90,5	**92,30**
32	El Salvador*	83,5	89,1	**91,86**
33	Iran	78,8	..	**91,77**
34	Paraguay	91,3	**91,69**	..
35	Panama	86,6	**91,41**	..
36	Irak*	91,1	**90,74**	..

NI Rank	Country	Nutrition Index (NI) 1981	1992	1997
37	Swaziland	..	**90,47**	..
38	Ecuador	..	**90,09**	..
39	Armenia*	..	..	**89,70**
40	Peru	80,9	81,2	**89,27**
41	China*	80,2	87,3	**89,01**
42	Dominican Rep.*	84,0	85,8	**87,68**
43	Uzbekistan	..	..	**87,10**
44	Kyrgyz Rep.	..	..	**87,08**
45	Bolivia	81,3	83,9	**86,62**
46	Azerbaijan*	..	..	**86,35**
47	Gabun	83,8	**86,15**	..
48	Guyana*	..	84,1	**85,99**
49	Indonesia*	72,3	80,0	**84,76**
50	Guatemala*	75,7	83,7	**83,95**
51	Ghana	64,5	75,8	**83,89**
52	Nicaragua*	83,2	..	**83,87**
53	Myanmar[2]	75,2	82,8	**83,72**
54	Honduras*	79,5	84,7	**83,37**
55	Botswana	76,5	**83,19**	..
56	Cote d'Ivoire	86,9	87,2	**83,00**
57	Senegal	79,8	82,6	**82,91**
58	Thailand	77,1	**82,83**	..
59	Mauritania	69,8	72,7	**81,95**
60	Philippines	78,0	80,3	**81,83**
61	Togo	76,2	77,8	**80,94**
62	Lesotho	81,1	79,3	**80,85**
63	The Gambia	..	81,4	**80,32**
64	Namibia	..	**80,27**	..
65	Benin	71,3	80,5	**79,86**
66	Nigeria	70,2	77,7	**79,62**
67	Vietnam	68,4	75,7	**79,49**
68	Cameroon	81,8	81,3	**79,40**
69	Zimbabwe	78,2	80,1	**79,37**
70	Sri Lanka*	75,7	77,8	**79,02**
71	Sudan*	76,6	74,5	**78,53**
72	Congo, Rep.*	73,5	**77,98**	..

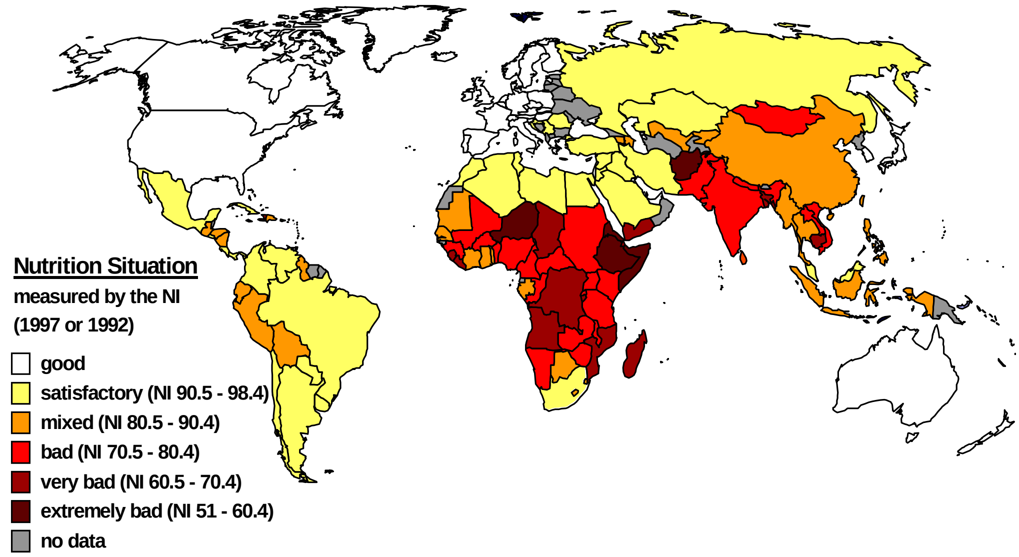
NI Rank	Country	Nutrition Index (NI) 1981	1992	1997
73	Uganda*	75,5	78,6	**77,81**
74	Kenya	80,8	77,1	**76,76**
75	Pakistan	68,4	75,7	**76,75**
76	Mongolia	..	82,1	**76,16**
77	Nepal	57,4	72,4	**74,42**
78	Mali	58,7	74,5	**74,31**
79	Burkina Faso	60,0	74,6	**73,72**
80	Central African Rep	68,8	68,7	**72,66**
81	Rwanda*	..	**72,46**	..
82	Guinea	73,0	**72,20**	..
83	Laos	70,8	74,0	**72,04**
84	Tanzania	77,7	75,0	**72,00**
85	India	59,5	67,6	**71,94**
86	Comoros	..	70,7	**71,38**
87	Malawi	74,5	68,5	**70,70**
88	Zambia	78,3	72,0	**70,56**
89	Liberia*	77,9	**69,80**	..
90	Yemen	61,6	73,4	**69,54**
91	Burundi*	72,4	**69,33**	..
92	Madagascar	76,9	70,0	**68,80**
93	Djibouti	..	**68,24**	..
94	Cambodia*	53,8	**68,07**	..
95	Haiti*	65,7	66,1	**66,45**
96	Sierra Leone*	68,8	**66,36**	..
97	Bangladesh*	56,3	64,7	**65,96**
98	Chad*	58,1	63,9	**65,47**
99	Congo, Dem. Rep.[3]	71,7	71,0	**63,60**
100	Mosambik*	58,7	53,4	**63,58**
101	Angola*	72,9	**61,98**	..
102	Niger	62,6	61,6	**60,06**
103	Eritrea*	..	..	**59,85**
104	Somalia*	59,8	**57,10**	..
105	Ethiopia*	61,0	**56,45**	..
106	Afghanistan*	72,6	59,3	**54,77**

Countries for which data availability did not permit NI calculation, but where nutrition problems probably exist: Albania, Bahrain, Belarus, Bhutan, Bosnia and Herzegovina, Bulgaria, Estonia, Georgia*, Guinea-Bissau*, North Korea*, Latvia, Lithuania, Macedonia, Moldavia, Oman, Papua New Guinea, Qatar, Slovak Rep., Tadjikistan, Turkmenistan*, Ukraine

[1] Serbia and Montenegro [2] former Birma [3] former Zaire * countries where the nutrition situation has probably been affected by armed conflicts or natural disasters after 1997

Source: own calculation

Figure 6: International Nutrition Index (NI) – Map of the World Nutrition Situation

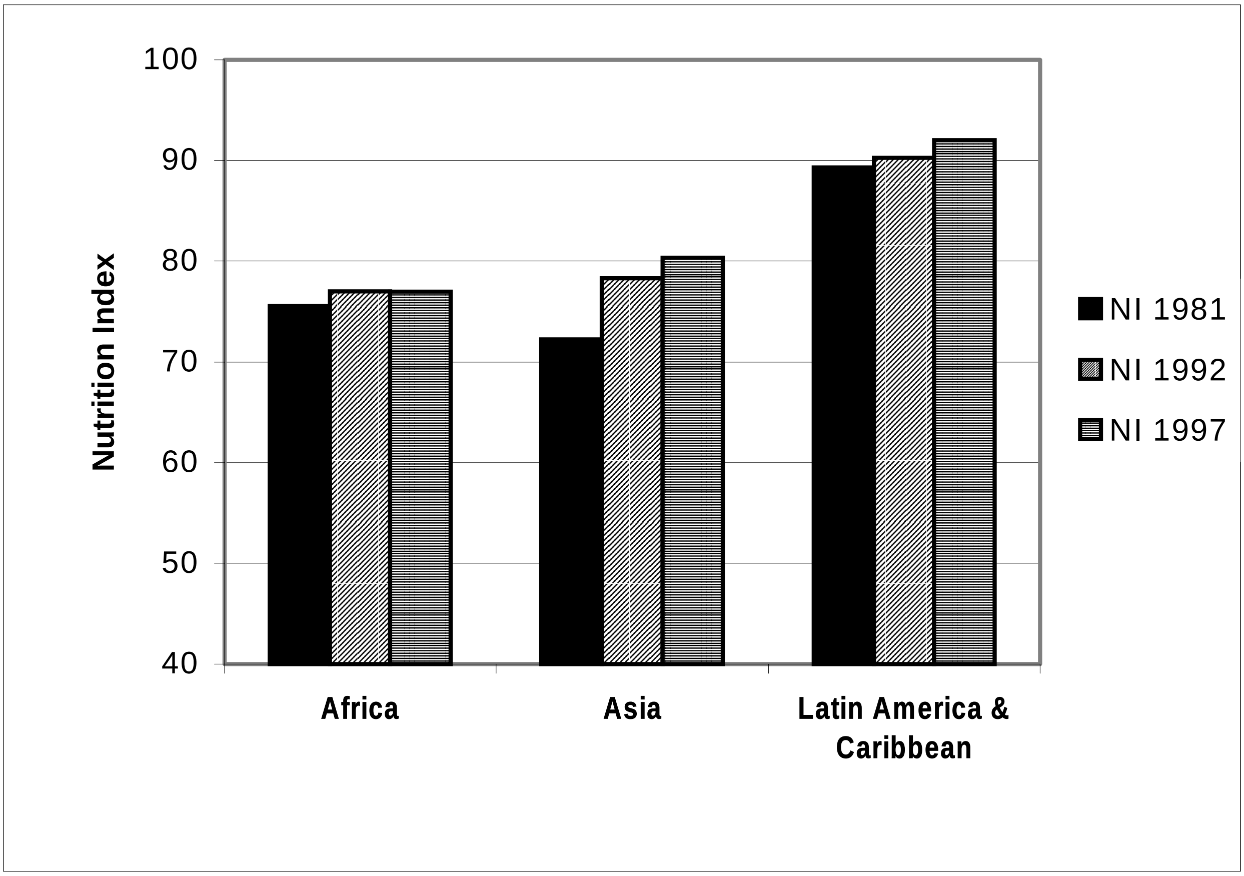


Source: Own calculations

4.2 Regional Comparisons and Trends

Before looking at the development of the nutrition situation in several regions in detail, NI trends for regional aggregates[23] of the main developing regions are presented in Figure 7.

Figure 7: NI Trends 1981-1997 in Regional Aggregates



Source: own presentation

In **Africa** as a whole, little progress has been made since the beginning of the 80s, and stagnation is found throughout the nineties. Slight declines in the percentage of undernourished and the under-five-mortality rate are outweighed by rising underweight prevalence in children (see Table 8).

[23] Due to limited NI coverage, the three indicators were weighed with population size and aggregated separately for the UN regions, and the NI was computed subsequently from the results. In the case of underweight prevalence, estimates for 1980 (ACC/SCN 1993) were aggregated and the numbers published by WHO for the UN regions and the years 1990 and 1995 were adopted directly (WHO 1997). Developed countries in Asia and the Pacific, like Japan, Australia and New Zealand, and the successor states of the former Soviet Union were omitted.

Table 8: Nutrition Index and Underlying Data, Aggregated by Region

	Undernourished [1]			Underweight [2]			Under-5-Mortality [3]			Nutrition Index		
	1979-1981	1990-1992	1995-1997	1980	1990	1995	1980	1992	1995	1981	1992	1997
Africa	29.3	27.8	26.3	24.7	26.0	28.4	193	151	144	75.6	77.0	77.0
Asia	30.5	19.8	16.7	41.2	37.2	35.0	115	81	73	72.2	78.3	80.3
Latin America & Caribbean	12.2	13.1	10.8	11.6	11.4	9.5	82	46	35	89.3	90.3	92.1

[1] in the population (in %) [2] in children under five (in %) [3] per 1000 live births
Data Sources: WHO 1997, ACC/SCN 1993, UNICEF 1995 and 1999; FAO 1999b; own calculations

In contrast to the development in Africa, **Asia** has experienced considerable improvements in its overall nutrition situation. Starting with the lowest regional NI score in the eighties, Asia has surpassed the African continent in the meantime due to notable reductions of undernourishment, underweight prevalence and child mortality. But the NI 1997 for Asia is still far from the NI reached in **Latin America and the Caribbean** throughout the 80s and the 90s. Ongoing progress can be seen in this region, though not at a great pace, with slowly falling levels of undernourishment, underweight prevalence and more pronounced reductions in child mortality since 1980. Clearly, highly aggregated NI scores can easily conceal disparities among and within regions. The first overview given here is further differentiated in Figure 8, where states are grouped by regions and ranked by their NI 1997 (only countries where data availability allowed the calculation of NI 1997 are shown).

In **North Africa and the Middle East**, improvements of the nutrition situation dominate the picture during the 1981-1997 period. NI scores are quite high in this region, indicating a satisfactory nutrition situation in all these countries except for Yemen.

In contrast to this high scores, most **West – and Central African** states are characterised by low NI values (below 81) and therefore show a bad nutrition situation. But fortunately, the majority of countries in this region experienced positive trends since the beginning of the 80s. The largest rise was seen in Ghana, where the NI jumped from 64,5 in 1980 to 83,9 in 1997, a gain of almost 20 points. Considerable, but smaller improvements were found for Mali, Burkina Faso and Mauritania. The nutrition situation has worsened in Niger, Cameroon, Cote d'Ivoire and Sierra Leone since 1981. In civil war-shaken Liberia, the downward trend of the NI is more pronounced (1992 as compared to 1981, no data for 1997, see Table 7).

In **Eastern and Southern Africa**, NI trends do not provide much scope for optimism. While Mosambik, Mauritius and Botswana show improvements in their nutrition situation, a great number of countries in this region suffer from a deteriorating nutrition situation, especially the war-torn Democratic Republic of Congo (former Zaire), but also Madagascar, Zambia, Tanzania and Kenya. All four countries in this region for which NI scores could only be calculated for 1981 and 1992 – Burundi and the war-ravaged states Angola, Ethiopia and Somalia - had NI scores below 73 in 1981 and showed a further decline during the following decade. The most serious downward trends could be observed in Angola and Ethiopia.

When looking at the NI values for the **South and Southeast Asian** region in Figure 8, the dramatic fall of NI scores for Afghanistan stands out. Apart from this South Asian country that has been ruined by violent conflict, the overall impression is quite positive due to considerable improvements in the nutrition situation of most countries in this region. Especially Nepal, Indonesia, India and Vietnam experienced large NI rises of more than 10 points, and the same holds true for Cambodia in the 1981-1992 period (no NI for 1997 calculable and not included in Figure 8, see the ranking in Table 7). But it should be stressed that despite the notable progress in these five countries, the nutrition situation is still quite bad in Vietnam and Cambodia, in Nepal, India and all other South Asian countries. At least, Malaysia's NI of 92,5 reflects a satisfactory nutrition situation, and China is likely to reach this level in the near future. The more recent effects of the Asian crisis in 1996/97 may not yet be captured in the 1997 NI.

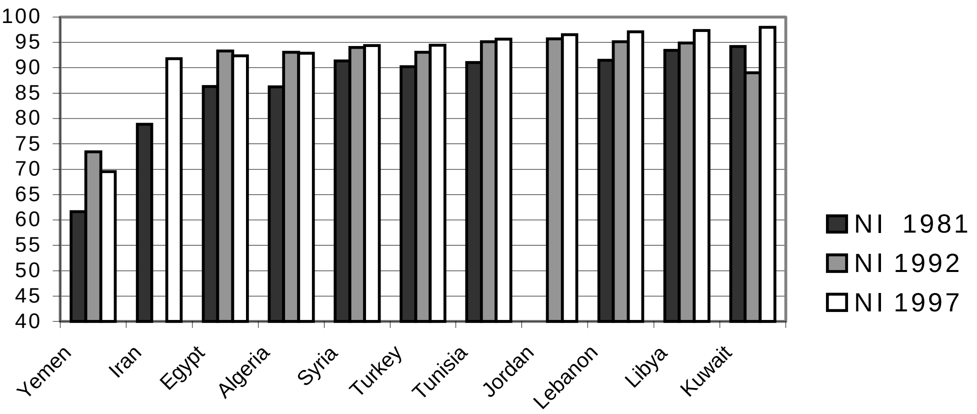
In **Latin America and the Caribbean**, the nutrition situation is fair to mixed in the vast majority of countries. In some states in this region that had reached high NI scores for 1981, only slight changes have taken place in the meantime. Considerable progress can be noted for Peru and El Salvador. Unfortunately, the nutrition situation in Haiti, the country with the lowest NI in the region, has not improved between 1981 and 1997.

Concerning **Eastern Europe and the countries of the former Soviet Union**, data availability permits NI calculation only for a very limited number of states and points of time[24]. As Figure 8 shows, the nutrition situation in Armenia and Azerbaijan - both situated in the Caucasus region - and in the Kyrgyz Republic and Uzbekistan can be classified as mixed according to their NI scores. Two successor states of the former Yugoslavia (Croatia and the present Yugoslavia), Kazakstan and the Russian Federation reach comparatively better NI values that indicate a satisfactory, though not good, nutrition situation.

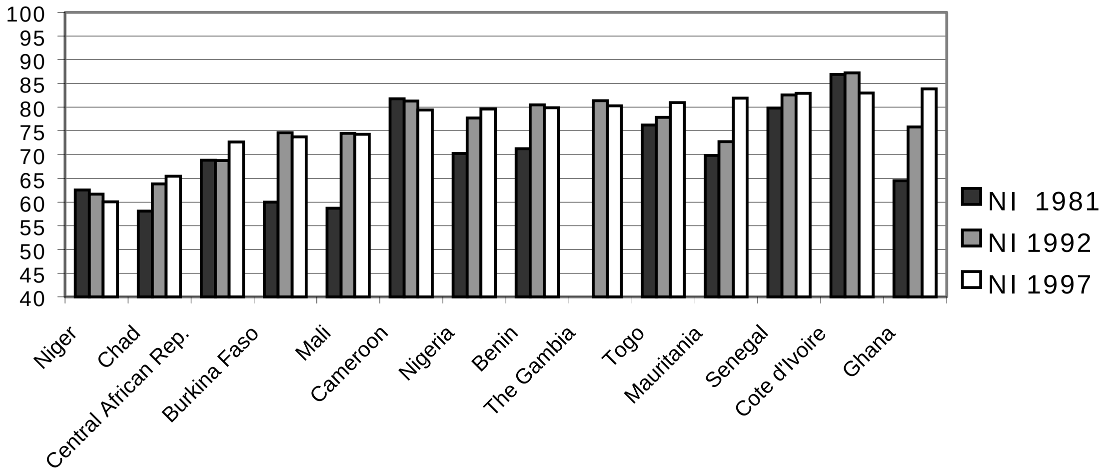
[24] Moreover, NI values for 1981 and 1992 could not be determined, because the respective countries have not been in existence in their current borders before the beginning of the 90s.

Figure 8: NI Trends 1981-1997, Countries Grouped by Regions

North Africa and Middle East



West and Central Africa



East and Southern Africa

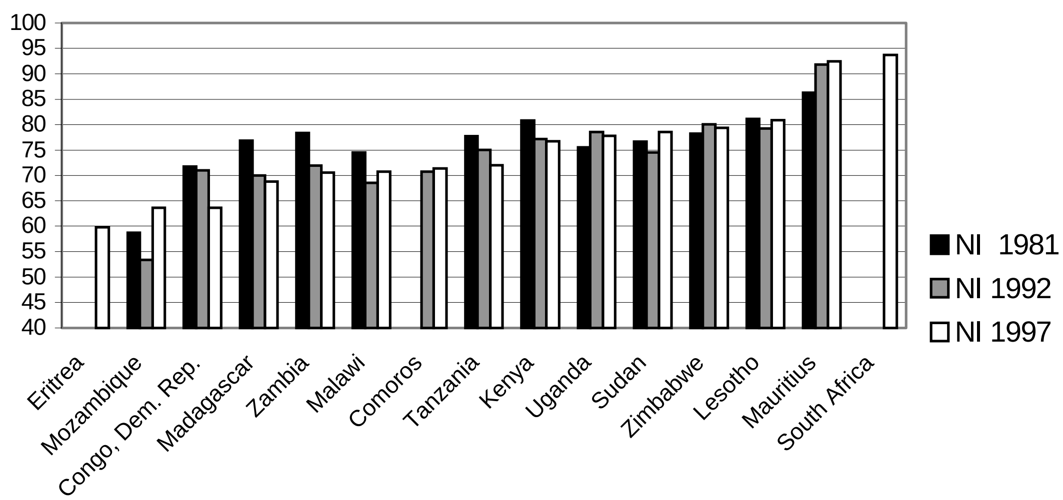
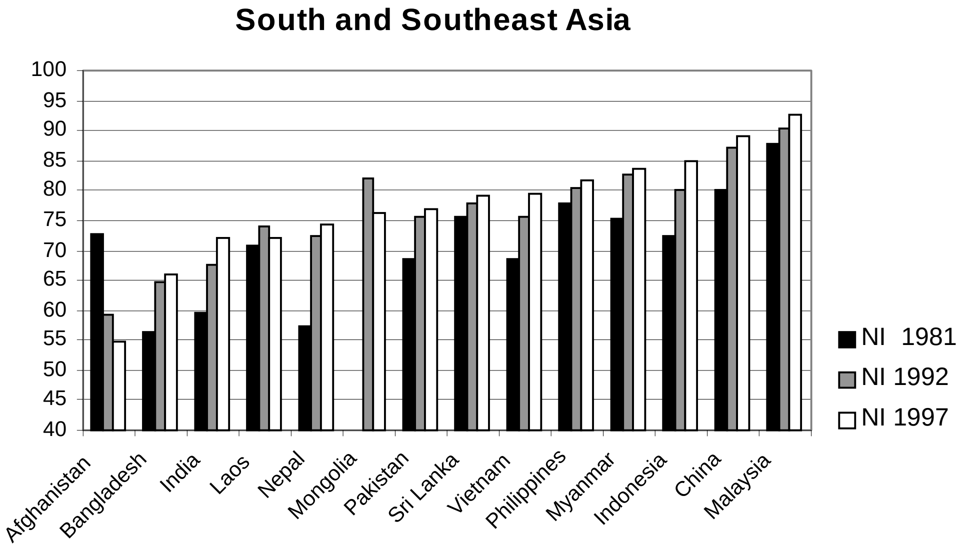
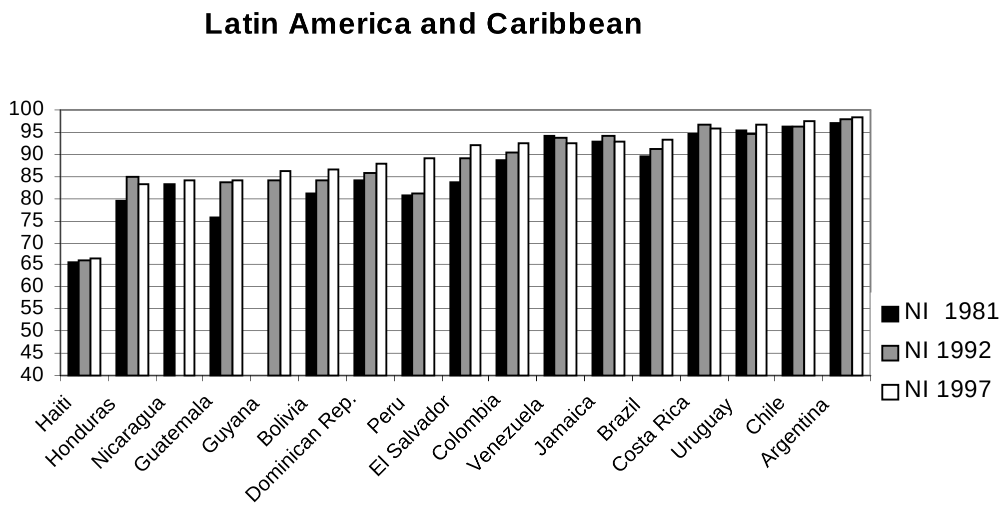
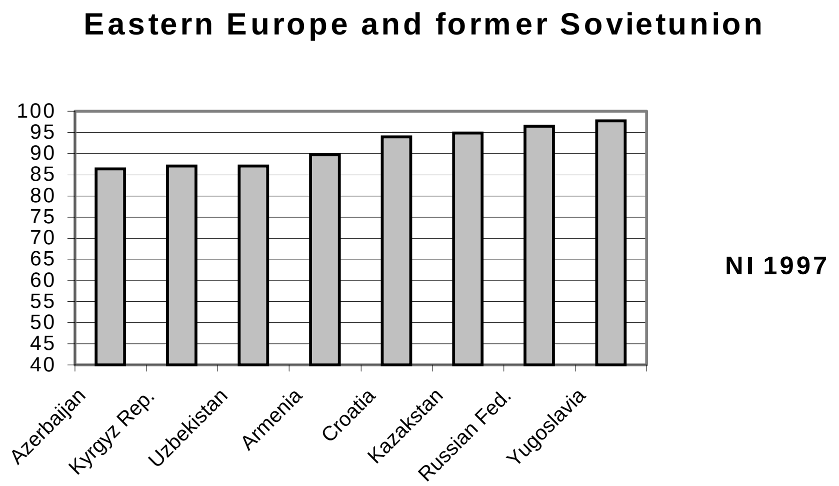


Figure 8 (continued): NI Trends 1981-1997, Countries Grouped by Regions







Summing up, it may be said that the North African and Near Eastern region, just as Latin America and the Caribbean, have experienced small to medium NI improvements from 1981 to 1997 and have achieved a fair or mixed nutrition situation – with the exception of Haiti in the Caribbean and Yemen in the Near East. The few states of Eastern Europe and the former Soviet Union for which NI calculations were possible also showed good or mixed NI scores. The nutrition situation is still bad in South Asia and no better than middling in most of Southeast Asia, but apart from the depressing situation in Afghanistan, there are very promising upward trends in this region. In Sub-Saharan Africa, the nutrition situation is bad or even extremely bad in about three quarters of the countries, though some West African states have experienced a large NI score increase over the last two decades. Moreover, in large parts of Eastern and Southern Africa and in the West African state of Liberia, the quite bad nutrition situation in the beginning of the 80s has even deteriorated since then. Therefore, not only in terms of absolute NI levels, but also with respect to recent trends, Sub-Saharan African nations give rise to the most serious concern about their nutrition situation.

5 Analyses of the NI

In the following, the relationship of the newly created NI to indicators of micro-nutrient deficiencies and measures of development (GNP per capita as indicator for economic performance and Human Development Index) is investigated in further analyses.

5.1 NI and Indicators for Micro-Nutrient Deficiencies

The connections between the most prevalent micro-nutrient deficiencies and the indicators the NI is composed of have been outlined in the conceptual part (see Tables 1 and 2). Low NI scores can therefore be expected to reflect a multitude of vitamin and mineral deficiencies, though indicators for micro-nutrient deficiencies were not explicitly included into the index. To test the relation between micro-nutrient deficiencies and the NI, correlation coefficients were calculated for the NI 1997 and iron, iodine and Vitamin A deficiencies as indicated by anaemia in pregnant women, the goitre rate in children aged 6-11 years, and sub-clinical as well as clinical Vitamin A deficiency[25]. For comparison, correlation coefficients for these deficiencies and some single indicators of the nutrition situation were also determined (average dietary energy intake, the percentage of undernourished, the proportion of underweight children and the under-five-mortality rate). The results are shown in Table 9.

[25] Sub-clinical deficiency was detected by measuring low serum retinol levels, clinical Vitamin A deficiency was identified by observing eye signs like Bitot’s spots or blindness (The Micronutrient Initiative/ UNICEF/ Tulane University 1998).

Table 9: Correlations Between Micronutrient Deficiencies, the NI and Single Indicators for the Nutrition Situation

Deficient Minerals/Vitamins and Indicators (in percent of reference group)	No. of Cases	Correlation Coefficients (Pearson) with Single Nutrition Indicators				
		Average Dietary Energy Intake	Under-nourished in Population	Under-five Mortality Rate	Under-weight Children under 5	Nutrition Index (NI) 1997
Iron						
Anaemia in pregnant women	50	0.23 *	0.23 *	0.25 **	0.48 ***	0.40 ***
Iodine						
Goitre in children aged 6-11 years	63	-0.10	0.16	0.10	0.17 *	0.18 *
Vitamin A						
Subclinical Deficiency [1]	28	0.18	0.19	0.66 ***	0.56 ***	0.55 ***
Clinical Deficiency [2]	25	-0.46 ***	0.49 ***	0.63 ***	0.58 ***	0.75 ***

[1] low serum retinol level [2] eye signs *** significant at the 1% level
* significant at the 10% level ** significant at the 5% level

anaemia in pregnant women: latest data from 1985-95 (World Bank 1997)
goitre rate: latest data from 1985-97 (UNICEF 1999)
Vit. A deficiency: latest data from 1982-1996 (Micronutrient Initiative/UNICEF/Tulane University 1998)
average dietary energy intake: mean 1995-97 (FAO 1999a)
undernourished in population: 1995-97 (FAO 1999b)
underweight children: latest data from 1993-1998 (WHO 1997/1999)
under-five mortality: 1997 (UNICEF 1999)

Source: own calculation

Because data availability for micro-nutrient deficiencies is quite limited, only a sub-sample of countries with NI data for 1997 could be examined (the respective number of cases is given in the second column). Considering the correlation coefficients, one should bear in mind that average dietary energy intake and the percentage of undernourished refer to the whole population, whereas the other indicators are based on a sub-group, mostly children of a certain age group or, in the case of anaemia, pregnant women (whose nutritional well-being, however, has strong effects on children's health and nutrition status). Part of the explanation for the weak correlations between dietary energy intake and the percentage of undernourished on the one hand and the prevalence of micro-nutrient deficiencies on the other hand can be seen in these differing reference groups. Another problem is the wide time span from which the data about micro-nutrient deficiencies are drawn. Despite this incomplete coherence in reference groups and time of measurement, a notably high and highly significant correlation coefficient could be found especially for clinical Vitamin A deficiency and the NI, but also for this severe form of Vitamin A deficiency and the single indicators. The weak correlation between the total goitre rate, the NI and the other indicators is not surprising, given the fact that iodine intake is strongly determined by the existence of successful salt iodisation programs and by environmental conditions like the iodine contents of soils and water - factors that are not necessarily reflected in the NI and the single indicators noted above. Compared to the other indicators, the NI tends to perform better in terms of connection with micro-nutrient deficiencies, though anaemia and sub-clinical Vitamin A deficiency are more highly correlated to the proportion of underweight children and to the under-five-mortality rate, respectively.

5.2 NI and Development

In the conceptual framework, the impact of economic development on the nutrition situation has been laid out. GNP per capita as an indicator of economic performance is therefore expected to be a valid predictor for the NI. This hypothesis is tested in the following in a regression analysis[26]. Even more interesting may be the identification of countries with large residuals in the regression analysis– that is those countries that do notably better or worse than would be predicted from their level of GNP per capita.

For the analysis, NI data for 1997 were supplemented by 1992 data for the countries for which more recent NI scores could not be determined. The GNP per capita data (in constant 1995 PPP$[27]) were matched with the NI data in the following manner: an average value was formed for each country with the mean GNP per capita of the three-year-period to which the percentage of the undernourished referred to, of the GNP per capita for the year the under-five-mortality rate was taken from and of the GNP per capita for the year the underweight data were collected. This was done to take into account the different points and periods in time the underlying data for the NI 1997 and NI 1992 referred to. 11 countries could not be included in the analysis due to lack of GNP data for the respective years[28]. Linear regressions were run with GNP per capita and its logarithm, and GNP per capita squared to find the most appropriate functional form for the relation of GNP per capita and NI. A simple linear regression with the logarithm of GNP per capita as independent variable and the NI as dependent variable yielded a good fit: adjusted R squared reached 0.74, which means that GNP per capita accounted for 74% of NI variation. Actual NI scores and predicted values are plotted against GNP per capita in Figure 9.

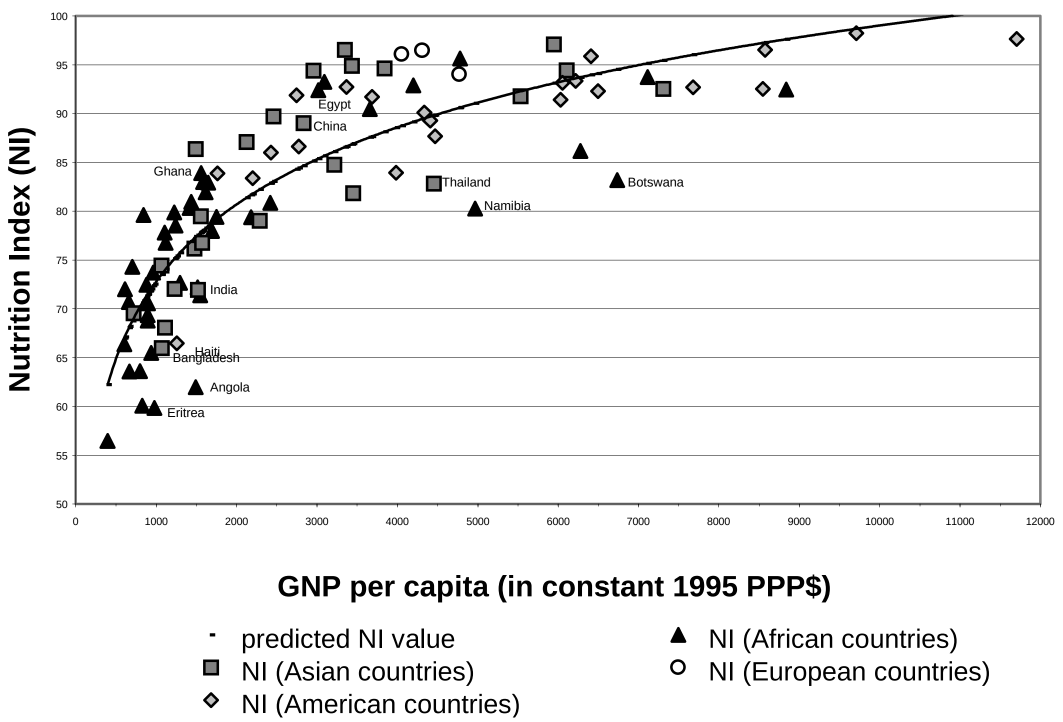
[26] Possible long-term endogeneity problems due to the feedback of bad health and nutrition status on learning and working capacity are not taken into account here.

[27] Purchasing Power Parity Dollars. Because GNP per capita data were only available in current PPP$ on the latest World Bank WDI CD-ROM (World Bank 1999), GNP per capita in constant 1995 PPP$ was calculated from these data by means of the ratio obtained by dividing GDP at market prices in constant 1995 US$ through GDP at market prices in current US$.

[28] This holds true for Somalia, Djibouti, Liberia, Libya, Afghanistan, Myanmar, Uzbekistan, Iraq, Kuwait, Yugoslavia (Serbia and Montenegro) and Cuba.

The logarithmic functional relationship between the NI and GNP per capita and the declining marginal returns to nutritional improvement of GNP per capita growth are evident. For example, a rise of GNP from 500 to 2,000 PPP$ leads to a NI increase of about 15 points, whereas the same absolute rise from a level of 3,500 PPP$ to 5,000 PPP$ results in a five points gain only. This means that large improvements of the nutrition situation can be brought about by rises in economic performance especially if the average GNP of a country is low. The disaggregation by regions shows that the bulk of African countries is concentrated in the low GNP per capita – low NI area of the graph. In contrast, the majority of Asian and Latin American nations can be found in the middle income class with higher NI scores.

Figure 9: Actual and Predicted Values for the NI (for 1997 supplemented by NI 1992) Plotted Against GNP per Capita



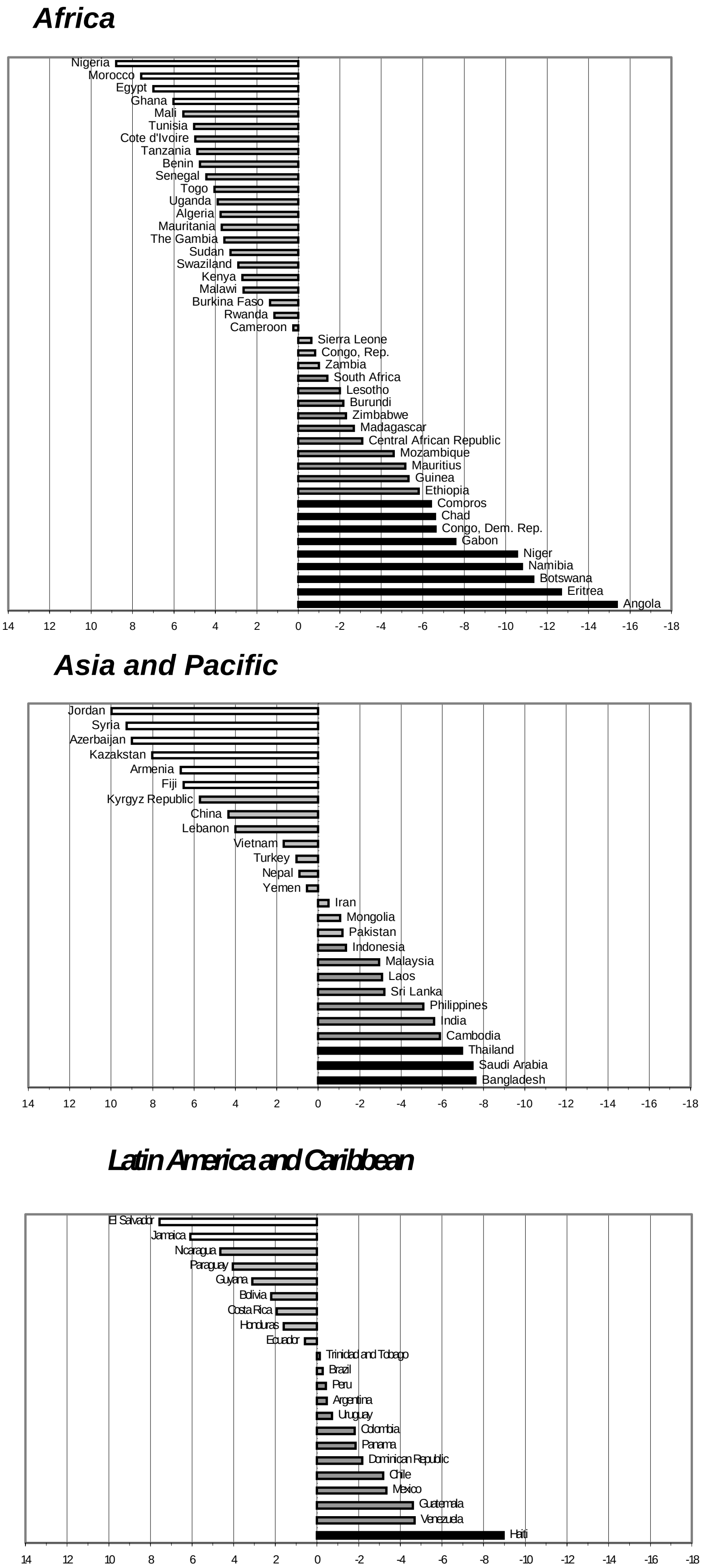
Source: own calculation

The three European states for which data availability allowed inclusion into the analysis – Croatia, Romania and Russia – performed relatively well with respect to their economic resources. The differences between actual NI scores and predicted values (residuals) are listed in Figure 10 for the other continents' countries.

Of course, lacking willingness and ability of states to convert economic resources into nutritional improvements are not the only explanation for the divergences between actual and predicted NI scores. Residuals are surely to some extent the result of inevitable errors in the data and of random deviations, therefore not too much emphasis should be put on small divergences from predicted values. The standard deviation of residuals is 5.18, non-standardised residuals between –6 and 6 are shown in grey in Figure 10. The focus is on countries with larger negative or positive residuals, that are depicted in black and white, respectively, in the graphs.

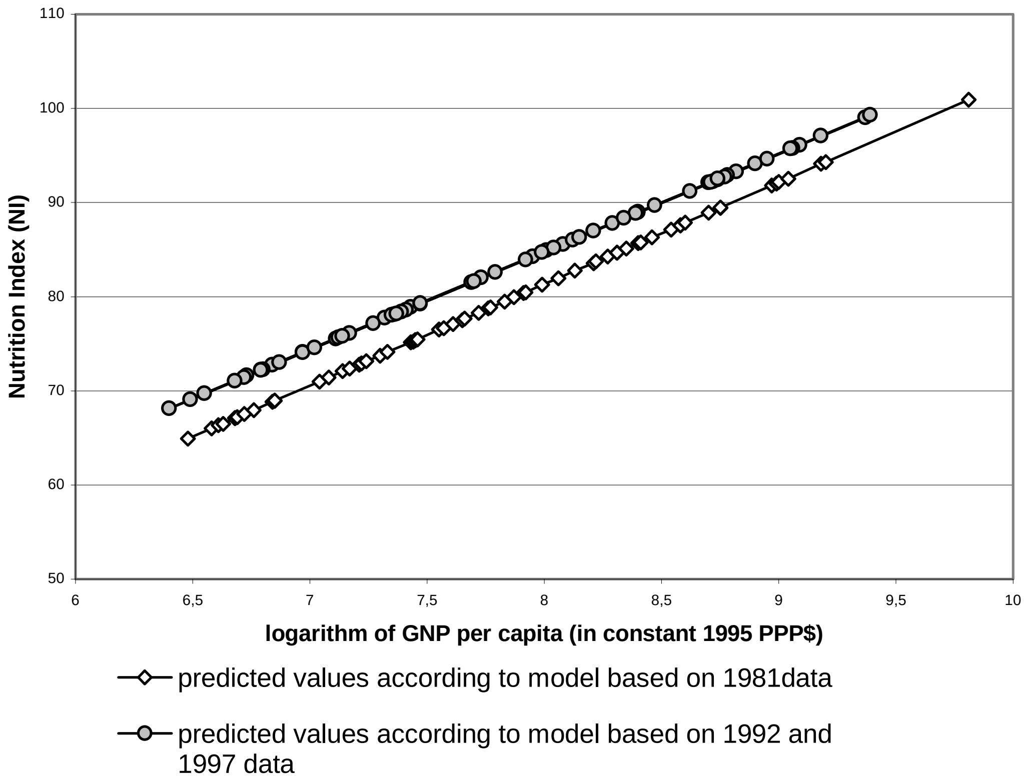
On the African continent, quite a large number of countries have worse nutrition situations than would be expected according to their GNP per capita – this applies in particular to the South African countries Angola, Botswana and Namibia, to Eritrea in East and to Niger in West Africa. In contrast, the nutrition situation in Nigeria, Ghana and the North African states Morocco and Egypt is better than predicted by the simple GNP-based model. In Asia, a lot of countries managed to convert economic resources quite well into nutritional well-being for their people, especially Jordan, Syria, Azerbaijan and Kazakstan. Substantial lower NI scores than predicted on the basis of GNP per capita could be observed only for Thailand, Saudi Arabia and Bangladesh. In Latin America and the Caribbean, only El Salvador and Jamaica with a quite good nutrition situation from the viewpoint of their economic development and Haiti with a considerably lower NI than predicted can be considered as outliers.

Figure 10: Residuals Generated by the Simple GNP-based Model, Countries Grouped by Continents (own calculation)



In a further analysis, a data subset was formed with GNP per capita data (in constant 1995 PPP$) and NI scores for the years 1981 and 1997, the latter supplemented with NI 1992 - that is, only countries with NI and GNP data for both the 80s and the 90s were left in the data set[29]. As the inflation of the US$ had been taken into account by using constant PPP$, it was possible to compare the efficiency of the conversion of economic resources in both periods. For this purpose, two separate models were calculated using the NI and GNP data referring to the 80s and 90s, respectively. The predicted values obtained from the two models are shown in Figure 11 (plotted against the logarithm of GNP per capita). Equal amounts of economic resources were converted to higher NI scores in the 90s as compared to the 80s. This seems to be a hopeful development with respect to the efficiency of resource use for improving nutrition. Possible reasons need to be analysed by further research.

Figure 11: Predicted NI Values According to Different Models with Pooled Data Plotted Against GNP per Capita



Source: own calculation

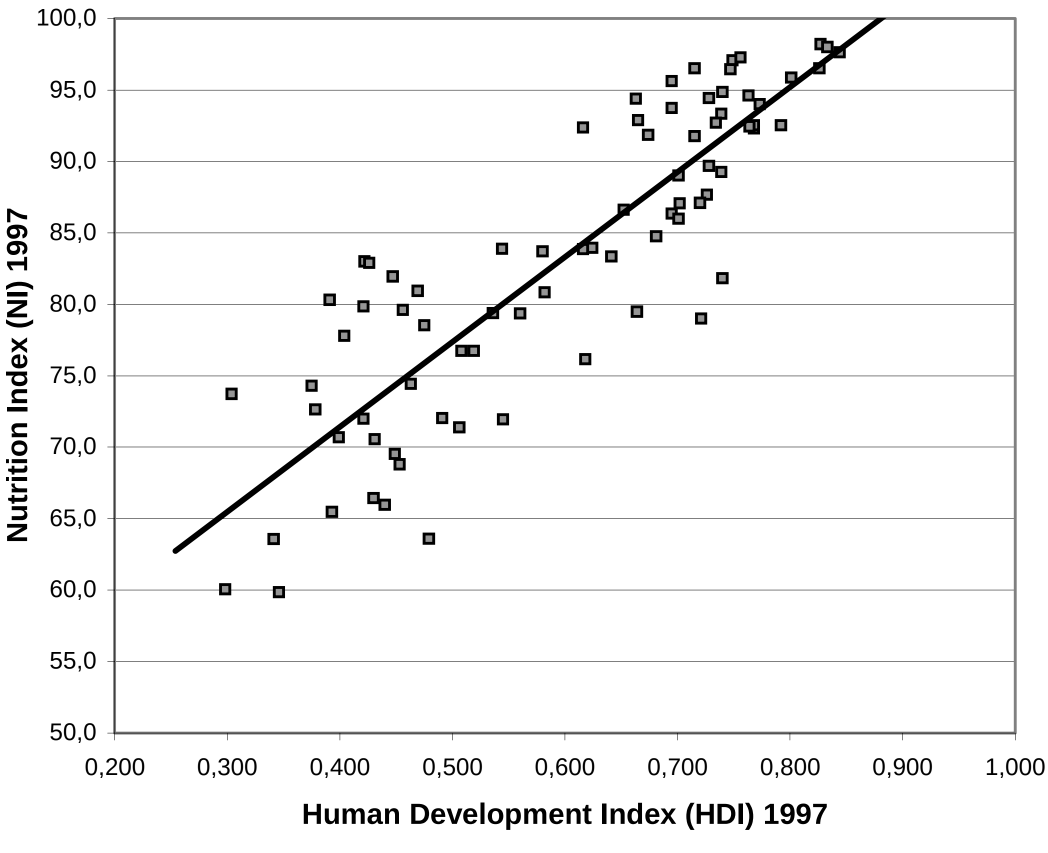
Another possibility to explore how the NI relates to a country's level of development is the comparison with the Human Development Index (HDI). The HDI has been designed in 1990 as a measure of development that has a broader focus than simply GNP per capita (UNDP 1990). It is composed of the logarithm of GNP per capita (in the newest version of the HDI from 1999), life

[29] Again, the GNP data were matched with the reference periods and years of the indicators constituting the NI.

expectancy and the mean of literacy rate and school enrolment rates (UNDP 1999). All three rise with declining marginal rates when GNP per capita increases.

The connection of the Human Development Index (HDI) and the NI is illustrated in Figure 12 that also depicts the close relationship of the two indices: the correlation coefficient amounts to 0.87. This high correlation is the result of the tight connection of under-five-mortality rate and life expectancy (indicators included in the NI and HDI, respectively) and of the strong impact of logarithmised GNP per capita and literacy rate - both part of the HDI – on the nutrition situation, as measured by the NI as a whole. Nevertheless, there are large divergences between the two measures among countries.

Figure 12: Nutrition Index 1997 Plotted Against Human Development Index 1997



Source: own calculation

6 Conclusions

A world which aims for ending hunger and malnutrition must know how nutrition develops on a country-by–country basis. The new Nutrition Index presented here permits measurement of progress or the lack thereof since the important international conferences, such as the World Children's Summit (1990), the International Conference on Nutrition (1992) and the World Food Summit (1996).

The nutrition index has been designed as a new measure for countries' nutrition situation that is more comprehensive than the indicators currently used for this purpose by FAO, WHO and UNICEF. Both the conceptual consistency of the NI and empirical results relating to micro-nutrient deficiencies confirm that the NI is a suitable measure for the monitoring of the world's nutrition situation.

Empirical analysis shows the tight connection of overall economic performance and people's ability to be free from hunger and malnutrition and the deadly consequences of mismanaged economies. We find signs that the differences in the efficiency of conversion of economic resources into nutritional improvements may have gained in the 1990s. Though economic growth is very important to ameliorate desolate nutrition situations, there remains a lot of scope for policies to relieve hunger and malnutrition in many countries, independent from the pace of GNP growth. Well-designed, effective food- and nutrition-oriented policies contribute to people's welfare directly and indirectly via raising their working capacity and incomes.

Nutritional improvement very much remains a task of public action by both, government and civil society organizations. International support for such action in the agriculture, food, health and education sectors is needed and can have high returns, if not counteracted by bad governance and military conflict. The Nutrition Index thus also serves as an important tool for monitoring countries' performance when receiving debt relief or incremental development aid or not. ZEF is planning updates and refinements of the NI for these purposes in the future.

Table A-1: Nutrition Index 1981-1997 and Underlying Data

	Underweight [1]			Undernourished [2]			Under-5-Mortality [3]			Nutrition Index		
	77-82	87-92	93-98	79-81	90-92	95-97	80	92	97	1981	1992	1997
Afghanistan	20,9 *	40,3*	49,3	33,0	57,0	62,0	280	257	257	72,6	59,3	54,8
Albania	..	..	..	9,2 **	13,6 **	4,1 **	57	41	40	..	..	..
Algeria	18,0 *	9,2	12,8	9,0	5,0	5,0	145	68	39	86,2	93,0	92,9
Angola	26,3 *	35,3*	..	29,0	50,0	43,0	261	292	292	72,9	62,0	..
Argentina	3,5 *	1,2*	1,9	1,0	2,0	1,0	41	27	24	97,1	98,0	98,2
Armenia	..	..	3,3	..	..	24,8 **	..	33	30	..	..	89,7
Australia	..	..	..	..	..	..	13	8	6	..	..	..
Austria	..	..	..	..	..	..	17	8	5	..	..	..
Azerbaijan	..	..	9,3	..	..	27,6 **	..	52	45	..	..	86,4
Bahrain	..	..	..	..	..	..	..	..	22	..	..	..
Bangladesh	70,1	61,8	56,3	42,0	34,0	37,0	211	122	109	56,3	64,7	66,0
Belarus	..	..	..	..	..	..	..	..	18	..	..	..
Belgium	..	..	..	..	..	..	15	10	7	..	..	..
Benin	33,4 *	23,5 *	29,2	36,0	21,0	15,0	176	144	167	71,3	80,5	79,9
Bhutan	..	..	..	..	..	..	249	197	121	..	..	..
Bolivia	13,2	12,0	7,6	26,0	25,0	23,0	170	114	96	81,3	83,9	86,6
Bosnia and Herzeg.	..	..	..	..	..	21,0 **	..	..	16	..	..	..
Botswana	34,4 *	26,8 *	..	28,0	19,0	25,0	94	56	49	76,5	83,2	..
Brazil	7,0 *	7,0	5,7	15,0	13,0	10,0	93	63	44	89,6	91,3	93,3
Bulgaria	..	..	..	..	..	7,7 **	25	19	19	..	..	..
Burkina Faso	32,2 *	27,1 *	32,7	64,0	32,0	30,0	246	175	169	60,0	74,6	73,7
Burundi	25,9 *	31,0	..	38,0	44,0	63,0	193	178	176	72,4	69,3	..
Cambodia	44,3 *	37,7 *	..	62,0	41,0	33,0	330	181	167	53,8	68,1	..
Cameroon	17,3	15,1	20,6	20,0	30,0	32,0	173	113	99	81,8	81,3	79,4
Canada	..	..	..	..	..	..	13	8	7	..	..	..
Central Afric. Rep.	52,7 *	31,9 *	23,2	22,0	45,0	42,0	202	177	173	68,8	68,7	72,7
Chad	32,1 *	30,6 *	38,8	69,0	58,0	46,0	254	206	198	58,1	63,9	65,5
Chile	1,1	2,0 *	0,8	7,0	8,0	5,0	35	17	13	96,1	96,1	97,6
China	23,8 *	17,4	15,8	30,0	17,0	13,0	65	43	47	80,2	87,3	89,0
Colombia	16,7	10,1	8,4	12,0	17,0	12,0	59	19	30	88,6	90,5	92,3
Comoros	..	18,5	25,8	56,6 **	51,4 **	51,8 **	..	182 x	93	..	70,7	71,4
Congo, Dem. Rep.	27,9 *	33,2 *	34,4	37,0	36,0	55,0	204	187	207	71,7	71,0	63,6
Congo, Rep.	39,1 *	23,9	..	29,0	32,0	34,0	125	109	108	73,5	78,0	..
Costa Rica	6,0	2,3	4,1	8,0	6,0	7,0	29	16	14	94,4	96,7	95,9
Cote d'Ivoire	14,1 *	12,3 *	21,3	7,0	14,0	15,0	180	120	150	86,9	87,2	83,0
Croatia	..	..	0,6	..	..	16,6 **	..	..	9	..	..	94,0
Cuba	8,3 *	8,4 *	..	3,0	3,0	19,0	26	10	8	95,4	96,0	..
Cyprus	..	..	..	..	..	..	..	10 x	9	..	..	..
Czech Republic	..	..	..	..	..	..	..	10	7	..	..	..
Denmark	..	..	..	..	..	..	10	7	6	..	..	..
Djibouti	..	22,9	..	55,4 **	57,3 **	34,4 **	..	158 x	156	..	68,2	..
Dominican Rep.	14,0 *	10,3	5,9	25,0	28,0	26,0	94	48	53	84,0	85,8	87,7
Ecuador	..	16,5	..	12,0	8,0	5,0	101	57	39	..	90,1	..
Egypt	14,9	10,4	11,7	8,0	4,0	4,0	180	59	73	86,3	93,3	92,4
El Salvador	20,9 *	15,2	11,2	17,0	12,0	10,0	120	60	36	83,5	89,1	91,9
Eritrea	..	..	43,7	..	..	67,0	260	204	116	..	..	59,8
Estonia	..	..	..	..	..	6,6 **	..	23	14	..	..	..
Ethiopia	38,1	43,8	..	53,5 **	67,9 **	51,0	260	204	175	61,0	56,5	..
Fiji	..	..	7,9	..	10,4 **	6,1 **	..	..	24	..	..	94,6
Finland	..	..	..	..	..	..	9	5	4	..	..	..
France	..	..	..	..	..	..	13	9	5	..	..	..
Gabon	16,1 *	15,1 *	..	13,0	11,0	8,0	194	154	145	83,8	86,1	..
Gambia, The	25,6 *	17,1 *	26,2	57,0	17,0	25,0	..	216 x	87	..	81,4	80,3

1 in children under five (in%) 2 in the population (in%) 3 per 1000 live births * estimates reported in ACC/SCN 1993 ** own estimates x data refer to 1993

Table A-1 (continued): Nutrition Index 1981-1997 and Underlying Data

	Underweight [1]			Undernourished [2]			Under-5-Mortality [3]			Nutrition Index		
	77-82	87-92	93-98	79-81	90-92	95-97	80	92	97	1981	1992	1997
Georgia	..	..	..	..	..	12,8 **	..	28	29	..	..	..
Germany	..	..	..	..	..	..	16	7	5	..	..	..
Ghana	30,9 *	27,1	27,3	61,0	29,0	11,0	157	170	107	64,5	75,8	83,9
Greece	..	..	..	..	..	..	23	10	8	..	..	..
Guatemala	43,6	28,5	26,6	17,0	14,0	17,0	136	73	55	75,7	83,7	84,0
Guinea	23,4	24,0 *	..	30,0	37,0	31,0	276	226	201	73,0	72,2	..
Guinea-Bissau	..	..	..	39,6 **	15,9 **	17,3 **	290	235	220	..	..	..
Guyana	22,1	18,0 *	18,3	13,0	24,0	16,0	..	63 x	82	..	84,1	86,0
Haiti	37,4	26,8	27,5	47,0	63,0	61,0	195	130	132	65,7	66,1	66,5
Honduras	21,2 *	18,0	25,4	31,0	23,0	21,0	100	56	45	79,5	84,7	83,4
Hungary	..	..	..	..	..	..	26	15	11	..	..	..
India	68,0 *	61,0	53,2	38,0	26,0	22,0	177	122	108	59,5	67,6	71,9
Indonesia	45,7 *	39,9	34,0	26,0	10,0	6,0	128	111	68	72,3	80,0	84,8
Iran	43,1	..	15,7	9,0	6,0	6,0	126	54	35	78,8	..	91,8
Iraq	14,5 *	11,9	..	4,0	9,0	15,0	83	71	122	91,1	90,7	..
Ireland	..	..	..	..	..	..	14	7	7	..	..	..
Israel	..	..	..	..	..	..	19	9	6	..	..	..
Italy	..	..	..	..	..	..	17	9	6	..	..	..
Jamaica	9,3	4,6	10,2	8,0	12,0	11,0	39	13	11	93,0	94,1	92,7
Japan	..	..	..	..	..	..	11	6	6	..	..	..
Jordan	..	6,4	5,1	6,0	4,0	3,0	66	27	24	..	95,7	96,5
Kazakstan	..	..	8,3	..	..	2,8 **	..	49	44	..	..	94,9
Kenya	22,0	13,2	20,8	25,0	47,0	41,0	112	90	87	80,8	77,1	76,8
Korea, Dem. Rep.	..	..	..	19,0	16,0	48,0	43	32	30	..	..	..
Korea, Rep.	..	..	..	1,0	1,0	1,0	18	9	6	..	..	..
Kuwait	10,1 *	5,0 *	1,7	4,0	27,0	3,0	35	13	13	94,2	89,0	98,0
Kyrgyz Rep.	..	..	11,0	..	..	23,4 **	..	58	48	..	..	87,1
Lao PDR	37,6 *	34,0 *	40,0	32,0	31,0	33,0	190	141	122	70,8	74,0	72,0
Latvia	..	..	..	..	..	5,0 **	..	26	20	..	..	..
Lebanon	14,0 *	8,9 *	3,0	8,0	2,0	2,0	40	40	37	91,5	95,1	97,1
Lesotho	13,3	15,8	16,0	26,0	31,0	28,0	173	156	137	81,1	79,3	80,8
Liberia	20,8 *	20,1 *	..	22,0	49,0	42,0	235	217	235	77,9	69,8	..
Libya	4,1 *	4,0 *	4,7	0,0	1,0	1,0	150	100	25	93,4	94,9	97,3
Lithuania	..	..	..	..	..	..	..	20	15	..	..	..
Macedonia	..	..	..	..	..	11,3 **	..	..	23	..	..	..
Madagascar	30,1 *	40,9	40,0	18,0	34,0	39,0	216	164	158	76,9	70,0	68,8
Malawi	21,2	27,6	29,9	26,0	45,0	37,0	290	223	215	74,5	68,5	70,7
Malaysia	29,8 *	25,6	20,1	4,0	3,0	2,0	42	17	11	87,7	90,2	92,5
Mali	34,3 *	25,1	24,2	59,0	30,0	29,0	310	217	239	58,7	74,5	74,3
Mauritania	31,0	47,6	23,0	35,0	15,0	13,0	249	202	183	69,8	72,7	81,9
Mauritius	28,0 *	17,0 *	14,9	10,0	6,0	6,0	42	22	23	86,3	91,8	92,4
Mexico	16,7 *	14,2	..	5,0	5,0	6,0	81	32	35	90,2	92,7	..
Moldova	..	..	..	..	..	13,7 **	..	36	31	..	..	..
Mongolia	..	12,3	8,6	27,0	34,0	48,0	112	78	150	..	82,1	76,2
Morocco	16,6 *	9,5	..	10,0	5,0	5,0	145	59	72	86,3	93,2	..
Mozambique	43,8 *	46,8 *	26,1	54,0	66,0	63,0	269	282	208	58,7	53,4	63,6
Myanmar	42,0	32,4	31,2	19,0	9,0	7,0	146	111	114	75,2	82,8	83,7
Namibia	..	26,2	..	25,0	26,0	30,0	114	79	75	..	80,3	..
Nepal	66,2 *	50,5 *	46,9	46,0	21,0	21,0	177	128	104	57,4	72,4	74,4
Netherlands	..	..	..	..	..	..	11	8	6	..	..	..
New Zealand	..	..	..	..	..	..	16	9	7	..	..	..
Nicaragua	10,0	..	12,2	26,0	29,0	31,0	143	72	57	83,2	..	83,9
Niger	49,0 *	42,6	49,6	32,0	41,0	39,0	320	320	320	62,6	61,6	60,1

1 in children under five (in%) 2 in the population (in%) 3 per 1000 live births * estimates reported in ACC/SCN 1993 ** own estimates x data refer to 1993

Table A-1 (continued): Nutrition Index 1981-1997 and Underlying Data

	Underweight [1]			Undernourished [2]			Under-5-Mortality [3]			Nutrition Index		
	77-82	87-92	93-98	79-81	90-92	95-97	80	92	97	1981	1992	1997
Nigeria	30,4 *	35,3	35,0	40,0	13,0	8,0	196	191	187	70,2	77,7	79,6
Norway	..	..	..	..	..	..	11	8	4	..	..	..
Oman	..	24,3	23,3	..	..	..	95	29	18	..	..	..
Pakistan	50,2	40,2	38,2	31,0	20,0	19,0	151	137	136	68,4	75,7	76,7
Panama	15,7	6,1	..	22,0	18,0	17,0	31	20	20	86,6	91,4	..
Papua New Guin.	29,9	..	..	31,0	27,0	24,0	95	95	112	76,9	..	..
Paraguay	7,0 *	3,7	..	13,0	18,0	13,0	61	34	33	91,3	91,7	..
Peru	16,7 *	10,7	7,8	28,0	40,0	19,0	130	62	56	80,9	81,2	89,3
Philippines	33,2	33,4	29,6	27,0	21,0	22,0	70	59	41	78,0	80,3	81,8
Poland	..	..	..	..	..	..	24	15	11	..	..	..
Portugal	..	..	..	..	..	..	31	11	8	..	..	..
Qatar	..	..	5,5	..	..	..	..	..	20	..	..	..
Romania	..	5,7	..	..	3,3 **	..	36	29	26	..	96,1	..
Russian Fed.	..	..	3,0	..	..	5,2 **	..	31	25	..	..	96,4
Rwanda	..	29,4	..	24,0	40,0	37,0	222	141	170	..	72,5	..
Saudi Arabia	14,9 *	12,6 *		3,0	3,0	4,0	90	38	28	91,1	93,6	..
Senegal	19,4 *	21,6	22,3	19,0	19,0	17,0	221	120	124	79,8	82,6	82,9
Sierra Leone	23,2	28,7	..	40,0	44,0	43,0	301	284	316	68,8	66,4	..
Singapore	..	..	..	..	..	..	13	6	4	..	..	..
Slovak Rep.	..	..	..	..	..	4,2 **	..	18	11	..	..	..
Slovenia	..	..	..	..	..	..	..	..	6	..	..	..
Somalia	41,9 *	38,8 *	..	55,0	70,0	73,0	246	211	211	59,8	57,1	..
South Africa	..	..	8,2	5,5	4,9	4,1 **	91	69	65	..	..	93,7
Spain	..	..	..	..	..	..	16	9	5	..	..	..
Sri Lanka	47,5	37,3	37,7	22,0	29,0	25,0	52	19	19	75,7	77,8	79,0
Sudan	26,4 *	33,7 *	33,9	24,0	31,0	20,0	200	128	115	76,6	74,5	78,5
Swaziland	12,6 *	8,8 *	..	14,0	9,0	14,0	..	107 x	94	..	90,5	..
Sweden	..	..	..	..	..	..	9	6	4	..	..	..
Switzerland	..	..	..	..	..	..	11	8	5	..	..	..
Syria	16,0 *	12,5 *	12,9	3,0	2,0	1,0	73	39	33	91,3	94,0	94,4
Tajikistan	..	..	..	..	..	32,5 **	..	83	76	..	..	..
Tanzania	23,8 *	28,9	30,6	23,0	30,0	40,0	202	167	143	77,7	75,0	72,0
Thailand	36,0	22,2	..	28,0	27,0	24,0	61	33	38	77,1	82,8	..
Togo	23,2 *	24,6	22,2	31,0	29,0	23,0	175	135	125	76,2	77,8	80,9
Trinidad & Tobago	10,0 *	6,7	..	5,0	12,0	11,0	40	21	17	93,8	93,2	..
Tunisia	14,8 *	10,3	9,0	2,0	1,0	1,0	102	36	33	91,0	95,1	95,6
Turkey	13,2 *	10,5 *	10,4	2,0	2,0	2,0	141	84	45	90,2	93,0	94,4
Turkmenistan	..	..	..	..	..	17,5 **	..	89	78	..	..	..
Uganda	24,8 *	23,0	25,5	31,0	23,0	28,0	181	185	137	75,5	78,6	77,8
Ukraine	..	..	..	..	..	6,6 **	..	25	24	..	..	..
United Arab Em.	..	..	..	1,0	2,0	1,0	64	21	10	..	..	..
United Kingdom	..	..	..	..	..	..	14	8	7	..	..	..
United States	..	..	..	..	..	..	15	10	8	..	..	..
Uruguay	6,5 *	7,4	4,4	3,0	7,0	4,0	42	21	21	95,5	94,6	96,5
Uzbekistan	..	..	18,8	..	..	14,5 **	..	66	60	..	..	87,1
Venezuela	10,2	5,1	5,1	4,0	11,0	15,0	42	24	25	93,9	93,9	92,5
Vietnam	53,1 *	41,9	39,8	33,0	28,0	19,0	105	48	43	68,4	75,7	79,5
Yemen	55,7	30,0	46,1	40,0	37,0	37,0	210	137	100	61,6	73,4	69,5
Yugoslavia	..	..	1,6	2,6 **	..	3,1 **	37	22	21	..	..	97,7
Zambia	19,3 *	25,2	23,5	30,0	39,0	45,0	160	203	202	78,3	72,0	70,6
Zimbabwe	23,5 *	12,0	15,5	30,0	40,0	39,0	125	83	80	78,2	80,1	79,4

1 in children under five (in%) 2 in the population (in%) 3 per 1000 live births * estimates reported in ACC/SCN 1993 ** own estimates x data refer to 1993

Data Sources: Underweight in Children, ACC/SCN 1993, WHO 1997; Undernourished, FAO 1999b; Under-5-Mortality Rate, UNICEF 1999

Table A-2: Correction Factors by Country and Region

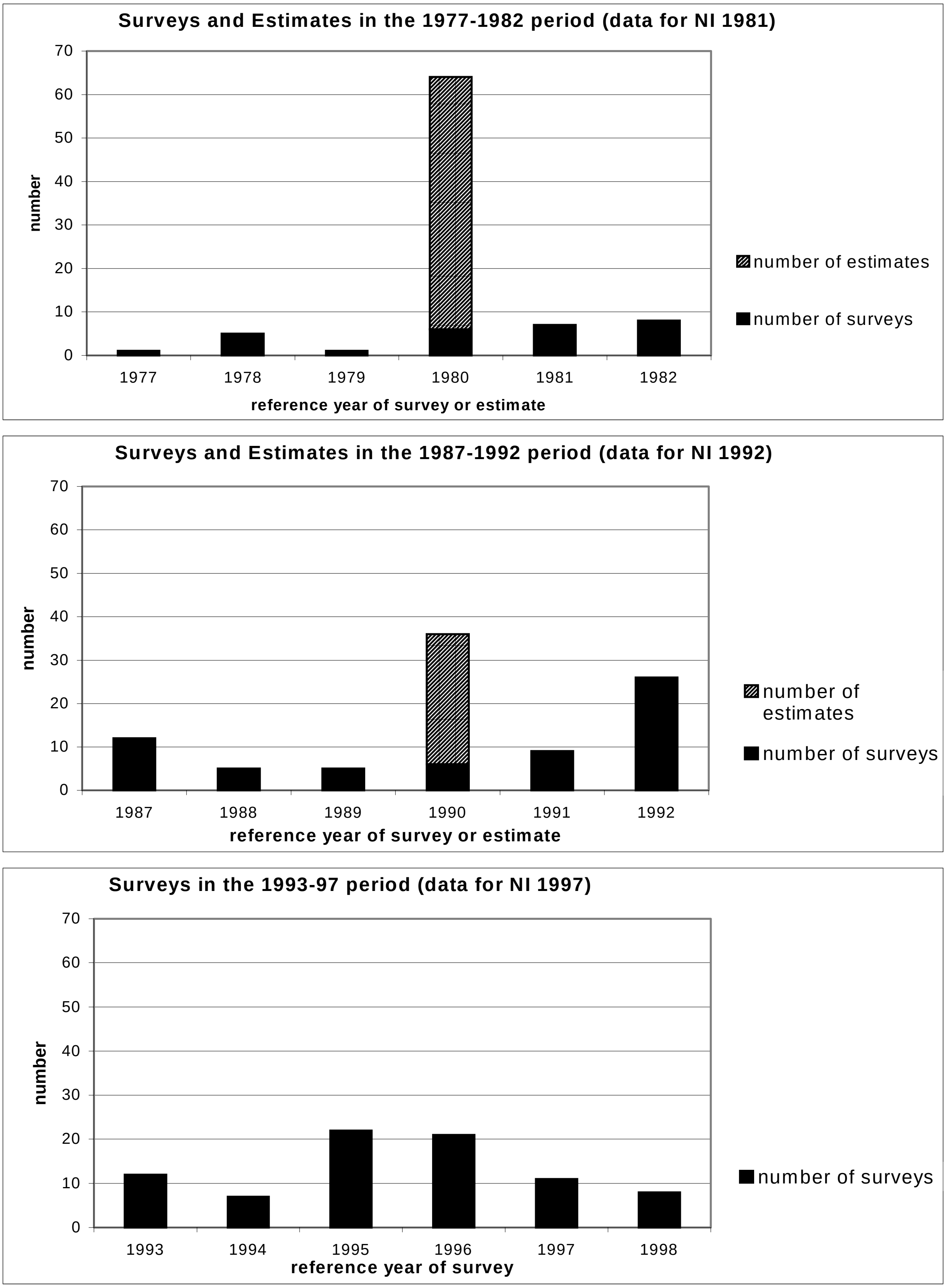
Region, Subregion, Country	Year of Survey	Correction Factors			
		0-<3/ 0-<5 years	0.5-<3/ 0-<5 years	0.5-<5/ 0-<5 years	0-<4/ 0-<5 years
North Africa and Middle East					
Near East					
Bahrain	1989	0.92	..	..	1.01
Iraq	1991	1.06	1.23	1.09	1.05
Syria	1993	0.98	1.06	1.04	1.01
Turkey	1993	0.95	1.13	1.11	0.96
Yemen	1979	0.98	1.05	1.05	0.99
North Africa					
Algeria	1995	1.15	1.18	1.00	1.04
Egypt	1992-93	1.25	1.42	1.07	1.10
Egypt	1995-96	1.20	1.40	1.09	1.12
Egypt	1997-98	1.16	1.33	1.08	1.11
Morocco	1987	1.09	1.26	1.09	1.04
Morocco	1992	1.07	1.21	1.06	1.04
Tunisia	1973-75	1.04	1.14	1.05	1.05
Means*		*1.05*	*1.16*	*1.06*	*1.03*
Standard Deviations*		*0.08*	*0.09*	*0.03*	*0.04*
Sub-Saharan Africa					
West Africa					
Burkina Faso	1992-93	1.08	1.32	1.13	1.02
Cote d'Ivoire	1986	1.12	..	..	1.08
Ghana	1987-88	0.95	..	..	1.01
Mauritania	1988	0.98	1.07	1.06	1.02
Niger	1992	1.02	1.25	1.14	1.03
Nigeria	1990	0.98	1.18	1.12	1.00
Senegal	1992-93	0.97	1.20	1.14	1.00
Sierra Leone	1989	1.05	1.26	1.12	1.03
Sierra Leone	1990	1.03	1.22	1.12	1.02
East Africa					
Kenya	1993	1.03	1.17	1.08	1.02
Rwanda	1992	0.89	1.04	1.09	0.96
Tanzania	1991-92	1.00	1.17	1.11	1.01
Tanzania	1996	1.04	1.20	1.10	1.03
Uganda	1988-89	1.01	1.19	1.11	1.00
Central Africa					
Cameroon	1991	1.08	1.26	1.10	1.04
Congo, Rep.	1987	0.96	1.14	1.11	0.98
Southern Africa					
Lesotho	1992	0.91	1.06	1.11	0.96
Madagascar	1992	0.95	1.14	1.13	0.99
Malawi	1992	1.01	1.24	1.13	1.03
Namibia	1992	0.99	1.19	1.13	0.99
South Africa	1986	1.10	..	..	1.06
Zambia	1992	1.04	1.24	1.12	1.03
Zambia	1996-97	1.08	1.26	1.10	1.04
Means*		*1*	*1.18*	*1.11*	*1.01*
Standard Deviations*		*0.06*	*0.07*	*0.03*	*0.02*

Table A-2 (continued): Correction Factors by Country and Region

Region, Subregion, Country	Year of Survey	Correction Factors			
		0-<3/ 0-<5 years	0.5-<3/ 0-<5 years	0.5-<5/ 0-<5 years	0-<4/ 0-<5 years
South, Southeast and East Asia					
South Asia					
Bangladesh	1996-97	0.93	1.06	1.08	0.97
India	1974-79	0.91	..	..	0.97
India	1991-92	0.94	1.03	1.05	0.98
Pakistan	1990-91	0.92	1.05	1.09	0.97
Southeast and East Asia					
Indonesia	1987	0.98	1.10	1.07	1.00
Indonesia	1995	0.92	1.04	1.07	0.99
Laos	1994	0.94	1.11	1.10	0.99
Mongolia	1997	0.84	1.06	1.17	1.04
Philippines	1989-90	0.98	1.10	1.07	0.98
Philippines	1993	0.93	1.10	1.11	1.00
Viet Nam	1983-84	0.95	..	..	0.99
Viet Nam	1998	0.89	0.99	1.07	0.96
Means*		*0.91*	*1.05*	*1.09*	*0.99*
Standard Deviations*		*0.04*	*0.04*	*0.04*	*0.03*
Latin America and Caribbean					
Central America and Caribbean					
Guatemala	1995	1.02	1.19	1.10	1.02
Haiti	1994-95	0.93	1.08	1.10	0.96
Honduras	1987	1.02	..	..	1.00
Honduras	1991-92	1.00	..	..	1.01
Mexico	1988	0.95	1.00	1.04	0.97
Nicaragua	1993	1.04	1.20	1.08	0.99
South America					
Colombia	1965-66	0.94	1.13	1.11	1.02
Colombia	1977-80	0.92	1.08	1.1	0.97
Colombia	1989	1.03	1.23	1.11	0.94
Colombia	1995	1.01	1.15	1.08	1.03
Guyana	1981	0.97	..	..	0.98
Guyana	1993	1.04	1.14	1.05	0.96
Peru	1991-92	1.05	1.23	1.09	0.98
Peru	1996	1.11	1.27	1.08	1.05
Means*		*1.01*	*1.15*	*1.08*	*1.00*
Standard Deviations*		*0.06*	*0.09*	*0.02*	*0.03*
All Regions					
Means*		*1.00*	*1.15*	*1.09*	*1.01*
Standard Deviations*		*0.07*	*0.09*	*0.03*	*0.03*

* Means and Standard Deviations for regions were calculated from the most recent correction factors of each listed country (including only countries for which all four correction factors could be computed)

Figure A-1: Distribution of Surveys and Estimates in NI Reference Periods



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