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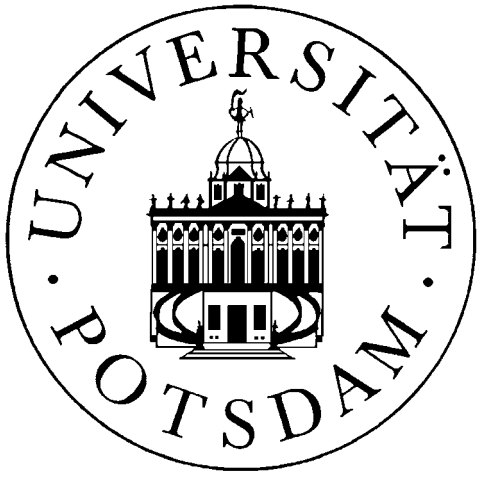
Food Deficits, Food Security and Food Aid: Concepts and Measurement

by

Silke Gabbert

and

Hans-Peter Weikard



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Food Deficits, Food Security and Food Aid: Concepts and Measurement

by

Silke Gabbert[*] and *Hans-Peter Weikard*[**]

Abstract: The concepts of food deficit, hunger, undernourishment and food security are discussed. Axioms and indices for the assessment of nutrition of individuals and groups are suggested. Furthermore a measure for food aid donor performance is developed and applied to a sample of bilateral and multilateral donors providing food aid for African countries.

Journal of Economic Literature Classification: I32

1 Introduction

Today, more than 800 million people do not have enough food to meet their basic nutritional needs. Most of them live in regions which can be characterised by low economic returns to agriculture and high transaction costs due to deficient infrastructure and inefficient markets. These regions are typically found in developing countries, especially in so-called low-income, food-deficit countries (LIFDCs). Although food production in developing countries has steadily increased during the past twenty years, this was not sufficient to keep pace with population growth. As a consequence, net food imports of developing countries are still increasing as well. It is often stated by scientists that even with an ongoing population growth enough food can be produced world-wide to guarantee all human beings an adequate diet (Uvin 1993, 1). But as long as constraints on access to food persist and developing countries are not able to purchase enough food on commercial markets, hunger will remain to be a problem of global dimension. This was underlined by the "Rome Declaration on World Food Security and World Food Summit Plan of Action". The Heads of State and Government stressed the necessity of "urgent, determined and concerted action" in order to reach food

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security. The efforts of the international community consist of a wide range of instruments, including financial and technical assistance as well as food aid.

It is hardly necessary to point out the importance of policies which tackle hunger. But it must be stressed that these policies need to be effective in the sense that they relate to and achieve the underlying objectives (Clay et al. 1996, 5). Therefore a critical examination of food policies is necessary. Here we do not want to enter the development policy debate about the short and long term effects of policies that have been suggested to improve the situation in LIFDCs. Many studies have taken up this issue, e.g. Maxwell and Singer (1981), Hay and Clay (1986), Stewart (1988), Fitzpatrick and Storey (1989), Isenman and Singer (1993). Instead, we focus on the criteria on which any analysis of food policies must be based. Our basic assumption is that policies should be needs-oriented. If, for example, food aid is regarded to be an adequate tool to tackle the problem of hunger, supplies should be directed towards the neediest individuals, regions or countries. The purpose of this paper is to develop analytical tools to assess whether food policies respond to needs.

There is a broad range of different food policies. These include policies which focus on directly food-related income transfers (targeted feeding programs, food stamps, food subsidies, food storage strategies) as well as policies which tackle hunger and food insecurity more indirectly (production-oriented policies, labour-intensive public work programmes, credits) (von Braun et al. 1992, 2). A food policy that has been discussed very controversially during recent years is food aid. In particular, one of the most insisting critiques relies on the insufficient targeting of the transfers towards recipient countries' needs. There is no doubt that in addition to humanitarian objectives a wide range of political and strategic interests influence the distribution of food aid (Shapouri et al. 1986, 51ff; Hopkins 1987, 153ff; Hanrahan 1988, 16ff; Shapouri and Missiaen 1990; Clay and Stokke 1995, 2). Despite this knowledge nothing is known about the extent to which different donors allocate their transfers towards the needs. We shall try to fill this gap.

Strictly speaking, an assessment of food policies would require a comparative model which captures all variables influencing a recipient country's food situation with and without the policy under review. However, it is beyond the scope of this paper to develop such a model. Instead we focus on the normative side of the issue. The aim of this paper is to develop a performance index in order to rank different donor countries' food aid programmes. The index captures some normative ideas about how food aid should be allocated. For this purpose we have to identify each recipient country's state of food security.

The plan of the paper is as follows: In section 2 some key concepts like food security and food aid effectiveness are discussed. These concepts are formally defined in section 3. This section also develops a measure to assess food aid policies. Since the measurement of food security has a close analogy with poverty measurement, we draw heavily on the literature in

this field. We examine whether or not the axioms suggested for poverty measures can be applied to the problem of measuring food security.
An empirical examination of food aid policy performance is presented in section 4 for a sample of African countries. Section 5 concludes with a brief discussion of some remaining problems.

2 Some key concepts

2.1 Hunger and Food Security

The concept of hunger is often not clearly distinguished from the concepts of food insecurity, malnutrition and undernutrition. As regards content, "hunger" is a very common and broadly descriptive term and therefore most difficult to define specifically. Millman and Chen (1991, 1) define hunger as "a dietary intake inadequate to sustain good health, normal growth and development, and a level of physical activity appropriate to an individual's occupation and lifestyle". Food security, however, prevails "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (World Food Summit 1996, §1).[1] This clarifies that food security goes beyond the hunger concept by including the risk and time dimension. Food security, therefore, is a multi-dimensional concept, addressing the three aspects (i) sufficiency and access, (ii) time, and (iii) security.

"Sufficiency and access" refer to the minimum necessary food intake of a person or a population group, usually expressed in calories per capita and day. Therefore, the amount of food each person would need (but actually does not have access to) to sustain good health, normal growth and development is identical with her individual food deficit. People who face food deficits are said to be undernourished, if their "physical functioning (...) is impaired to the point where they cannot maintain an adequate level of performance at physical work, or at resisting or recovering from the effects of (...) diseases. It is also a state in which individuals are unable to maintain an adequate rate of growth (...)" (Dasgupta 1993, 412).[2] But, as Sen (1990, 34ff) has pointed out, the supply of sufficient amounts of food is not enough to ensure adequate nutrition. In addition, individuals must be able to acquire the food they need. Following Sen's entitlement-approach, hunger is caused if the commodity bundles (entitlements) people are able to acquire do not contain enough food.

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[1] An excellent review about the change of food security definitions from 1975-1991 is given in Maxwell and Frankenberger (1992, 68ff).

[2] Malnutrition refers to any disorder of nutrition and includes excess of food intake (overnutrition) just as undernutrition or an unbalanced diet; cf. Foster (1992, 13) and Latham (1997, 8).

Furthermore, the access to sufficient food has to be secure in the sense that the various risks which cause lack of availability and access are minimised. These risks include variability in crop production and food supply, market and price variability, risks in employment and wages, risks in health and morbidity, and risks of man-made conflicts. Finally, the threat of food insecurity to human lives depends to a large extent on the time span during which individuals or groups are unable to meet their food needs (Maxwell and Frankenberger 1992, 48).

2.2 Food Aid

Food aid is a form of foreign economic assistance. It is defined as the food received by a country on grant or concessional terms[3] for purposes of meeting its food needs (Shapouri et al. 1986, 6). However, it should be stressed that food aid does not only include physical transfers of food commodities from a donor to a recipient country. Monetary grants tied to purchases of food as well as sales and loans on soft credit terms also fall under the definition of food aid presented above (Shaw and Clay 1993, 1). Therefore, a precise distinction between food aid and financial assistance is sometimes hardly possible. The largest proportion of food aid is provided on a government to government basis (bilateral food aid), but during the last decade an increasing amount is channelled through multilateral organisations, with the World Food Programme of United Nations (WFP) being the largest multilateral donor. Non-governmental organisations (NGO's), for example the International Red Cross, are also of increasing significance.[4]

Food aid is provided for a variety of different purposes. Therefore, it seems reasonable to group it under certain categories. Usually, the transfers are classified as programme, project or emergency food aid. Programme food aid, donated exclusively through bilateral donors, serves as an un-targeted, indirect form of financial assistance. It is supplied as a grant or on concessional terms and usually sold on recipient countries' local markets.[5] By replacing commercial imports in recipient countries, foreign exchange is saved which implicitly leads to balance of payment support.

Project food aid, on the other side, is always an integral part of specific development projects (e.g. food-for-work projects, food aid for mothers and pre-school children, community development and self-help projects, public health programmes). Provided on a grant basis,

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[3] "Concessional terms" relate to price or to other conditions of sale or payment more favourable than those obtainable in the open market (FAO 1992, vi).

[4] The proportion of bilateral food aid has fallen from 63 per cent in 1991 to 50 per cent in 1995. During the same period, multilateral food aid has increased from 23 per cent to 30 percent; deliveries from NGO’s have increased from 14 to 20 per cent (WFP 1995b, 51).

[5] By „monetisation“ of programme food aid counterpart funds can be generated which are used for specific development activities (WFP 1995a, 5).

project food aid can be interpreted as an income transfer to the poor and needy people usually living in rural areas. The main objective of this kind of food aid is to enable those people to meet their basic nutritional needs and to eliminate their food deficit.

Emergency food aid is provided as free distributions in cases of natural or man-made disasters (civil wars, droughts, famines, disease attacks). It serves as a "response to urgent situations created by an event which the affected people and their governments lack the means to remedy" (Clay and Singer 1985, 62 f). The underlying objective of emergency food aid is to save human lives through the supply of additional food resources. Additionally, it is used for disaster mitigation and for disaster rehabilitation (Hannusch 1997, 5).

With respect to these explanations, the concept of effectiveness, which is the essential criterion for food policy assessment, can be applied to food aid. Food aid policies are assumed to be effective, if they contribute as far as possible to secure and durable access to sufficient food. The effectiveness of food aid policies can therefore be defined as the extent to which they improve food security. Thus, the role of food aid goes beyond the pure elimination of food deficits. It must also ensure the stability of food supply over time and help to improve access of the hungry to the food needed.[6] This must hold not only on the national and the household level, but also on the level of individuals.

3 Axioms for the assessment of food policies

We define food policy performance as the extent to which a policy measure improves food security of recipients. A performance measure has to address the three dimensions of food security (access, time, and risk). In order to determine a performance measure we need to develop a quantifiable concept of food security. We proceed systematically and start with the development of a food deficit measure, which captures the lack of access to sufficient nutrition. The second step is to include the time dimension. Finally, risk is introduced.

In the following it will become clear that the problem of measuring food security has a close analogy with poverty measurement. So, we can draw on results of the axiomatic approach to poverty measurement pioneered by Sen (1976).[7] We initially define some theoretical requirements (axioms) for the measures we are trying to develop and then show that the suggested measures satisfy the axioms.

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[6] Of course, the three food aid categories do not support these aims in the same way. According to their different design they make specific contributions to food security. The relative advantages of each food aid category in promoting food security is not discussed in this paper.

[7] Cf. Seidl (1988) for an extensive survey.

3.1 Food deficit

To begin with we introduce some notation. Let a society *I* consist of *n* individuals. Typical individuals are denoted *i, j, k*. Individual *i*'s food consumption is y_i. We consider an ordered distribution of food consumption $y = (y_1, \ldots, y_i, y_j, \ldots, y_n); y_i \leq y_j$. Furthermore, there exists a minimum need of food to maintain body weight and health, which we call the food deficit line δ. Here we assume for simplicity that δ is the same for every member of society.[8] Individual *i* is said to suffer from a food deficit, if and only if $y_i < \delta$. The set of individuals who suffer a food deficit is given by $S(y) = \{i \mid y_i < \delta\}$. Finally, $D(y) \in [0,1]$ is a normalised food deficit index for distribution *y* which should satisfy the following axioms.

A (*Anonymity Axiom*): The food deficit measure remains unchanged if the same food consumption bundles are allocated to the individuals in society *I* in different ways.

I (*Indicator Axiom*): The food deficit measure must have a positive value if and only if some individual suffers a food deficit.

$$S(y) \neq \varnothing \Leftrightarrow D(y) > 0.$$

F (*Focus Axiom*): An increase in food consumption or a redistribution of food which concerns only persons living above the food deficit line must leave the food deficit measure unchanged. This rules out that a fall in the food consumption of those with deficient access to food may be compensated by any rise in the food consumption of others who do not suffer from a deficit (cf. Sen 1981, 186).

Let *y* and *x* denote two distributions of food consumption such that $S(y)=S(x)$ and $y_i=x_i$ for all $i \in S(y)$. Then $D(y)=D(x)$.

M (*Monotonicity Axiom*): If the food consumption of someone suffering from a food deficit increases, the food deficit measure must decrease.[9]

Let *y* and *x* denote two food consumption distributions such that $y_i = x_i$ for all $i \in I - \{j\}$ and $y_j > x_j$ and $j \in S(x)$. Then $D(y) < D(x)$.

Define the food deficit of individual *i* as

$$d_i = \begin{cases} \delta - y_i & \text{for } y_i < \delta \\ 0 & \text{for } y_i \geq \delta \end{cases}. \qquad (1)$$

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[8] In fact, the minimum dietary requirements inside a given society are not the same for all members. They vary according to people's membership to different age-sex groups and to different levels of physical activity. However, we follow the approach of FAO (1996, 115ff) and assume that for each age-sex group a range of acceptable energy intakes can be identified. The lower end of this range determines the minimum value of energy requirements necessary for an active and healthy life. If for each group the number of people falling below this range is known, the aggregate minimum dietary requirement of the whole society can be calculated as the weighted average of the age-sex specific minimum requirements (FAO 1996, 37 and 131).

[9] Notice that in this version of the monotonicity axiom the hungry person *j* may or may not cross the food deficit line δ.

d_i is the gap between the minimum dietary requirement δ and the actual food consumption y_i. It is the amount of food measured in units of calories needed to feed an individual with deficient food consumption.

We consider the following food deficit index:

$$D = \frac{1}{C(S)\delta}\sum_{i \in S} d_i \,, \tag{2}$$

where $C(S)$ is the cardinality of set S, i.e. the number of individuals suffering a food deficit.[10]

Proposition 1: D is a normalised food deficit index satisfying axioms **A**, **I**, **F** and **M**.

Proof: By definition (1) $0 \leq \frac{d_i}{\delta} \leq 1$. Therefore, $D \in [0,1]$ is normalised. **A** is satisfied because D does not refer to individuals' characteristics. From definition (1) it also follows that Axioms **I** and **F** are satisfied. To see that Axiom **M** is satisfied, consider two food consumption distributions x, y such that $y_i = x_i$ for all $i \in I - \{j\}$ and $y_j > x_j$ and $j \in S(x)$. By (1) d_j is greater under x than under y. Thus $D(x) > D(y)$.

3.2 Hunger

A food deficit measure like D has several shortcomings. First, D implicitly assumes a person's severity of suffering to be linear in d_i. Furthermore, the time and risk dimension are not yet included. Consequently, the next step will be to include time explicitly in the considerations and to develop an index which serves as a valuation of hunger.

Hunger means pain and suffering, but, in addition, hunger means a risk to life. The probability to be infected by diseases, for example diarrhoea, increases with the decrease of adequate food consumption. If hunger persists, also the duration of infections is increased. In addition a weakened immune system lowers metabolic rates (Foster 1992, 199). We therefore suggest to value situations with food deficits by their effects on mortality. Our considerations are confined to mortality caused by undernourishment. We neglect all other risks to life and assume that the survival probability π of a well-nourished person is 1. For the reasons just mentioned an individual i's life is at risk ($\pi_i < 1$), if i is suffering from a food deficit $d_i > 0$. We assume that π_i is decreasing in d_i and decreasing in the length of time i suffers from a food deficit. Survival probability can be interpreted as a health status. We introduce the time dimension by assuming that the health status of individual i on a particular day t depends on the food-consumption at t and health status at t-1. Formally,

$$\pi_{i,t} = \pi_{i,t}(\pi_{i,t-1}, d_i). \tag{3}$$

[10] Note that D is formally equivalent with the income gap ratio in the analysis of poverty.

This allows to capture the cumulative effects on health, if undernourishment prevails over time.[11]

We now construct an index for the evaluation of food deficits. An index *H* (for hunger) applied to two situations *y*, *x* should indicate which of the two situations is worse than the other. We use the health status of the individuals in society *I* as the criterion for evaluation. The evaluation of the nutritional gap should reflect how the food deficit affects a person's survival probability.

First, we consider two axioms taken from the literature on poverty measurement.

T (*Transfer Axiom*): Let *y* and *x* denote two distributions of food consumption such that $y_i = x_i$ for all $i \in I - \{j,k\}$, and $y_j > x_j \geq x_k > y_k$, $y_j - x_j = x_k - y_k$ for $k \in S(y)$. Then $H(y) > H(x)$.

In contrast to the monotonicity axiom the transfer axiom refers to situations in which a redistribution of food among the members of the society occurs. A transfer of food from person *j* who is better off to person *k* who is worse off (progressive transfer) must decrease *H*. A redistribution of food from a hungry person to a better-off person (regressive transfer) increases the suffering whether or not the recipient is below the food deficit line.[12] The case where a hungry person receives a food transfer and is lifted above the survival line by this transfer is not ruled out.

S (*Sensitivity Axiom*): Let $(\Delta H)_i$ denote the decrease in *H* due to a small increase ε in the food consumption of individual *i*. Then $(\Delta H)_i > (\Delta H)_j$, if and only if $\delta > y_j > y_i$.

The sensitivity axiom requires that the improvement of food consumption of the worse-off individual is more important. *H* should be sensitive towards greater needs.

Axioms of type **T** and **S** are well accepted in the context of poverty measurement. But should we accept them for the evaluation of hunger? **S** and **T** are debatable because they can be incompatible with the following requirement.

SP (*Survival probability axiom*): For individuals below the food deficit line $i \in S$ a small increase in food consumption ε affects survival probabilities. Suppose $\pi_i = \pi_i(y_i)$ and $d\pi_i / dy_i > 0$. Then $(\Delta H)_i > (\Delta H)_j$, if and only if
$\pi_i(y_i + \varepsilon) - \pi_i(y_i) > \pi_j(y_j + \varepsilon) - \pi_j(y_j)$.

[11] Quite similarly, Ravallion (1987, 24 ff) considers health production functions.

[12] To be precise, it is important to note that there exist four versions of the transfer axiom (Seidl 1988, 93f), which differ with respect to the persons involved and whether or not persons are allowed to cross the survival line. Here we present the most common version of transfer axioms, which is commonly known as "strong downward transfer axiom" (Seidl 1988, 94).

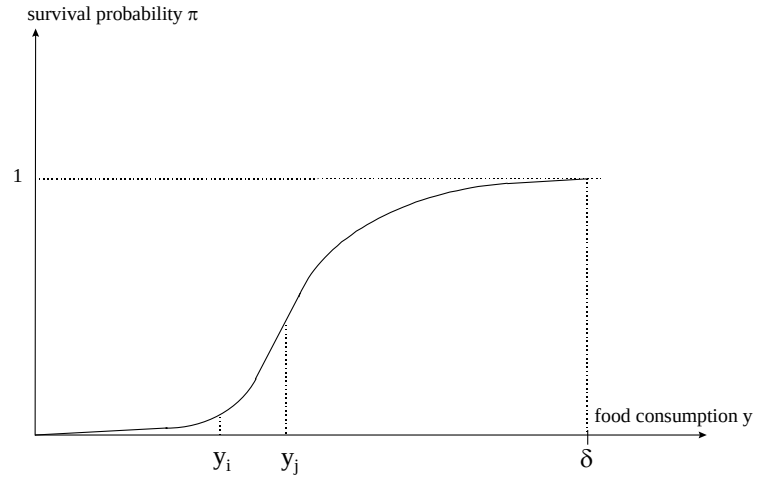
According to **SP** the health status (survival probability) is the most important criterion. If we accept **SP**, then **S** and **T** can only be satisfied under certain restrictive conditions which are stated in the following proposition.

Proposition 2: **SP** is compatible with **S** and **T**, if and only if $\pi_i(y_i)$ is a concave function, i.e. $d\pi_i / dy_i > 0$ and $d^2\pi_i / dy_i^2 < 0$.

Proof: If π is concave a small amount of food will have a greater impact on the survival probabilities of those who suffer from a greater food deficit d_i. Therefore **S** is satisfied. A progressive transfer will also enhance aggregate survival probabilities. Therefore, with π being concave, **T** will be satisfied. Suppose π is not concave. In this case there will be a range where a progressive transfer will not enhance (or even decrease) the aggregate survival probability. Therefore, in this case the measure violates either **SP** or **T** and **S**.

Whether or not $\pi_i(y_i)$ is indeed a concave function is, however, an empirical question. **SP** requires that an additional small amount of food should be given to the person whose survival probability is affected most strongly. This person need not be the one who suffers most from undernourishment, i. e. the person with the worst health status. For very low levels of food consumption the health status may be so bad that an improvement in food consumption has only a small effect on survival probability. A stylised survival function is given in figure 1.

Figure 1: Survival probability function



Consider two individuals with food consumption y_i and y_j. If the situation is evaluated by a measure satisfying **SP,** an additional unit of food should be allocated to person *j* who is better off. This would improve the situation more than giving food to *i*. Such a measure violates axiom **S** which is stated in proposition 2. Clearly, it would be possible to construct an alternative index satisfying **S** and **T**.

First, consider an index H_1 which is based on a subjective concept like "suffering" instead of survival probabilities. Let $\sigma_i(d_i) \in [0,1]$ denote the suffering caused by a food deficit d_i, with $\mathrm{d}\sigma_i / \mathrm{d}d_i > 0$ and $\mathrm{d}^2\sigma_i / \mathrm{d}d_i^2 > 0$. Then

$$H_1 = \frac{1}{C(S)} \sum_{i \in S} \sigma_i(d_i),$$

is a measure to capture the suffering of the undernourished.

Proposition 3: H_1 satisfies axioms **I**, **A**, **F**, **M, S** and **T**.

Proof: It is obvious that H satisfies **I**, **A** and **F**. **M** is satisfied because σ_i is increasing in d_i. **S** and **T** are satisfied because σ attaches increasingly greater weight to larger food deficits.

To satisfy axiom **SP** we have to capture the impact of nutrition on the survival probabilities. We therefore propose the following measure:

$$H_2 = \frac{1}{C(S)} \sum_{i \in S} (1 - \pi_i(y_i)).$$

H_2 measures the aggregate survival probability gap.

Proposition 4: If π is increasing in y_i, H satisfies axioms **I**, **A**, **F**, **M** and **SP**.

Proof: It is obvious that H satisfies **I**, **A** and **F**. **M** is satisfied, because π is increasing in y_i. **SP** is satisfied because the measure is sensitive with regard to effects on survival probabilities, i.e. $-dH / dy_i = d\pi_i(y_i) / dy_i$.

3.3 Food security

Our next step is to include the risk dimension. Even if an individual does not actually suffer from undernourishment, access to food may not be secured at all times. There are basically two types of risks. Firstly, the individual faces a risk to become ill, disabled or unemployed. Secondly, the price for food may rise. In both cases some individuals cannot earn enough to feed themselves. Both types of risk can be captured in the following way. We take the food consumption as the numeraire good. Then the food consumption bundle which is sufficient to survive costs δ. Suppose for simplicity that there are no other subsistence costs.[13] Individuals with wage $w<\delta$ will spend their entire budget on food. Thus,

$$w_j = y_j \text{ for all } j \in \left\{ i \mid w_i < \delta \right\}. \qquad (4)$$

If for all individuals $i \in I$ the wage $w_i \geq \delta$ with probability 1, society would be in a state of perfect food security. A measure which captures the state of food security of society I must be

[13] In an empirical application the share of income the household can spend on food – i. e. the relevant Engel curve – must be considered; cf. Bigman (1993, 240).

based on the risks faced by individual members. Let f_i be the density of the probability distribution of w_i. Then the expected food deficit of individual i is given by

$$\hat{d}_i = \int d_i f_i \ \mathrm{d}w_i .$$

Note that by (1) and (4) $d_i=d_i(w_i)$.

As discussed before we take a person's health status π_i to be a function of her food consumption in earlier periods. Therefore, the expected health status of person i at time t, denoted $\hat{\pi}_{i,t}$, can be given by the following recursive expression:

$$\hat{\pi}_{i,t} = \hat{\pi}_{i,t}(\hat{d}_{i,t}, \hat{\pi}_{i,t-1}) . \qquad (5)$$

Given (5) an index to describe the state of food (in)security of society I can be constructed:

$$F = \frac{1}{C(S)} \sum_{i \in S} (1 - \hat{\pi}_i) .$$

F is an indicator of the expected survival probability gap.

Proposition 5: F satisfies Axioms **A**, **I**, **F**, **M** and **SP**, if these are suitably redefined for the case of uncertainty.

Proof: The proof is analogue to the proof of proposition 4.

3.4 Donor performance

Finally, we consider two measures for the performance of food policies. A policy is effective if it improves the situation of those suffering a food deficit. In order to measure the effectiveness of a policy, one must compare a food security index for a situation with and without the policy implemented. However, the necessary data for such an assessment will hardly be available. Therefore, in the following we only consider the effectiveness of food aid rather than food policies in general.

Our first performance measure P_1 attaches higher weight to donations received by the neediest person. This feature is captured by axiom

N (Needs orientation): A donation schedule which favours the needy has a better performance.

The suggested performance measure is a weighted sum of donations where the recipient's state of food security is used as a weight. The performance index is given by

$$P_1 = \frac{\sum_{i \in I} (1 - \hat{\pi}_i)\ \mathrm{aid}_i}{\sum_{i \in I} \mathrm{aid}_i},$$

where aid_i is the aid given to individual *i*.

Proposition 6: P_1 satisfies **N**.

Proof: By construction of the measure P_1, if the survival probability of some person *i* is lower than *j*'s survival probability, aid given to person *i* has a higher weight.

For practical purposes the performance index P_1 can also be applied to groups of individuals receiving aid. Let $\varphi = (1,2,\ldots,m,\ldots,M)$ be a partition of the population *I* such that every individual belongs to one and only one group *m*. P_1 can be refined as follows:

$$P_1' = \frac{\sum_{m \in \varphi} F_m\, \mathrm{aid}_m}{\sum_{m \in \varphi} \mathrm{aid}_m}.$$

However, P_1' works properly as a performance measure only for small donations of aid which do not alter the needs as captured by *F*.

An alternative measure P_2 may aim at providing maximum food security or minimising deaths caused by hunger. This is stated by the following axiom.

E (*Effectiveness*): Food aid is most effective if it maximises food-security, i.e. it minimises expected losses of life due to insufficient access to adequate food.

A measure to assess the effectiveness of donations is

$$P_2 = F_{\mathrm{aid}} - F_{\mathrm{initial}},$$

which simply measures the difference between the state of food security after the donation F_{aid} and the initial state of food security F_{initial}.

We want to emphasise that both performance measures are not suitable for any judgement about the moral worth of a donor. They do not capture whether or not a donor provides a sufficient or fair share to feed the hungry.

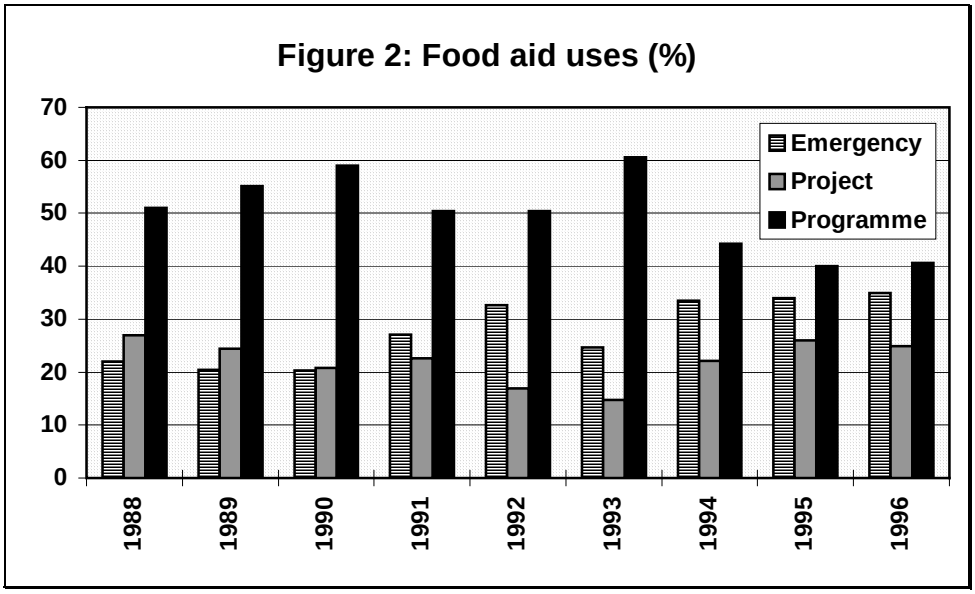
In the next section we apply an index of type P_1 to assess the effectiveness of bilateral and multilateral food aid donations.

4 Donor performance of food aid in Africa: Some empirical results

4.1 Data sources

The performance index P_1' is a measure for assessing cross-country effectiveness of food aid. It does not provide any information on the effectiveness of food aid inside a recipient country and, therefore, implicitly assumes perfect targeting of food aid donations. Although this is not always correct in reality, this assumption is both suitable and necessary here. Our intent is to find out to what extent donors have taken recipient's food needs into account when they allocate food aid among different countries. We consider for all other influences on the effectiveness (e.g. implementation mode of food aid projects, composition of the food-basket, punctuality of provision) the best possible case.

The performance index is calculated for the five most important donors, namely the USA, the European Union, Canada, Japan and the World Food Programme (WFP) of the United Nations. Together these donors provide more than 90 per cent of total food aid. WFP is included into the selection of donors in order to compare multilateral versus bilateral donors. The proportion of food aid delivered through multilateral organisations has increased steadily since 1985 (FAO 1995, 25) and is now at about 30 per cent of which WFP represents more than 95 per cent (WFP 1995b, 51).



Source: Own calculations; WFP/INTERFAIS (1996).

As we have explained in section 2, food aid is provided for different purposes and is, therefore, categorised into programme-, project- and emergency food aid. The share of each

category is presented in figure 1. The largest proportion of total food aid is provided for programme aid. Nevertheless, there has been a substantial decrease of this type of aid, whereas the amount of food aid for emergencies has increased significantly[14]. This trend can be explained by a global decline in food aid availability in absolute terms[15], which is accompanied by an increasing number of people suffering from emergencies such as natural and man-made disasters (WFP 1994, 9). This has led to a shift in food aid priorities from development to relief operations. Although the absolute amount of project food aid was also decreasing during the last decade, its share has remained relatively stable.

We measure donor performance separately for programme, project and emergency food aid. This requires data on the quantity of food aid classified by type of aid, donor country, and recipient country. Unfortunately, data of this kind are not available for the whole sample of recipient and donor countries. Thus, our empirical results are confined to African recipient countries consisting of the regions Sub-Sahara- and North Africa. With these two regions only a part of recipient countries is included into the assessment of donor effectiveness. Nevertheless, the African countries can be considered to be the most important sample. Firstly, Sub-Sahara Africa is the region with the highest rate of people without access to sufficient food. While this rate declined on average in developing countries from 35 to 20 per cent between 1970 and 1990, in Sub-Sahara Africa the rate increased from 38 to 43 per cent. North Africa, however, has a lower rate of people with inadequate access to food (about 12 per cent since 1980), although the absolute number of undernourished individuals has increased from 27 million (1979-81) to 37 million (1990-92) (FAO 1996, 45). Secondly, as it is shown in the following table, Africa has obtained the largest part of total cereal food aid deliveries.

Proportion of cereal food aid deliveries (in per cent, 1988-1995)

	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Sub-Sahara Africa	31,4	24,0	23,3	30,1	40,9	28,3	35,3	32,9
North Africa	16,2	18,6	17,5	18,5	6,4	2,9	3,8	2,6
Near East	2,2	6,0	5,1	6,0	4,8	3,7	4,0	5,0
South/East Asia	33,2	28,6	20,4	23,9	18,2	12,9	21,3	26,2
Latin America/Caribbean	17,1	17,4	16,8	15,0	11,7	12,2	11,6	9,2
Europe and NIS	0,0	5,7	16,9	6,4	18,4	41,4	24,0	24,0

Source: WFP (1996) 44-46.

For an empirical examination of donor performance data on recipient countries' state of food security are required. Again, data availability does not allow for a direct calculation of the performance index developed above. The food security measure which indicates the need of

[14] In the late-1970s and early-1980s, the proportion of emergency food aid was only about 13 per cent. Since the beginning of this decade, it has grown to over 30 per cent (Konandreas 1997, 5).

[15] This growing scarcity of food aid resources is due to increasing world market prices causing opportunity costs of food aid within donor countries to rise (Konandreas 1997, 9).

food aid for each recipient country requires information about survival probabilities and food intake of people below the food deficit line. Furthermore, cumulative effects of persistent hunger must be known. Since such information is presently not available we have to rely on suitable proxies. To our knowledge there exist only two relevant data sources. These are the Food Security Index (*FSI*) developed by the International Fund of Agricultural Development (Jazairi et al. 1992, 458) and the Aggregate Household Food Security Index (*AHFSI*) of FAO (FAO 1997). The *FSI* has been calculated for one year (1992) only, whereas the *AHFSI* is available for several years. Therefore the *AHFSI* is the only possible proxy for our purpose. It is defined as follows:

$$AHFSI = 1 - [H(D + (1 - D)I^P) + 0.5\,\sigma\,\{1 - H(D + (1 - D)I^P)\}]$$

where

H is the head count ratio $C(S)/I$, measuring the proportion of undernourished in the total population;

D is the food gap ratio, as defined by (2) above, measuring the proportion shortfall of the average daily dietary energy intake of the undernourished from average national nutritional requirements;

I^P is the Gini coefficient of food consumption of the undernourished. It measures the inequality of the distribution of food gaps;

σ is the coefficient of variation in dietary energy supplies.

AHFSI lies in the closed interval [0, 1]. If a country is in a state of total famine, *AHFSI*=0; if a country is in the state of complete food security, *AHFSI*=1. Formally, *AHFSI* is an extension of Sen's poverty index (Sen 1976). All variables are based on estimated distribution functions of food consumption in developing countries.[16] It should be noticed that for calculating *D* the average food consumption of the undernourished is compared to the *average* instead of the *minimum* national nutritional requirement. Therefore, *ceteris paribus*, *D* as used in the calculation of *AHFSI* has a greater value than an ideal measure *D*. The measure I^P shows the extent of relative food deprivation within the group of undernourished people. Because the variables *H*, *D* and I^P refer to an average year and are based on the average food consumption of an individual, the term $H(D + (1 - D)I^P)$ –which is the formal analogue to Sen's poverty index– indicates chronic food insecurity. Following Bigman (1993, 242) this measure alone would underestimate the impact of food insecurity. Variations of food consumption over time

[16] It is pointed out in „The Sixth World Food Survey“ (FAO 1996, 33; 41; 128) that an accurate description of the distribution of food consumption within a society would require data from national sample surveys (household food consumption surveys). Unfortunately, these surveys exist only for very few developing countries. For other developing countries the distribution of food intake is estimated from data referring to the distribution of per capita household income or expenditures. If these data are also missing, the assumed distribution of food consumption is taken from neighbouring countries with a similar socio-economic situation.

due to variations in food production, food prices or income levels are not taken into account.[17] The aspect of food insecurity (which we call the risk dimension) is recorded by the term $0.5\,\sigma\,\{1 - H(D + (1 - D)I^P)\}$. σ expresses the instability in dietary energy availability within a country and therefore values the risk caused by temporary annual shortfalls in dietary energy supplies (FAO 1994, 19). From a conceptual point of view the *AHFSI* addresses two of the three dimensions of food security (sufficiency and access; security). The time dimension, however, is not included.

If we insert the *AHFSI* for F_m into the performance measure P_1', we have to check which of the axioms proposed in section 3 will be satisfied.

Proposition 7: *AHFSI* satisfies **A**, **I**, **F**.

Proof: The *AHFSI* can be written in the following way:

$$AHFSI = 1 - [P^S + 0.5\,\sigma\,(1 - P^S)]$$

where $P^S = H\,(D + (1 - D)I^P)$ is Sen's index.

From the literature on poverty measurement it is well-known that P^S satisfies axioms **A**, **I**, and **F**. Furthermore P^S satisfies a weak monotonicity condition and a weak transfer axiom where individuals are not allowed to cross the poverty line, i.e. the numbers of poor and rich people remain constant (Seidl 1988, 109 f).

Clearly, since P^S satisfies **A**, **I**, and **F**, *AHFSI* will also satisfy these axioms.

Unfortunately, *AHFSI* does not satisfy axioms **M**, **T** and **S** for sufficiently large σ. However, our empirical calculations will nevertheless be based on *AHFSI* since it is the only measure of food security for which a sufficiently large data set is available.

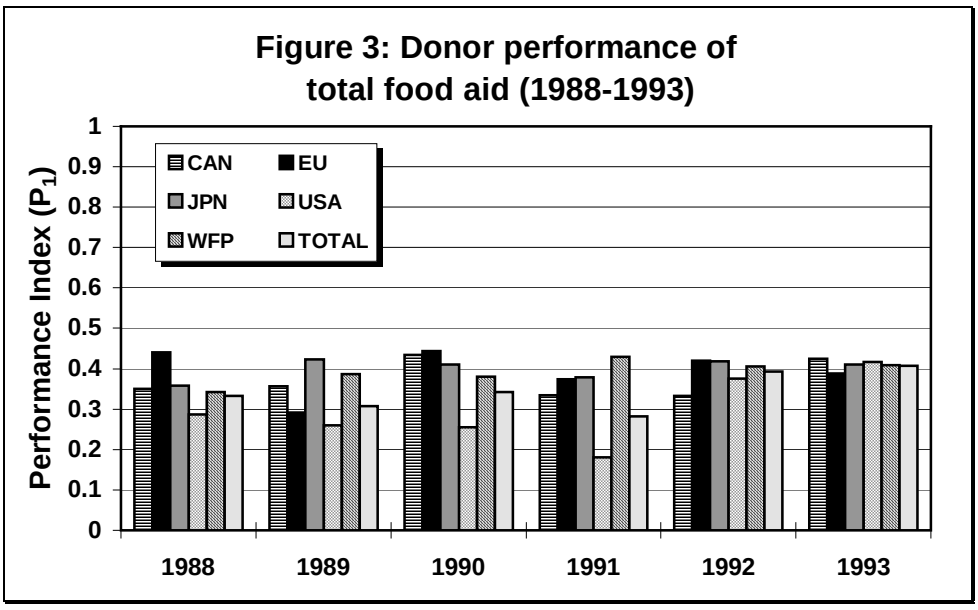
4.2 Empirical results

The calculation of donor performance includes all African recipient countries for which *AHFSI* figures are available (see Appendix). The data on food aid deliveries were provided by WFP.

Donor performance with respect to total emergency flows is shown in figure 2. For none of the donors the value of the index exceeds 0.5, i.e. donor performance does hardly reach half of the maximum possible level. Among all chosen donors the USA performs worst throughout the whole period. Providing the largest proportion of global food aid the USA has

[17] Instead of taking the average food consumption of a representative individual, Bigman suggests to take the certainty equivalent food consumption as a measure. For risk averse individuals the certainty equivalent is below the average food consumption level, because individuals have to bear the costs to stabilise their food consumption over time. Therefore, the difference between the minimum required food intake and an individual's average food consumption expresses the chronic food gap of this person. The difference between the average and the certainty equivalent food consumption, however, represents the food gap caused by variations in food availability (Bigman 1993, 247).

considerable influence on the aggregate performance.[18] This is most obvious in 1991. This proves wrong the conjecture that due to biases of donations towards particular countries a low performance of single donors is compensated in the aggregate. The dominant influence of major donors on the aggregate performance level will also become clear from a disaggregation into the different food aid categories.



Source: Own calculations; WFP/INTERFAIS (1997); FAO/CFS (1997).

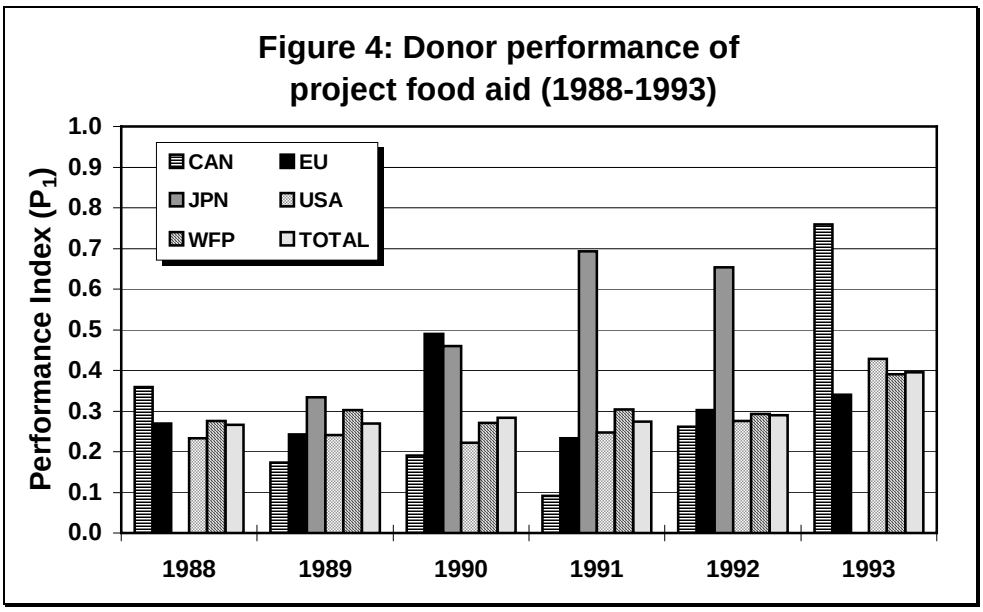
Calculating the performance index separately for different food aid categories gives more detailed information on donors' allocative effectiveness. These results are illustrated in figures 3, 4 and 5.

The variation of donor performance is greatest within the project food aid category (see figure 4). This holds for each donor with respect to the whole period examined as well as between the different donors in each year. For Japan, the performance index shows remarkable high values in 1991 and 1992, whereas in 1988 and in 1993 Japan did not provide any project food aid at all. For the years 1991 and 1992 Japan distributed its food aid to very few, but extremely needy (food insecure) countries (Ethiopia and Mozambique).[19] Although Japan delivered much less food aid than EU, USA, and WFP, the selective allocation leads to a high

[18] In the years 1988-1993 the USA delivered on average about 50 per cent of total food aid flows (WFP 1989-1994).

[19] According to the value of the AHFSI, FAO has classified developing countries into the categories „critically low level of food security“ (AHFSI less than 65), „low level of food security“ (AHFSI between 65 and 75), „medium level of food security“ (AHFSI between 75 and 85) and „high level of food security“ (AHFSI equal or greater than 85) (FAO/CFS 1994, 3-4).

performance.[20] The same holds for Canada in 1993 which gave its project food aid (5080 tons) completely to Ethiopia, one of the countries with very severe food insecurity. In 1991, however, Canada's donor performance is at an extremely low level because about 70 per cent of donations was delivered to recipient countries with a high level of food security (Algeria, Tunisia). These observations show that donor performance is the better, the more selective donors allocate their food aid resources towards the countries most in need. The EU only in 1990 reaches a performance level higher than 0.35 due to a large proportion of food aid given to Ethiopia. In all other years large shares of project food aid were delivered to countries having a high (Egypt, Algeria) or medium food security status (Congo, Niger, Benin, Madagascar, Burkina Faso), whereas needier countries like Burundi, Central African Republic, Mozambique and Somalia received much less or no project food aid at all. Similar to the EU, the USA only in 1993 gave a recognisable priority to an extremely needy country.[21]



Source: Own calculations; WFP/INTERFAIS (1997); FAO/CFS (1997).

In this context the results for WFP are of particular interest. Being the world's largest donor of project food aid, WFP does not perform significantly better than bilateral donors. One possible explanation could be that, compared to bilateral donors, WFP distributes aid to a much greater number of recipient countries. Within this group the food security status varies strongly. In addition, WFP's food aid allocation does not show a clear priority in favour of the

[20] For example, within the category "project food aid", the European Commission delivered 30042 tons in 1991 and 34636 tons in 1992, whereas in the same years Japan donated 6772 and 156 tons, respectively (WFP/INTERFAIS 1997).

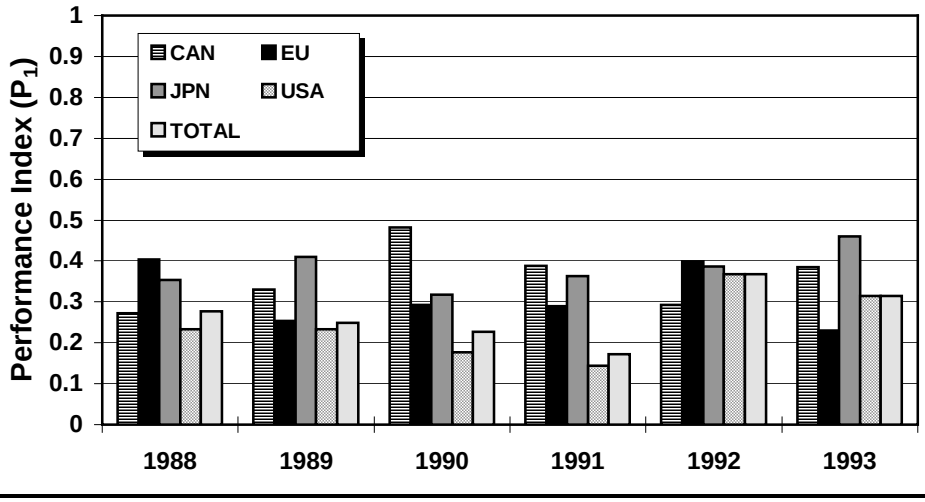
[21] In this year, around 25 per cent of the USA's project food aid were delivered to Ethiopia. Burundi and Somalia, on the other hand, received no food aid throughout the whole period observed. Instead, especially in 1988 and 1989 large amounts of project food aid were given to Morocco.

neediest countries. For example, in 1988, 1990 and 1992 the proportion of project food aid given to Egypt, Morocco and Tunisia was about 30 per cent, whereas the five most food insecure countries received only between 13 and 17 per cent.

As it can be seen from figure 5, the results for programme food aid are without any exception below the level of 0.5. As mentioned in section 2, programme aid is exclusively provided bilaterally. Therefore WFP is not included in the calculation. The low performance of USA results from the fact that a considerable share of USA's programme food aid (more than 40 per cent in 1988 and 1989 and even more than 60 per cent in 1990 and 1991) was delivered to Egypt, Morocco and Tunisia. Compared to all other donors of programme food aid USA shows the clearest priority towards recipient countries with high food security levels.

A comparison of programme and project food aid performance levels does not show systematic differences between both categories. Whereas Canada and Japan allocate their programme food aid resources in 1990, 1991 and 1992 more effectively than their project food aid, the opposite holds for the years 1988 and 1993. The USA's programme food aid performance exceeds project food aid performance only in one year (1992). For the EU this holds for four years (1988, 1988, 1991, 1992). In each category of food aid low performance levels result from an insufficient consideration of recipient countries' needs.

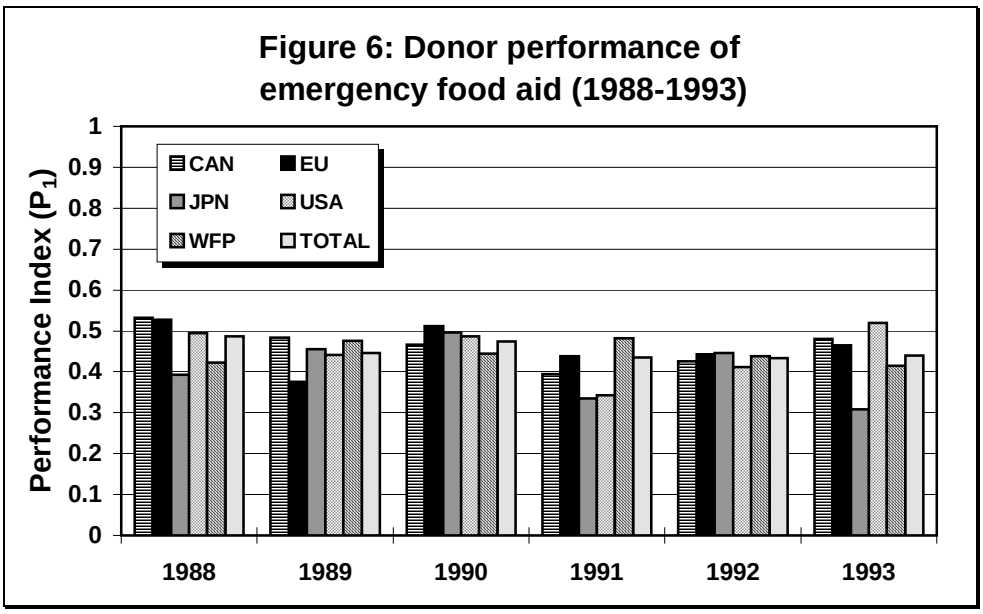
Figure 5: Donor performance of programme food aid (1988-1993)



Source: Own calculations; WFP/INTERFAIS (1997); FAO/CFS (1997).

Finally, we discuss results of donor performance for emergency food aid (see figure 6). Except for a few examples (like WFP in 1988, Japan and USA in 1991, and Japan in 1993), performance levels are higher compared to those of programme and most of project food aid. This results from a more selective allocation of food aid resources towards countries with low or critically low food security levels. In order to explain this observation one has to keep in mind that a country's eligibility for emergency food aid depends on the existence of an

emergency case. While these countries are quite easy to identify, the determination of the amount of food aid needed raises a variety of problems, especially if the exact number of people affected is unknown and the aid is urgently needed.
Again, it should be noticed that there is no remarkable difference between performance levels of multilateral and bilateral donors in the case of emergency food aid.



Source: Own calculations; WFP/INTERFAIS (1997); FAO/CFS (1997).

5 Further considerations

In part 4 of this paper we find clear evidence that food aid donations are not strictly oriented towards recipient countries' needs The variation of donor performance within the project and programme food aid category as well as between these categories seems to be rather arbitrary than showing a systematic trend. With respect to emergency food aid allocation donors perform slightly better. Nevertheless, the performance level rarely exceeds 0.5. Therefore, one can reasonably claim that food aid could contribute much more to food security if recipients' needs would matter more. From the results obtained it can be concluded that, during the period observed, the potential impact of food aid on food security in developing countries has not been fully exploited.

Clearly, the index does not provide an explanation why the needs of recipient countries play a rather subordinate role for food aid allocation. Such an explanation should pay special attention to multilateral donors. For multilateral organisations like WFP it is often assumed that they perform better than bilateral donors because they do not depend on national political interests (Ballenger and Mabbs-Zeno 1992, 274). With our findings this has to be questioned.

An economic interpretation of the results obtained requires a deeper insight into the institutional structure and the decision-making of multilateral organisations.

Some further considerations concerning the formal structure of the performance measure are worth mentioning. As we have explained in section 4.1, we assume a perfect targeting of food aid donations. This assumption was necessary because of missing data in this field. Nevertheless, we cannot rule out that performance results will differ if we could take a targeting measure into account. In contrast to the performance index developed in section 3, the index used for our calculation of donor performance does not satisfy all axioms proposed. In particular, the monotonicity axiom is violated and the time dimension is not included. Therefore, cumulative effects resulting from long-lasting food deficits, which reduce people's survival probability and therefore directly influence their food aid needs, remain unconsidered. Furthermore, due to limited data availability the calculation is focused on African recipients. In order to get a more comprehensive picture of donor performance other regions (East- and South-East Asia, Latin America and the Caribbean, Eastern Europe) should be included into the calculation.

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Appendix

Aggregate Household Food Security Index of African countries (1988-1993)*

SUB-SAHARAN AFRICA	1988	1989	1990	1991	1992	1993
ANGOLA	70.3	73.6	69.5	82.8	86.6	52.1
BENIN	76.5	78.1	76.0	79.4	77.4	75.7
BOTSWANA	73.2	73.2	74.2	70.4	62.3	61.0
BURKINA FASO	67.2	68.6	68.4	85.2	78.1	73.9
BURUNDI	61.6	58.2	59.4	59.0	58.0	56.4
CAMEROON	73.4	72.8	73.4	76.0	74.2	70.5
CAPE VERDE	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
CENT.AF.REP.	44.5	47.0	61.0	32.7	21.2	20.6
CHAD	50.5	43.8	40.5	66.8	65.9	49.6
COMOROS	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
CONGO	76.6	74.6	76.6	72.0	75.7	70.2
CTE D'IVOIRE	84.5	84.1	79.3	79.6	79.6	71.8
DJIBOUTI	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
EQ.GUINEA	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
ERITREA	39.2	37.6	36.2	30.7	50.8	24.1
ETHIOPIA	39.2	37.6	36.2	30.7	50.8	24.1
GAMBIA	72.3	72.6	72.9	78.8	70.1	72.1
GHANA	69.8	71.7	66.6	77.9	72.8	72.5
GUINEA	73.3	75.0	74.0	74.9	65.0	70.3
GUINEA BIS.	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
KENYA	68.9	68.5	68.6	67.7	70.3	66.5
LESOTHO	69.8	70.0	69.6	64.5	61.0	58.7
LIBERIA	74.5	74.7	66.5	63.7	63.7	55.9
MADAGASCAR	75.8	76.4	76.6	73.5	73.9	73.3
MALAWI	69.2	68.9	68.7	71.5	59.1	72.2
MALI	70.6	69.9	70.8	82.1	72.2	73.2
MAURITANIA	73.7	73.1	73.9	88	67.7	58.9

MAURITIUS	84.1	84.8	85.0	81.4	85.7	79.9
MOZAMBIQUE	43.0	40.0	41.0	34.4	34.7	34.5
NAMIBIA	70.1	69.1	69.2	70.2	69.6	65.9
NIGER	71.2	71	71.8	91.1	83.3	75.7
NIGERIA	70.7	72.6	71.1	71.1	71.3	70.9
RWANDA	63.0	68.7	67.4	67.7	62.4	57
SAO TOME PRN	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
SENEGAL	73.0	74.7	75.5	68.9	65.5	69.7
SEYCHELLES	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
SIERRA LEONE	68.7	69.3	70.5	67.8	67.5	67.4
SOMALIA	49.9	43.7	36.7	35.2	34.5	37.5
SOUTH AFRICA	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
SUDAN	70.2	69.5	69.5	85.8	74.6	73.2
SWAZILAND	84.6	82.8	84.4	93.3	68.5	71.8
TANZANIA	71.6	72.4	72.1	70.0	66.6	67.0
TOGO	72.4	74.6	72.6	68.3	67.0	72.5
UGANDA	70.9	71.9	70.8	69.4	69.1	72.2
ZAIRE	71.7	71.7	70.9	70.4	69.6	69.3
ZAMBIA	71.4	71.5	71.5	69.1	40.4	76.7
ZIMBABWE	73.8	74.0	73.3	64.7	69.0	68.5
NORTH AFRICA	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
ALGERIA	91.9	93.0	93.0	95.8	91.6	90.7
EGYPT	90.6	90.7	91.0	91.3	91.3	91.2
MOROCCO	89.8	90.3	90.7	95.3	78.5	64.0
TUNISIA	91.3	92.3	92.7	95.5	92.6	93.7

* n.a: not available.

Source: FAO/CFS (1994), Annex Table 4.

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