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MAPPING VULNERABILITY TO FOOD INSECURITY: TENTATIVE GUIDELINES FOR WFP COUNTRY OFFICES

A Study Commissioned by the World Food Programme

by

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CCRDA

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March 1991

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ACKNOWLEDGEMENTS

The authors would like to express their thanks to all those who assisted in this study.

Particular thanks are due to Peter Jobber, Director of Operations WFP Sudan in 1990 and former Director of Operations WFP Bangladesh, and the staff of the WFP Country Office in Khartoum.

Thanks too to Kay Sharpe, Ibrahim Deraige, Suzanne Jaspers and Mohammed Omer for participating so patiently in the subjective mapping exercise.

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CHAPTER 1.
VULNERABILITY AND VULNERABILITY MAPPING

1.1 Introduction

As a multilateral agency involved in the provision of project food aid and emergency food aid to developing countries, a central concern of the World Food Programme (WFP) is how to differentiate the need for food aid between populations and areas. The notion of vulnerability, whether defined in relation to famine, food intake or food insecurity, is therefore one with which the staff of WFP already have some familiarity.

As a result of WFP's long involvement in nutritional interventions using food aid, vulnerability has often been viewed primarily in physiological terms, so that those individuals within a population whose growth and health status are most likely to be impaired by a low or reduced food intake, ie. the pregnant and lactating women and children under the age of five years are seen as being members of the "Vulnerable Groups". However, vulnerability to famine and food shortage can be viewed in other ways as other areas of WFP activity can attest. Thus, assessments of the requirements for emergency food aid usually go beyond viewing vulnerability in physiological terms and take into account food stocks, access to alternative income sources and household assets. The notion of the risk that famine conditions may develop in a population in the absence of food aid is central to these emergency assessments.

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The last decade has witnessed a number of conceptual, technical and organisational developments in relation to food-related vulnerability, which have resulted in the concept of vulnerability, and approaches to it, being refined and also to an increased interest in spatially representing differences in vulnerability. Three factors deserve to be noted here.

First, during the 1980s, food security emerged as a central "organising theme" for many donor agencies, particularly those involved in the provision of food aid. This has led to an increase in multidisciplinary research on the determinants of vulnerability to food insecurity, not only at a national level but more importantly at the community and household level. Attempts to reduce the vulnerability to household food insecurity now frequently form part of developments programmes using financial aid as well as food aid.

Second, a separate but related development has been a paradigm shift in the way that famines are conceptualised. Research on famines by Sen (1981) and others, has shown that famines may occur in situations where food is physically available but not accessible because of the erosion of people's "entitlements" to food. Such "entitlements" would include assets (livestock, jewellery, etc.) which might be sold to acquire food, community support mechanisms (charity, borrowing, etc.) and other coping mechanisms such as the consumption of wild foods and migration. This has resulted in a shift from famines being perceived primarily as the result of supply-side failures to the current situation where failures of effective demand and "entitlements" are treated with equal if not greater importance. A product of this shift is that alongside food balance sheet

calculations involving estimates of requirements in terms of production, imports and exports, most Famine Early Warning Systems now include assessments of vulnerability to famine in terms of a population's "entitlements" and ability to cope.

Third, recent advances in computing capability and the ability to now run Geographic Information System (GIS) software on Personal Computers, has resulted in increased interest in the use of such capacity to map vulnerability for the purposes of monitoring the situation and allocating food aid resources, whether regular or emergency.

Initiatives by WFP, in Bangladesh in the early 1980s and more recently in the Sudan, have resulted in the agency acquiring experience in the mapping of food-related vulnerability and the use of such maps in programming regular and emergency food aid. In Bangladesh WFP played a key role in a process which identified and graded those areas of the country that were judged to be poorest and most vulnerable to famine. Since 1982 the "Distress Maps" produced by this process have been used by the Government and food aid donor organisations to weight the bulk of allocations under the large Vulnerable Group Distribution and Food for Work Programmes.

WFP Headquarters now wishes to build upon its experiences with mapping vulnerability, taking account of developments in respect to food security and the way that famines are now conceptualised. The intention is to explore ways by which WFP Country Offices might incorporate notions of food-related vulnerability, and spatial variations that may exist in such vulnerability, into their programming and monitoring activities.

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More specifically WFP Headquarters envisages that vulnerability maps may serve the following purposes:

- weighting allocations within regular food aid programmes supported by WFP and other donors;
- highlighting those areas of a country where WFP and other agencies might consider starting new regular programmes and/or concentrate their existing activities;
- highlighting those areas of a country that should be monitored more closely, particularly during times of food shortage and stress;
- providing background information for Country Offices and visiting WFP staff/consultants on spatial variations in vulnerability within the country;
- that the process of preparing the vulnerability maps will help stimulate greater consideration of issues relating to food insecurity within the WFP Country Office and also amongst the Government and other donor agencies.

This report represents a first attempt by WFP Headquarters to explore this agenda(1). Sudan was selected as a Case Study and was visited in May 1990. An initial report prepared over a three week period was submitted in June 1990. That report has now been

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(1) As a first attempt, WFP Headquarters (ODR) and the authors would welcome comments on this report and the method set out in Chapter 3.

reorganised and some sections expanded so as to increase its accessibility and usefulness to WFP Country Office personnel in countries other than Sudan.

The report is divided into four Chapters. The remainder of this first Chapter examines the concept of vulnerability to food insecurity and possible approaches to its spatial representation. Chapter 2 reviews WFP's experience in mapping vulnerability in two very different contexts - Bangladesh and Sudan, and also that of the USAID-funded Famine Early Warning System (FEWS) Project covering countries in the Sahel and Horn of Africa. Chapter 3 outlines a step-by-step method by which WFP Country Offices, particularly those where the available statistics are limited and of poor quality, might prepare vulnerability maps for their country. Chapter 4 contains a case study of the methods discussed in Chapter 3 as applied to the Sudan.

1.2 What is Vulnerability?

Chambers (1989) notes that the terms 'vulnerable' and 'vulnerability' are common terms in the lexicon of development, but their use is often vague, often being seen as substitutes for 'poor' and 'poverty'. He defines vulnerability as being "... not the same as poverty. It means not lack or want, but defencelessness, insecurity and exposure to risk, shocks and stress, ... and difficulty in coping with them".

To be useful vulnerability has to be defined terms of what it is that a population is considered to be *vulnerable to* and its definition therefore requires specificity. Thus, for an agency concerned with health interventions vulnerability would need to be defined in terms of vulnerability to ill-health and the various factors contributing to ill-health. For a food aid agency such as WFP, vulnerability needs to be defined in relation to food. To define it in relation to internationally set Recommended Daily Nutritional Allowances leads to the notion of Vulnerable Groups described above which is too restricted for an agency concerned with broader issues of hunger and food security.

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A widely used definition of food security is that introduced by the World Bank (1986) as "access by all people at all times to enough food for an active, healthy life". Thus, vulnerability to food insecurity, ie. where part of the population does not have access to enough food, should be suitable for WFP's purposes. For the purposes of this report we define vulnerability to food insecurity as:

> "an aggregate measure, for a given population or region, of the risk of exposure to food insecurity and the ability of the population to cope with the consequences of that insecurity"

This definition (which borrows significantly from that used by Downing 1990) sees vulnerability as being composed of two principle components, namely.

i) risk of exposure to different types of shock or disaster event. This introduces the notion of the probability of a shock or disaster event occurring, and that its severity may vary, both between areas and population groups and between different events.

ii) ability of the population to cope with different types of shock or disaster event. The ability of a given population to cope, ie. to physically survive with its livelihood more or less intact, will depend on the type of event, the options open to the population and their ability to utilise those options. The income of households and the assets they hold which may be sold (without damaging their long-term livelihood) in order to purchase food and other necessities will undoubtedly play an important role in determining the ability to cope. However, despite its significance, poverty is not the only factor determining the ability of a population to cope. As more research is carried out on Sen's concept of entitlements and the determinants of vulnerability generally, so our understanding of the role of factors other than poverty is being increased. Swift (1989) introduced the notion of "claims" in considering the determinants of vulnerability. These may take the form of redistributive processes within the community (ie. claims on other households within the community), or in terms of the external relations of the community (ie. claims on the government and the international community). In addition to the material/physical component of vulnerability, Anderson and Woodrow (1989) add the components of social/organisational and motivational/attitudinal. Thus, in addition to poverty, factors such as social and economic relations within the community and the effectiveness of the household and community strategies employed will also be of crucial importance.

Chronic and Transitory; Baseline and Current

The World Bank definition of food security differentiates between chronic and transitory food insecurity. Chronic food insecurity is defined as "a continuously inadequate diet caused by the inability to acquire food" and transitory food insecurity is defined as "a temporary decline in a household's access to enough food" (World Bank 1986). The inclusion of both chronic and transitory food insecurity within the overall term "food insecurity" is useful from WFP's perspective as it encompasses the agency's concern with emergency and non-emergency situations. In the former, food aid is provided with the objective of preventing or mitigating the extreme form of temporary food insecurity, ie. famine, whereas in non-emergency situations food aid is provided with broader objectives including the reduction of poverty and the underlying causes of hunger.

In practice however it may be difficult or impossible to differentiate between chronic and transitory food insecurity, as this requires that a distinction can be drawn between "normal" and "emergency" periods. In countries such as Sudan such distinctions cannot meaningfully be drawn. Long term climatic change in the north of the country, stagnation of the macro-economy and reduced administrative capacity have been compounded over the last decade by the successive "shocks" of drought, famine, refugee influxes and the civil war in the south of the country which all interact to affect the level of vulnerability. Another criticism of the chronic and transitory distinction is that it implies that following a transitory disaster event or "shock", societies return to the pre-event state. Whilst many societies "recover" it is often not to exactly the same state as that which prevailed before the event.

For the purposes of mapping vulnerability to food insecurity, a potentially much more useful differentiation is that made between

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"baseline" vulnerability and "current" vulnerability by Downing (1990). This study was prepared for the US-funded Famine Early Warning Systems Project operating in eight countries in the Sahel, and consequently views vulnerability in terms of vulnerability to famine rather than to the somewhat broader notion of food insecurity. Central to the FEWS approach, which continues to be developed, are assessments of baseline vulnerability at the start of the crop season focussing on underlying processes encompassing the previous few seasons, or years. The baseline assessment is subsequently updated as the season progresses, reflecting the current risk of famine based on, for example, the projected harvest, prices of staple foods, food stocks and food aid deliveries.

The differentiation between baseline and current vulnerability is useful from WFP's perspective for a number of reasons.

1. It views vulnerability as a composite of past and current states and events which is a necessary perspective in countries such as Sudan where chronic economic and climatic difficulties have been overlain by successive "shocks".

2. It is practical and relatively easy to use, as differentiating between "baseline" and "current" vulnerability need only involve a separation between two temporal periods rather than attempting to disentangle what is chronic and what is transitory.

3. It provides a framework which is of use in emergency and non-emergency situations and is therefore appropriate for the context in which WFP Country Offices operate, ie. periodically having to switch from non-emergency to emergency food aid programming. Baseline vulnerability can be of use in programming regular food aid and highlighting those areas which should be more closely monitored. Once an event or "shock" occurs, such as rain failure, outbreak of conflict or sharp change in macro-economic conditions, the baseline can readily made "current" or related to information produced by famine early warning systems, most of which now incorporate notions of vulnerability.

4. The distinction between baseline and current vulnerability closely resembles the distinction between the Distress Factor and Flood/Drought Damage Factor already used by WFP and the Government of Bangladesh in that country (see Section 2.2).

This report utilises the distinction between "baseline" and "current" vulnerability and focuses on the mapping of "baseline" vulnerability. "Baseline" vulnerability is taken to be the average over a five year period ending at the start of the current agricultural season. "Current" vulnerability is taken as describing the status of the population during the current agricultural season or year. To take account of underlying changes in the level of vulnerability over time, baseline assessment would have to be regularly repeated. For WFP's purposes, we would suggest that the assessments of baseline vulnerability ought to be repeated every five years.

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1.3 Approaches to the Mapping of Food-Related Vulnerability

A number of different approaches are available or have been employed for mapping food-related vulnerability, each of which has particular strengths and weaknesses. Five are identified here. As will be seen the methods used to map food-related vulnerability in practice frequently combine elements of two or more of these approaches, so they should not be seen as being mutually exclusive.

A. Disaggregating Existing Data on Socio-Economic Groups
B. Undertaking New Statistical Surveys to Collect Data Directly Relevant to Vulnerability
C. Using Existing Data as Key Indicators of Vulnerability
D. Rapid Rural Appraisal Methods
E. Delbecq-Delphi Methods

A. Disaggregating Existing Data on Socio-Economic Groups

Vulnerability to food insecurity is rarely, if ever directly measured in national data sets such as censuses and income and expenditure surveys. One approach to mapping food-related vulnerability has therefore been to take poverty as a proxy indicator of vulnerability to food insecurity. Such approaches generally involve the selection of socio-economic groups judged to be vulnerable, and then the estimation of the numbers within each group by geographical region, so that maps can then be prepared showing the regional distribution of "vulnerable" groups. This might be characterised as a "top down" approach in that it relies heavily on the geographical disaggregation of national data sets.

One example of such an approach is the identification of ten socio-economic groups judged to be vulnerable to "food poverty" in Kenya by Hunt (1984). These were:

Pastoralists
- Nomadic
- Agro-pastoralist
- Migrant farmers

Landless
- Poor
- Skilled

Rural landholders
- Large farm squatters
- Smallholders
- Gap farms
- Large farms

Urban
- Nairobi
- Other

The numbers within these different groups was subsequently estimated on a Provincial basis by Downing (1990).

In those countries where socio-economic statistics are available and of good quality such a process is comparatively straightforward, though as indicated in the previous section vulnerability to food insecurity requires an account to be taken of risk of exposure to shocks and factors other than poverty, such as the effectiveness of coping

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strategies and the strength of "claims". However, in countries where the national data sets on poverty are unavailable or of poor quality such an approach can be problematic or of limited value. Sudan may be regarded as an extreme case of a country with poor national data sets on poverty. The last national Population Census was carried out in 1973 and the last national Household Income and Budget Survey between 1978-80. The small sample sizes of the latter survey rendered it of limited use even at the Provincial level.

A recent attempt to provide a Provincial-level picture of vulnerability to food insecurity in Sudan was that prepared by the Sudan-based representative of the Famine Early Warning System Project funded by USAID (FEWS 1990). This involved the identification of seven socio-economic groups as being vulnerable, ie. displaced, refugees, farmers, agropastoralists, pastoralists and nomads, landless, and urban residents. Estimates of baseline and current vulnerability were then made for each group on a provincial basis using three grades (low, moderate and high). Allowance was then made for differences in the level of vulnerability within the group. Thus, as can be seen in Table 1, of the estimated displaced population in and around Khartoum of 1.8 million, baseline vulnerability was estimated to be low for 75%, moderate for 20% and high for 5%.

This approach is useful where data availability and quality is poor and the disaggregation process is only carried so far down the administrative hierarchy. However, it is heavily dependent upon estimates of numbers within different socio-economic groups. In a country where both population data and income and expenditure data is so weak, room for error increases as the process extends down the administrative hierarchy. In the case of Sudan and Kenya the Province is probably as far as the data permits. In such countries this approach may therefore be only of limited use from WFP's perspective.

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B. Undertaking New Surveys Using Formal Survey Techniques to Collect Data More Directly Relevant to Vulnerability

An alternative to the lack of data directly related to all components of vulnerability is to carry out surveys using formal survey techniques which collect information more directly related to vulnerability. This approach is often used by relief agencies as part of their monitoring and targeting activities during large-scale relief operations. During the response by the international community to the African Food Crisis of the mid-1980's western Non-Governmental Organisations (NGOs) carried out extensive household surveys which attempted to assess the need for food aid at the household and community level. Many of the surveys incorporated the notion of coping strategies and the level of entitlements. Some even carried out mini-censuses to compensate for the inaccurate census information available (Shoham and Borton 1989).

Whilst this approach is potentially the most effective for gathering data which could be used to map vulnerability to food insecurity, it is beyond the resources of WFP and cannot be considered further.

Table 1 **Vulnerable Groups in Sudan for 1990** Source: FEWS 1990

Group	Subgroup	Subgroup Population	Location	Percentage Vulnerable	Base Vuln	Current Vuln	Current Relief
DISPLACED		1,800,000	Khartoum	75	Low	Low	No
			Khartoum	20	Moderate	Moderate	No
			Khartoum	5	High	High	Yes
	Trans. Zone	350,000	S. Darfur	90	High	High	Yes
			S. Darfur	10	Moderate	Moderate	No
			S. Kordofan	90	High	High	Yes
			S. Kordofan	10	Moderate	Moderate	No
	South	2,350,000	Equatoria	80	High	High	Yes
			Equatoria	20	Moderate	Moderate	No
			Bahr El Ghazal	75	High	High	Yes
			Bar El Ghazal	25	Moderate	Moderate	No
			Upper Nile	65	High	High	Yes
			Upper Nile	35	Moderate	Moderate	No
REFUGEES	Settled		Kassala Prov East	100	Low	Low	No
	Camps	110,000	Kassala Prov	100	Moderate	Moderate	Yes
			Darfur	100	Moderate	Moderate	
	Urban	50,000	Khartoum	100	Low	Low	No
		21,000	Juba	100	Low	Low	No
FARMERS	Trad.	1,267,000	North Darfur	100	Moderate	High	Yes
		1,633,700	South Darfur	100	Moderate	Moderate	
		1,244,500	North Kordofan	100	Moderate	High	Yes
		969,600	South Kordofan	100	Moderate	Moderate	
			Central/East	100	Moderate	Low	
			South	100	Moderate	Moderate	
	Mech.	Several '000 Families	Central	100	Very Low	Very Low	No
			East	100	Very Low	Very Low	No
			West	75	Low	Very Low	No
			West	25	Low	Moderate	No
	Irrig.	200,000 Families	Central	100	Very Low	Very Low	No
			East	100	Very Low	Very Low	No
AGRO-PASTORALISTS		111,000	North Darfur		Moderate	High	No
		272,300	South Darfur		Moderate	Moderate	No
		284,700	North Kordofan		Moderate	High	No
		248,800	South Kordofan		Moderate	Moderate	No
			Red Sea		Moderate	Moderate	No
PASTORALISTS AND NOMADS		111,000	North Darfur	100	Moderate	High	No
		90,800	South Darfur	100	Moderate	Moderate	No
		284,700	North Kordofan	100	Moderate	High	No
		83,000	South Kordofan	100	Moderate	Moderate	No
		474,200	Red Sea	100	Moderate	Moderate	No
LANDLESS	Settled		East	100	Low	Moderate	No
	Ag. Labor		Central	100	Low	Moderate	No
URBAN RESIDENTS	Poor			100	Moderate	Moderate	No
	Laborers			100	Low	Low	No
	Skilled			100	Very Low	Very Low	No
	South			60	Moderate	Moderate	No

Note: Population estimates are projections from the 1983 census using regional growth rates. Subgroup populations are obtained from estimates of the percent of provincial population within each group.

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C. *Using Existing Data as Key Indicators of Vulnerability*

An alternative approach to collecting primary data is to identify the key components or determinants of vulnerability to food insecurity and then select direct or "proxy" indicators of those components for which data is available and capable of describing vulnerability to food insecurity for the chosen mapping units. This approach was utilised in the Bangladesh case (see Section 2.2 and Annex 1), and forms an important component of the approach suggested in Chapter 3 for use by WFP Country Offices. Its main advantage is that it makes use of existing data. Its main weakness is that it requires a very careful assessment of the strengths and weaknesses of different indicators and an in depth knowledge of the context in which the indicators are to be used. The process for selecting key indicators is discussed further in Chapter 3 and Annex 2.

D. *Rapid Rural Appraisal Methods*

In situations where data that might be used to indicate vulnerability to food insecurity is not available or of poor quality, one option is to collect the information required through specially organised surveys. Resource and time limitations place a premium on survey techniques which can be carried out more quickly and at lower cost than large statistical surveys. Since the late 1970's a number of techniques have been developed under the heading Rapid Rural Appraisal (RRA) which enable surveys to be carried out comparatively quickly and inexpensively. Central to the RRA approach is the use of multi-disciplinary teams and the utilisation of the knowledge and experience of local communities (Khon Kaen 1987).

A recent attempt to utilise the RRA approach in assessing the provincial distribution of groups vulnerable to food insecurity was that devised by Maxwell (1989) and others in the Sudan. This involved "Rapid Food Security Assessments" being carried out in nine communities in different parts of the country. As well as attempting a provincial breakdown of vulnerable groups an attempt was made to take account of the World Bank's distinction between chronic and transitory food insecurity. The approach saw food insecurity as being composed of three dimensions: poverty, vulnerability and malnutrition. Populations were judged to be chronically food insecure when they are poor, malnourished and vulnerable. Populations who are both poor and vulnerable or just vulnerable are judged to be prone to transitory food insecurity.

Based on the results of the assessments in the nine communities, seven main groups of food insecure were identified:

i) the working poor in urban areas;
ii) female headed households in urban areas (largely a sub-group of i));
iii) the disabled or handicapped in urban areas;
iv) resource-poor families in rural areas;
v) female headed households in rural areas (largely a sub-group of iv));
vi) people not belonging to iv) or v) but who live in marginal areas;
vi) poor nomads.

By a process which is not entirely clear the numbers of households in each group were estimated for each province and organised within

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the three dimensions of poverty, vulnerability and malnutrition to produce a map of chronic and transitory food insecurity for Northern Sudan (Map 1).

As Maxwell stresses, the approach and the lack of data required that highly questionable assumptions and estimates had to be made, for example that 40% of the population were "poor" and 50% were "vulnerable". The method manages to estimate the size of the population vulnerable to food insecurity by Province, though quite how reliable these estimates are is open to question. The approach of identifying the socio-economic groups and then estimating the populations in each group on a Provincial basis is very similar to that for disaggregating socio-economic groups discussed in "A" above.

An alternative RRA-style approach might be for the assessment team, following their assessment in an area, to rank the degree of food insecurity for the area. The population estimate for the area could be derived separately or using rapid survey techniques to estimate the population in each area. The rankings could then be represented on a map using different shadings. To ensure comparability between the areas it would be either for the same team to carry out the assessments or for separate teams to carry out the assessments but ensure that all use the same methodology and criteria for the ranking process. The problems of ensuring comparability between separate teams working in different areas are substantial. The use of one assessment team is feasible in small countries but impracticable in larger countries.

Two potential problems may be anticipated with the RRA approach from the perspective of this study. The first is that it will tend to focus on "current" rather than "baseline" vulnerability to food insecurity. Second, to be effective if requires multi-disciplinary teams to tour the country. At this stage it is not clear that all WFP Country Offices will be able to assemble such teams as part of this initial attempt to map vulnerability.

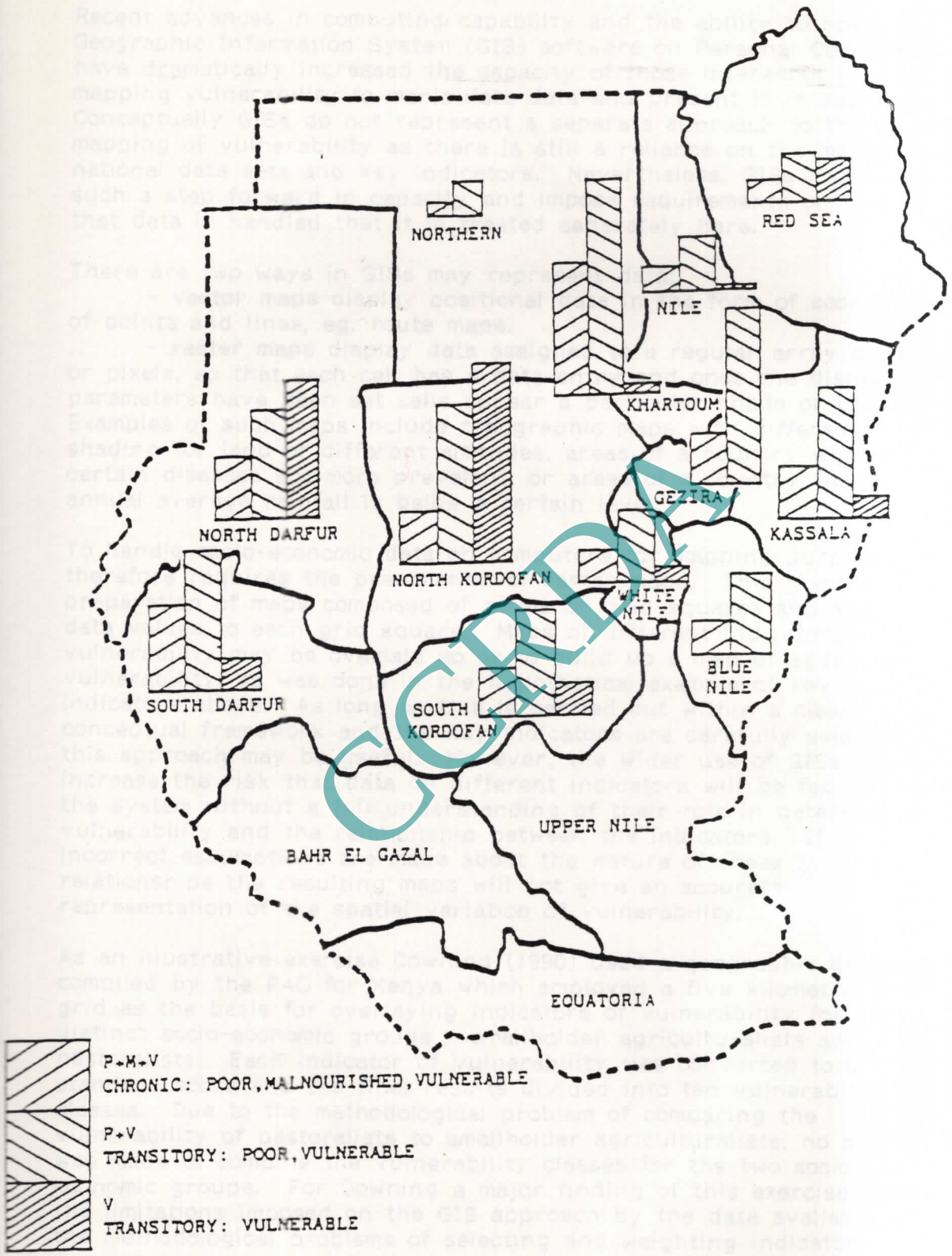
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E. Delbecq-Delphi Methods

An alternative to using the knowledge of local communities when data is either unavailable or unreliable is to utilise the knowledge of individuals with extensive knowledge of conditions throughout the country who are also familiar with the issues being addressed. A range of techniques for utilising such knowledge in a structured manner, principally through careful ranking and weighting procedures were developed in the 1960s and 1970s (eg. Delbecq and Van de Ven 1971; Linstone and Turoff 1975). The best example of the use of such techniques to map food-related vulnerability is the work of Currey (1978) in Bangladesh. This involved four panels of individuals, one of "technical experts", one of aid distributors, another of senior retired government officials and another of village elders from a particular area of the country ranking and then weighting indicators of factors making certain areas liable to famine. This process is described in more detail in Chapter 2 and Annex 1.

MAP 1

Map of chronic and transitory food insecurity



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Source: Maxwell 1989

1.4 *Geographic Information Systems*

Recent advances in computing capability and the ability to now run Geographic Information System (GIS) software on Personal Computers have dramatically increased the capacity of those interested in mapping vulnerability to manipulate data and present it in map form. Conceptually GISs do not represent a separate approach to the mapping of vulnerability as there is still a reliance on the mapping of national data sets and key indicators. Nevertheless, GISs represent such a step forward in capacity and impose requirements on the way that data is handled that it is treated separately here.

There are two ways in GISs may represent data:

- **vector maps** display positional data in the form of coordinates of points and lines, eg. route maps.
- **raster maps** display data assigned to a regular array of cells or pixels, so that each cell has a data entry and once the display parameters have been set cells appear a particular shade or colour. Examples of such maps include topographic maps with different shading for land of different altitudes, areas of a country where certain diseases are more prevalent, or areas of a country where annual average rainfall is below a certain level.

To handle socio-economic data on computers for mapping purposes therefore requires the preparation of raster maps. This involves the preparation of maps composed of pixels or grid squares and assigning data values to each grid square. Maps of different indicators of vulnerability may be overlaid so as to build up a map of aggregate vulnerability, as was done in the hypothetical example of key indicators above. As long as this is carried out within a clear conceptual framework and the key indicators are carefully selected this approach may be useful. However, the wider use of GISs does increase the risk that data on different indicators will be fed into the system without a full understanding of their role in determining vulnerability and the relationship between the indicators. If incorrect assumptions are made about the nature of these relationships the resulting maps will not give an accurate representation of the spatial variation of vulnerability.

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As an illustrative exercise Downing (1990) used a geographic database compiled by the FAO for Kenya which employed a five kilometre UTM grid as the basis for overlaying indicators of vulnerability for two distinct socio-economic groups - smallholder agriculturalists and pastoralists. Each indicator of vulnerability was converted to a standard score and the final results divided into ten vulnerability classes. Due to the methodological problem of comparing the vulnerability of pastoralists to smallholder agriculturalists, no attempt was made to combine the vulnerability classes for the two socio-economic groups. For Downing a major finding of this exercise were the limitations imposed on the GIS approach by the data available and the methodological problems of selecting and weighting indicators. He concludes:

"Without analysing original household survey data, it is impossible to estimate the distribution of food poverty and its spatial correlation with other characteristics of vulnerability to hunger - natural resources, development infrastructure, markets and government services" (Downing 1990).

CHAPTER 2.
EXPERIENCES WITH VULNERABILITY MAPPING: WFP IN BANGLADESH AND SUDAN AND THE FAMINE EARLY WARNING SYSTEM PROJECT IN THE SAHEL

2.1 Introduction

This chapter reviews three very different experiences in the mapping of food-related vulnerability. To date WFP has been involved in attempts to map vulnerability to food insecurity in two countries - Bangladesh and Sudan. Sections 2.2 to 2.4 of this chapter describe WFP's experience in these two very different contexts. Section 2.5 describes the method for mapping vulnerability to famine recently devised by the USAID supported Famine Early Warning System (FEWS) Project in the eight African countries covered by the Project.

2.2 WFPs Experience in Bangladesh

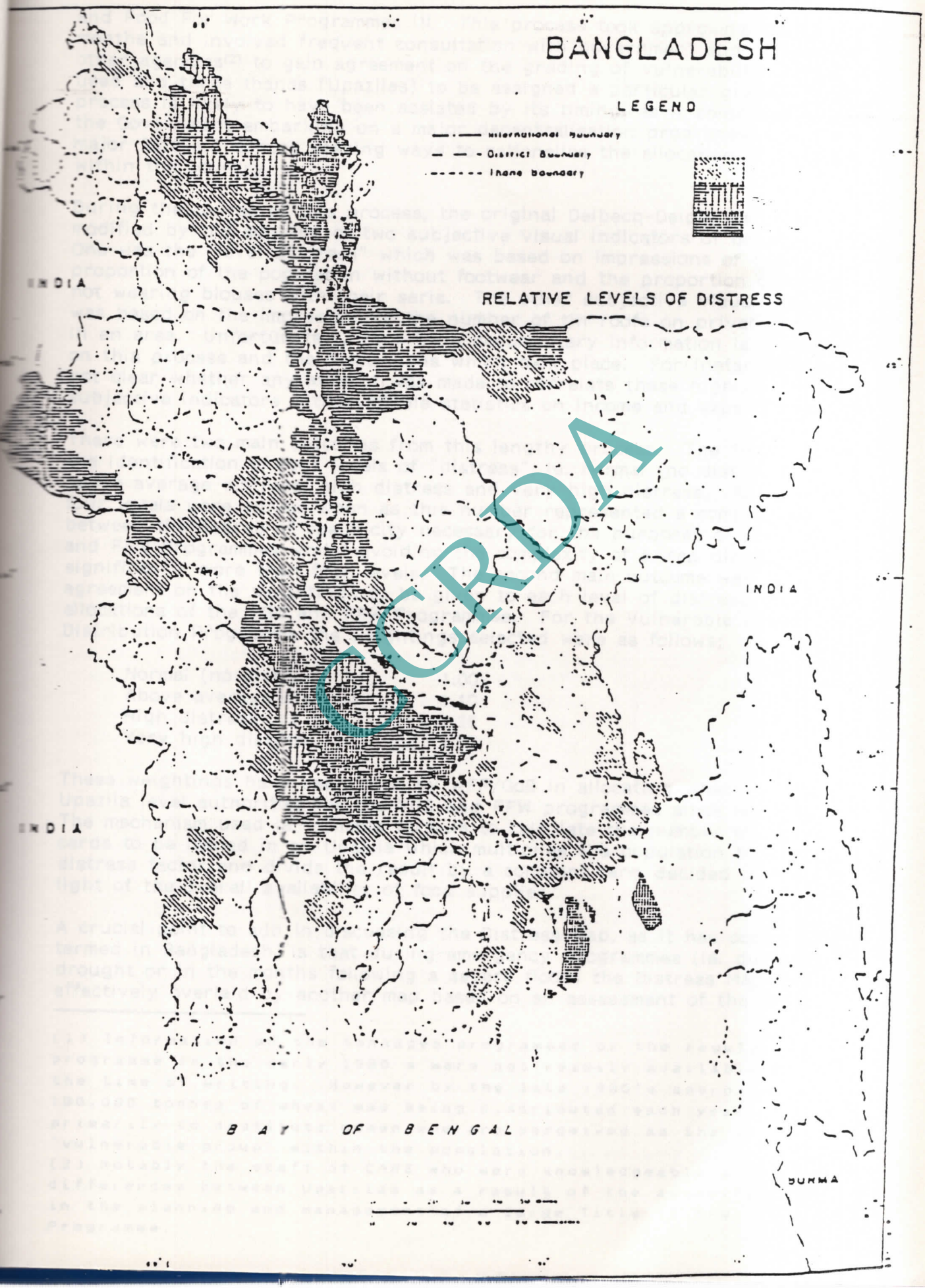
During the early 1980's the WFP Country Office in Bangladesh played a key role in a process which built upon earlier research and resulted in the identification and grading of areas (Upazila) that were judged to be the poorest and most vulnerable to famine. In addition the process resulted in the Government of Bangladesh (GoB) and donor organisations accepting that the bulk of allocations under the large Vulnerable Group Distribution and Food for Work Programmes be weighted towards those Upazila identified as being the poorest and most vulnerable. The "Distress Map" produced by the exercise (Map 2.) has been used as the basis for weighting allocations through these programmes since 1982.

WFP's role in the development of the Distress Map grew out of an earlier research programme designed to identify those areas of the country which were more liable to experience famine (Currey 1979). This research programme took place during 1975-76, just after the peak of the 1974-75 famine in Bangladesh. The research was commissioned by the Ministry of Relief and Rehabilitation and funded by USAID. The study made innovative use of methods (notably the Delbecq and Delphi techniques of ranking and weighting) to draw on the knowledge and experience of a wide range of individuals in Bangladesh to identify indicators of an area's liability to experience famine, select the most significant and then accord each indicator a weight so that it could be mapped. (The methods used by the study are described in more detail in Annex 1.) The result was a large wall map of thanas (Upazilas) judged liable to famine with two broad categories of "liable" and "very liable", but 66 sub-categories dependent on the particular permutation of indicators coinciding in any given thana. Through the involvement of a large number of government and donor officials in the research and as a result of the wide dissemination of the wall map, both the concept of vulnerability mapping and the most vulnerable areas of the country had become familiar within central government and donor circles by the late 1970's. However, it is understood that some detailed aspects of the map (eg. the inclusion of areas in the south east of the country as "liable to famine") were not accepted by all those involved in its preparation.

In 1981 the WFP Country Office set about integrating the concept of spatial differences into the criteria employed in the allocation of food commodities within the nationwide WFP/GoB Vulnerable Group Distribution Programme

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Map 2 "Distress Map" of Bangladesh
Source: WFP Dhaka



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and Food For Work Programmes [1]. This process took approximately 18 months and involved frequent consultation with government and officials of other agencies[2] to gain agreement on the grading of vulnerability to be used and those thanas (Upazilas) to be assigned a particular grade. This process is likely to have been assisted by its timing, as it coincided with the Government embarking on a major decentralisation programme and the major food aid donors seeking ways to rationalise the allocation of food aid within the country.

During the course of this process, the original Delbecq-Delphi map was modified by the addition of two subjective visual indicators of poverty. One was the "level of dress" which was based on impressions of the proportion of the population without footwear and the proportion of women not wearing blouses with their saris. The other subjective visual indicator was based on the impression of the number of tin roofs on private houses in an area. Unfortunately, very little documentary information is available on this process and the discussions which took place. For instance, it is not clear whether any attempt was made to correlate these highly subjective indicators with available statistics on income and expenditure.

There were two main outcomes from this lengthy process. The first was the identification of four levels of "distress", ie. normal (no distress), above average distress, high distress and very high distress. Apparently four levels were agreed upon as this number represented a compromise between the degree of specificity necessary for the purposes of the VGD and FFW Programmes whilst avoiding the complexity of a map displaying significantly more than four levels. The second main outcome was agreement on the weightings to be given to each level of distress in allocations of the VGD and FFW Programmes. For the Vulnerable Group Distribution Programme the weightings selected were as follows:

Normal (no distress)	1.00
Above average distress	1.10
High distress	1.25
Very high distress	1.50

These weightings have been used by WFP/GoB in allocating wheat to the Upazila level authorities for the VGD and FFW programmes since late 1982. The mechanism used is a simple formula to calculate the number of ration cards to be issued in an Upazila which multiplies the population by the distress factor and divide the result by a constant term decided in the light of the overall availability of food supplies.

A crucial point to add in discussing the Distress Map, as it has come to be termed in Bangladesh, is that during emergency programmes (ie. during a drought or in the months following a severe flood) the Distress Map is effectively overlaid by another map based on an assessment of the crop

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(1) Information on the tonnages programmed by the regular VGD programme in the early 1980's were not readily available at the time of writing. However by the late 1980's approximately 180,000 tonnes of wheat was being distributed each year primarily to destitute women who are perceived as the key "vulnerable group" within the population.

(2) Notably the staff of CARE who were knowledgeable about differences between Upazilas as a result of the agency's role in the planning and management of a large Title II FFW Programme.

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losses in each Upazilla, so that the greater the crop losses the higher the flood damage/drought damage factor. Rather than set up a separate emergency programme, the additional allocations during emergency programmes are channelled through the VGD so that larger rations are provided to an expanded target population. Thus following the severe floods of 1988 which affected 46% of the surface area of the country, the formula used in estimating the number of ration cards to be issued in each Upazila was: Population multiplied by the distress factor multiplied by the flood damage factor divided by four (Ockwell 1989).(3)

In the context of the present study three observations can be made of the Bangladesh experience in developing the Distress Map. These points will be returned to in later discussions.

First, the map is used to weight allocations of nationwide regular food distribution programmes.

Second, the use of a flood/drought damage factor map to complement the Distress Map implicitly draws a distinction between baseline vulnerability and current vulnerability, even though these terms are not those used.

Third, it is understood that the weightings assigned during 1981-82 have not been altered in the eight years that have elapsed since then. It is likely that the spatial pattern of poverty in Bangladesh has changed since the early 1980's, so a review of the Upazilas included and the weightings assigned to them would appear to be justified.

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2.3 Differences Between Bangladesh and Sudan

In terms of population density, the predominant disaster types and perhaps the spatial variation of socio-economic characteristics, Sudan presents a very different context from Bangladesh for attempts to map baseline vulnerability. Before describing the WFP Country Office's recent attempts to map baseline vulnerability in Sudan, it would be useful to indicate some of the primary differences between Bangladesh and Sudan in terms of mapping vulnerability.

With a population in 1985 of 100.5 million and a surface area of 144,000 square kilometres Bangladesh had one of the highest population densities in the world at 698 persons per square kilometre (Bangladesh Bureau of Statistics 1989). At 2,506,000 square kilometres, Sudan's surface area is over seventeen times that of Bangladesh's whilst its 1985 population of 21.6 million is less than one quarter (WFP Country Profile). Consequently Sudan has one of the lowest population densities in the world at just 9 persons per square kilometre.

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(3) The scale of the expansion which can be achieved within the framework of the VGD can be seen from the distributions following the 1988 floods. Between September 1988 and March 1989, the VGD Emergency Programme channelled an additional 230,000 tonnes to women and their families in 361 flood affected Upazila, reaching an estimated 1.56 million women (WFP 1989). This was in addition to the amounts channelled through the regular VGD programme.

Districts) and 492 Upazila with each Upazila measuring approximately 10-15 kilometres across. In Sudan there are over 250 Rural Councils, but with each Rural Council measuring approximately 50-80 kilometres across[4].

The comparatively large size of the basic mapping unit in Sudan presents a number of problems for the mapping of vulnerability on the basis of administrative units. Intuitively, it must be the case that the larger the geographical unit the less homogeneity of socio-economic conditions within the unit. In addition, potential indicators of vulnerability such as proximity to roads are less useful in the context of large geographical units. Such issues are discussed in more detail in relation to Sudan in Section 3.

Because of its enormous size Sudan incorporates a range of ecological and agro-economic systems not found in Bangladesh. For instance, mean annual rainfall ranges from less than 10 mm. in the extreme north west of Sudan to over 1,200 mm. in the south-west, whereas in Bangladesh the range is from 1200 near the western border to 5,600 mm. in the north-east. Thus arable agriculture is practised in all of Bangladesh (indeed some areas achieve three crops a year) whereas Sudan incorporates areas which are too dry even for camel nomads as well as extensive areas of rainfed cultivation where the population is settled. With the Nile flowing through such an arid environment the contrast between irrigated areas alongside the Nile and the rainfed areas is far more pronounced than differences between irrigated and non-irrigated areas in Bangladesh. In large areas of northern Sudan semi-nomadic pastoralists, farmers cultivating crops on rainfed, sandy goz soils and farmers cultivating crops along wadis may coexist, even within the same Rural Council. At the risk of oversimplification it would seem that agro-economic variations within the basic mapping unit may be more pronounced in the case of Sudan than Bangladesh. This creates particular problems which are discussed in more detail in Section 3.

In Bangladesh the main disaster events are drought and flood with cyclones and tornadoes having an intense but more localised impact. In Sudan drought and insecurity have been the primary causes of famine. Flooding does occur along the Nile (as during the August 1988 floods which affected Khartoum as well as other areas) but the impact is limited to a narrow band on either side. Whilst hydrological and meteorological historical records can be used to assess the probability that an area will experience a drought or flood, the same cannot be done for insecurity in a way that can be considered to be at all satisfactory (see Annex 2). As a result the mapping of baseline vulnerability in the insecure areas of Sudan is exceptionally difficult and of doubtful use.

The southern half of Sudan has been affected by civil war for much of the period since Independence and over the last few years the affected area has been extending northwards. Within this area famines have occurred as a result of military operations and the collapse of economic activity. Where the option to migrate has been open to the population this has resulted in massive population displacements across international borders, to the relative security of north Sudan and into Government-held garrison towns.

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(4) Below the Rural Council level are Village Councils consisting of a number of settlements in an area. However the Village Councils do not offer a suitable mapping unit for reasons of aggregation of available data and the difficulties of presenting so many units on a single, national map.

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The mapping of *current* vulnerability in this context is vital and is attempted in an informal way by those UN agencies involved in Operation Lifeline. However even the mapping of current vulnerability in this context is fraught with difficulty as a result of the unpredictability of events such as the particular areas of conflict and the migration routes (if any) available to the affected populations and the lack of available information on the situation in large areas of South Sudan. Given the ability of conflict to rapidly alter areas that would normally appear to have low vulnerability (in terms of their asset base, stability of agricultural production and food supply, etc) into areas experiencing severe food shortage and famine, the mapping of baseline vulnerability in such a context is extremely difficult and of dubious value. However, if a cessation of the conflict is anticipated there may be some value in attempting to map baseline vulnerability using pre-conflict data as the information may be of potential use in the preparation of rehabilitation programmes.

Another important difference between Bangladesh and Sudan is the scale of WFP development activities in the two countries. In Bangladesh the WFP/GOB VGD and FFW programmes annually distribute approximately 700,000 tonnes of wheat and as noted above the Distress Map is used to weight allocations under these two programmes. However, in the Sudan, WFP's development activities are more modest and with a more restricted spatial coverage and this necessarily alters the potential role of any map of baseline vulnerability.

At present the development activities take place within the framework of two programmes, the School Feeding Programme and Public Works in Drought Prone Areas Programme. Both programmes involve the provision of approximately $26 million of resources over a four year period. The former covers all boarding secondary and technical schools and teacher training institutions and 60% of the boarding primary schools in the northern regions of the country. Under the programme commodities are imported by WFP and sold to generate funds for use by the Ministry of Education in the maintenance of existing school facilities and the construction of new facilities. The Public Works in Drought Prone Areas Programme incorporates existing projects, such as the rehabilitation of the Gum Arabic Belt which stretches through northern regions, as well as food-for-works activities designed to follow on from earlier projects, such as the recovery activities implemented amongst Beja Nomads in the Red Sea Hills area together with the UK NGO Oxfam. Under the Programme 60% of the resources are earmarked for the Red Sea Hills area, 30% for North Kordofan and 10% for North Darfur.

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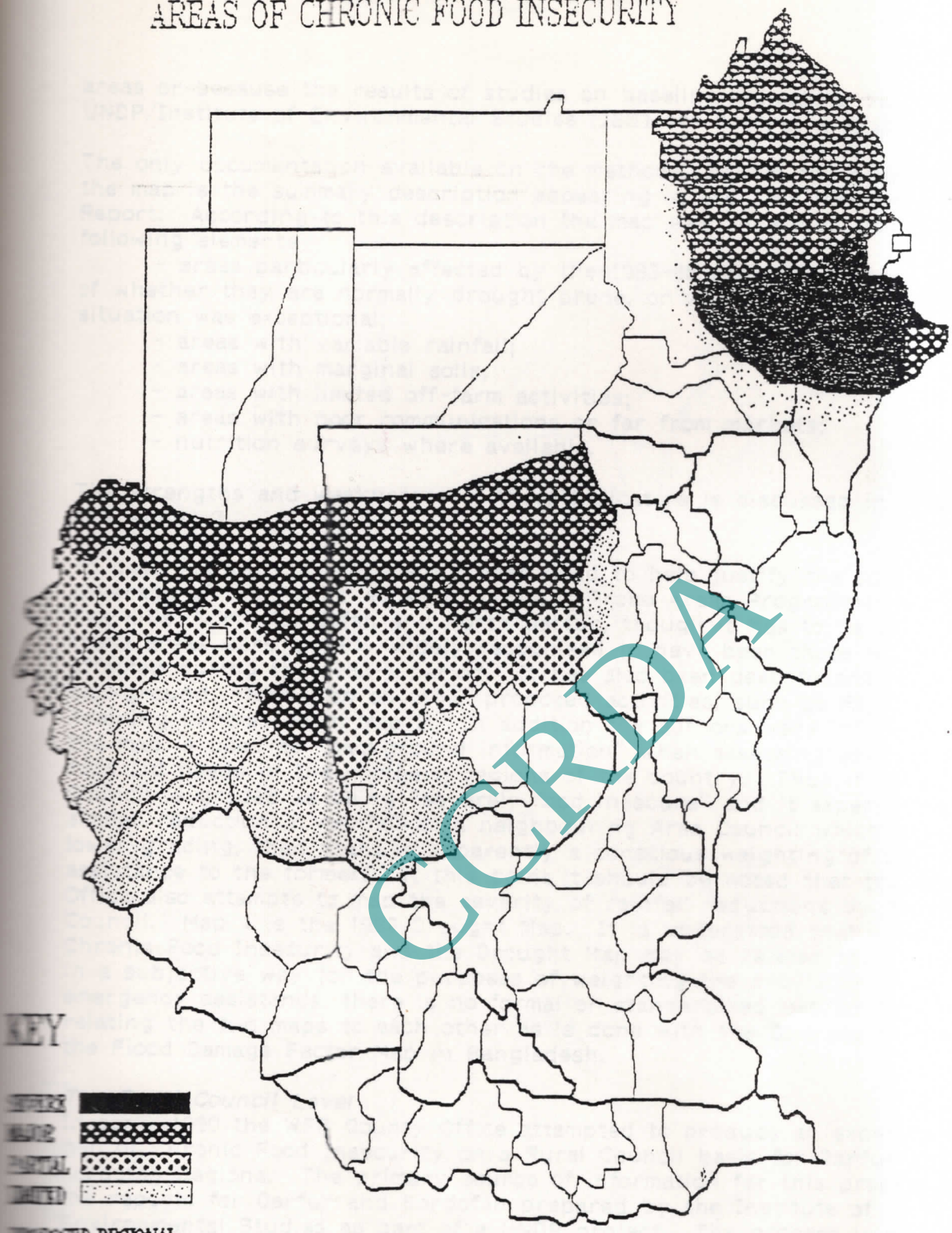
2.4 The Current Status of WFP's Vulnerability Mapping Efforts in Sudan

The Area Council Level

In 1989 the WFP Country Office in Sudan prepared a tentative map of Chronic Food Insecurity on the basis of Area Councils (Map 3). This exercise drew on the then WFP Director of Operation's experience in the preparation of the Bangladesh Distress Map during the early 1980s. The Country Office recognised that a map on the basis of Rural Councils would be more useful but felt that given the lack of reliable data at the rural council level and the lack of experience in mapping vulnerability in the Sudan that it was appropriate to work initially on the basis of Area Councils. As of mid-1990 the map only covers Darfur, Kordofan and Eastern regions. Other areas have not been included because they are conflict

MAP 3

REGIONAL TRAINING CENTRES IN AREAS OF CHRONIC FOOD INSECURITY



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areas or because the results of studies on baseline indicators by the UNDP/Institute of Environmental Studies (IES) are not yet available.

The only documentation available on the methods used in the preparation of the map is the summary description appearing in the 1988 WFP Annual Report. According to this description the map was developed using the following elements

- areas particularly affected by the 1983-85 drought, with an estimate of whether they are normally drought prone, or whether the 1983-85 situation was exceptional;
- areas with variable rainfall;
- areas with marginal soils;
- areas with limited off-farm activities;
- areas with poor communications or far from markets;
- nutrition surveys where available.

The strengths and weaknesses of these indicators is discussed in Chapter 4 and Annex 2.

To date the map has apparently been used to help justify the spatial coverage of the Public Works in Drought Prone Areas Programme in the Red Sea Hills, North Kordofan and North Darfur, though it has to be said that these areas were already widely recognised to have been those worst affected during the 1983-5 period. It has also been used to provide background information on other proposed activities, such as Regional Training Centres as in Map 3. In addition the authors were informed that the map is used as "background information" when assessing emergency food aid needs in the northern regions of the country. Thus if an Area Council is graded as being "severely food insecure" and it experiences a similar reduction in rainfall as a neighbouring Area Council which has a lower grading, then there is apparently a conscious weighting of any assistance to the former. At this point it should be noted that the Country Office also attempts to map the severity of rainfall reductions by Area Council. Map 4 is the 1989 Drought Map. It is understood that whilst the Chronic Food Insecurity and the Drought Map may be related to each other in a subjective way for the purposes of weighting the provision of emergency assistance, there is no formal or standardised method for relating the two maps to each other as is done with the Distress Map and the Flood Damage Factor Map in Bangladesh.

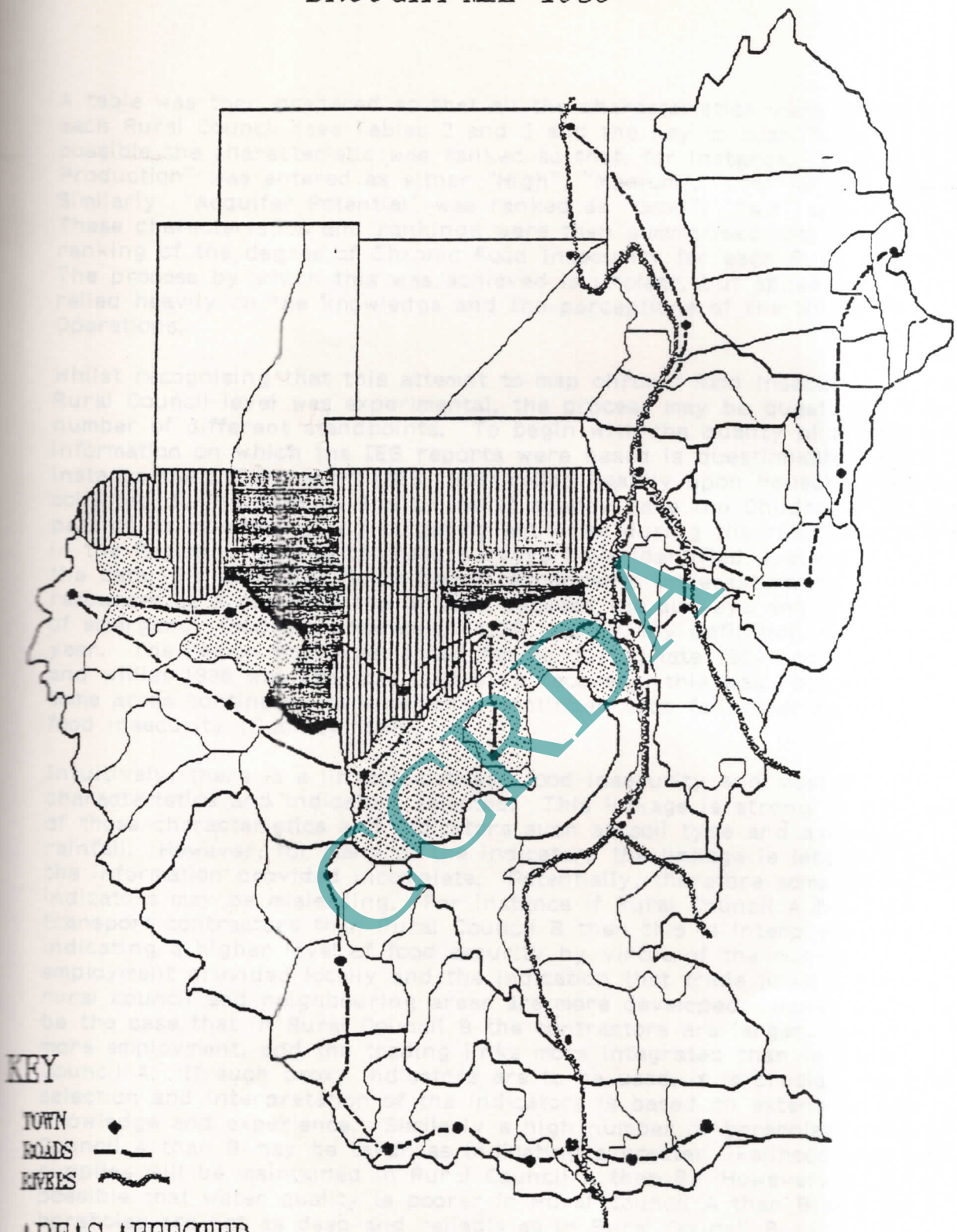
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The Rural Council Level

In early 1990 the WFP County Office attempted to produce an experimental map of Chronic Food Insecurity on a Rural Council basis for Darfur and Kordofan Regions. The primary source of information for this process were the reports for Darfur and Kordofan prepared by the Institute of Environmental Studies as part of a UNDP project. The process involved the WFP Director of Operations assisted by other members of staff, selecting all types of economic and environmental information contained in the reports that could be taken as being related, whether in a causal or descriptive way, to food insecurity at the Rural Council level. This resulted in the selection of 34 characteristics or indicators. These included the main ecological and soil types; the importance of pastoral nomadism and different types of subsistence and cash crop production (eg. millet, sorghum, sesame, tombac and dates); grazing resources; the relative importance of different types of livestock (camels, sheep, goats, etc.); acquifer potential, the number of boreholes and wateryards; the numbers of traditional and modern oilmills, the number of brick kilns for bread baking; and the number of transport contractors.

MAP 4

DROUGHT MAP 1989



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A table was then prepared so that all the characteristics were listed for each Rural Council (see Tables 2 and 3 and the key to both Tables). Where possible the characteristic was ranked so that, for instance, "Livestock Production" was entered as either "High", "Medium", "Low" or "Available". Similarly "Acquifer Potential" was ranked as "Good", "Fair" and "Poor". These characteristics and rankings were then summarised into an overall ranking of the degree of Chronic Food Insecurity for each Rural Council. The process by which this was achieved is unclear, but appears to have relied heavily on the knowledge and the perceptions of the WFP Director of Operations.

Whilst recognising that this attempt to map chronic food insecurity at the Rural Council level was experimental, the process may be questioned from a number of different standpoints. To begin with the quality of much of the information on which the IES reports were based is questionable. For instance the Dafur report (IES 1988) relied heavily upon household surveys collected during 1986 by the UK relief agency Save the Children Fund, as part of its monitoring and targeting activities during the relief operations in the Region. Reviews of these surveys have identified systematic bias in the data, the most significant being respondents underestimating their resources as a result of the linkage between the surveys and the allocation of emergency food aid. Moreover, 1986 was by any definition an "unusual" year. The region had experienced famine during late 1984 and early 1985, and whilst 1986 was characterised by a recovery, this was "patchy" with some areas continuing to experience continued crop failure and extreme food insecurity (Buckley 1988).

Intuitively, there is a linkage between food insecurity and most of the characteristics and indicators selected. This linkage is strong in the case of those characteristics and indicators such as soil type and average rainfall. However, for many of the indicators the linkage is less strong and the information provided incomplete. Potentially, therefore some of the indicators may be misleading. For instance if Rural Council A has more transport contractors than Rural Council B then this is interpreted as indicating a higher level of food security by virtue of the non-farm employment provided locally and the indication that trade links between the rural council and neighbouring areas are more developed. However, it may be the case that in Rural Council B the contractors are larger, providing more employment, and the trading links more integrated than in Rural Council A. If such proxy indicators are to be used, it is crucial that the selection and interpretation of the indicators is based on extensive local knowledge and experience. Similarly a high number of boreholes in Rural Council A than B may be taken as indicating a greater likelihood that water supplies will be maintained in Rural Council A than B. However, it is possible that water quality is poorer in Rural Council A than B and the boreholes are not as deep and reliable as in Rural Council B.

Another possible criticism of this experiment is that it excluded a number of important variables determining the level of vulnerability to food insecurity in the Rural Councils. Remittances from migrant workers in Khartoum, the mechanised farming areas of Central and Eastern Sudan and also in the Gulf States are recognised to be an important source of income for many households in Darfur (de Waal 1989). Though information on the level of remittances on a Rural Council basis is very scanty, it is important that account is taken of this variable. Similarly, local tribal and ethnic conflicts are an important source of vulnerability in the area but no account was taken of the likelihood of these occurring.

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TABLE 2

DARFUR REGION

Rural Council	Main Ecological Zone	Soiltype	Average Annual Rain	Traditional Crop Production	Mechanised Crop Production	Village Based Livestock	Pastoral Nomadism	Horticultural Crop Production	Gum Production	Millet Production	Sorghum Production	Sesame Production	Groundnut Production	Karkade Production	Watermelon Production	Tombac Production	Tobacco Production	Senna Production	Dates Producti
Kutum																			
Kutum R.C.	LRSSD	SCP	300	S	-	S	-	M	-	LD	L	-	-	-	-	-	-	-	M
Fata Burnu RC	LRS	PSC	0	S	-	S	-	M	-	LD	L	-	-	-	-	-	-	-	M
Umuburu RC	LRSSD	SC	0	S	-	S	M	S	-	LD	L	-	-	-	-	-	-	-	H
Karnoi RC	LRS	SC	0	S	-	S	M	S	-	LD	L	-	-	-	-	-	-	-	-
Nomads RC	-	-	0	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-	-
Mellit																			
Mellit RC	SD	SC	0	M	-	S	-	S	-	LD	L	-	-	L	-	-	-	-	-
Khuriet RC	SD	SC	0	S	-	S	M	-	-	LD	L	-	-	L	-	-	-	-	-
Malha RC	SD	SC	0	S	-	S	M	-	-	LD	L	-	-	-	-	-	-	-	-
Wadi Marieg RC	SD	CS	0	S	-	S	M	-	-	LD	L	-	-	-	-	-	-	-	-
Umkeddada																			
Umkeddada RC	LRS	SC	0	M	-	S	-	-	-	LD	L	-	M	-	L	-	-	-	-
Tweisha RC	LRS	SC	0	M	-	S	-	-	S	MD	M	L	M	M	M	-	-	-	-
Alliet Rc	LRS	SC	0	M	-	S	-	-	S	M	M	M	MD	L	M	-	-	-	-
El Fasher																			
El Fasher TC	LRS	-	0	M	S	-	-	S	-	LD	H	-	-	-	-	-	-	-	-
El Fasher RC	LRS	SC	0	M	S	S	S	S	-	LD	L	L	-	L	-	M	-	-	-
Kuram RC	LRS	SC	0	M	-	S	-	-	-	LD	L	-	-	L	-	L	-	-	-
Tawila RC	LRS	SC	0	M	-	S	-	S	-	LD	L	-	-	L	-	H	-	-	-
Katal RC	LRS	SC	0	M	-	S	S	-	S	LD	M	M	M	M	-	H	-	-	-
Kebkabiya																			
Kebkabiya RC	LRS	PSC	0	M	-	S	S	S	-	HD	H	-	-	L	-	-	-	-	M
Saraf Amra RC	LRS	CS	0	M	-	S	S	S	-	HD	H	-	L	-	-	-	-	-	-
Surief RC	LRS	SC	0	M	-	S	S	-	S	HD	H	-	L	-	-	-	-	-	-
Geneina																			
Geneina TC	-	SC	0	M	-	-	-	S	-	HD	HD	-	-	-	-	-	-	-	-
Geneina RC	LRS	SC	0	M	-	S	S	S	-	HD	HD	M	M	-	-	-	-	-	-
North Geneina RC	LRS	SC	0	M	-	S	S	S	-	HD	HD	-	-	-	-	-	-	-	-
South Geneina RC	LRS	CS	0	M	S	S	S	S	-	HD	HD	M	L	L	-	-	-	-	-

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TABLE 3

DARFUR REGION

Rural Council	GRAZING RESOURCES	RANGE CONDITION	LIVESTOCK PRODUCTION: CATTLE	SHEEP	GAMELS	GOATS	EQUINES	POULTRY	AQUIFER POTENTIAL	TOTAL No OF WATER-YARDS	TOTAL No OF BORE-HOLES	No OF TRADTNL OILMILLS	No OF MODERN OILMILLS	BRICK KILNS	TRANSPOR CONTRACT
Eutum															
Eutum R.C.	L	P	L	M	L	M	M	A	G	2	4	0	0	7	6
Fata Burnu RC	L	P	L	L	L	M	M	A	F	0	0	0	0	3	0
Umburu RC	M	F	L	M	HD	M	L	A	G	6	8	0	0	1	0
Karnoi RC	M	F	L	M	HD	M	L	A	G	2	2	0	0	0	0
Nomads RC	-	-	L	M	HD	L	L	A	-	0	0	0	0	0	0
Subtotal										10	14	0	0	11	6
Mellit															
Mellit RC	M	P	L	M	M	HD	L	A	G	1	2	0	0	8	15
Khuriet RC	L	P	HD	M	L	M	L	A	G	7	5	0	0	0	4
Malha RC	L	P	L	M	HD	M	L	A	G	6	11	0	0	1	4
Wadi Marieg RC	L	-	L	M	HD	L	L	A	-	10	12	0	0	0	0
Subtotal										24	40	0	0	9	23
Umkeddada															
Umkeddada RC	M	F	L	M	M	M	L	NOT	G	28	48	0	0	1	5
Tweisha RC	M	G	HD	M	L	M	L	NOT	G	15	25	0	0	0	0
Alliet Rc	M	G	HD	M	L	M	M	NOT	G	23	30	2	2	0	3
Subtotal										66	103	2	2	1	8
El Fasher															
El Fasher TC	-	-	L	L	L	M	M	A	F	3	3	3	2	6	30
El Fasher RC	L	P	L	L	L	HD	M	A	P	7	10	0	0	3	0
Euram RC	L	P	L	L	L	HD	M	A	P	0	0	0	0	3	3
Tawila RC	L	P	L	L	L	HD	M	A	G	1	1	7	0	5	1
Katal RC	M	P	M	L	L	HD	M	A	G	17	25	15	0	4	4
Subtotal										28	39	35	2	21	38
Kebkabiya															
Kebkabiya RC	L	P	HD	L	L	M	M	A	G	1	1	0	0	10	7
Saraf Umra RC	L	P	HD	L	L	M	M	A	G	0	0	0	0	3	1
Surief RC	M	P	HD	L	L	M	M	A	F	0	0	0	0	0	0
Subtotal										1	1	0	0	13	8
Geneina															
Geneina TC	-	-	-	-	-	L	L	A	G	5	15	0	0	0	0
Geneina RC	L	P	L	L	L	HD	L	M	G	0	0	0	1	3	21
North Geneina RC	M	F	L	L	M	HD	L	A	G	2	4	0	0	1	1
South Geneina RC	M	F	HD	L	M	M	M	A	G	0	1	0	0	2	5
Subtotal										7	20	0	1	6	27

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conflicts are an important source of vulnerability in the area but no account was taken of the likelihood of these occurring.

The use of a large number of characteristics and indicators increases the difficulties encountered in the weighting process. How should camel production be weighted in relation to the number of vegetable oil mills or boreholes? Ideally a smaller number of indicators with a strong and direct linkage to the level of food insecurity would be used. Once again, the effective interpretation and weighting of the indicators requires extensive local knowledge and experience.

2.5 Vulnerability Assessments by the Famine Early Warning System Project

The Famine Early Warning System (FEWS) Project was set up during the African Crisis of the mid-1980s to provide USAID and the US Congress with detailed assessments of food security and famine conditions in eight African countries. In 1989 the project was reorganised. The second phase of the Project (FEWS II) has as its primary objectives:

i) Strengthen the early warning capability within USAID,
ii) Reinforce host country early warning efforts, and
iii) Promote a common approach to early warning in the international community.

The Project currently covers seven countries, Mauritania, Mali, Burkina Faso, Niger, Chad, Sudan and Ethiopia. The Project utilises satellite data on rainfall, temperature and vegetation and secondary data produced by the host governments and other agencies in each country which is collated and interpreted by FEWS Field Representatives based in six of the countries with Ethiopia being covered by a Washington-based analyst. The Washington-based staff number seven analysts, administrators and report editors.

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Since 1989 the Project has been developing a methodology for assessing vulnerability to famine. The methodology continues to be developed but a number of important elements have already been established. As part of this process a study was commissioned (Downing 1989) which has been heavily drawn on by this report. The first Vulnerability Assessment for each of the countries covered was produced in June 1990 (FEWS 1990) and it is planned to repeat these assessments at the same time each year. The other main assessments are Pre-Harvest Assessments published annually in October and Harvest Assessment published annually in January. The harvest oriented reports predominantly monitor contemporary physical data that influence national production and availability of food. The Vulnerability Assessment complements the harvest oriented reports by emphasising socio-economic conditions affecting the resources that socio-economic groups utilise to ensure access to food.

Key elements of the FEWS methodology for assessing vulnerability to famine are:

- the differentiation between baseline and current vulnerability as discussed in Section 1.2,
- the viewing of all people as being vulnerable to famine with people differing in their degree of vulnerability,
- the use of an ordinal (ranking) scale to assess vulnerability levels thereby avoiding the need to consider the absolute difference between levels. The four levels of vulnerability ie. "Famine", "Extreme", "Moderate" and "Slight" are determined by the need for particular responses by decision-makers.

As a result of differences between the countries and the fact that the Vulnerability Assessments are prepared by the FEWS Field Representatives, within the centrally set conceptual framework there are differences between the countries in terms of the approach and indicators used. The approach used by the Sudan FEWS Field Representative in categorising socio-economic groups vulnerable to famine was noted in Section 1.3. Of particular interest from the standpoint of mapping vulnerability is the approach employed for Niger during the preparation of the 1990 Vulnerability Assessment.

The approach which is described more fully in the FEWS Vulnerability Assessment Report (1990 Appendix A and shown in Table 4) involved combining ordinal scores (usually for three levels) for each Arrondisement (district) for the following indicators:

1. Assessment of Normalized Difference Vegetation Index (NDVI) (6) and Pasture Condition
2. Current years per capita cereal production
3. Previous years per capita cereal production
4. Percentage change in cereal production over the period 1980-89
5. Percentage change in cereal production current year versus 1980-89 average
6. Current cereal stocks
7. Percentage change in millet price - current situation versus 1980-89 average
8. Condition of off-season garden production
9. Importance of cash crops as income source
10. Significance of remittances
11. Importance of cross border trade with Nigeria, Benin and Burkina Faso
12. Chronic Vulnerability Rating
13. Current Vulnerability Rating

Chronic (baseline) Vulnerability Ratings were prepared by overlaying three levels of "production variability" and three levels of "production sufficiency" onto a map. Arrondisements (districts) with millet and sorghum production greater than 190 kg. per person and a variability of less than 50% were given a rating of 0.0 and were not considered "vulnerable". Areas with production greater than 190 kg. per person but where variability was greater than 50% were given a rating of 1.0 and considered "slightly vulnerable". Areas with production between 140 kg. and 190 kg. per person and variability greater than 50% were given a rating of 2.0 and considered "moderately vulnerable". Ares with production less than 140 kg. per person were given a rating of 3.0 and considered "extremely vulnerable".

Current Vulnerability Ratings were produced in a similar way with three levels of current cereal prices overlaying three levels of cereal stocks and areas allocated rating of 0.0, 1.0, 2.0 and 3.0. An Overall Vulnerability Rating for each Arrondisement was then derived by summing the ordinal scores for each factor/indicator (1-13) and dividing by the number of indicators

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Table 4 Summary of Indicators for Vulnerable Arrondissements in Niger

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Department/ Arrondissement	Total Popultn	NDVI/ Pasture	89 Prod KG/CAP	88 Prod KG/CAP	80-89 Prod % Change	89 Prod vs Avg % Change	Currnt Stock	Mil Prc vs Avg % Change	Irrig Gardn	Cash Crops	Remit-tances	Cross Border	Chronic Rating	Currnt Rating	Overall Rating
[illegible]	195,182														
[illegible]	29,506	avg/poor	165	50	-43	49	low	9	poor	-	-	imp	3	1	1.54
		low/poor	26	233	-36	-79	none	0	fair	-	-	imp	3	2	1.77
		low/poor	26	166	-10	-64	none	53	poor	-	sig	imp	3	3	2.00
[illegible]	1,503,636														
[illegible]	168,363	avg/avg	88	205	-11	-38	none	0	poor	-	-	imp	2	2	1.23
	586,870	avg/NA	202	317	4	-6	low	5	fair	imp	-	imp	1	0	0.46
	371,419	low/NA	204	299	-14	-11	low	9	poor	imp	sig	imp	1	0	0.77
	200,794	avg/good	483	711	109	57	low	-1	none	-	-	-	1	0	0.62
[illegible]	1,494,860														
[illegible]	276,097	avg/avg	163	335	31	-12	low	30	poor	-	-	imp	1	1	1.08
[illegible]	1,376,996														
[illegible]raden	79,655	high/good	42	150	15	-64	none	-3	fair	-	sig	-	3	2	1.38
[illegible]	1,861,249														
[illegible]	696,767	avg/NA	187	331	-3	-22	fair	-13	good	imp	sig	-	1	0	0.45
	313,130	avg/avg	174	285	16	-9	low	40	poor	imp	sig	imp	1	1	0.85
	164,109	avg/avg	146	230	3	-20	low	33	good	imp	sig	-	1	2	0.92
	201,050	avg/avg	130	207	-20	-16	none	-3	poor	-	sig	-	2	1	1.15
	305,563	avg/avg	127	247	-16	-35	none	-19	poor	-	sig	-	1	1	1.15

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[illegible]OLUMNS AND SOURCES:

[illegible] Total population by department (GON) and by affected arrondissement (FEWS).
[illegible] Evaluations of Normalized Differential Vegetation Index (NASA) and pasture production (GON).
High, good or average = 0; low or fair = 1; poor = 2
[illegible] Millet and sorghum net production in kilograms per capita (GON). > 190 = 0; 140-190 = 2; < 100 = 3
[illegible] Millet and sorghum net production in kilograms per capita (GON). > 190 = 0; 140-190 = 2; < 100 = 3
[illegible] Percent change in millet and sorghum production, 1980-89, based on GON data.
Increase = 0; no change = 1; 15-25% decline = 2; > 25% decline = 3
[illegible] Percent change in millet and sorghum production, 1989 vs 1980-89 average, based on GON data.
< 5% change = 0; 5-25% decrease = 1; 25-50% = 2; > 50% decrease = 3.
[illegible] Current cereal stocks based on USAID field trips. Fair = 1; low = 2; none = 3
[illegible] Percent change in millet price, April 1990 vs 1985-89 April average.
No change or lower = 3; 5-10% higher = 1; 10-20% higher = 2; > 20% higher = 3
[illegible] Condition of off-season garden production, 1990, based on USAID field trips. Good = 0; fair = 1; poor = 2; none = 3
[illegible] Cash crop importance as income component, based on USAID field trips. Important = 0; "-" or not a component = 1.
[illegible] Remittance significance on cereals purchase, based on USAID field trips. Significance = 0; "-" or not a component = 1.
[illegible] Proximity to Nigeria, Benin or Burkina for cross border trade & cereals access. Important = 0; "-" or not a factor = 1.
[illegible] Chronic Food Insecurity: Initial assessment of structural food security based on production sufficiency and variability from 1980-89 (see Map 2). Rating derived from overlay of 3 levels of production variability on 3 levels of production sufficiency (see text for detailed scoring). Not vulnerable = 0; slightly vulnerable = 1; moderately vulnerable = 2; extremely vulnerable = 3.
[illegible] Current Risk from Food Insecurity: Initial assessment of immediate risk from food insecurity based on stocks at 1989 harvest and millet prices for April 1990 (see Map 2). Rating derived from overlay of 3 levels of cereal prices of 3 levels of cereal stocks, (see text).
Not vulnerable = 0; slightly vulnerable = 1; moderately vulnerable = 2; extremely vulnerable = 3.
[illegible] Overall Vulnerability Rating: Final score derived from ordinal ranking of factors (1) to (14); sum of each factor divided by the number of factors.

Source: FEWS 1990

Some of the techniques may be questioned, for example why were the chronic and current maps accorded the same weighting as single indicators such as the condition of off-season garden production? However, the method is experimental and is likely to be refined by the time of the 1991 Vulnerability Assessment.

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CHAPTER 3

PREPARING BASELINE VULNERABILITY MAPS: A TENTATIVE GUIDE FOR WFP COUNTRY OFFICES

3.1 Introduction

The objective of this study is to devise a method for WFP Country Offices to use in formulating maps of baseline vulnerability to food insecurity. Having reviewed the range of potential approaches to the mapping of vulnerability to food insecurity in Section 1.3, and the actual experience of efforts to map vulnerability in Bangladesh and Sudan and the FEWS Project in the Sahel and Horn of Africa in Chapter 2, the task now is to select an appropriate method for WFP Country Offices operating in a range of contexts. This is done in Section 3.2 . Section 3.3 then sets out the method giving a step by step practical guide for use by Country Offices undertaking the preparation of maps of baseline vulnerability using the approach selected.

3.2 Selecting the Most Appropriate Method of Mapping

In selecting the most appropriate method for WFP Country Offices to map baseline vulnerability to food insecurity, it is necessary to take account of a number of considerations. Three are of particular importance:

i) the purposes to be served by the maps and the process of preparing them;

ii) the considerable variation in the contexts in which WFP Country Programmes operate;

iii) the level of the resources that are likely to be available for the mapping process.

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The Purposes to be Served by the Maps and the Process of Preparing Them

As noted in Section 1.1 WFP Headquarters envisages that maps of baseline vulnerability may serve the following purposes:

- weighting allocations within regular food aid programmes supported by WFP and other donors;
- highlighting those areas of a country where WFP and other agencies might consider starting new regular programmes and/or concentrate their existing activities;
- highlighting those areas of a country that should be monitored more closely, particularly during times of food shortage and stress;
- providing background information for Country Offices and visiting WFP staff/consultants on spatial variations in vulnerability within the country;

It is also envisaged that the process of preparing the maps will be educative, helping to stimulate greater consideration of issues relating to food insecurity within the WFP Country Office and also within the Government and amongst other donor agencies.

The Variation in the Contexts in which WFP Country Programmes Operate
WFP operates Country Programmes in most of the 80 or so countries classified by the World Bank (1990) as "low income" and "lower-middle income". WFP operates in countries as diverse as Ethiopia, Mauritius, China, Jamaica, Mozambique, Columbia and India. At this stage there is no indication as to how many Country Programmes might undertake a vulnerability mapping exercise. Nevertheless, the method devised for mapping baseline vulnerability should be capable of working effectively in a wide range of contexts.

From the perspective of mapping baseline vulnerability to food insecurity, some of the key characteristics that will need to be taken into account in the mapping process are the level of national income, the distribution of income both spatially and by social class, the nature of the food security problems, the frequency and type of shocks and disaster events, the availability, coverage and quality of statistics, the size of the country, the density of its population and the complexity of agro-economic variations in the country.

Some of these characteristics tend to vary with national income levels. Thus in the poorest low-income countries food security problems are invariably of a national scale. The countries are exposed to political and economic shocks and disaster events, which by virtue of their poverty they are often ill-equipped to cope with. The level of vulnerability to food insecurity therefore is generally very high. In such countries the available statistics are invariably of poor quality and coverage and often based upon out of date data.

At the other extreme are those middle-income countries where food insecurity is not widespread but may be restricted to spatially or socio-economically defined pockets of food insecure and malnourished groups. Such countries may also be exposed to frequent economic and political shocks and disaster events but, by virtue of their higher levels of income and better developed infrastructure are better able to cope and consequently have comparatively low levels of vulnerability. Available statistics in such countries are generally of adequate to good quality, coverage and often upto date.

Cutting across these broadly associated characteristics are those of area, population density and complexity of agro-economic variations. Thus each of the above extremes may contain countries which either cover a very small area or a very large area, have either a high or low population density and be either broadly uniform or highly varied in their agro-economic make-up.

The Level of Resources Likely to be Available for the Mapping Process.
WFP Headquarters has indicated that Country Offices should be able to prepare baseline vulnerability maps with a minimum of additional resources and external assistance. The existing capacity of Country Offices in terms of the skills, staff-time, and data processing and analysis is therefore an important consideration in devising an appropriate method for vulnerability mapping. Whilst funds might be available for, say, hiring the services of the Geography Department of a local University to assist the Country Office, it is extremely unlikely that the level of funds required for a substantial input by foreign consultants will be available. Country Offices will not be provided with sophisticated computer-based Geographic

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Information Systems, though it is conceivable that in some countries such services may be locally-hired from a University.

Thus, the method selected cannot involve new and rigorous research involving the collection of primary data. The method selected must rely on data which is already available. Where there are gaps in existing data it will be necessary that they be filled using methods which are of low-cost financially and in terms of staff time. For this reason, in countries where reliable data is lacking it will be necessary to utilise experience-based methods similar to the Delbeq-Delphi methods used in the Bangladesh case or, where appropriate, Rapid Rural Appraisal methods to draw in a structured way on knowledge at the local level.

The Method Selected

Taking the above considerations into account we have devised a tentative method for mapping baseline vulnerability to food insecurity which incorporates elements of four of the approaches discussed in Section 1.3, namely:

- spatial representation of data sets with national coverage
- key indicators of vulnerability to food insecurity
- Rapid Rural Appraisal
- Delphic methods

Central to our suggested method is the careful selection of administrative units (such as the province, district or sub-district) for use as the basic mapping unit and the identification of indicators of vulnerability to food insecurity which are capable of reflecting differences in vulnerability at the administrative level selected.

The use of administrative units rather than some other form of mapping unit more directly related to vulnerability to food insecurity (such as agro-economic zones), is necessitated by WFP being required to work with and through the host government administrative system wherever possible. This is entirely appropriate as the resource allocation decisions that may be based on the final maps of baseline vulnerability will be implemented through the existing administrative structures. However, the use of administrative units is potentially problematic as some administrative units may be composed of a range of agro-economic areas which differ significantly in terms of their vulnerability to food insecurity. Overcoming this potential problem requires the careful selection of administrative units and indicators.

In line with the definition of vulnerability to food insecurity introduced in Section 1.2, the country specific indicators must represent the two principle components of "risk of exposure" to shocks and disaster events and the "coping ability" of the population. No single indicator is likely to be available for either of these components so it will be necessary to select a number of indicators and combine them into a composite indicator of vulnerability to food insecurity that can be mapped for each administrative unit.

We distinguish between "objective", quantitative, data-based indicators and qualitative, information-based indicators. The former use factual information (such as population surveys and the length of all-weather road in an area), whilst the latter reflect the views of one or more people on indicators for which data is not directly available (such as an estimate of the strength of an area's "claim" on national and international relief

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resources in the event of a disaster). Whilst it may be preferable to rely on objective data-based indicators in mapping vulnerability to food insecurity it may be necessary, particularly in countries where the coverage and quality of available data is poor, to use subjective experience-based indicators.

For some of the potential indicators, data may already be available in a form that can be mapped directly. For instance in some countries the national data on the prevalence of poverty (a sub-component of "coping ability"), may already be available on the basis of the administrative units selected (province, district, etc.) and easily mapped. However, to gain a more complete picture of "coping ability" it will be necessary to complement the poverty indicator with other indicators (e.g.. the level of transport infrastructure and likelihood that the area will have access to relief supplies in the event of a disaster event). For such indicators data will not be available in a form which can be readily mapped and it will be necessary to choose a method for grading the indicator (possibly on the basis of distance of the administrative centre from a tarred road in the case of level of transport infrastructure) so as to present it in map form.

Decisions such as the choice of administrative unit and selection and method of representing certain indicators should not be made by the WFP Country Office alone. Indeed an objective of the process is to encourage the government and other donor agencies to consider issues of food insecurity and its spatial variation within the country. We therefore envisage that the process should be initiated and overseen by a small Steering Committee convened by the WFP Country Office.

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For all countries it will be necessary to combine maps of the various indicator of "risk of exposure" and "coping ability" into a final composite map. Some indicators will be felt to be a more significant determinant of the level of vulnerability than another indicator so it will be necessary to assign a weight to each indicator. This weighting process is largely subjective. In order to draw on a wide range of local knowledge and experience in assigning these weights we envisage the formation of a larger group or panel which we refer to as the Vulnerability Assessment Group.

As well as being responsible for weighting the data-based indicators, the Vulnerability Assessment Group also has the role of preparing their own subjective experienced-based maps of vulnerability to food insecurity. In countries where the data quality and coverage is good, such subjective experience-based maps may have only a minor role serving as a check on the composite map prepared using objective data-based indicators. However, in countries where data quality and coverage is poor the subjective experience-based maps will have an important role in complementing the composite, objective, data-based map. Thus in countries with inadequate data, we envisage an important role for Delbec-Dephi techniques similar to those used by Currey in preparing the original maps of vulnerability to famine in the Bangladesh case.

In all types of country context, we envisage that some form of Rapid Rural Appraisal is likely to be useful, either to help fill in gaps in the information available or to cross-check or "ground truth" the initial results of the mapping process.

3.3 Factors to be Considered Before Commencing the Mapping Process

Before commencing the step by step guidelines it is necessary to explain broadly how it is envisaged that the process might be carried out.

It is intended that the Country Office should play the lead role in the process within the country, but that agencies of the host-government should be encouraged to participate as fully as possible in the process. Other donor agencies involved in the provision of food aid or supporting food security measures should also be encouraged to participate.

There may be some countries where the Country Office does not consider it worthwhile to go through the mapping process. A number of possible situations can be envisaged.

1. There may be a few small, middle income countries, perhaps small island economies, where the spatial variation in vulnerability to food insecurity is so limited as to render the mapping process unhelpful.
2. In countries such as India and China it may be inappropriate for WFP to take the lead in such an exercise. However, if a similar process of mapping vulnerability to food insecurity has not already been carried out, the Country Office might encourage the host-government to initiate its own mapping process.
3. In some countries vulnerability to food insecurity may already have been mapped by a government agency, university department or another donor organisation. However, it is unlikely that such maps will completely meet WFP's requirements and it may be appropriate for the Country Office to initiate its own mapping process, but drawing on the existing study. As was done with the famine vulnerability maps produced by Currey in Bangladesh in the late 1970's, it may be appropriate for the WFP Country Office to build upon and tailor the existing study to suit its needs more directly.
4. In countries experiencing armed conflict it may appear that the concept of baseline vulnerability is invalidated as previously food secure areas with low vulnerability are rendered highly vulnerable as a result of the disruption of agricultural production and marketing systems and social dislocation caused by the conflict. In such situations it is unlikely that vulnerability can be measured in terms other than current vulnerability. However, a review of pre-conflict indicators of baseline vulnerability by the Country Office will be of use once hostilities have ceased and rehabilitation projects are required.

Thus careful consideration needs to be given as to whether to undertake the mapping process. We envisage that for most WFP Country Programmes it will be a worthwhile exercise. However, in some situations it may be inappropriate. In other situations it may appear inappropriate but there may be some value in proceeding with the process, though possibly in a modified way.

For ease of explanation the guidelines are presented as an idealised, linear sequence. In reality the sequence may be modified as result of staff changes involving those staff responsible for coordinating the process, possibly as a result of reassignment to other, higher priority activities such as an emergency programme. Similarly in some countries the results of a particular part of the sequence may be repeated because it was felt that the earlier results were unsatisfactory.

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There is no recommended timetable for the process. Some Country Offices may complete the process within a matter of months, whilst others may take considerably longer.

3.4 A Tentative Step by Step Guide for Country Offices

Step 1. The Country Office considers the primary purpose of developing baseline vulnerability maps and the implications of this in terms of the way the exercise is approached and which organisations/individuals should be involved and at what stage.

For instance, is the primary purpose:

i) to weight allocations of nationwide regular food programmes;

ii) to highlight those areas where WFP and other agencies might consider starting new regular programmes and/or concentrate their existing activities;

iii) to highlight those areas that WFP should monitor more closely, particularly during times of food shortage and stress;

iv) to identify spatial variations in vulnerability as background information for the Country Office and visiting WFP staff/consultants;

v) to encourage greater consideration of issues relating to food insecurity within the Country Office and also amongst the Government and other donor agencies.

If the primary objective is for monitoring purposes (ie. iii), it is very important that the activity should be closely integrated with existing and planned information/early warning systems. A map of baseline vulnerability that cannot be used in conjunction with maps of current vulnerability produced by an Early Warning System will be of limited use.

An important consideration at this point is the attitude of the Government towards the exercise. Ideally all governments should be properly briefed on the objectives of the exercise before it commences and then be fully involved in the process (e.g. by providing relevant officials to sit on the proposed Vulnerability Assessment Group). However, there are bound to be variations between countries in the official acceptability of the process and the WFP Country Office may decide to commence the process on a "closed" internal basis with the intention of involving the Government more fully at a later stage. If this is the case the steps described below involving the Vulnerability Assessment Group and the preparation of subjective, experience-based maps will therefore have a very limited role in the process so that it becomes almost entirely reliant on the objective, data-based methods. The utility of a map produced using mainly data-based methods will not be as great as one combining data-based and experience-based methods and this will have to be taken into account in the way it is used by the Country Office. During the course of their work and field visits Country Office staff may be able to obtain subjective, experienced-based maps from individuals they work with.

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Step 2. Country Office convenes a small Steering Committee which then plans the approach to be adopted and a rough timetable to be followed.

The composition of the Steering Committee should be decided by the Country Office. As an example, it might include a Government official, the representative of another food aid donor, an academic from a local University and possibly a person with long experience in many different areas of the country, perhaps a retired civil servant.

Step 3. The Steering Committee:

i) identifies the main causes of vulnerability to food insecurity both spatially and in terms of socio-economic group, using existing studies where they are available;

ii) assembles and reviews available national statistics on poverty and food insecurity in the country;

iii) decides on the appropriate administrative unit to be used in compiling the maps;

iv) selects the indicators for which reasonably reliable data is available and which can be taken as representing the baseline vulnerability for the scale of administrative unit selected.

v) prepares separate maps for each of the selected data-based indicators.

This step is a crucial part of the process and is likely to involve repeated meetings of the Steering Committee.

3.i. Identifying the main causes of vulnerability

In many countries studies will already be available which identify or shed light on the causes of food insecurity and possibly differences in the levels of vulnerability to food insecurity. The Country Office should assemble the available studies most of which will be obtainable from the relevant Government ministry, from local Universities and those donor agencies which have an involvement in food security issues. The Steering Committee should then review the available studies.

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In line with the definition of vulnerability to food insecurity introduced in Section 1.2, the examination of the causes of vulnerability to food insecurity should focus separately on the "risk of exposure" and "coping ability" components of vulnerability.

With the "risk of exposure" component the Steering Committee should consider the types of disaster (drought, flood, pest infestations, cyclone, earthquake, landslides, bushfires, etc.) that affect different parts of the country, their severity and frequency. This is likely to involve consulting historical records maintained by the relevant government departments and universities. Some countries have disaster management research and training institutes which have already collated such data and may even have prepared maps of the risk of different types of disaster for the country. In countries where the private sector insurance industry is well developed, insurance companies may have developed their own maps of "risk of exposure" as a basis for estimating their premiums.

The Steering Committee should not limit its consideration to natural disasters but should also consider risk of exposure to shocks such as conflict, the influx of refugees and displaced persons and sudden economic changes such as the removal of food or fuel subsidies as part of macro-economic adjustment measures. In some countries such "human induced"

shocks may have had a greater influence on levels of food security in the recent past than natural disaster events. Representatives of other UN agencies (e.g.. UNHCR, UNDP, the IMF, the World Bank, etc.) are likely to be among those best placed to comment on the likelihood of such shocks.

In considering the "coping ability" component, the Steering Committee will naturally spend much of its time examining the available studies on poverty and its distribution by socio-economic group and spatial distribution. In some countries the literature on the causes and distribution of poverty is substantial and it may be necessary to consult local Universities (probably the Sociology, Geography or Economics Departments) to gain an overview of the literature.

The Steering Committee should not just confine itself to poverty as a determinant of "coping ability", but attempt to identify other factors that may have contributed to a population's ability to cope and recover from earlier shocks and disaster events. This will involve an examination of earlier disaster events and accounts how the local population responded. Among the factors that might be considered are:
- access to alternative income sources during a time of crisis;
- the level of transport infrastructure;
- the strength of political representation of the area in the capital city;
- the level of social cohesion and community cooperation.

(See below and Annex 2 for a detailed discussion of a range of potential indicators of the ability of a population to cope.)

3.ii. Assembling and reviewing national statistics

The Steering Committee has to take a view of the adequacy of the available national statistics to describe baseline vulnerability to food insecurity. Statistics with a national coverage resulting from surveys and censuses carried out over the previous ten years should be assembled and reviewed:

a) for their quality (ie. accuracy, evidence of bias, etc);
b) for their age (ie. can they be considered up to date?)
c) whether they contain information directly relevant to food insecurity and vulnerability to it;
d) the lowest administrative level for which representative information is readily available (ie. without having to go back to original data).

Among the national surveys likely to be of most use are:

The Population Census
Household Income and Budget Surveys
National Nutrition Surveys
National Agricultural Censuses/Surveys
National Health Surveys
National Surveys of Access to Clean Water

Surveys of natural phenomena and resources such as National Soil Surveys, Ecological Zones and Maps of Mean Annual Rainfall and Variability, etc. should also be assembled.

In many countries these surveys and censuses will have been prepared with assistance from UN Agencies. Representatives of these agencies may be well-placed to comment on issues of data quality, coverage, etc. UNICEF Country Programmes usually monitor national indicators of poverty and well-being and should be able to indicate the range of national statistics available and their quality.

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3.iii Choosing the appropriate administrative unit

This is a crucial part of the process and is likely to involve repeated meetings of the Steering Committee. Initial decisions on the appropriate administrative unit to be used may have to be revised in the light of discussions over the quality of the data and ability of an indicator to represent the overall vulnerability of the areas covered by the administrative units. The support of other technical personnel within the Government, Universities or donor agencies might usefully be drawn on during this stage.

Several factors may be involved in the process of selecting appropriate administrative units, e.g. regions, provinces, districts, sub-districts, village councils, etc.

a) For an agency such as WFP which works with and through the host government's administrative system it is important to use a mapping unit based on the appropriate administrative unit. Therefore the various administrative levels used for development and emergency programme planning and management, need to be considered, as does the potential value of being able to distinguish vulnerability between different administrative units.

b) The homogeneity of the food systems within selected administrative units, e.g. farmers on irrigated or non-irrigated land, pastoralists, etc. The greater the heterogeneity, the harder it is to identify an indicator which describes vulnerability of the entire population within a unit.

c) The level of aggregation of accessible data. We assume here that WFP programme staff should not be required to undertake exercises of re-aggregating or disaggregating data.

d) The number of administrative units to appear on the map and the ability to visually distinguish between such units on the basis of some colour or intensity scheme.
This will also be affected by the number of gradings used to represent vulnerability. For large countries such as Sudan it is important to select a unit of sufficient size to ensure that not too many units are represented on the vulnerability map to allow a visual impression of different vulnerabilities. This becomes less of a consideration in small countries or islands.

It may ultimately be decided that there is insufficient homogeneity within the administrative units for which data is available (eg. because of significant agro-economic or cultural variations) to allow representation of the administrative units as single entities on a map. In such situations the Steering Committee might also decide to attempt to represent vulnerable groups numerically in tabular form rather than spatially on a map. The more the tabular representation of vulnerability can be disaggregated down the administrative hierarchy the more useful it will be.

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3.iv. Selecting indicators

The types of information which will be suitable for use as indicators of vulnerability to food insecurity will vary enormously between country. It is not possible here to provide an exhaustive list of potential indicators. Instead we outline the categories of potential indicators and briefly discuss some of those which are most likely to be available and of use in the mapping process.

We have attempted to classify indicators in a way that reflects the model of vulnerability proposed in these guidelines. We therefore identify two categories of indicator.

a) Indicators of "risk of an event"
b) Indicators of "coping ability"

Risk of event indicators are those which provide information on:
i) the likelihood of a shock or disaster event that will adversely affect food security, e.g. drought
ii) the likely severity and impact of that event.

Coping ability indicators are those which provide information on the capacity of populations affected by an event to withstand its effects. This class of indicator will therefore include data on poverty with its traditional focus on income generation, as well as non-monetary assets which potentially, through sale or exchange, provide an entitlement to food. Also included will be those indicators that reflect a <u>potential</u> to cope. These may include assets which are realisable but are not actually held, such as wild foods, or only likely to be utilised as a last resort, e.g. breading livestock. Coping strategies such as eating wild foods or selling key livestock, may well impose costs on the population/household in terms of family disruption, erosion of future subsistence base, and increased health and nutritional risks so that care should be taken in the way such indicators are treated in the vulnerability mapping process. Indicators of level of infrastructure and service provision will also fall within this class of indicator as a community-held asset which assists that community in withstanding an event.

One problem with attempting to assign all indicators within the two classes is that certain specific indicators could be classified under "risk of event" or "coping ability", e.g. nutritional status reflects an event as well as the capacity to withstand the effects of that event. Where this is so, the indicator is arbitrarily assigned a position under one indicator class for editorial convenience. This will be acknowledged in the text for each case.

Finally, the selection of indicators for these guidelines is influenced by recognition of the dangers of over-dependence upon supply/production side indicators in assessing vulnerability to food insecurity. There is therefore an attempt to ensure an even balance between such indicators and those which indicate effective demand and behavioural responses to support that demand.

CORDA

3.v. Preparing maps for each of the selected data-based indicators

A base map of the country should be prepared showing just the national borders and the boundaries of the administrative unit selected as the basic mapping unit. If the Steering Committee considers that the map requires drawing skills beyond their capacity, the preparation of the map may be contracted locally. This base map will be used for mapping all the data-based indicators, preparing the subjective, experience-based maps and for the final, overall map of vulnerability, so it should be prepared to a scale that can be readily copied (e.g. A3 or A4 size paper).

The values for all the objective, data-based indicators selected should be graded using an appropriate number of grades. Those data-based indicators on variables which are thought to have a significant impact on vulnerability and for which reliable data are available, should be assigned a greater number of vulnerability grades than other less significant indicators. For example, if rainfall levels are believed to significantly affect vulnerability, and are likely to be accorded a sizeable weighting in the final composite vulnerability map, then it may be necessary to have seven or eight grades of vulnerability as a mis-classification of a mapping unit by one grade (eg. as a result of inaccurate data) would have a significant bearing on the final vulnerability score given to that mapping unit. The highest and lowest grades should reflect the highest and lowest values for each indicator. The values for each indicator for each administrative unit can be shaded onto the base map using various degrees of shading intensity.

CGRDA

Step 4. The Steering Committee supervises the formation of a Vulnerability Assessment Group representing a wide range of skills and experience and knowledge of different parts of the country.

The role of the Vulnerability Assessment Group will be to:

a) weight the objective, data-based maps in order to produce a composite data-based map (see Step 5.)

b) prepare subjective, experience-based maps for comparison with the data-based maps (in countries where data quality and coverage is good) and complementing the data-based maps (in countries where the data-based maps are comparatively poor as a result of poor data quality and coverage). (See Steps 5 and 6)

c) weight the composite data-based map and aggregate subjective, experience-based map to produce a single map of baseline vulnerability to food insecurity (see Step 7).

The size and composition of the Vulnerability Assessment Group should be decided by the Steering Committee depending on the size of the country and the number felt to be manageable. It is recognised that a Group numbering significantly more than 20 is difficult to organise. However a larger group than this may be preferable given the importance of the Vulnerability Assessment Group in the process, in particular its role in the preparation of the subjective, experience-based maps.

In large countries the effectiveness of the Vulnerability Assessment Group may be limited by the lack of individuals with a sound knowledge of all the different regions of the country. It will be up to the Steering Committee to decide whether this is the case in their country. As a very approximate rule of thumb we would suggest that this issue be given very careful consideration if it takes more than two days to drive from one border to

another in a north-south and east-west direction. In such "large" countries it may be necessary to form Regional Vulnerability Assessment Groups which prepare their own subjective, experience-based maps which are subsequently combined to form a national subjective, experience-based map. This process is potentially problematic as it will be difficult to grade the regional experience-based maps according to some sort of national standard. A method for reducing the difficulties of preparing national aggregate subjective maps in large countries is suggested in Step 5.

Step 5. The Vulnerability Assessment Group:
i) reviews the maps of objective, data-based indicators produced in Step 3;
ii) prepares an aggregated subjective map ranking the vulnerability of each administrative unit.
iii) compares the subjective and objective maps.

In reviewing the maps of objective, data-based indicators, the Vulnerability Assessment Group may suggest additional indicators and data series for the Steering Committee to explore and present back to the Vulnerability Assessment Group. Some indicators may not be felt to adequately describe vulnerability and be discarded.

The aggregate subjective, experience-based map is produced by:

a) A member of the Steering Committee makes a presentation to the Vulnerability Assessment Group explaining the concept of vulnerability, its two main components and the factors that should be borne in mind when completing the ranking exercise.
b) Each member of the Vulnerability Assessment Group ranks their subjective perception of the vulnerability level of each administrative unit onto a blank map perhaps using a scale of 1-4. Problems which may arise at this stage are.
i) reluctance to accept constraints of administrative boundaries,
ii) difficulty in discounting current vulnerability from the perception of baseline vulnerability,
iii) different knowledge of areas between respondents and differences in respondent models of risk/vulnerability.
c) The average of the aggregate score for each administrative unit is calculated and the aggregate subjective map is prepared using 4 shades of the degree of vulnerability.

In large countries where many of the individuals on the Vulnerability Assessment Group do not have a sound knowledge of all the different regions of the country, the following process might be employed:

i) the Vulnerability Assessment Group should specifically include a number of representatives from each region;
ii) before the subjective experience-based maps are prepared there should be a discussion of differences in vulnerability between regions;
iii) the regional representatives should only complete the maps for their region;
iv) working groups composed of the representatives of two diverse regions should be convened with other members of the Vulnerability Assessment Group familiar with the two regions. The working groups should review the range of ranked grades of vulnerability and attempt to gain agreement on the relative grades for the two regions.

CCRDA

v) the regional maps should be transferred onto a national base map. If difficulties are experienced in gaining agreement on the ranking of particular areas a greater range of values (say 0-10) might be used at this stage and then converted back to a 1-4 grading for the preparation of the aggregate subjective map.

Step 6 The Vulnerability Assessment Group decides on:
i) the overall weighting to be accorded to the objective, data-based and subjective, experience-based maps;
ii) the weighting to be accorded to each of the objective indicator maps.

If the objective indicators are considered to be comparatively few and weak in terms of describing variations in vulnerability then the Vulnerability Assessment Group may decide to accord less weight to the data-based map and more to the aggregate subjective map, e.g. 30% to the data-based map and 70% to the aggregate subjective map. Similarly if there are many data-based indicators which are considered to be powerful indicators then a higher weighting might be accorded to the data-based map than the aggregate experience-based subjective map.

In similar vein, if one of the objective indicators is considered to be a particularly strong determinant of baseline vulnerability then this might be accorded the bulk of the total score available to the objective group of indicators. Some decision about this may already have been taken in step 3.v. when preparing maps for each of the selected data-based indicators. At this stage the number of vulnerability gradings for each data-based indicator map will have been determined by the overall "strength" of the indicator in identifying vulnerability to food insecurity and the need to minimise inaccuracy.

CCRDA

Step 7. The Steering Committee produces the final Composite Map and presents it to the Vulnerability Assessment Group for review.

This is carried out by expressing each data-based indicators score for each mapping unit as a fraction of the maximum score possible for that indicator, e.g. if the score is 2 out of 4 possible scores (1-4) then the fraction is 0.5. This fraction is then multiplied by the overall weighting given to the particular indicator for the final composite map. Thus, if the indicator is given a weighting of 5% then the final contribution of this indicator to the final composite map will be 5% multiplied by 0.5 = 2.5%

The same process will be gone through for the subjective experience based maps once an average score is calculated for each mapping unit. A fuller example of this calculation process can be found in the Sudan case study in chapter 4.

Step 8. The Steering Committee evaluates the process and agrees on how and when the map should be revised/updated.

How the final Composite Map is disseminated and used will depend on a number of factors which will vary between countries. This is a matter to be decided locally. Ideally the map will be widely disseminated together with a summary of the process gone through and why certain indicators were chosen and others not used. Those involved on the Steering Committee and the Vulnerability Assessment Group may wish to utilise the

map in regard to their own programmes and encourage others involved in food security, poverty alleviation and resource allocation generally to make use of the map. Ideally the process would be evaluated.

CCRDA

CHAPTER 4.
AN EXPERIMENTAL APPLICATION OF THE METHOD OF MAPPING BASELINE VULNERABILITY IN THE SUDAN

4.1 Introduction

During the course of this study, the authors visited Sudan for ten days. The primary justification was to review the WFP Country Programme's initial attempts to map levels of chronic food insecurity (see Section 2.4) and to examine ways in which the mapping process could be improved upon at the level of the Rural Council. In addition, the visit enabled discussion of WFP's vulnerability mapping experiences in Bangladesh with the Director of Operations in Dhaka during the early 1980s, who by 1990 was the Director of Operations in Khartoum.

During the visit an attempt was made to test some of the methods set out in Chapter 3 for mapping baseline vulnerability to food insecurity at the Rural Council level. Data for a number of different regions were considered but Darfur Region was focussed upon as:

i) the authors were most familiar with this part of the country as a result of previous visits;

ii) North Darfur is comparatively well covered by reports of food security (eg Swift and Gray 1989);

iii) personnel from WFP, the Regional Government and NGOs involved in food-security related activities in Darfur were, fortuitously, in Khartoum at the time of our visit. This presented an opportunity to prepare subjective, experience based maps of baseline vulnerability, to discuss the reasoning of the individuals after they had completed the maps and to compare the maps with the available data sets for Darfur.

This Chapter presents the results of this preliminary testing of the methods and discusses some of the practical difficulties encountered. The material is presented in a form which may serve as a more detailed, practical demonstration of some of the key steps in the tentative guidelines outlined in Chapter 3. The initial and final steps in the process are not considered as the discussion would be too hypothetical and of limited interest to other Country Offices.

4.2 Data Availability and Quality in the Sudan: General Comments

There is a substantial amount of data within the Sudan relevant to vulnerability to food insecurity. However, much of the data is now out of date. For instance the last national census was carried out in 1983. The last National household income and budget survey was conducted between 1978-80 and was based upon extremely small sample sizes. The more current data that exists within the different regions of Sudan have mostly been collected by different agencies often using different methodologies with the result that regional comparisons are difficult.

The quality of much of the data used in the baseline surveys currently being compiled by UNDP in conjunction with the Institute of Environmental Studies of Khartoum University for Darfur, Kordofan, Eastern and Northern Regions are known to be poor. For

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example, the 1986 Darfur baseline survey (IES 1988) relies heavily upon household budget survey data collected by the relief agency Save the Children Fund as part of its relief monitoring and targeting activities in the Region in 1985-86. Several reviews of this survey have identified systematic bias in the data (ie. respondent underestimates of resources) as the survey was linked to emergency food allocations. In the final analysis greater weighting was given to subjective estimates of rural council need than the quantitative household budget data (Shoham and Borton 1989).

Another factor that affects the quality of data relevant to food security in the Sudan is the difficulty in quantifying certain types of indicator. For example the availability of wild foods, the levels of famine distress migration as opposed to normal seasonal migration, and the capacity for communities to support vulnerable groups from their own resources are all important indicators of vulnerability but are extremely difficult to quantify.

Finally, the quality of data can vary considerably between regions as can the way the data is presented. Thus, whereas for Darfur much of the data collated by the UNDP/IES reports is for the rural council level, it is understood that in Eastern region the majority of the data are aggregated and presented at regional level.

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4.3 Area Unit Selection in the Sudan

By considering a variety of factors, it was decided that the most suitable area unit for vulnerability mapping in the Sudan is the rural council. The use of the rural council as the basic mapping unit represents a compromise and was recognised to carry with it a number of difficulties for the mapping of vulnerability.;

One problem is that because of the large size of most rural councils it is extremely difficult to identify indicators that can confidently be thought to represent baseline vulnerability to food insecurity of an entire rural council. On average there are 20 rural councils per province which gives approximately 250 rural councils in the northern half of the country. Many of the rural councils in North Darfur measure at least 50 Kms by 80Kms.

Factors which fit models of food insecurity such as soil quality or level of disposable assets may therefore only apply to population groups adopting particular food procurement systems. For example, if a large population group in a rural council is comprised of families who rely predominantly on seasonal migration of certain family members to distant agricultural or labour schemes, then local rainfall variability/levels will be less relevant to their food security than population groups within those rural councils relying on rainfed agriculture for traditional subsistence. Smaller mapping units such as the village council would ideally be used in order to have confidence in representative indicator values. However, in a country as large as Sudan this would lead to an extremely large number of mapping units and final map of such complexity that visual clarity may be significantly reduced. Clearly, there is a trade-off between the practicality of constructing maps and their eventual utility, with the capacity to identify representative indicator values.

A related issue which then emerges is whether reliable data exists on different socio-economic groups employing different food procurement systems within the same rural councils and how such groups might be represented in a vulnerability mapping exercise. Even if reasonable baseline data were available on the proportion of different population groups within a rural council so that majority groups could be identified and representative values of vulnerability assigned to such groups, the problem of adaptation of livelihood systems remains.

In a country such as Sudan where drought, floods and conflict are common, populations frequently adapt by adopting alternative patterns of subsistence. For instance in North Darfur, some population groups have adapted to rainfall variability by switching to camel herding and this pastoral system coexists alongside others based on sheep and goats. Many households may also complement their income from livestock with other sources of income. A recent livestock survey in the Red Sea Province by Oxfam (1990) states that almost all pastoralists have non-livestock means of providing resources. If this resource access is not available within a household then it is usually accessible through tribal lineage. Thus, reliance upon livestock as the sole source of livelihood within the Red Sea Province is relatively rare. In this context it becomes extremely difficult to define population groups, even within the same rural council on the basis of one predominant food system.

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4.4 Potential Indicators and Data Sets for Defining Baseline Vulnerability

The majority of the indicators and data sets examined were for Darfur Province as this allowed comparison with the subjective, experience-based mapping exercise. Nevertheless many of the points raised in relation to specific indicators will probably apply to other regions in the Sudan. It must also be stated that not all indicators relevant to vulnerability in Darfur and Sudan were considered. Thus, indicators of flood risk or large refugee influxes have been omitted from the analysis. Rather, the purpose of the exercise was to assess the ***types of problem*** (rather than an exhaustive review of all the problems) that would be encountered in utilising specific indicators to map rural council vulnerability.

a) Rainfall Levels/Variability:

There are good historical and current records of rainfall levels and variability in the Sudan (Eldridge, Salter and Rydjeski 1986). Mean quantitative rainfall levels are readily available by area and rural council as are standard deviations around the mean. However, within rural councils there are inevitably differences in rainfall levels and variability with the greatest variation in those rural councils which span different isohyets. In spite of these intra-rural council variations, some confidence can be placed in mean rural council rainfall levels and variability as an indicator of vulnerability to food insecurity. This is because most socio-economic groups (as defined by a predominant food procurement system) will be adversely affected by inadequate rainfall whether this affects their own crop production, livestock grazing capacity and health, demand for agricultural labour, or market prices.

b) Soil Type and Quality

Information on soils is readily available within the Sudan. Once again, however, these differ significantly within rural councils. Soil types in Darfur alone include, semi-desert, goz, alluvial, shallow skeletic soils on pediment, and volcanic (Ibrahim. F., 1984). Several studies, including the tentative map of chronic food insecurity in Sudan prepared by the WFP Country Office (see Section 2.4), have attempted to rank rural councils on the basis of soil productivity for different crops, (high, medium and low). However, this can only properly be done in conjunction with information on rainfall and crop type so that the marginality of soils must be defined in terms of at least three variables.

To add to this complication is the fact that farmers have developed methods for spreading risk in an extremely drought-prone environment. Such methods frequently involve the cultivation of several different crops. Thus if rains for millet fail then farmers may switch to water melon. Added to this difficulty is the problem discussed above of the differences in the food systems of different population groups within a rural council. Traditional farmers who mainly rely upon millet production for subsistence will be more affected by soil type and productivity than cattle or camel herders who may indeed have switched away from crop production because of poor soils to a more profitable and secure food system.

In conclusion, indicators of soil type and quality are probably not an appropriate indicator of rural council vulnerability to food insecurity.

c) Evidence of Recent Severe Food Crisis/Large Scale Distress Migration:

Some confidence can probably be placed in data on large scale distress migration/destitution and the place of origin of such populations. Although there are certain general qualifications in using such data (see Annex 2), we would support the use of data on recent distress migration/destitution presented as a qualitative or nominal indicator on a rural council basis as a suitable indicator of baseline vulnerability within the Sudan.

d) Access to Alternative Forms of Livelihood Provision:

The following are potentially important forms of livelihood provision in the Sudan.

i) Income Generating Activities

Data on average values of earned income calculated on a rural council basis is available in the Sudan, e.g. SCF Darfur data and Oxfam Red Sea Province data (Shoham and Borton 1989). However, as previously discussed, there have been many criticisms concerning the quality of these data. In the Sudan case an alternative to using quantitative data on this variable may be to qualitatively grade rural councils on the basis of access to income generating activities such as agricultural schemes or urban jobs on the basis of proximity to such employment sources. It is probably not possible in Sudan to distinguish between rural councils on the basis of other income generating activities, such as the percent of households involved in cash crop sales or making goods to sell or collecting items to sell/petty trading, unless upto date household budget data were available.

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ii) Saleable Assets
Credible rural council data on saleable assets are not available. For instance livestock data in the 1986 Darfur baseline study is based upon a 1973 Livestock Marketing Corporation report. Even if such data were accessible from household budget surveys then it would be necessary to make certain assumptions regarding the degree of sale possible without undermining long term viability, e.g. viable herd size. Furthermore, it is oversimplistic to assume that levels of assets correlate with food insecurity. The Oxfam livestock study in the Red Sea Province states that the only livestock ownership patterns that correlated with food insecure areas were those where households possessed sizeable herds of sheep and goats. Ownership of cattle or camels bore no relation to vulnerability (OXFAM 1990). To some extent indicators of saleable assets are proxied by evidence of recent severe food crisis/distress migration and destitution.

iii) Remittances from Absent Migrant Workers in Sudan or the Gulf States
Such remittances undoubtedly form an important component of household coping strategies in Sudan. Unfortunately, there are no data on these incomes which could be used to represent differences between rural councils.

iv) Wild Foods Consumption
The use of wild foods is an important coping strategy for many households in the Sudan during the lean season as well as during crisis periods. There is undoubtedly variation in the availability of wild foods between rural councils. However, there are no data available on these rural council differences. It may be possible to draw upon qualitative assessments of knowledgeable local specialists to distinguish between rural councils but this would require a considerable process of discussion and revision before any confidence could be placed in ensuing estimates.

v) Community Support for Vulnerable Groups
It is traditional amongst many communities and tribal groups within the Sudan to support the poor and vulnerable in times of hardship, e.g. the Islamic alms tax *Zakat*. However, the extent to which this actually occurs will depend upon the existing resources of richer community members and the extent to which traditional structures have been eroded. Although there can be no doubting the importance of this coping strategy for many poor households, it would not prove possible to map such capacity and propensity to support the poor, on a rural council basis.

In conclusion it must be said that within Sudan the vast majority of baseline vulnerability indicators that reflect access to alternative forms of livelihood are probably best proxied by recent evidence of severe food crisis/large scale distress migration.

e) Level of Infrastructure/Marketing Networks/Regional Food Stores

There are significant problems in representing such variables on the basis of rural councils. For instance there are few all-weather roads in North Darfur. Should the extensive areas well away from such roads all be assigned the same grading of vulnerability? If a rural council has a large market in the main town, does this mean that the

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population in the rest of the rural council are assigned the same level of vulnerability as those adjacent to the town? If a road passes through the corner of one rural council and through the centre of another is there a discernible difference in their level of baseline vulnerability? Our conclusion is that such considerations are best taken account of by those knowledgeable of the area in preparing the subjective, experience-based maps.

f) Nutritional Status Data

The most recent National nutritional survey in Sudan was carried out between 1986-7 (SERRIS 1987). Since then there have been some NGO and Ministry of Health surveys in different regions but the majority of these surveys have been ad hoc and in response to requests for food aid in order to confirm the need for intervention. Growth monitoring through rural health centres is poorly managed and has undoubtedly suffered from the inadequate funding over recent years. It is understood that the Nutrition Unit in the Ministry of Health in Khartoum has not received growth monitoring reports from most areas of the country for the last 3-4 years.

An important point to consider in the Sudan is that weight-for-height data which are the normal measure used to assess current nutritional status and was the indicator chosen for the 1986-7 National Survey, will not identify chronic malnutrition. Weight-for-age data would be more appropriate for baseline vulnerability mapping. As has repeatedly been shown in the Sudan, weight-for-height data can be extremely sensitive to seasonal fluctuations and current food insecurity conditions (Table 1).

Table 5 Oxfam Nutrition Survey Reports for Malha and Mareiga

Mareiga	under 80% Wt for Ht
June 1988	22.2
Oct 1988	24.8
Jan 1989	4.3
Aug 1989	22.7
Nov 1989	11.9

Malha Town	under 80 Wt for Ht
June 1988	19.6
Sep 1988	25.5
Jan 1989	5.0
July 1989	14.8
Nov 1989	5.7

Source: Jaspers 1989

It is also important to note that the SERRIS data shows marked variations in the rates of malnutrition within rural councils (Table 6) and that this is thought to reflect the wide variation in agrosocio-zones between village councils. Indeed the strongest predictor of nutritional status in the SERISS survey was village council which tends to confirm the above.

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Table 6: SERISS Results for Rural Councils in North Darfur

North Darfur Rural Councils	Village Councils	% under 2 Standard deviations
Kutum	Guri	19.1
Kutum	Tumartim	23.7
Kebkabiya		43.9
El Serif		27.7
Tawilah		24.6
Korma		27.9
Katal		11.6
Silel'ah		17.4
Habila	Masmagi	23.8
Habila	Mamoon	15.0
Mukjar		11.7
Seraf Omra		20.5
Katal		25.0
Fascher	Shagra	8.9
El Lait		22.7
Fascher	Hag Tigania	18.3
Geneina		11.4

Source: SERISS Report No 2 November 1987

In conclusion, it is believed that these factors do not predispose to utilising existing nutritional status data in Sudan as an indicator of the variation between rural councils for baseline vulnerability.

g) Water Resources

While it is possible to map the distribution of wadis, hafirs and boreholes for rural councils it is not so easy to relate these water sources to vulnerability of communities, as areas with uncertain supplies will almost certainly have evolved coping mechanism for seasonal shortages, eg. migration. It is unseasonal shortages that predispose to area risk and this would be described in the main by indicators of rainfall variability and recent distress migration/destitution. Thus, as it is not easy to determine proportions of populations at risk, i.e. without coping strategies, it may be better to incorporate this aspect of food insecurity by using the proxy indicators of rainfall variability and distress migration.

h) Conflict

Many areas of the Sudan are becoming increasingly insecure as a result of conflict which significantly affects the food security of these areas. The war in the South and incursions from Chad in the West coupled with escalating banditry have caused the numbers of displaced to rise. Clearly, mapping these factors into a picture of baseline vulnerability poses enormous difficulties. Firstly, conflict is by its very nature unpredictable. Secondly, vulnerable areas can only be identified from recent events and whilst this is useful in terms of assessing current vulnerability it is of little or no use in assessing baseline vulnerability. Thus, whilst it may be possible to broadly define areas in the South and the West as vulnerable to these types of insecurity, further disaggregation by area or rural council is impossible.

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However, insecurity caused by tribal conflict over access to land and water resources is possibly more predictable. At a local level certain areas are known to have periodic conflicts over these resources - especially when scarcity increases due to drought. There have been many examples of grazing disputes in Northern Darfur including the recent bloody conflict which took place between Mahria and Beni Halba in Idd el Ghanam area (IES 1988). To some extent, it may be possible to complement local knowledge of where events are likely with proxy indicators such as numbers of tribal groups within a rural council and normal migratory routes. Such data does exist but there is no proven correlative power with risk of conflict. Also, utilising evidence of past conflict as a predictor of possible future risk is problematic as past conflicts may have resulted in resolution and agreement. Furthermore, even if confidence could be placed in risk of conflict between certain tribal groups, the difficulty of representing this as aggregate risk for a rural council remains and involves estimates of the numbers at risk.

In conclusion, incorporating an indicator of tribal insecurity is probably best left to the subjective assessment component of vulnerability mapping rather than the part which attempts to utilise data sets.

4.5 Subjective Assessment of Baseline Vulnerability

With the difficulties facing attempts to utilise data-based indicators of vulnerability for rural councils in Sudan, it was seen as necessary to complement the few reliable data-based indicators with subjective, experience-based assessments. The balance of importance attached to data-based or subjective indicators would of course depend on the quality and number of the data-based indicators available.

As noted earlier four individuals working on food security related activities in North Darfur kindly participated in a simple exercise to obtain their views on differences in baseline vulnerability between rural councils and understand their reasoning in ranking some rural councils as having a greater level of baseline vulnerability. The individuals were the WFP Representative in North Darfur (Deraige), a member of the Darfur Ministry of Agriculture's Agricultural Planning Unit (Sharpe), the Coordinator of the Sudanese Red Crescent's Drought Monitoring Programme in North Darfur (Omer) and the Oxfam Nutritionist based in El Fasher (Jaspers).

A number of difficulties emerged during this exercise.

1) Reluctance to accept constraints of administrative boundaries

All respondents felt unable to assign one vulnerability value to certain rural councils. These problematic councils were not the same for all respondents. Thus, of the 21 rural councils in Northern Darfur eight were identified as 'impossible ' to represent with one vulnerability grading. Five of these eight (Kornoi, Malha, Umkeddada, Kutum, and Kebkabiya) were identified by two or more respondents in this way.

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2) Difficulty in discounting current vulnerability from the perception of baseline vulnerability

Due to the recurrent problems in North Darfur, respondents confessed to having difficulty in eliminating awareness of current or recent crises in their assessments of *baseline* vulnerability. Whilst current and recent shocks and disaster events may, as we have argued earlier, have a significant bearing on baseline vulnerability, there may be situations in which this biases vulnerability assessments too much towards the current. This therefore requires discussion before respondents complete the map.

3) Different knowledge of areas between respondents and differences in respondent models of risk/vulnerability:

There were two problems here. Firstly, respondents had incomplete knowledge of the entire region. Thus, it would have been necessary to rely upon several groups of people to map vulnerability in Darfur. However, this would have carried the risk that respondents might employ different concepts and thresholds of vulnerability. An overview person or panel is therefore needed on a common understanding among all respondents as to concepts and thresholds of vulnerability and differences on a regional scale.

4.6 Correlation Between the Data-Based Indicators and the Subjective Assessments

The results of the subjective mapping exercise were compared with the available data-based indicators. The scores of the four respondents were totalled for each rural council and an average calculated. The average was then converted to a whole number score (e.g. 1 - 1.75 = 1, 1.75 - 2.5 = 2, 2.5 - 3.25 = 3, 3.25 - 4.0 = 4). Where respondents were unable to represent one rural council with one score, an average of the two scores were used. As can be seen from Table 7, the five most vulnerable rural councils were Malha, Mareiga, Umkeddada, Kuma and Kornoi, and the least vulnerable were El Lait, Tawila and Katal. This is also represented in map 5.

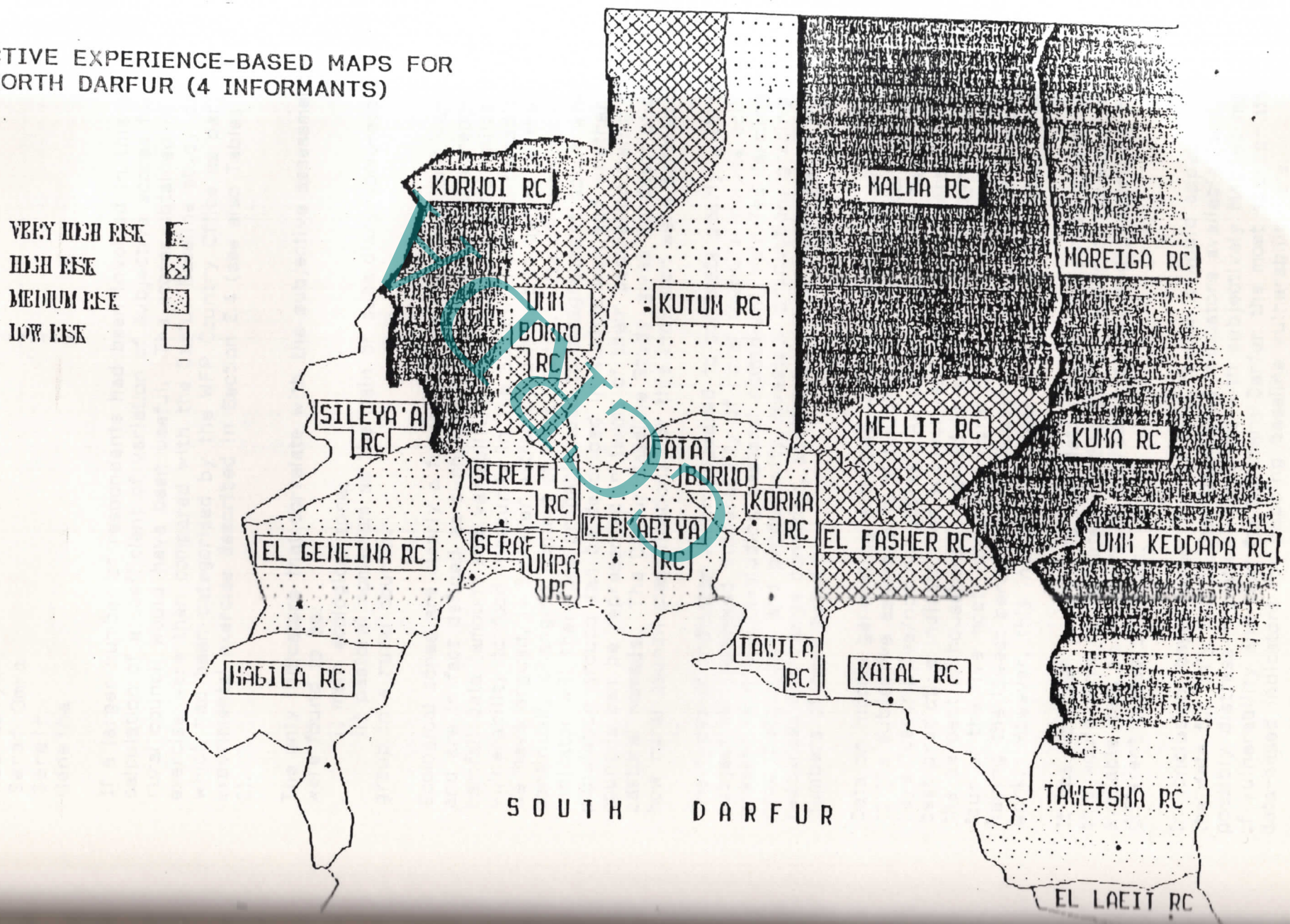
Table 7. Average Subjective Map Scores for Rural Councils in Northern Darfur:

Rural Council	Score (1-4)
Kutum	2
Fata Borno	2
Umboro	3
Kornoi	4
Mellit	3
Kuma	4
Malha	4
Mariega	4
Umkeddada	4
Tweisha	2
El Laiet	1
Fascher	3
Korma	2

CCRDA

MAP 5

SUBJECTIVE EXPERIENCE-BASED MAPS FOR
NORTH DARFUR (4 INFORMANTS)



Tawila	1
Kebkabiya	3
Seraf Omra	2
Sereif	2
Geneina	2

If a larger number of respondents had been involved in this process, calculation of a coefficient of variation of subjective scores for each rural council would have been useful. The scores obtained in this exercise were then compared with the Darfur Baseline study data which had been categorised by the WFP Country Office as part of the experimental exercise described in Section 2.4 (see also Tables 2 and 3).

The only indicators that correlate with the subjective assessments were found to be:

i) main ecological zone;

ii) pastoral nomadism as the main or subsidiary socio-economic group in a rural council.

Ecological zones are clearly a function of rainfall level and variability and are in fact defined as such. We have argued in this report that rainfall data (amount and variability) is probably a good indicator of vulnerability to food insecurity in the Sudan. Pastoral nomadism, as we have argued, is however extremely difficult to define in the continually changing context of rural Sudan. Use of such an indicator will therefore probably lead to disagreement about whether population groups can be described in such a way and whether rural councils can be represented in terms of their population being mainly pastoral nomads. The Darfur Baseline Study gives no description of how rural council classifications for this indicator were arrived at.

The types of indicator which appeared to correlate poorly with the subjectively assessed vulnerability of rural councils include soil type, present land use (excluding pastoral nomadism), rain-fed farming, crop distribution and productivity, livestock production, grazing resources and range condition, aquifer potential, water yards and numbers of bore holes.

Data on income generating activities were also assessed with respect to the subjective assessments although these were not converted into keys (descriptive/nominal scores). As can be seen from Table 5 the best predictive indicator for subjectively assessed vulnerability is the percent of households involved in agricultural employment with four of the five most vulnerable rural councils (subjectively mapped) having the lowest percentage of households involved in this type of work. However, this indicator is clearly more sensitive than specific.

It has not been possible to test data on recent distress migration as this would have necessitated visiting Darfur region to collect available data on numbers of distress migrants and proportions from different places of origin.

In conclusion, based upon this cursory review it would appear that the data for only two of the data-based indicators available (and possibly distress migration) correlate with subjectively mapped models of vulnerability and that for Northern Darfur the most appropriate data-based indicators for mapping baseline vulnerability are:

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TABLE 5

Percent of Houeholds Engaged in Income Generating Activities - North Darfur

Rural Council	No.	% H/holds with IGA	% H/holds with Employment	% H/holds involved in Agric. Labour	% H/holds involved in Casual Labour	% H/holds making to sell
Kebkabiya	17	16.88	4.12	5.88	6.47	4.12
Seraf Umra	11	32.76	4.55	2.73	15.46	7.27
El Serief	15	18.53	5.33	0.67	8.00	2.00
El Geneina	26	64.77	12.69	7.69	26.54	11.15
Habila	26	83.59	15.39	11.54	48.08	14.23
Tawilia	26	55.57	2.31	19.23	23.08	3.46
Korma	18	64.71	3.89	12.78	33.89	7.78
El Fasher	18	77.60	2.22	16.11	17.78	2.78
Katal	9	39.82	1.11	8.89	16.67	3.33
Kutum	28	45.10	7.50	9.64	23.21	4.29
Fata Porno	22	37.32	8.64	2.73	27.73	2.73
Um Borro	10	28.22	6.00	4.00	14.00	2.00
Kornoi	21	23.97	13.33	1.91	12.86	1.43
El Lamn	17	44.74	2.94	21.77	8.24	6.47
Umm Keddede	14	43.29	1.43	17.14	5.00	4.29
Mareiga	15	5.66	6.67	0.67	0.67	0.00
Kuma	7	56.37	10.00	0.00	4.29	17.14
El Malha	14	29.39	9.29	0.00	12.14	0.71
Mellit	17	54.62	12.94	0.59	11.77	11.77

Source: Save the children Fund, (1986).

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1) Rainfall levels and variability
2) Recent distress migration/destitution (within the last five years)
3) Physical access to off-farm agricultural and urban employment.

It must be re-iterated that the above discussion on data based indicators have been based on incomplete knowledge of Darfur and the various data sets available to describe conditions in the region. Much of the rationale might reasonably be described as subjective and over-simplistic in relation to the Sudanese context. It is however, hoped that the discussion succeeds in raising some of the issues involved in using data-based indicators to define areas of vulnerability and also demonstrates the type of process that will be gone through in selecting data-based indicators for this part of the vulnerability mapping exercise.

4.7 Weighting Issues

To produce composite maps of the data-based indicators and to then merge this with the composite subjective maps requires that each be weighted. This weighting process raises a number of difficult methodological issues. Although there are certain common principles to be followed in this process, each type of indicator will present different considerations and types of decision, such as cut-off points, representivity, etc. The indicators and maps selected and developed for Darfur demonstrate the types of issues and how a calculation and mapping process may be attempted. However, it cannot be over-emphasized that any figures used in this example for weighting purposes have been hastily derived and that a far lengthier and more thorough consultative process would have to be gone through before final decisions about weighting could be made.

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The first issue to consider is the relative weighting given in the overall national map to the data-based objective maps compared to the subjective experience-based maps. In this case we decided to allocate 50% of the weighting to both the objective and subjective maps. This is based upon the following considerations:
1) rural council representivity of data;
2) quality of the data;
3) confidence placed in the knowledge of those compiling the subjective maps;
4) the correlation between the data and the subjective maps.

One issue that emerges in deciding upon this particular weighting is that the greater the emphasis given to either the subjective or objective components of the map, then the greater the need for a gradation of that component. For example, if subjective maps were allocated 90% of the overall weighting then it might be necessary to have more than four grades of vulnerability, as a misclassification of one rural council by one grade would have a significant bearing on the final vulnerability score given to that rural council.

A similar consideration applies to the objective data-based indicators. In the Darfur example, we would suggest that for the remaining 50% of the overall weighting, the weighting given to each of the three indicators should be:

35% Rainfall level and variability
10% Recent distress migration
5% Access to off-farm agricultural or urban employment

As rainfall would have such a significant bearing on the eventual vulnerability score, an attempt should be made to allocate a larger number of vulnerability gradation levels than to other data-based indicators in order to minimise the risk of mis-classifying rural council vulnerability.

Although the issues concerned with utilising each type of data based indicator will vary it may be useful to consider **how** our three selected indicators might be weighted.

Rainfall levels/variability

Data on mean levels (in millimetres per year), variability (standard deviation around the mean), and probability of failure in relation to crop cycles, are available in the Sudan on a rural council basis. (IES 1988) If mean rainfall level is selected as the indicator then eight scores of vulnerability might be identified for northern Sudan, eg.

	score
100-200mm/year	= 8
200-300mm/year	= 7
300-400mm/year	= 6
" "	
" "	
" "	
800-900mm/year	= 1

Recent Evidence of Large Scale Distress Migration

This is given a fairly low weighting in the overall map (10%) for reasons of data quality, availability and representivity. If data can be obtained on the proportions of populations within rural councils that experienced distress migration in the last five years then after a process of extensive consultation the following scores might be applied:

	score
less than 5% of rural council population	= 1
between 5-10% of rural council population	= 2
between 10-15% " " " "	= 3
between 15-20% " " " "	= 4

Access to Off Farm Agricultural and Urban Employment

The low weighting given to this indicator (5%) again suggests the need for the minimum number of grading levels. This indicator might be graded on the basis of average days walking to an important employment source. After consultation the following type of scoring system might be adopted.

	score
Less than one days walk	= 1
None to three days walk	= 2
Three to seven days walk	= 3
One week to two weeks walk	= 4

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Subjective map scoring

Average scores for each rural council would be obtained and these would range from 1-4. Scoring might then be as follows:

score		
1.00 - 1.75	=	1
1.75 - 2.50	=	2
2.50 - 3.25	=	3
3.25 - 4.00	=	4

As an illustrative example of calculating baseline vulnerability scores and weighting them to produce a composite map, we set out below the process for a fictional rural council.

a)

Average subjective map score = 2.6

Vulnerability score therefore = 3 = $^3/_4$ (1) x 50% (maximum%) = 37.5%

Subtotal a = 37.5%

b)

Average rainfall = 280mm/year = score = 7 (8 possible scores of 1 - 8. A score of 7 is therefore $^7/_8$ of max. score of 8)

Thus vulnerability score = $^7/_8$ x 35%

Subtotal b = 31%

c)

Percent of rural council recently undergoing distress migration = 8%

This is equivalent to a score of 2 (4 possible scores of 1 - 4 and score of 2 is $^2/_4$ of max. score of 4)

Thus vulnerability score = $^2/_4$ x10% = 5%

Subtotal c = 5%

d)

Number of days walk from large employment source = 5 days.

This is equivalent to a score of 3 (4 possible scores of 1 - 4 and score of 3 is $^3/_4$ of max score of 4)

Thus vulnerability score = $^3/_4$ x 5% = 3.75%

Subtotal d = 3.75%

e)

Total Baseline Vulnerability Score

= 37.5 + 31 + 5 + 3.75 = 77.25%

Percentages can then be converted into grades equivalent to a colour scheme or shade intensity and depicted in map form.

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(1) There are 4 possible scores (1-4) and score of 3 is 3/4 of maximum score of 4.

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ANNEX 1.

A SUMMARY OF THE METHODS USED BY CURREY (1978) IN MAPPING AREAS LIABLE TO FAMINE IN BANGLADESH

The initial stage involved the establishment of four panels composed of 45 individuals each, with each panel representing a particular area of expertise, ie. "technical experts", aid distributors, senior retired government officials and village elders from a particular area of the country. Each panel was asked to identify those factors making certain areas liable to famine. This resulted in a list of 60 separate factors which were edited down to 30 indicators for which data were available and critical values assigned to them by 9 individuals from the panel of "technical experts". In addition the individuals on each of the panels (excluding the village elders) were asked to identify the areas of the country they considered to be liable to famine. The "mental maps" of each individual were then combined to produce a Combined Mental Map for each panel.

A nominal group of 9 individuals from each of the panels of senior retired government officials, the aid distributors and the "technical experts" then met for two sessions. In the first "Delbecq Session" the 30 indicators with critical values were ranked with the ten highest ranked indicators being taken forward to a second session known as a "Delphi Session". The ten indicators selected were: liability to flooding, drought, population pressure, food deficit, lack of alternative employment areas, low crop yield, poor land transport, river erosion, cyclones and maldistribution of agricultural inputs. During the Delphi Sessions the ten indicators were then assigned "importance weightings", so that the more important the perceived role of the indicator in making an area liable to famine the higher the weighting. The importance weightings assigned to the ten indicators were:

- flooding areas 16.4%
- drought areas 15.4%
- population pressure 13.7%
- food deficit areas 13.4%
- lack of alternative employment areas 12.6%
- low crop yield areas 11.8%
- poor land transport areas 6.9%
- river erosion areas 5.6%
- cyclones 1.8%
- maldistribution of agricultural inputs 1.8%

The panel of technical experts then selected "critical values" for each indicator using data sets which were considered to be comparatively reliable. Thus the critical value for the drought indicator was taken to be those areas with less than 80% probability of receiving 2 inches of rain in any 2 week period during the critical Aman seedling period. That for the flooding areas indicator was taken to be those areas suffering extensive flood damage during the 1962-67 period, the period being selected on the basis of a World Bank study of the records of the Bangladesh Water and Power Development Authority. The critical value of population pressure was taken to be those areas with a 1974 population density greater than one standard deviation above the national mean.

Maps of the ten indicators were then overlaid onto a 5 kilometre square grid and the weighted factors transferred to the grid map so that each

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grid square had a score of between 1-100. For example, a grid square that was overlaid by the maps of drought areas, population pressure areas and lack of alternative employment areas was given a composite weight of 41.7% (15.4% + 13.7% + 12.6%). The scores for each grid square were then transferred to an administrative map of thanas, so that a thana where the majority of grid squares had a value of between 65-100 were classified as being "very liable to famine" and shaded in red, whilst those with a majority of grid squares between 45-65 were classified as being "liable to famine" and were shaded in yellow. Within each of the two classifications shading methods were used to show the particular combination of factors contributing to a thanas liability to experience famine. As a result the map contains a total of 66 sub-categories.

The final map (referred to as the Delbecq-Delphi Map) was then evaluated by comparison with

a) the Combined Mental Maps produced by the three Panels;

b) alternative measures of the spatial severity of the 1974-75 famine (ie. analysis of newspaper reports of areas affected by the famine and the place of origin of famine migrants to Dhaka city); and

c) the results of an earlier survey of ten thanas in northern Bangladesh carried out just after the peak of the famine in 1975.

There was general consistency between the Delbecq-Delphi map and the combined mental maps. Where there was disagreement the researcher attributed this to the inherent weaknesses of the mental maps. An intrinsic strength of the Delbecq-Delphi map was felt to be its greater spatial specificity than the mental maps. However, whilst the Delbecq-Delphi Map was felt to be effective at differentiating areas liable to famine at a regional scale, the study conducted in the ten thanas suggested that the Delbecq-Delphi Map was not able to predict the intensity of famine symptoms at the thana (Upazila) level.

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ANNEX 2

POTENTIAL INDICATORS OF BASELINE VULNERABILITY TO FOOD INSECURITY

The following categories of indicator might be identified as " Risk of Event" indicators.

1) Average rainfall and the probability of receiving adequate rainfall for the main food crop

This is potentially the most important indicator for vulnerability mapping particularly in rainfed farming areas, as all socio-economic groups are likely to be affected by adequacy of rainfall. In most countries there are good historical and current records of rainfall levels and variability so data on probability of rainfall failure for administrative or geographic areas and for main food systems within those areas are likely to be available. Where the selected mapping units cover a large area, there is likely to be significant variation of these indicators within single mapping units. While such intra-mapping unit variability may complicate the use of other indicators for mapping purposes, some confidence can still be placed in rainfall data as most socio-economic groups will be adversely affected by rainfall failure whether this affects their own crop production, livestock grazing capacity and health, demand for agricultural labour or market prices.

2) Frequency of pest attack or cattle disease in preceding years/access to pest and cattle disease control services

Good historical data on crop and cattle loss due to pestilence and disease may be available within Departments of the Ministry of Agriculture responsible for pest and vetinary care. Risk will often be climatically and geographically related, e.g. proximity to vector born sources of disease, access to vetinary immunisation services, so that it may be possible to grade mapping units for risk of crop or cattle loss on the basis of historical records in conjunction with data on agricultural services. Clearly, however, the larger the mapping unit the more difficult it is to determine one indicator value for the whole unit.

3) Areas of conflict and insecurity and likelihood of refugee influx

It may be possible to delineate areas or regions where there is risk of disruption to food production and marketing systems as a result of civil war or border conflicts with neighbouring countries. Local disputes over land or grazing rights may also pose a threat to food security. However, distinguishing risk between mapping units may be extremely difficult. Armed conflict is by its very nature unpredictable while vulnerable areas can only be identified from records of recent events and therefore current vulnerability. Thus, it may only be possible to define broad areas rather than individual mapping units as vulnerable to these types of risk.

Similar considerations may apply to risk of refugee influx. Such influxes can impose severe strain upon local populations with adverse consequences for their food security. The likelihood of an influx is

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dependent upon proximity to national boundaries and areas within neighbouring countries where political and/or environmental factors predispose to creating refugee populations. Past evidence of such influxes map allow the identification of "broad" areas of risk in host countries, but as with armed conflict, it will be difficult to disaggregate risk, eg. to differentiate between smaller areas, due to the unpredictability of such events.

It may be easier to identify areas of risk more precisely in the case of conflict and displacement caused by indigenous and local resource disputes, e.g. tribal conflicts over grazing rights, but this also presents difficulties and would involve constant updating of information. Relying on evidence of past disputes may be misleading as these conflicts may have been resolved. Furthermore, representing mapping unit risk would involve an estimate of numbers likely to be at risk.

4) Average per capita food production over preceding years

Data on crop production for main food crops are normally available on the basis of administrative areas and providing population data for selected mapping units are reliable and reasonably up to date, it should be possible to calculate average per capita food production over a number of years. Such data could also be used to calculate the variability of yields and therefore the probability of inadequate crop production. In most areas this is likely to be a good indicator of vulnerability in the selected mapping unit as all socio-economic groups will directly or indirectly be affected by local food availability.

5) Average vegetation index (NDVI) over preceding years and variation of NDVI.

These data can be obtained from the National Aeronautics and Space Administration (NASA) Global Inventory Modelling and Monitoring System. Images are obtained from infrared imagery from orbiting satellites. Because chlorophyll in vegetation on the ground reflects infrared the NDVI measures vegetation and its response to weather conditions. In conjunction with data on pasture production over preceding years from National Ministries of Agriculture, some assessment can therefore be made of vulnerability of pastoral populations. Thus, where predominant food systems within mapping units are pastoral, vulnerability scores may be allocated on the basis of these data.

6) Food crop price zones over preceding years

Price data are fairly accessible within most countries. Such data may be converted into price zones for key foods (cereal and livestock) over a number of preceding years. Differences between price zones may reflect vulnerability to crop failure or poor livestock performance for producers and also indicate vulnerability to entitlement failure through the market for non-producers. Thus it may be possible to rank mapping units that fall within different price zones. However, good knowledge of markets is needed to utilise these

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data as price differences may sometimes reflect the existence of particular trading arrangements within areas such as local cartels, or indeed differences in effective demand rather than supply failures.

7) Large scale distress migration/evidence of recent severe food crisis

Data on recent severe food crisis (say within the last five years) as manifested by extremely high rates of malnutrition or excess mortality or large scale distress migration/destitution, are a potentially valuable indicator of baseline vulnerability. Such recent events indicate that the area is prone to these types of event and that resources and coping mechanisms will have been exhausted and that a period of time will be required before "buffers" of reserves and assets can be established to protect against further food crises. It may also suggests that wealthier populations within the area from where distress migration took place, were unable to support or assist the vulnerable groups. Defining a measure or indicator of recent severe food crisis is however problematic as data on high rates of malnutrition or mortality may not be available. Moreover, and as will be discussed in the section on nutritional status indicators, data on the prevalence of malnutrition may in any case be unreliable. There are also other qualifications;

i) It is important to be able to distinguish between seasonal migration as a coping mechanism and unusual/terminal migration, e.g. displacement due to destitution and immanent starvation.

ii) An estimate of the proportion of the displaced population from different locations of origin is needed. Some cut-off would then need to be employed to define the magnitude of the migration, e.g. 5% of a mapping unit might be classified as a moderate migration. Availability of these types of data will ultimately depend upon administrative unit registration and survey procedures and will almost certainly require access to regional sources of information.

iii) Account needs to be taken of the fact that households will tend to migrate or assume destitute status more readily where there is a history of assistance at a chosen destination. Indeed, governments may favour certain areas or population groups in their readiness to respond with assistance. This may reflect considerations of political constituency.

8) Nutritional status and health data(1)

Anthropometric data

Great care must be taken in using anthropometric data as an indicator of vulnerability to food insecurity.
In some situations such data may in fact have little bearing upon baseline vulnerability to food insecurity. Poor nutritional status of children under five (the traditionally measured age group in nutritional surveys) can reflect disease patterns, access to health care and a variety of sociocultural factors. Thus, high levels of

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(1) These types of indicator could also be categorised as "coping ability" indicators.

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malnutrition in an area do not necessarily reflect low food intake or food insecurity amongst that community. This is an important point as it makes it difficult to compare malnutrition rates between population groups or areas in relation to food needs unless it is possible to control for these other variables.

Another consideration is that weight-for-height (Wt for Ht) data which are the normal measure used to assess current nutritional status, will not identify chronic malnutrition. Weight-for age data would be more appropriate for baseline vulnerability mapping. Wt for Ht data can be extremely sensitive to seasonal fluctuations and current food insecurity and also show wide variation in rates of malnutrition within very small areas due to the many factors which it is affected by. Thus, by using Wt for Ht data it may prove very difficult to identify representative rates of malnutrition for selected mapping units even if these units represent small geographic areas.

However, under certain circumstances nutritional status data may have an important role in helping to identify baseline vulnerability to food insecurity. The prerequisite for this would be that the data should be available over a series of years and that, if based upon surveys , sample sizes are used which allow statistical validation of differences found between mapping units. In the event that no such survey data or capacity exists, then clinic-based surveillance data could also serve to distinguish vulnerability providing that the differences seen between mapping units were marked and repeated over a series of years and providing that it is possible to account for variations in clinic coverage and enrollment practices between areas.

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While not providing accurate information on levels of malnutrition, clinic-based data in a number of countries are believed to roughly describe long term differences in nutritional status between areas. However, even with credible nutritional status data, these can only be used to infer baseline vulnerability in the sense that high levels of malnutrition would suggest an outcome of higher child mortality rates in the event of food deficit and insecurity. However, as already stated due to the many non-food related factors which exert an influence over nutritional status, higher malnutrition rates do not in themselves unequivocally reflect baseline vulnerability to food insecurity in the mapped area represented by the data.

Micro-nutrient deficiency data

Micro-nutrient deficiencies normally occur in combination with inadequate caloric intake. Thus, deficiencies rarely occur without accompanying poverty and food insecurity. Consequently, data on micro-nutrient deficiencies of an order which constitutes a public health problem can usefully reinforce anthropometric data in their role of identifying areas of chronic vulnerability to food insecurity.

Data on pregnancy, e.g. Weight gain and Low Birth Weight

Data on low birth weights (LBW) and weight gain during pregnancy may also have a role in corroborating anthropometric data in identifying areas of chronic food insecurity. These data are however, likely to only be available at clinic level and may therefore be biased and unrepresentative so that great care should be taken in comparing data between mapping units.

Health data, e.g. disease rates.

Health status directly affects nutritional status by interfering with absorption of nutrients, causing loss of appetite and raising nutrient requirements. Thus, infection and disease can often be a primary cause of malnutrition. The relationship between nutritional and health status is however, interactive as poor nutritional status reduces immunity and therefore leads to increased likelihood of infection. Thus, one might expect a strong association between poor health status (and data which reflects this, e.g. lack of health services and clean water, and low immunisation rates), malnutrition and related food insecurity. This association is further strengthened by the effect of ill-health and malnutrition upon work productivity which may in turn affect food production.

Most health data will only be available through clinics and health centres and will therefore be subject to the same bias and confounding variables as anthropometric data. Thus, great care must be taken in using these data to represent absolute and relative situations for selected mapping units.

The following indicators might be classified as "coping ability" indicators.

9) Soil types and quality

Information on soil type and quality within a country may allow ranking of mapping units on the basis of soil quality for the purposes of crop production (e.g. high, medium and low). However, this would need to be done in conjunction with information on rainfall and crop type so that data on at least three variables are required. This is a particularly important consideration in drought prone areas where farmers will have learnt to spread risk by employing a variety of different crops at different times in the agricultural calender depending on timeliness and levels of rainfall. Furthermore, in areas of marginal soils, population groups may have adopted other more profitable and secure food systems, e.g. seasonal labour migration, or camel herding, so that data on the percentage of the population directly dependant on their own agriculture for food production within a mapping unit may be needed if data on this indicator are to be utilised for vulnerability mapping.

10) Non-rainfed agriculture

Irrigated crop production is far more assured than rain-fed agriculture in tropical areas. Nevertheless, irrigated systems do have an element of risk and this should be taken account of where a country has large irrigated areas. Potential indicators of risk might include: historical river level data showing fluctuations which may affect water supplies to the irrigated area; information on the risk of pumps malfunctioning may be obtained from records obtained by the management institution. In countries experiencing foreign exchange shortages, lack of fuel or spare parts may represent a serious risk to the maintenance of water supplies. Soil salination is a potential problem in irrigated areas and information on the risk of this occurring may be obtained from the Geological and Soils Survey Departments and the management institution.

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11) Average land holding relative to population density.

In certain parts of the world such as S.E. Asia, highland Ethiopia, and areas of Malawi, population pressures on land resources is such that significant proportions of households are incapable of producing sufficient food for their needs, even when they achieve their maximum possible yields. Data on average land holding size within selected mapping units and the variation around that average may be readily available, and, in conjunction with crop yield and population data may be used in calculating average household food production and the proportion of households which are, in the absence of other income sources, unable to meet adequate food requirements . Care will be needed in using these data in areas where alternative means of securing income and access to food have been developed.

12) Data on income generation.

Data from sources such as Household Income and Expenditure surveys, may be available on average income obtained from different sources such as, sale of cash crops, remittances from work abroad or distant work locations within the country, and local agricultural or urban employment. While potentially useful, such data can only really be used if in a form that shows the income distribution for the population within the mapping unit, and the seasonal and annual variability of this income. Furthermore, if the average income obtained from these sources accounts for only a small proportion of subsistence needs, eg. it only provides entitlement to a small proportion of overall food needs, then the significance of this information for vulnerability mapping must be carefully assessed in relation to the adequacy and reliability of other modes of subsistence production. For example, if agricultural crop production in the area is consistently sufficient to meet subsistence needs then low levels of off-farm income generation may not warrant a vulnerability score. The same considerations apply to other potentially valuable income related data, e.g. employment rates, numbers of wage earners within an average household, and proportion of income spent on food.

13) Convertible assets, e.g. livestock, jewellery, farming equipment, credit or cash reserves

Data on assets which can be converted into food will provide some measure of the ability of the population to cope. However, reliable information may be hard to come by as survey data may be affected by respondent perception of survey role resulting in either an under or overestimate of the size of the convertible assets available. Furthermore, even if good data are available then it may be necessary to make assumptions about the degree to which the assets may be converted into cash for use in purchasing food without undermining long term viability of the household or population, e.g. what proportion of a livestock herd can be sold before the household loses the option of regenerating their herd after the crisis is over. Precise quantification of this indicator may therefore not be appropriate for vulnerability mapping, although qualitative ranking,

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e.g. large, medium, small asset resources, may have a useful role. It should also be noted that those populations with significant available assets may not necessarily be the ones which best withstand serious external shocks. Recent research carried out during famine in Sudan has shown that communities that live in chronic poverty may have devised a variety of coping mechanisms to withstand disaster, whereas wealthier communities are less able to endure sporadic shocks or disaster events.

14) Physical signs of wealth, e.g. brick housing, presence of bicycles, type of farm equipment, locally funded schools and clinics.

Data on visual signs of wealth may have a useful role in vulnerability mapping as these may indicate a standard of living above bare subsistence and therefore some resilience to external shocks. Such data may be readily available from household surveys, e.g. the number of brick houses within a mapping unit. Alternatively, information may be available through rapid low cost appraisals which lend themselves to collecting this type of information. However, where such data/information are used for vulnerability mapping care must be taken to consider other recent data that might demonstrate increased vulnerability. This is because certain signs of physical wealth may remain in areas where there has been recent economic hardship as the selected indicator/asset may not be convertible into currency or food.

15) Access to wild foods/wild food consumption.

Consumption of wild "famine foods" may be a particularly established practice in those areas where famine is a regular or even sporadic threat. However, access to these foods may be extremely variable and determined primarily by agro-ecology. Thus, it may be possible to map areas on the basis of access to certain wild food crops using local knowledge of administrators and regional agricultural staff. It must however, be noted that while certain wild foods perform a valuable "fallback" function during periods of extreme hardship, certain wild foods may be physiologically dangerous and consumed out of utter desperation. In such situations, the availability of wild foods as a factor which mitigates against vulnerability, should be clearly discounted.

16) Employment opportunities/labour migration

The availability of employment opportunities will be partly determined by proximity to employment source. There will also be a historical element as some communities will have traditions of sending out migrant labourers to established work centres in times of hardship. Thus, it may be possible to map this capacity on the basis of proximity to employment sources and historical patterns of labour migration. This, indicator is probably best represented qualitatively, e.g. good, moderate or poor access, and may be a good indicator of reduced vulnerability to food insecurity.

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17) Community support indicators, e.g. self-help groups, networks for sharing resources

Communities may well have devised systems to protect the poor and those households experiencing unusual hardship. In Islamic countries a tax is often levied on better off families and allocated to identified poor families.
Communities may also establish self-help groups which protect vulnerable groups. Although these systems can afford considerable protection to vulnerable families, it would probably prove extremely difficult to grade selected mapping units on the basis of differences in protection afforded by these systems.

18) Health services data

Given the effect of ill-health upon nutritional status, its direct impact upon work productivity, and the opportunity cost to households in terms of time for care and lost resources, access to and performance of health services is relevant to food security. Thus, data on health services coverage and access as well as the operation of these services, e.g. immunisation rates, may have a role in vulnerability mapping. Careful consideration will however, have to be given to the overall weighting of these indicators in relation to other indicators which may have a more direct impact upon food security.

19) Level of infrastructure/marketing/regional food stores

Intuitively it must be the case that the greater the level of infrastructure for transporting and storing food and the more integrated and "robust" the food marketing system in an area the less vulnerable the population. In areas where roads are poor and the operating costs of traders high the more likely that a slight fall in effective demand or an increase in the price of fuel will result in traders reducing their level of operations in the area. In addition the better the transport infrastructure the easier it is for the affected population to make their "claims" heard and acted upon by the government and relief agencies. The presence of grain stores in an area may facilitate action by those responsible for providing relief by removing a potential logistical bottle-neck.

However, these factors cannot be taken unquestioningly as indicators of vulnerability. A well developed marketing system may over the years have resulted in the erosion of traditional strategies of maintaining household grain stores so that populations have become overdependent on the marketing system. Also there have been cases, such as during the Great Famine in Ireland where populations experiencing famine have not benefited immediately from the relief food supplies being transported through their areas.

Other difficulties with using data on these factors as indicators of vulnerability involve ensuring representativity for mapping units. For example, if a main road runs through the corner of a mapping unit and the centre of another can the two units be described as equivalent with respect to this variable?

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