Linking Water Scarcity to Population Movements:

From Global Models to Local Experiences

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1 Introduction

Changes in the relationship between people and environmental systems that support us are currently taking place at an unprecedented rate and scale. Numerous studies attempting to foresee the environmental circumstances people in different parts of the world will confront, investigate the adaptive potential of society and estimate human potential to meet these circumstances successfully (i.e. the Millennium Ecosystem Assessment). Several of these studies predict that anticipated deterioration of environmental conditions will force millions of people to leave their communities and become "environmental refugees" (See Boxes 1 and 2). Other researchers focus on predicting specific aspects of environmental change and among those, water scarcity is receiving particular attention (e.g. Alcamo et al., 2000; Falkenmark and Widstrand, 1989; Rosegrant et al., 2002; Cosgrove and Rijsberman, 2000). Because water is fundamental to health and agricultural production and cannot be easily substituted, it must be available in sufficient quantities at the local level wherever people live in order to sustain communities. Thus, the threat of water scarcity is a potential contributor to population movements, although the relative significance of this factor has not been carefully evaluated.

BOX 1. NUMBER OF REFUGEES AND MIGRANTS GLOBALLY

Refugees are specific category people within the broader context of the global population movement. First, to put environmentally induced movement in the context of all global population movement, we note that the International Migration Organization estimates that there were 175 million migrants in the world in 2003 (IOM, 2003). Of this number in 2003, the UN High Commissioner for Refugees estimated that there were approximately 10.4 million refugees in the world (UNHCR, 2004). An additional 10.2 million people, including asylum-seekers, recently returned refugees, internally displaced persons, and people without nations were identified as populations of concern.

Estimates of Environmental Refugees Today

There are a variety of estimates of environmental refugees. These differ by data source, environmental stressor, and length of forecasts, as well as by the definition of "refugee." Estimates of the number of environmental refugees today start at 10 million, more than half of whom are believed to be in Sub-Saharan Africa (Lonergan, 2000). According to Westing's 1992 study, 3% of the African population has been permanently displaced largely as a result of environmental degradation. Other estimates put the number of environmental refugees in 1995 as high as 25 million (Myers and Kent, 1995).

In this paper, we review forecasts of global water scarcity and evaluate linkages between these forecasts and understanding of migration in order to better focus research and policy addressing the role of the environmental factors contributing to population movement and "environmental refugees". The evaluation of the "refugee" forecasts we present here differs from existing studies as it incorporates more of the current research on migration and on human vulnerability and resilience in the face of environmental stresses. This approach balances the focus between the physical lack of resources (i.e., litres per capita) and the social-ecological systems supporting human communities. It considers physical issues of water scarcity together with assessments of local water needs and the social capability to adjust water demands or draw on other resources to make water available locally. For example, drought has caused many large population movements as well as loss and disruption of lives, but there are also many cases in which people have coped with drought by continuing to live in difficult circumstances, adapting, and drawing on other types of assets.

Between water scarcity and large-scale population movement there is a large array of options that allow people to continue their lives in their homes and communities. Studies of

physical scarcity and demand forecasts have identified areas of high and increasing stress. Understanding the contribution of these pressures to population displacement allows for identification of opportunities to reduce stress and identify strategies to support community resilience.

Like many other global impact forecasts, the assessments of environmental refugees tend to draw on other global scale estimates, nationally aggregated data on environmental resources, generalized conceptualizations of interactions between society and environmental processes, simplified models of human behavior, and best approximations of demand as driven by economic and social development trends. While all of these assumptions are potential sources for error in under- or overestimating a problem, they also obscure the specific, and often more localized, intervention points where actions might reduce the consequences of environmental change. By drawing on case studies of migration and analysis of livelihood vulnerability to water stress, this review reframes global estimates within the structure of local circumstances – both challenges and opportunities – that people face when dealing with water stress, and to recognize the options for interventions in support of sustainable livelihood goals.

BOX 2. ANTICIPATED NUMBERS OF ENVIRONMENTAL REFUGEES

Numbers of environmental refugees are expected to increase over time, due to a variety of causes. According to Myers (2002), "The total of 25 million may well double by the year 2010 if not before, as increasing numbers of impoverished people press even harder on over-loaded environments". Myers further projects that there will be as many as 150 million environmental refugees by 2050 due to climate change related impacts (Myers, 1997).

The International Symposium on Environmentally Induced Population Displacement and Environmental Impacts Resulting from Mass Migration held by IOM, RPG and UNHCR in 1996, estimated that more than 135 million people were at risk of being displaced mostly as a result of severe desertification (as cited in Rechkemmer, 2000). The mid-eighties drought in the Sahel region, for example, drove more than 2 million people out of Burkina Faso, Chad, Mali, Mauritania and Niger (Renner, 1997).

In addition, the Intergovernmental Panel on Climate Change noted particular risks to coastal populations in low-lying areas, deltas and small islands. Estimates based on one metre sea level rise scenarios in 2100 suggested that, in the absence of adaptation measures, the 118 million people currently occupying the areas potentially affected by ocean flooding would be at risk. If population growth is factored into these estimates, the affected population is likely to be much larger (IPCC SAR, 1995). (Note that in the IPCC TAR, 1 metre rise in sea level is seen as higher than the most likely outcome).

Migration caused by insufficient food availability as a consequence of various types of environmental degradation is expected to increase to 50 million people by the year 2050 (Döös, 1997). Semi-arid and arid regions in sub-Saharan Africa, northeastern Brazil, and South and Southeast Asia will be most vulnerable. For example, in China alone it is estimated that at least 30-40 million people will be displaced by environmental degradation by 2025 (Renner, 1997).

The next section of this paper focuses on issues of exposure to water scarcity and water stress provided by global scenarios and forecasts. It reviews major efforts to estimate future water stresses and notes the limitations to these in terms of drawing connections between water scarcity and people's livelihoods and vulnerability. The third section draws on studies of migration, environment, and development in examining community sensitivity and resilience to water stress. This part of the discussion considers migration among the many strategies potentially available for coping with limited water resources. In this section, we also address the debate over the terminology used to describe population movements linked to environmental change and natural resource stress. Coping strategies and the resilience they create in livelihoods are introduced as important 'intermediaries' between environmental degradation, in this case water scarcity, and possible population displacement. While many people may move from

environmentally stressed parts of the world, it is not clear whether they are being forced to flee as "refugees," or whether an environmental factor, such as water stress, is the dominant reason for their movement. The fourth section explores the relation between migration and environmental degradation, of which water scarcity is an important component. This section reviews the migration literature exploring contemporary efforts to understand migration as they enhance our understanding of connections between population movements and environmental stress. The final section summarizes evidence on those connections (and the gaps) in relation to policy options.

2 Estimating Global Water Scarcity

Evaluating present and future levels of water scarcity is a sufficiently complex undertaking of assessment, modelling, and data collection that findings are still either quite general on a global scale or detailed in local cases. In this section we review forecasts of future water scarcity, their definitions of water scarcity, and the limitations of information provided by global water scarcity assessments for addressing population movements.

BOX 3. DEVELOPING LOCAL MEASURES OF WATER STRESS LEVELS AND THRESHOLDS

During the 20th century, the world population tripled and water use for human purposes multiplied sixfold. Since the net amount of water on earth will not change, water is becoming a scarce resource. The notion of water scarcity, however, is highly dependent on expectations and adaptation.

Populations with high levels of consumption may experience temporary scarcity as more severe than societies accustomed to using much less water. For example, people in the sub-Saharan countries often use only 15-20 litres of water per person per day; some African people living in arid regions use even less. On the other hand, in Europe and the United States, people use as much as 200 litres a day or more.

Similarly, water required to grow the average daily food needs of an individual varies enormously depending on climate and the diet and agricultural practices of people in different regions. An average North American diet requires 5000 litres of water per day, whereas the average diet in sub-Saharan Africa may require only 1800 litres of water per day.

Gleick (2000) recommends a basic water requirement of 25 litres per person per day to meet the most basic human needs: five litres of clean water for drinking and twenty litres for sanitation and hygiene. He recommends an additional fifteen litres for bathing and ten litres for cooking. Nonetheless, more than a third of the world's population lives in the 62 countries that report an average domestic water use below 50 litres per day. Local conditions, the inability to address root causes of water scarcity, and/or low-level technology has forced people to adapt as best they can to living without enough water.

2.1 WHAT IS WATER SCARCITY?

Climate, geography and, increasingly, technological interventions determine the distribution of water around the world. Water scarcity is defined in relation to needs and livelihoods (See Box 3). Current efforts to assess global and regional water scarcities conclude that such scarcity already affects hundreds of millions of people, and point to severe future water challenges (see Box 4).

BOX 4. CURRENT AND FUTURE WATER PROJECTIONS

The World Water Vision reports that one in five people does not have access to safe and affordable drinking water, and that half of the world's population does not have access to sanitation (Cosgrove and Rijsberman, 2000). The Intergovernmental Panel on Climate Change (IPCC, 2001) states that one third of the world's population lives in countries that are considered water stressed; that is, countries that are using more than twenty percent of their renewable water supply.

Similar calculations assert that growing water demands and a potentially variable water supply due to continuing population growth, economic development, changing consumption patterns, climate change and urbanisation, may lead to even greater shortfalls. The World Water Vision estimates that by 2025 as many as four billion people, more than half the world population, will live in countries that suffer from high levels of water stress, and in which more than forty percent of the renewable resources are withdrawn for human uses (Cosgrove and Rijsberman, 2000).

These high exposures to current and expected water scarcities raise concerns about the future, and set enormous challenges to global food production, ecosystem health, and political and social stability.

2.2 TRENDS IN WATER DEMAND AND AVAILABILITY

A variety of studies examining quality and quantity dimensions of water demand and availability suggest that the increasing intensity of municipal, industrial and agricultural demands and growing population pressure will lead to a continued decline of water availability per person. In some areas, current demand is having dramatic effects.

- Estimates indicate that with present day technologies, global water withdrawals will need to increase by up to one quarter in 2025 just to feed growing populations.
- The number of people living in water stressed regions is currently growing. In these water stressed regions, the demand on renewable supply exceeds the amount required to meet needs for food production, ecological services, and industrial activities.
- A number of large rivers including the Colorado River, China's Huanghe (Yellow River), and the Nile, have such high demands that little, if any, streamflow reaches the oceans during dry seasons.
- Water is becoming more scarce, not only in absolute terms but also in that pollution is rendering existing supplies unsafe for human use. A lack of basic sanitation for human and animal waste causes microbial pollution and eutrophication of aquatic systems; industrial discharges containing chemicals, heavy metals, and other compounds poison aquatic resources and create persistent toxic pollution. In many parts of the world, rivers are becoming so contaminated that they are no longer suitable for human use, or even for irrigation.
- In many areas, the world's freshwater systems are so degraded that their ability to support ecological systems is in peril. As a result, many freshwater species are facing rapid population decline or extinction, and an increasing number of people face serious water shortages, including the loss of services provided by freshwater ecosystems.

2.3 INDICATORS TO ASSESS WATER SCARCITY

It is difficult to describe water scarcity in absolute, easily comparable terms that link to societal livelihood and adaptation capabilities that structure what is viewed as normal necessary demand

for water with lower and higher levels of usage. Societies with sustainable water use practices have developed around the world in regions with very different water conditions. Seen from a local perspective, it is water availability, the societal context that shapes water demand, and the combination of future changes in water availability and societal structure taken together that determine the relative scarcity of water resources.

To begin exploring how current water scarcity forecast indicators relate to migration decisions, it is necessary to review the various ways in which water scarcity is defined. A number of different approaches to calculating water scarcity indicators have been developed and refined over the last two decades. The variety of water scarcity indicators used today include indicators based on water supply or demand, current versus future demands through various scenarios, consumptive versus non-consumptive uses, and by distinguishing the use of renewable and non-renewable sources. They all face the challenge of providing comparability on a global scale while also remaining relevant on a local scale.

The most commonly used indicators of water scarcity are based on calculations of either one or a combination of the following two main approaches to estimate future water demand (see Box 5):

- per capita population pressure on the natural water supply;
- the percentage of natural water resources utilised to satisfy various human demands, including agriculture and different forms of irrigation, versus those contributing to ecological services and ecosystem functions.

2.3.1 Water scarcity as measured by per capita availability

One of the most frequently referenced indicators of water scarcity definitions stems from a 1989 study by Falkenmark and Widstrand. They offer a measure of water scarcity based on a ratio of population and the total annual natural water supply, or available water, in a country. The study used estimates of national water availability and population to calculate annual per capita water availability, and ranked water scarcity levels according to per capita water availability thresholds.

BOX 5. EXAMPLES OF WATER SCARCITY INDICATORS

Population pressure on natural supply (Falkenmark et al., 1989)

Term	*Threshold*
Water Stressed	<1,700 m^3/capita and year
Water Scarce	<1,000 m^3/capita and year
Severe Water Stress	<500 m^3/capita and year

Share of natural supply withdrawn, "criticality ratio" (Alcamo et al., 2000)

Low water stress	>10%
Mid water stress	>20%
High water stress	>40%
Very high water stress	>80%

Percentage of natural supply in future demand (Seckler et al., 1999)

Absolute water scarcity	>50%

Increase in future water demand compared to present withdrawals (Seckler et al., 1998)

Economic water scarcity	>25% increase 1990–2025

Based on annual water accounting at the national level, the study argues that water availability greater than 1,700 m^3 per capita does not pose a national problem; shortages are expected to be local and rare. A country is considered water-scarce if it reaches the point of seasonal or regular water-stressed conditions below 1,700 m^3 annual per capita availability. At annual per capita levels below 1,000 m^3, water shortages begin to hamper human health, well being, and economic development. Shortages below 500 m^3 represent severe constraints to human life. These thresholds have been widely adopted as guidelines for the relative lack of water in different regions. Areas with less than 1,700 m^3 per person annually are referred to as *water stressed*, while areas with less than 1,000 m^3 per person annually are referred to as *water scarce*. Per capita water availability of less than 500 m^3 per year is considered *severe water stress*.

2.3.2 Water scarcity as a percentage of natural water resources utilized

Another way of evaluating water resources is to examine how much of the available natural supply in a specific area is utilised for human needs. Alcamo et al. (2000) offer a strong application of this approach. Using this method, an area is considered to be severely water scarce and a potential limiting factor to economic growth when withdrawals exceed 40 percent of the total renewable water supply. Above this level, water supply is expected to depend increasingly on costly supply solutions such as desalination, water transfer, or on the unsustainable use of groundwater. Between 20 and 40 percent utilisation, more effective sectoral management practices are considered necessary to cope with water utilisation. Areas with withdrawals from 10 to 20 percent are considered to have moderate water scarcity, while those with less than 10 percent withdrawals are considered to have little or no water scarcity.

2.4 FORECASTING WATER SCARCITY

A good grasp of how present population pressures and human activities affect today's water scarcities is a necessary starting point for a well-informed discussion on how pronounced water stress in certain areas may affect population in different areas in the future. However, water scarcity is not a static phenomenon; rather, it depends on how well local, regional and even global demands are balanced with respect to limited natural supplies, and possibly augmented with additional technical supplies such as desalination or virtual water imported into a region in the form of grain or other products.

Any such assessment of future water situations will rest on assumptions about future water use practices and demands for water quantity and quality and how these relate to a variety of key parameters such as changes in population, economy, technology innovations, and behaviour. There are, however, also great uncertainties on the natural supply side, mainly due to global warming and possible climate change trends. Box 6 discusses sources of uncertainty in developing modelling assumptions about future developments and their consequences.

BOX 6. UNCERTAINTY IN WATER SCARCITY PROJECTIONS, SCENARIOS AND ASSUMPTIONS

Modeling trends, scenarios and current or future water scarcity is a complex exercise. Uncertainty about the future, complexity in modeling, and the lack of adequate and reliable data on national, regional or local levels make forecasting of water scarcity extremely difficult. Still, models can provide a basis for reasoning about the extent of future water scarcity and possible solutions. Models, however, must build on some basic assumptions about the future concerning broad development issues such as population growth, economic development, health, and awareness.

One way of dealing with assumptions is to develop broad-based development scenarios. Scenarios are narratives about the future, with some quantitative support, that reflect plausible directions for development. Each "storyline," selected to capture some key features of current trends, describes one of a wide array of possible futures.

Scenarios were used to portray possible future outcomes for World Water Vision and other studies such as those by Rosegrant et al. (2000) and Alcamo et al. (2000). For example, Rosegrant et al. (2000), developed three global scenarios, each with a different assumption about the effectiveness of the irrigation sector. The Business-as-Usual scenario represents a continuation of current policies and the extrapolation of these trends. The Water Crisis scenario outlines potential outcomes if trends in food and water policy worsen and result in crises. The Sustainable Water scenario projects outcomes when sustainable development and research support greater social equity and environmental protection.

These scenarios also differ in their assumptions about population growth, economic growth, demographic change, technological change, social trends, and environmental quality, all of which may influence future water demand and management structures which determine the amount of water available for particular uses.

Different global water scarcity studies show similar patterns around the world, with the most problematic areas located in the developing world. There are important differences between studies that rely on different approaches to investigate water scarcity (see Gleick, 2000 for a review). The approach of Alcamo et al., introduced previously, based on use of natural water resource utilization at the level of the river basin is shown in Figure 1.

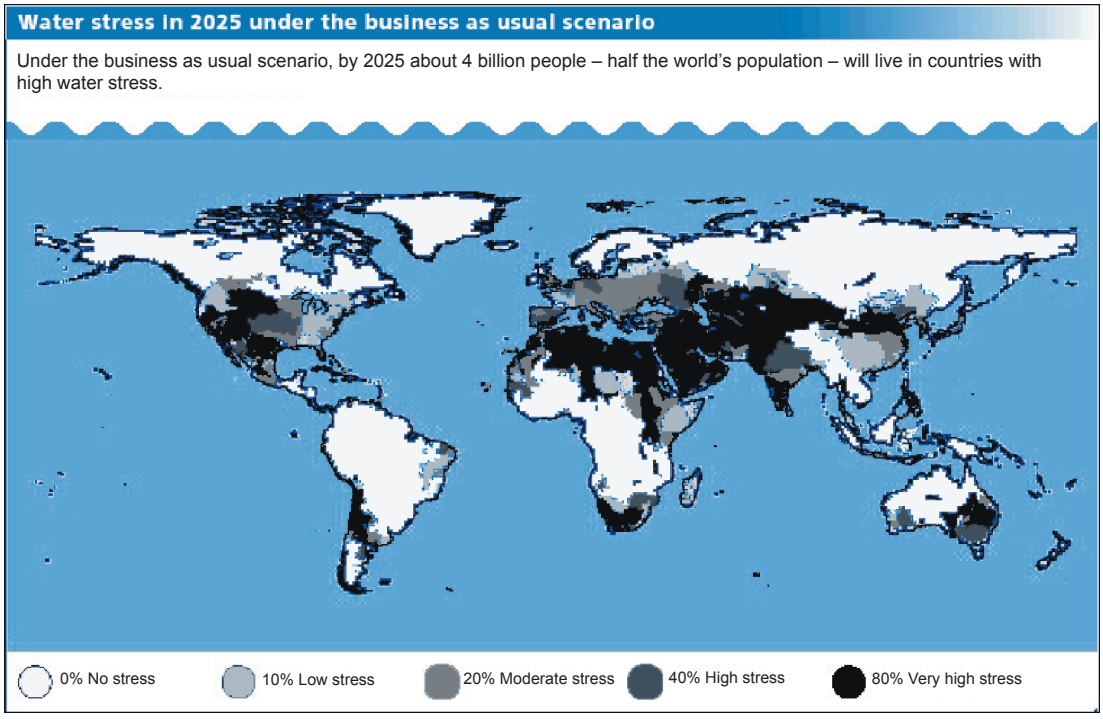

Figure 1 Relative lack of water based on degree of utilisation of total natural supply (based on Alcamo et al., 2000; figure from Cosgrove and Rijsberman 2000)

A second major effort is that of Rosegrant and colleagues, working at the International Water Management Institute (IWMI). They developed forecasts for future water scarcities for the year 2025 through estimating water demand. These estimates are based on a combination of assumptions about the current water resources and country's economic capabilities to invest in water resource infrastructure. To create a more dynamic picture of future developments, the analysis examines both the projected change in demands between 1990 and 2025 and the projected future pressure from those demands on both economic and physical systems (see Figure 2) (Seckler et al., 1998).

This study defines a country as likely to experience *"physical water-scarcity"* if the future demand is more than 50 percent of the current available water resources. The authors justify this definition through the argument that under these conditions countries will not have sufficient water resources to meet their agricultural, domestic, industrial, and environmental needs in 2025. The only options for such countries are to invest in expensive desalination plants, reduce the water used in agriculture and transfer it to other sectors, and/or import more food.

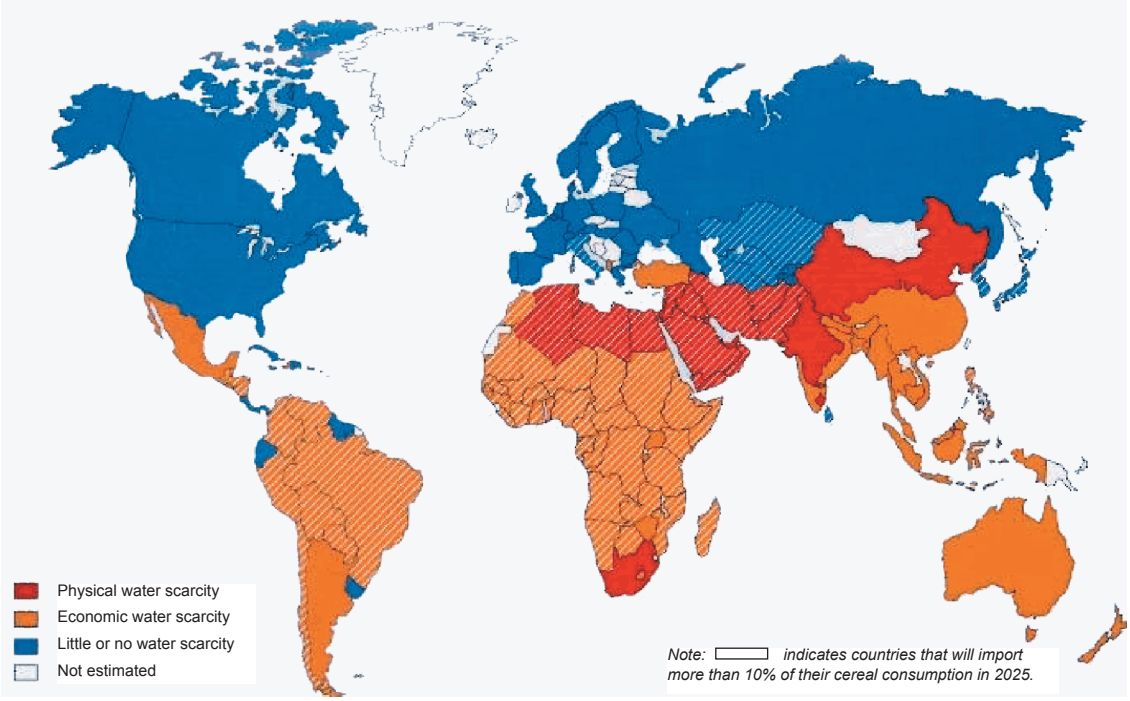

Figure 2 Projected water scarcity in 2025 (based on Seckler et al., 1998)

This study defines and analyzes a second dimension of water-related stress, *"economic water scarcity."* Since the development of proper water supply infrastructure is costly, a society is more or less water scarce in economic terms depending on the rate at which new water demands develop. The effort defines a country as severely economically water scarce if the future demand in 2025 will be 25% greater than the 1990 withdrawal level. *Economically water scarce* countries may have sufficient water resources but face severe financial and capacity problems in meeting their water needs.

2.5 LIMITATIONS OF FORECASTS

The global forecasting approach, illustrated by the two studies discussed above, faces several challenges in downscaling to the local level of migration decisions or refugee movements. To

reflect the aspects of water importance for livelihoods, the downscaling of global forecasts needs to address geographical scale, as well as temporal availability and water quality measures.

- **Scale of analysis — Countries, Major River Basins**

  Global models generally do not represent the substantial difference in water scarcity within countries at the levels of regions or river basins. These regional and river basin differences can result in dramatic differences in water scarcity affecting large numbers of people. For example, national averages do not differentiate between parts of China. About one half of China's population lives in the wet region in the south, mainly in the Yangtze basin, while the other half lives in the arid north, mainly in the Yellow River basin. Similarly, in India, about one half of the population lives in the arid northwest and southeast, while the remaining half lives in fairly wet areas. Significant differences in scarcity also appear at smaller scales. Finer-scale administrative boundaries play an important role since they demarcate the areas for decision-making, ruling institutions, and other structures. Note the contrast between the patterns of water scarcity portrayed in Figures 1 and 2. In these figures, the affect of units of analysis appears clearly across Africa.

  Some efforts have begun to work at subnational grid scales of 0.5 degrees (Vörosmarty et al., 2000) but in areas where seasonal waterways or scattered rainfall are significant elements of success or failure of agriculture, linking the models to livelihoods remains a challenge. In addition, efforts to assess regional or local water scarcity are often impeded by a lack of data.

- **Virtual Water—Substitutability and Local Scarcities**

  Water scarcity forecasts typically assume that water needs will be met by the water resources existing within national or river basin boundaries. Water resource specialists, however, have identified ways in which a local area may import substitutes for water. This so-called "virtual water" is brought into an area by importing food production and other products that demand large amounts of water to produce. As this trade in virtual water grows, combining local and global perspectives on water becomes increasingly important. From a global perspective, there must be enough water to produce food and for ecological services. From the local perspective, however, "virtual water" provides societies with a variety of coping options.

- **Temporal Scarcities—the Impacts of Varying Supply**

  For many rural livelihoods, the temporal dimensions of water scarcity are more significant than the broad geographic patterns. Agricultural practices are typically tied to expected patterns of rainfall, temperature, and soil moisture. Of course, access to water year-round is essential for cooking, cleaning, and drinking. Many regions adapt to and suffer from seasonal water scarcity or droughts which can undermine efforts to pursue some potentially productive livelihood options. Water scarcity forecasts, however, are generally constrained to reporting annual averages.

- **Usable Water—Water Quantity and Quality**

  While the complexity of estimating the quantity of water available at global and local scales continues to be significant due to limitations on data and system dynamics, linking models more closely to livelihoods and livelihood decisions also requires further expansion to address water quality issues. At present, most large-scale water scarcity

models address only the quantity of available water resources, while the quality of the available water resources is equally important to sustaining human and ecological uses.

- **Impacts of Limited Water Resources—Limits of Absolute Water Scarcity Thresholds**

  In the effort to provide comparable data, global models employ standard definitions of water scarcity and thresholds of scarcity causing stress. For example, Alcamo et al. (2000) use a criticality ratio (annual withdrawals over availability) greater than 0.4 as a threshold indicating river basins under severe water stress. Through sensitivity analyses, they show that results based on this threshold are fairly robust. They realize, however, that the consequences of water scarcity will not be the same in all countries or among groups within the countries. In industrialized countries, for instance, water is often treated before it is sent to downstream users. In addition, industries in these countries recycle their water supply fairly intensively. For these and other reasons, industrialized countries can often heavily utilize their water resources (as indicated by a criticality ratio of greater than 0.4) without negative consequences. By comparison, wastewater in developing countries is usually not treated, and industries do not recycle their water supplies as often. Hence, intensive use of water here can lead to the rapid degradation of water quality and quantity for downstream users, and frequent and persistent water emergencies.

  Therefore, although certain regions might be faced with a physical lack of sufficient quality and quantity of qualitative water resources, there are many other factors involved in the way this will impact people and ecosystems. In '*Water for the twenty-first century: challenges and misconceptions*' Metha (2000) argues that it is wrong to conceive of water scarcity in absolute terms. She points out that there is an urgent need to link water scarcity with socio-political, institutional and cultural factors: further, when assessing the link between water scarcity and population displacement, the role of social vulnerability in water scarcity is of great importance. Vulnerability can be sharply differentiated among different social groups, even those living in the same place. The greatest vulnerabilities worldwide are in unmanaged or unsustainable water systems in the developing world. Typically, these systems are already at high risk due to other forces such as population growth, water contamination, poor pricing systems, and growing irrigation uses, which push them further into unsustainability.

3 Water Scarcity and Livelihoods?

Global analyses of water scarcity, based on aggregated country or river basin data provide important indicators on human stress due to water scarcity around the world. It would be problematic, however, to stretch the use of such indicators to anticipate dramatic changes in migration patterns. In this section, we discuss the importance of water, as a specific component of the environment, to local livelihoods in rural developing economies to illustrate how disruption of water supply might impact such livelihoods[1] and related decisions to migrate.

1 We use the term livelihoods following Carney 1998:4 "A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base".

The movement of people due to environmental disasters or degradation is not a recent phenomenon. Historically, people have moved from land degraded by natural disasters, war or overexploitation. A concern about the potential for large-scale population movements resulting from a combination of resource depletion, irreversible destruction of the environment, and population growth has become part of the public discourse relatively recently. The United Nations Environment Programme (UNEP) introduced the concept of environmental refugees in 1985 (El-Hinnawi, 1985). In the 1993 State of the World's Refugees, the United Nations High Commissioner for Refugees (UNHCR) legitimized this concept by including environmental degradation as a root cause of refugee flows. Several academic and political discussions have since addressed the appropriateness of this concept, and the related issue of how to classify people who move due to environmental degradation.

These academic and policy discussions on the character of the relationship between environmental degradation and population movement take on urgency in the context of current global projections of rural to urban migration. According to the United Nations' *World Urbanization Prospects: The 2003 Revision* (2004), nearly all of the world's population growth over the next 30 years will be concentrated in urban areas of the global south. While some of this growth will be driven by natural increase within cities, the majority of urban growth is expected to come from rural-to-urban migration. In some areas, this rural-to-urban migration is likely to be stimulated by environmental issues, such as a shortage of arable land caused by population growth and/or environmental degradation. Understanding migration decision-making is of critical importance, for the destinations of these migrants will themselves face water supply issues. For example, while some of the expected two billion addition urban residents will be found in megacities of 10 million or more, there is enormous potential for growth in small and intermediate sized urban settlements in the global south that either are under 500,000 residents, or whose water demand issues are currently dwarfed by those facing the megacities. The provisioning of water to urban areas is a significant future stress that may not be well captured by broader water scarcity indicators, particularly those that focus on surface water systems, because of the difficulty in accounting for these future population flows.

3.1 WATER AND LIVELIHOODS

The relationship between water and livelihoods tends to be cast in terms of minimum requirements for human survival. This approach, while based on empirically valid data carefully weighted for different environmental conditions, has limited ability to represent the complex ways water influences livelihoods. This complexity makes the actual amount of water available in a given context something that often has only tangential bearing on the perception of shortage, and therefore human decision-making and behaviour.

The regional water scarcity maps and water scarcity indicators presented earlier are problematic when assessing the livelihoods outcomes of scarcity. The water stressed areas indicated in these maps and indicators cannot automatically be assumed to produce large population movements. As we have already argued, these maps and indicators do not include the quality of available water resources, and generally ignore spatial and temporal variation and local conditions. Further, they do not tell us how people experience the different levels of water scarcity. People differ in their perception and expectations of water resources, their dependency on water, and in their overall vulnerability towards situations of limited water availability. (See Box 8 on adapting to and coping with water scarcity.)

3.1.1 Water and human health

Water is more than a biological requirement for human life. It also plays an important role in cooking and preparing food throughout the world. The absence of water for cooking necessarily shifts diets. An extreme example is that of cassava, a common staple in West Africa. The husk of cassava contains cyanide, which is removed by discarding the husk and boiling the cassava to leach off any remaining poison. Without water to boil this plant, its consumption becomes problematic, and people in this region would have to shift their diets to other starch crops like yam and plantain.

Water also serves as a crucial means of maintaining hygiene. For example, without water for bathing and washing, the incidence of disease rises rapidly. Conditions in refugee camps throughout the world, which are breeding grounds for outbreaks of diseases like cholera and dysentery, represent examples of this particular impact of water shortage. Therefore, it is possible that people could have adequate water to meet their biological needs but inadequate supplies to meet their food preparation or hygiene needs, and thus perceive water to be in short supply.

The importance of perception is highlighted by socially differentiated relationships to water. In many parts of the world, women labor at tasks that require water for their successful completion, such as cooking and cleaning. For example, in places like Sub-Saharan Africa, where Bryceson and Howe (1993) have documented women's disproportionate responsibility for gathering water, their collection of water from remote sites during times of shortage results in greater travel times. Consequently, women in these areas will often note water shortage before men. Further, these women are likely to perceive such shortage to be more severe. This type of relocation of women's time may also influence the amount of time available to support children's development and education.

BOX 7. CAUSES AND CONSEQUENCES OF WATER SCARCITY IN KITULWATTE: A CASE STUDY

In Kitulwatte, a village in Sri Lanka, water scarcity poses a fundamental threat to people's livelihoods. Pine and eucalyptus plantations, vegetable cash crop cultivation and human settlement have seriously reduced water availability in the surrounding montane micro-watershed. Starkloff (1998) analyzes how the transformation of land use practices has jeopardized crop and household production, as well as people's health, in Kitulwatte. He explains water scarcity as the outcome of interdependent processes of resource competition and land degradation induced by the changing economic strategies of rural households and state actors.

These land use changes transformed the micro-watershed from an agro-ecological system in which water and biomass flows had linked landscape components and sustained human livelihoods to a state of fragmentation–and consequently desiccation and conflict. The ensuing competition for land and water among users with varied control over resources interacted with the degrading effects of their land use practices to undermine the productive capacities of the local hydro-cycle. Water scarcity in turn has changed the structure of crop cultivation in favour of intensified vegetable commodity production at the expense of subsistence paddy. It has led to the abandonment of fields and the increased cost of crops and household production as well as impaired food preparation, house construction and hygiene.

This case study demonstrates several challenges to understanding the origins of and remedies for water scarcity stresses:

- **Complex local environmental interactions.** The foresters aimed for the highest yields and best financial returns and therefore selected high productivity species (eucalyptus and Caribbean pine). No one anticipated the impact of the plantation trees on this type of environment: the deep roots of the pine suck up huge amounts of water, their evapotraspiration rate is high, and their needle litter covers the ground, thus preventing the establishment of undergrowth. Consequently, an increase in soil erosion, infertility, surface run-off and unbalanced water flows resulted from the cultivation of these types of trees. Water runs off quickly during the rainy season and no water is retained in the soil for the dry season.
- **Legal rights:** Land degradation and local water scarcity resulted from the replacement of climatically adapted grassland with water-intensive, fast-growing tree monocrops. By creating plantations, the Forest Department became the biggest water user in the area and created water resource competition. The resources claims of the Forest Department were protected by its exclusive control of legal regulations and means of coercion: its ability to call on the police and courts to enforce its land use rights. The farmers' customary use rights did not have the same legal status.
- **Importance of social status:** The farmers' status is low compared to government officials. Their power position is characterized by a relatively weak command of social resources, such as land ownership, political influence, financial and institutional support, and means of violence. Communication difficulties are exacerbated by the status differences between foresters and villagers.
- **Short term versus long-term coping strategies:** The Sri Lankan political system and international development agencies have provided short-term measures for coping with water scarcity in Kitulwatte. Starkloff points out that the projects involved (reservoirs, large wells, etc.) invariably ignore ecological rehabilitation and protection of water resources and permit all interests in the area to continue production as much as possible without calling into question current land use practices and their associated power relations. Most water supply projects have intensified the competition between household and irrigation water needs, and the preoccupation of development projects with water supply and hygiene favours household users at the expense of cultivation.

3.1.2 Water and agriculture

Issues of shortage in the context of agriculture tend to be cast in terms of severe drought that results in famine. This generalized equation underrepresents the significance of other social relationships and differences among farming systems. In their study of climate change impact in West Africa, where water stress and migration are common, Deitz et al. (2004:9-13) summarized nine major elements of livelihood strategies for dealing with low crop yields and food availability (Table 1).

Table 1 Livelihood strategies for responding to food stress

Option 1	Food acquisition by using stored food or selling other stored assets and buy/barter food in return
Option 2	Direct food intensification: increasing the total food production is a possibility
Option 3	Investing in indirect food intensification
Option 4	Food acquisition by marketing non-agricultural products and buying/bartering food
Option 5	Food acquisition by selling services and buying/bartering food
Option 6	Food acquisition by selling labour and buying/bartering food
Option 7	Food acquisition by social security arrangements
Option 8	Food acquisition by stealing
Option 9	Lowering food demand

Source: Deitz et al., 2004

While animals are not agricultural products in the strictest sense, water supply greatly influences local perceptions as to whether animal husbandry is practical or not. For example, there are groups like the pastoral herders of East Africa who store wealth in the form of cattle herds. In times of water shortage that threatens other aspects of livelihoods, such as agriculture, they might be compelled to sell their cattle at lower prices in an effort to avoid total loss if the animal dies. This process impoverishes households in the short term and leaves them far less resilient to later economic shocks.

Shortages of adequate water for cooking will also impact agricultural livelihoods indirectly by making some crops, like cassava, less popular for market sale in conditions of water shortage. This could induce shifts in agricultural strategy as farmers seek to grow alternative crops that meet this changing market demand. In extreme cases, rapid shifts in the desirability of crops may seriously compromise rural farm livelihoods.

3.1.3 Water, vulnerability and livelihoods

The availability of ample, high-quality water influences rural livelihoods in many ways and the degree of a household or community's vulnerability to water scarcity becomes an important dimension of migration decisions. The term "vulnerable" has been used in a variety of ways to characterize the response of social and ecological systems to perturbations. Vulnerability is the differential exposure, sensitivity, and resilience to environmental stresses of a system or group of interest is a dynamic quality that is influenced by changes in the external context, such as rainfall variability, as well as internal characteristics, such as the health of household members or the level of individual and household assets. Vulnerability is also shaped by access and the capability to employ a variety of coping strategies that may ease the losses associated with water scarcity. Depending on the assessment of vulnerability and the potential harm, some individuals and household groups may choose to avoid the threat of potential losses by migrating, others may experience some losses and include that information in their migration decision, and still others may suffer very severe losses. Their experience and perceptions of vulnerability will influence decisions about migration as well as their potential to move as a refugee.

BOX 8. COPING STRATEGIES FOR WATER SCARCITY ON A HOUSEHOLD LEVEL

Studies of livelihoods and coping with droughts in arid lands have identified a broad range of strategies for dealing with water scarcity (e.g. Deitz et al., 2004; Corbett, 1988; Watts, 1983). In arid regions, dry season migration is an established practice in some farming and livestock-raising communities. In other areas where drought occurs with relative frequency, households have strategies for dealing with the impacts of water scarcity, including arranging for some family members to spend time in other areas during water shortages. While some coping strategies can be pursued without significantly reducing household assets, other coping strategies delve more deeply into those reserves. Typically, many options are pursued before people move as refugees without assets or destinations.

Examples of coping strategies in times of water scarcity
Throughout the arid and semiarid regions farming communities are dependent on agriculture and vulnerable to water scarcity. Strategies for coping with water scarcity include choice of crops, timing of planting, and other livelihood activities in relation to the seasonal calendar. Examples of these activities are diversifying livelihood income sources and maintaining productive assets, such as livestock, which can be exchanged for necessary items when crop yields are lower than expected. Other strategies involve investing more time to obtain needed water resources.

These coping strategies place a heavy burden on people's lives. In some parts of Africa, women and children are responsible for collecting water from sources that are quite distant. Sometimes it can take many hours a day to collect the water, thereby immensely reducing the time they have available for work and education.

Coping strategies in times of drought and famine
Droughts can lead to declines in local food production, but the inability to bring in alternative sources of food, fuel, and water reflect failures in local, regional, national and international social and economic systems as well as unusually dry weather conditions. In a study in North Ethiopia, Meze-Hausken (2000) assessed the vulnerability of sedentary farmers to drought and famine. In her survey, she asked about people's repertoire of strategies to avert famine. These strategies included, in order of sequence: changing consumption patterns, selling livestock, selling oxen and household/farming equipment, using up food reserves, gathering wild fruit, searching for non-agricultural income, eating seeds for planting, part-time migration/off-farm employment, borrowing food, begging, selling jewellery, sending children to relatives, and placing cattle with relatives.

Meze-Hausken found that nearly every family had employed at least three of these strategies, and that one in two families had tried six different strategies to prolong their period of residence in the village. The chronological order of the survival strategies varied from family to family, and was influenced by the social status of the family and market dynamics, among other factors. She concluded that the value of applying coping strategies lies in its diversity and quality, which offer the best insurance against the risk of famine and migration. In addition, she concluded that increasing people's strength to cope with crises requires a stable socio-economic and political system to enable the successful performance of survival strategies.

Several other researchers have documented similar series of strategies for coping with drought (Corbett, 1988; Watts, 1983). In their volume Deitz et al. and contributors review the portfolio of theoretical, relevant, and applied strategies for individual decision-making units (from individuals to organizational representatives) and examine the implications of these for decision-making. Many of these strategies or signs of stress are monitored by local observers working for the Famine Early Warning System (FEWS) and other food security organizations. Such efforts complement the large-scale fiscal information on the amount and timing of rainfall and patterns of crop growth.

Coping with water scarcity on a national or regional level

Several measures and policies to cope with or avert water scarcity are adopted on national and regional levels as well. Some important strategies include water storage, transfer schemes, irrigation (including water recycling), increasing the productivity of water, waste water treatment, use of desalination plants, food importation, water pricing, institutional capacity building, land use strategies, appropriate legislation and institutions, appropriate property rights allocation, demographic policies, technology, and education.

Often these coping strategies alleviate the pressure water scarcity puts on people's lives or prolong the time they can cope with water scarcity. Sometimes, however, they have an adverse effect. For example, constructions of large dams and large-scale irrigation schemes have often substituted one kind of vulnerability for another: dependency on the supply of spare parts, technology, markets, prices, and subsidies, as well as the stress of relocation for many.

Regions, communities, or households exposed to water scarcity are not automatically vulnerable to water scarcity. The degree of vulnerability depends on the sensitivity of the region as well as its coping abilities. California is a good example of a region exposed to enormous water scarcity that is coping relatively well due to strong financial and legal resources. Global maps of water scarcity, drought-prone areas, and human development indicators all demonstrate that the Sahelian region, by contrast, is much more vulnerable due to high levels of water stress and generally low levels of assets.

Both socio-economic conditions and environmental/ecological conditions contribute to the vulnerability of a group. In addressing the question of water scarcity, the degree of resource dependence and the diversity of resources are significant variables. Other indicators of vulnerability address socioeconomic conditions that may also influence the degree of sensitivity or the array of coping options available. These include poverty and economic equities, access to other resources that might be used to obtain or substitute for scarce water, and the accessibility of institutional and social security structures to provide safety nets in times of stress.

3.2 DROUGHTS, FAMINE AND MIGRATION

The worst-case outcome of water scarcity is drought contributing to famine and refugee movements. Throughout history, drought and famines have affected millions of people, causing large numbers of deaths and forcing people to move. Recurrent droughts and famine have occurred in Africa and Asia (for example, see the recent record of famine in Africa, Table 2).

Table 2. Severe droughts and famine in Africa, 1972–2000

			Number killed	Number affected
1972	Famine	Ethiopia	600 000	No data
1973	Drought	Ethiopia	100 000	No data
1974	Drought	Ethiopia	200 000	No data
1980	Drought	Mozambique	no data	6 000 000
1982	Famine	Ghana	no data	12 500 000
1983	Drought	Ethiopia	no data	7 000 000
1984	Drought	Ethiopia	300 000	7 750 000
1984	Drought	Sudan	150 000	8 400 000
1985	Drought	Mozambique	100 000	2 466 000
1987	Drought	Ethiopia	no data	7 000 000
1990	Drought	Ethiopia	no data	6 500 000
1991	Drought	Ethiopia	no data	6 160 000
1991	Drought	Sudan	no data	8 600 000
1993	Drought	Malawi	no data	7 000 000
1993	Famine	Ethiopia	no data	6 700 000
1999	Famine	Ethiopia	no data	7 767 594
2000	Drought	Ethiopia	no data	10 500 000

Source: CRED-OFDA, 2002 in UNEP Global Environment Outlook 3

Droughts and famines still occur and pose serious threats in many regions, particularly in Sub-Saharan Africa, the Middle East, and Asia. The outcomes included in Table 2 are not, however, an inevitable result of drought. Rather, the degree of social vulnerability expressed as assets, access, and capabilities is a key factor in turning a stressful situation into a disaster.

Drought is a slow, gradually developing form of natural disaster that may extend over years. Over the duration of the drought, there may be several years of decreasing harvests and building stresses. Over this course of time as the drought progresses, households will begin to take on coping strategies, which include migration for short periods or for selected family members. Because of the differences in household situations and the way they experience the stresses, decisions to migrate do not occur at the same time for everyone nor necessarily involve entire households.

Blaikie et al. (1994) identify two main explanations for famine. The first explains famine as a result of food availability decline (often abbreviated as FAD) – droughts cause crop failure or reduced growth of pasture for livestock, or both, which result in insufficient food availability. The second explanation views famine as a result of reduced access to food due to the operation of social or political processes that deny or lessen people's 'entitlement' to food (FED: food entitlement decline). This explanation focuses on the unequal distribution of assets and income, which become a matter of life and death in times of droughts and famines. Famines can vary greatly in time and space and usually have complex, multiple causes. The two explanations above are often relevant when a famine occurs. Drought may be the direct cause of crop failure and lack of food, but the impact on individuals differs depending on the social mechanisms that determine people's vulnerability and access to food (see Sen, 1984).

Drought situations also contribute to famine when coupled with the stresses of war, policy failure, or government policy shifts that alter the way people obtain their food entitlements. The hard lessons learned from past famines illustrate the importance of reliable social networks. Potential environmental refugee situations will also reflect the existing weaknesses in such systems.

- In 2000, the Baluchistan Province in southwestern Pakistan faced one of the most severe droughts it had experienced in decades. The drought devastated crops and caused acute shortage of fodder. Millions of livestock perished and water wells were drawn down. Pakistani Authorities reported that as many as one million people had abandoned their homes in search for food, water and employment. To this day, many people still migrate from Baluchistan in search of water due to a depleting underground water table.

- This same drought in 2000 also severely hit southern Afghanistan and parts of western and central India. Hundreds of thousands of people in Afghanistan travelled north, away from their drought-ridden winter grazing areas, but their summer pastures also failed. Most families lost all of their livestock. Because many people tried to sell their livestock rather than maintain them throughout the drought, prices for livestock fell and people received little compensation for their loss of these assets. This persistent multi-year drought in central and southwest Asia had affected 60 million people by November 2001 (UNEP, 2002).

- Another example of the impact of drought on food availability, coping strategies and differences in people's vulnerability is provided by Haug's (2002) study of the Hawaheer, a nomadic, pastoralist group in Northern Sudan who were seriously affected by the drought in the Sahel during the mid-1980s. Famine triggered by the lack of rainfall resulted in both poor and rich people losing their livestock. Most families were forced to migrate to survive. While migration has always been part of the Hawaweer's livelihood strategy, the traditional coping strategy of seasonal labour migration in the Nile area was no longer sufficient to ward off hunger, nor was the nomadic lifestyle of trading animals and moving according to pasture opportunities. Thus, these traditional coping strategies

lost their efficacy during the drought, since the labour market was flooded with workers and the value of animals fell dramatically. But not all of the Hawaweer were affected in the same way. For example, those with reliable social networks had better employment opportunities, which facilitated the possibility of return. Further, not all of the people left; some chose to stay behind. Moving was impossible for them because they did not have enough animals for migration. Thus, they did not choose to stay because they wanted to, but rather because they were forced.

3.3 INTERACTIONS OF WATER SCARCITY AND LIVELIHOODS

Water is a crucial resource for the maintenance of human health, agricultural strategies, and socioeconomic resilience in the rural developing economies that mark much of the global south. How these various demands on water come together in particular places to distribute the pressures of water scarcity among people and ecosystems is highly dependent on the local sociopolitical, economic and environmental context. Within the same area, people of different social positions – men, women, farmers, herders, foresters – may experience different consequences as a result of water scarcity. Neither famine nor migration is the result of water scarcity alone, but rather part of an overall livelihood situation that involves opportunities and constraints that delimit feasible coping strategies.

4 Environmental degradation and population displacement: an overview

Review of the literature on environmental degradation and population displacement serves to illustrate the existing debates over the link between environment and migration, especially as this debate informs the institutional issue of environmental refugees. We then turn to the broader migration and political ecology literatures to examine alternative sources of understanding the link between environment and migration. While the link between environmental degradation and population movement remains poorly understood, this examination allows for the development of an approach to water scarcity and migration that recognizes the dynamic structural forces creating opportunities and constraints that guide peoples' choices.

While the potential for a strong relationship between environmental change and population displacement seems clear, the literature does not yet demonstrate a consensus on the nature of the relationship between these two issues. Evidence of the links between water and migration is even more sparse. Generally speaking, the environment and migration literature is divided into two camps. The first of these takes what Suhrke (1994) calls a "maximalist" point of view. In this view, environmental degradation is a cause of insecurity. This insecurity "displaces" people insofar as it causes them to seek out settings of greater safety and certainty (Kibreab, 1997:20; O'Lear, 1997:612).

Maximalist writing has been heavily critiqued within the migration literature on two major fronts. First, a number of writers (Hugo, 1996:106; Bates, 2002:466; Suhrke, 1994; Lonergan, 1998; Castles, 2002; Black, 2001) note that not all migrations relate to environmental change in the same manner. There are clear differences, for example, between those migrants fleeing a volcanic eruption and those who leave because of gradual soil degradation. In cases of gradual environmental change, actors weighing the decision to move appear to integrate environmental change with other issues, such as their economic and political situations.

The second environment and migration camp espouses a "minimalist" (Suhrke, 1994) approach. This approach argues against the simple environmental driver approach of the maximalist literature by highlighting the clear connections between the political, the economic and the environmental (see, for example, Bates, 2002; McGregor, 1993; Lonergan, 1998). Very little of this work, however, actually engages how the environment, as one of a suite of drivers in a specific context, becomes integrated with economic and political concerns. Instead, this literature tends to focus on case studies that illustrate the shared importance of economy, politics and environment in a given migration decision. These broad conceptual schools are reflected in debate over the appropriate classification – and associated policy responses – for people moving from areas experiencing environmental stress.

4.1 MIGRANTS OR REFUGEES?

One conceptual area in which the debate on the relationship between environmental change and migration crystallizes is in the identification of environmental change that constitutes a "legitimate" push for migration (see also Myers and Kent, 1995; Myers, 2002). In 1985, the UNEP recognized environmental degradation as a root cause of refugee flows, and introduced a new category of refugees: 'environmental refugees.' Myers and Kent (1995) defines environmental refugees as: "Persons who can no longer gain a secure livelihood in their traditional homelands because of environmental factors of unusual scope…. In the face of these environmental threats, people feel they have no alternative but to seek sustenance elsewhere, whether within their own countries or beyond and whether on a semi-permanent or permanent basis."

BOX 9. DEFINING DIFFERENT TYPES OF POPULATION MOVEMENTS

Proposed alternatives for the term environmental refugees are 'environmentally impelled migrants' and 'environmentally displaced persons.' In this paper we choose to talk about 'migrants' and 'population movement.' We understand that people are moving for a broad range of reasons, such as to escape from disasters or to seek opportunities elsewhere. The term 'migrants' in this paper, is meant to cover all these different types of movement.

The term environmental refugee is controversial, however, because such a term assumes that it is possible to link a particular displacement primarily to an environmental event--a "maximalist" viewpoint. Even if we can include environmental change and degradation as legitimate bases for classifying someone as a refugee (a point contested by many, especially in light of the legal definition of a refugee[2], which makes no mention of the environment), the term refugee implies that movement is an action of last resort to escape severe environmental threats. While there are some cases that might fit this definition, to limit this category in such a manner leaves aside other migrants, such as those who migrate seasonally as a means of managing livelihoods in marginal environments.

2 "Any person who, owing to a well-founded fear of being persecuted for reasons of race, religion, or political opinion, is outside the country of his nationality, and is unable, or owing to such fear unwilling, to avail himself of the protection of that country." Apart from yielding confusion, it has also been argued that to include environmentally displaced persons in the refugee definition has the effect of watering down the traditional understanding, and will result in reduced support for refugees of established sort.

The alternative "minimalist" approach to environment and migration argues that it is neither possible nor appropriate to distinguish environmental refugees from other types of refugees since environmental degradation is seldom the only reason for people to migrate. An emphasis on environmental stress as a root cause of migration may divert resources and attention from other major contributing factors and associated solutions, such as socio-political or economic change. In short, the term "environmental refugee" today is perceived as a simplification of situations that often exceed environmental explanations (McGregor, 1994).

Recent classificatory schemes dealing with migrants and the environment attempt to bridge the maximalist and minimalist perspectives, treating each as part of a continuum of migration types. The UNEP (El Hinnawi, 1985) distinguishes between three broad groups of environmental refugees, each moving for different reasons:

- Those who have been temporarily displaced because of an environmental stress (e.g. earthquakes, cyclones or other environmental incidents).
- Those who have to be permanently displaced and re-settled in a new area (e.g. in the case of the establishment of a dam).
- Individuals or groups of people who migrate from their original habitat, temporarily or permanently, in search of a better quality of life.

A more comprehensive classification is proposed by Meze-Hausken. In her study on migration in Northern Ethiopia (2000), she describes types of displacement using a continuum ranging from opportunity-driven population displacement to necessity-driven population displacement. Environmental disasters, such as coastal inundation, are treated as causes of necessary migration. People are compelled to leave, 'pushed' out by factors beyond their control. This type of movement is often linked with the strong hope of return as soon as conditions allow it. Climate change and environmental degradation, on the other hand, are seen as acting in concert with other opportunities that enable migration. When migration follows slow changes in climate and environmental conditions, migrants could be 'pulled' by a combination of worsening conditions at home and the prospect of a better job or higher earnings elsewhere. Bates (2002), who adopts a similar continuum, recognizes, for example, 'anticipatory refugees'– people who realise that their local situation will eventually deteriorate and have the ability to relocate before they are forced to do so. Such opportunity-driven migration is often permanent. The result of Meze-Hausken's classification is a continuum ranging from migrants who have been displaced by slow environmental change and motivated to migrate by better opportunities elsewhere to refugees who are driven from home by necessity when their basic survival is at stake.

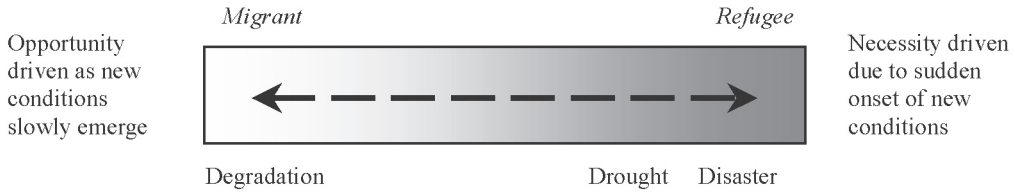

Figure 3 Types of displacement, from Meze-Hausken (2000)

These classificatory schemes, while incorporating different frameworks for understanding the relationship between environment and migration into a broad continuum, do not provide any clear means of identifying the causal role of the environment in migration except in the most

maximalist of frameworks. The current state of the environment and migration literature, then, is one of impasse (Carr, 2005). While the maximalist approach is generally discredited in the contemporary migration literature, the minimalist alternative does not provide a systematic means of addressing the connection between environment and migration. The dominant, minimalist perspective in migration studies today argues that any migration decision is the product of numerous decisions made by different people and households. Understanding these decision-making processes through the broader migration literature can help us to better understand the relationship between migration and environment.

4.2 WHY PEOPLE MOVE

There have been a number of recent efforts in the migration literature to rethink the approach to the migrant and migration (see Gidwani and Sivaramakrishnan, 2003; Silvey and Lawson, 1999; Lawson, 1998; Lonergan, 1998). The migration literature, like the narrower migration and environment literature, is also broadly divided into two camps. The first of these, a neoclassical (Lawson, 1998; Silvey and Lawson, 1999; Lonergan, 1998) or rational choice (Gidwani and Sivaramakrishnan, 2003) approach, argues that people migrate in an effort to maximize their economic or material situation. Adherents to this school argue away the fact that migrations rarely reflect the uniformity one might expect from economizing rationality through such issues as imperfect information, imperfect competition and bounded rationality on the part of the migrants (Gidwani and Sivaramakrishnan, 2003:188).

The other migration studies camp employs a political economy (Lawson, 1998; Lonergan, 1998) or Marxist (Gidwani and Sivaramakrishnan, 2003) perspective that deals with migration as a structural response to a change in political economy. Generally, proponents of a political economy approach see migration as a response to uneven development, often undergirded by efforts of the powerful in society to exploit the less powerful. These political economy models tend to (inadvertently) deny the agency of individuals in their analyses, instead finding structured behavior in political economy (Gidwani and Sivaramakrishnan, 2003:188; Silvey and Lawson, 1999:126; Lawson, 1998:41).

While there are extensive debates between the neoclassical and political economy approaches within the migration literature, the focus has recently shifted from these debates to a discussion of the shortcomings shared by both approaches. Gidwani and Sivaramakrishnan (2003:189) offer the broadest critique of both schools, arguing that neither offers any interrogation of a modernist rationality that reduces the migrant and migration to a "necessary, if sometimes unfortunate, subplot in the unfolding of history" (see also Silvey and Lawson, 1999:126). This broad critique is echoed in the work of other critics (see McHugh, 2000:74; Halfacree and Boyle, 1993:334-335), who argue that both camps reduce migrants to automatons acting out a stimulus-response cycle.

This recent critical turn in the migration literature, focused on "how migrants apprehend, negotiate, and transform the social structures that impinge on their lives" (Gidwani and Sivaramakrishnan, 2003:190; see also Halfacree and Boyle, 1993), has prompted the development of alternatives to these dominant schools. Among these alternatives are efforts to understand the power of consumption in migration decision-making (for example Gidwani and Sivaramakrishnan, 2003), the exploration of migrant subjectivity (for example, Silvey and Lawson, 1999) and biography (for example, Lawson, 2000; Halfacree and Boyle, 1993), and a heightened engagement with feminist theory (for example Lawson, 1998). In shifting the

focus to migrant perceptions and the transformative power of migration, some of these studies (for example, Gidwani and Sivaramakrishnan, 2003; McDowell and de Haan, 1997) recast migration, once treated as an event to be avoided at all costs, as a part of certain lifeways that serves to reduce resource dependency, generate more income, and increase livelihood security and resilience. As McDowell and de Haan (1997, p.3) note, "*Population movements, whether haphazard or ordered, are regarded as a threat to stability and a challenge to established lifestyles. In much of Africa and South Asia, however, movement is the established pattern and migration is both a strategy of survival and livelihood, and inseparable from identity*."

For example, Mosse et al. (2002) demonstrate in their study that seasonal labour migration is a critical aspect of rural livelihood strategies among farming families in western India. Seasonal migration is a socially embedded phenomenon in the area and one of the most important strategies to compensate for low agricultural output and low income. An important conclusion of the study suggests that the critical rural development issue is not how to reduce migration, but how to reduce its costs (social and economic), and increase its returns, especially for the poorest people.

Taking all of the above into consideration, we believe that in assessing the linkage between water scarcity and population displacement, households are the appropriate unit of analysis and the role of water should be the focus. Adopting a livelihoods perspective to assess water scarcity shifts the focus from the resource itself to people and their vulnerability. Migration related to water scarcity, therefore, cannot be isolated from livelihoods, household characteristics, local context, structural forces and individual decision-making processes.

4.3 UNDERSTANDING THE MIGRATION PROCESS

Several studies have attempted to systematize theoretical observations, assessing important interacting factors influencing the migration decision-making process. While these are important efforts to organize our understanding of the relationship between the environmental issues, such as water shortage, and migration outcomes, they all tend to identify issues shaping migration decisions without addressing *how and to what degree* these issues shape such decisions.

Döös (1997), for example, has made a schematic illustration of the factors that can influence or reinforce environmental degradation in general resulting in an increased risk of environmental migration, and their interconnections (Figure 4). In this illustration Döös highlights the complex interrelationships between the factors that affect particular migration decisions. However, there is no discussion in this schematic of how these various issues are integrated into a migration decision. The absence of this discussion leaves the reader with the impression that it is possible to make some form of a direct correlation between amounts of conflict, environmental degradation, and population pressure in a given area and the decision to migrate. Other efforts to model migration as a function of context dependent variables include Goria (1998) and Kroll et al.(2001).

Understanding the ways migration decisions reflect these complex, interrelated issues requires a deeper understanding of peoples' perspectives on the situations they face. As Döös' schematic illustrates, most people vulnerable to water scarcity are, or will be in the near future, confronting many other types of change – perhaps political, economic, social, or other environmental stresses – in their lives. Decisions about how to cope with water scarcity reflect people's perceptions of these processes of change as well as their values and aspirations.

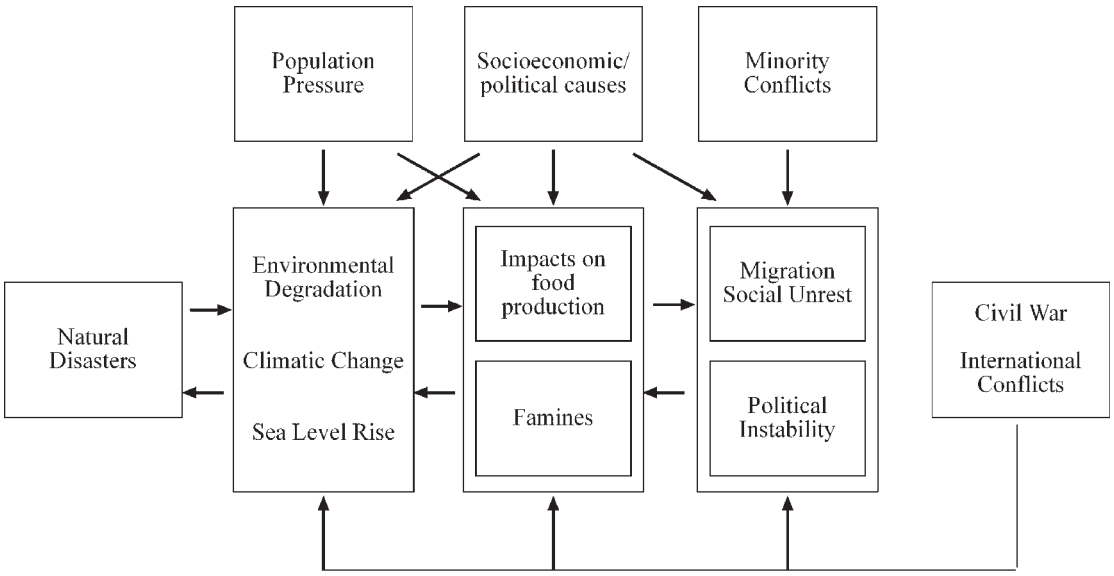

Figure 4 Döös' (1997) illustration of the factors influencing the risk of environmental migration area

Recent efforts to address this issue have centered on the social situations and perceptions of those dealing with different environmental issues. For example, Carr (2005) proposed a framework for exploring the relationship between environmental change and migration decision-making that inverts the conventional approach to environmental migration. This framework argues that migration is a local decision rooted in the local social relations and knowledge through which people apprehend and negotiate environmental change and other issues. Therefore, the study of "environmental migration" must begin not with biophysical or economic drivers or indicators, but from local social relations, livelihoods and perceptions as they relate to the biophysical and economic situation.

BOX 10. THE SEMI-ARID INTEGRATED MODEL

Krol et al. (2001) developed the Semi-Arid Integrated Model (SIM). SIM is a regional integrated model assessing the relationships between water availability, vulnerability of ecosystems and society, and quality of life and migration in rural semi-arid northeastern Brazil. The model is organized in a modular way, representing four themes: climate, water, agriculture and socio-economy.

In the model, migration from the rural areas is represented as an adaptive behaviour of inhabitants reacting to worsening living conditions. This is represented by an indicator for "quality of life." Employment and income from subsistence farming play a dominant role in quality of life. They depend much on the variable climatological and hydrological conditions. The main feedbacks are formed by societal responses to the situation in the region, including the management of agricultural and water resources and the effect of population dynamics on water and land use. Migration is accounted for in a demographic model resolving for age and gender.

Downing (2002), in an examination of the vulnerability of food systems to global climate change, also reevaluates the ways we link local decisions to biophysical or economic drivers. Downing argues for the examination of vulnerability in terms of relative adaptive capacity, since it is in this capacity that we can better understand the potential impacts of climate change on people, and therefore the responses (for example, migration) of those people. Among the issues he considers to be part of this relative adaptive capacity is social vulnerability, because individual social conditions represent the foundation on which individual perceptions of vulnerability takes shape.

A focus on the interaction of local social situations with key trends and indicators requires new adaptive methodologies that evolve to incorporate perceptions of risk, vulnerability, and opportunity. Such methods, which must engage local knowledge and bring stakeholders into environmental management processes, are not themselves new concepts. The role of citizens' advisory committees, stakeholder groups, and political debates over environmental management is well established in many disciplines and in professional practice in Western countries; it is also well known within development studies (most clearly in Chambers, 1995, 1997). However, discussions in the development literature still struggle to bring the same richness to their conceptual frameworks of risks, values, and opportunities that have become more common in developed world studies of risk assessment and risk debates. While the development debates are frequently more substantially grounded in discussions of human rights, they are less uniformly successful in incorporating details of the aspirations of individuals with different social status, cultural and/or political outlooks that we view as value conflicts in Western risk management.[3]

These multiple perspectives reveal a different kind of local knowledge, not information about the medicinal values of plants or patterns of seasonal variation in rainfall, but the interplay of broad structural change within the local political context of people's lives. It is this kind of knowledge that needs to be incorporated in vulnerability assessments as well as opportunity assessments in order to open the door to more nuanced understandings of migration decisions. Of course, perceptions should be complemented by other sources of information. Monitoring additional trend factors can be incorporated into the scenarios. What are the similarities and differences between "expert" and local expectations of the interplay of globalization, urbanization, political reform, democratization, and other changes? Both types of knowledge bring different sorts of understanding to vulnerability and the preferability of coping strategies.

5 Summary

Forecasts of water scarcity provide warnings of a variety of impacts on local livelihoods. Case studies further demonstrate that population movement is one potential response to these impacts, but studies of migration and coping with drought indicate that there are an array of coping strategies and considerations taken into account in such circumstances and refugee-type migration is one among the last choice responses to water stress. Modeling and forecasting tools are limited by the type, scale, and reliability of data available on national scales, as well as their ability to link to migration decisions in the local context. Therefore large scale assessments stress of water scarcity will very rarely provide a full accounting of factors leading to a particular decision to move. The presence or absence of other kinds of stresses, the vulnerability and capability of various groups, and the importance of these factors at different spatial and temporal scales have demonstrated significant differences in the outcomes of drought events. Though these stresses are insufficiently causally connected to form the basis for direct, long-term projections of population migration, the evaluation of this relationship between migration and water scarcity brings us to several significant conclusions.

3 Ironically, the one area of development studies that has best addressed issues of risks, values, opportunities and human rights in development is the anti-development literature (for example Mitchell, 1995; Shresha, 1995; Escobar, 1995, 1997; Ferguson, 1994; Crush, 1995; Yapa, 1996), which uses such issues to argue against the larger project of development.

5.1 WATER SCARCITY AND MIGRATION

Multiple stresses, including water availability, land degradation, and economic markets, influence decisions to incorporate migration among livelihoods strategies. As migration is currently a livelihoods strategy in many parts of the world, migration and transhumance are likely to continue as a means of dealing with changing water supplies and other dynamics. Further investigation is required to develop migration models and methods of analysis that incorporate multiple stresses ranging from the biophysical to social and multiple vulnerabilities within a local context (e.g. gender specific vulnerability) and vulnerability, as well as to understand how water scarcity intersects with these other livelihoods issues. To assume that migration in a water-stressed area is directly and simply linked to that water scarcity is to risk oversimplifying the actual motivations for migration, and therefore to risk misapprehending the needs of those negotiating the issues they perceive to be critical to their own well-being. Identification of the most highly stressed should be based on multiple stresses, recognizing the local combinations of pressures.

5.2 ENVIRONMENTAL REFUGEES

Because the relationship between water scarcity and migration decision-making is mitigated by many highly contextual factors, such as local livelihoods strategies, it is very unlikely that water scarcity alone will trigger abrupt, large-scale population movements in any part of the world. Therefore, it is doubtful that the world will see a growing tide of refugees displaced by water scarcity in the near future. Certainly, there will be changing levels of water available in many regions, and in some cases population movement will be motivated by this changing water supply in conjunction with other stress and opportunity factors. However, current global water scarcity indicators, which identify large areas expected to come under high levels of water stress, do not fully anticipate migration outcomes because they cannot capture the role of local livelihoods, politics, and society, among other issues, in migration decision-making.

5.3 ADVANCING RESEARCH AND POLICY

Policy aimed at reducing the stress associated with water scarcity and detrimental aspects of migration strategies has many opportunities to reinforce community resilience and maintain coping options. Such policy must recognize that people have extensive coping strategies that often allow for the relatively successful management of stressful circumstances and that careful coordination in creating additional community resources can enhance these abilities. Following this line of building coping capabilities, policy and research could benefit by more closely focusing on the communities which cope with water stress but do not become refugees. Understanding of how they negotiate change and stresses and how their well-being during times of stress might be enhanced can contribute to building community resilience.

Addressing the role of migration as a coping strategy for dealing with water scarcity is an important issue in light of many contemporary policies aimed towards reducing migration (land reform, the settlement of nomadic pastoralists) because such policies might restrict coping strategies and resilience of some communities while placing additional pressures on receiving communities. The arrival of migrants in new areas can place stresses upon the local economy, social structure, politics and environment that need to be addressed in terms of the resilience

of the receiving community. This potential is already being played out through the process of rural-urban migration which contributes to urban population growth rates that exceed the ability of governments and other institutions to provide adequate infrastructure and services. Evaluation of the potential impacts of water stress should include its potential to accelerate rural-urban migration and how shifting demand may increase water availability problems in urban areas already struggling with limited infrastructure. However, if policy starts from the assumption that migration is a problem that needs mitigation, it is likely to miss opportunities to improve the well being of many groups, and may even negatively impact their long-term livelihoods situations.

Water scarcity will impact the lives of millions in the years to come. If we are to meet the needs of those so affected, research and policy must not focus only on simple connections between water scarcity and migration. Instead, sustainable development efforts must engage with the complexity of local livelihoods and social structures through which water scarcity is understood and managed, because these complex relationships create the path to future community resilience.

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