

Global Environmental Change and Food Security

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Food security, defined as when *all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life* (World Food Summit, 1996), is a policy issue of importance in just about every country. Increases in the efficiency and productivity of food systems have resulted in successes around the world in reducing the prevalence of hunger and improving nutrition. However, these successes are shadowed by serious concerns about those

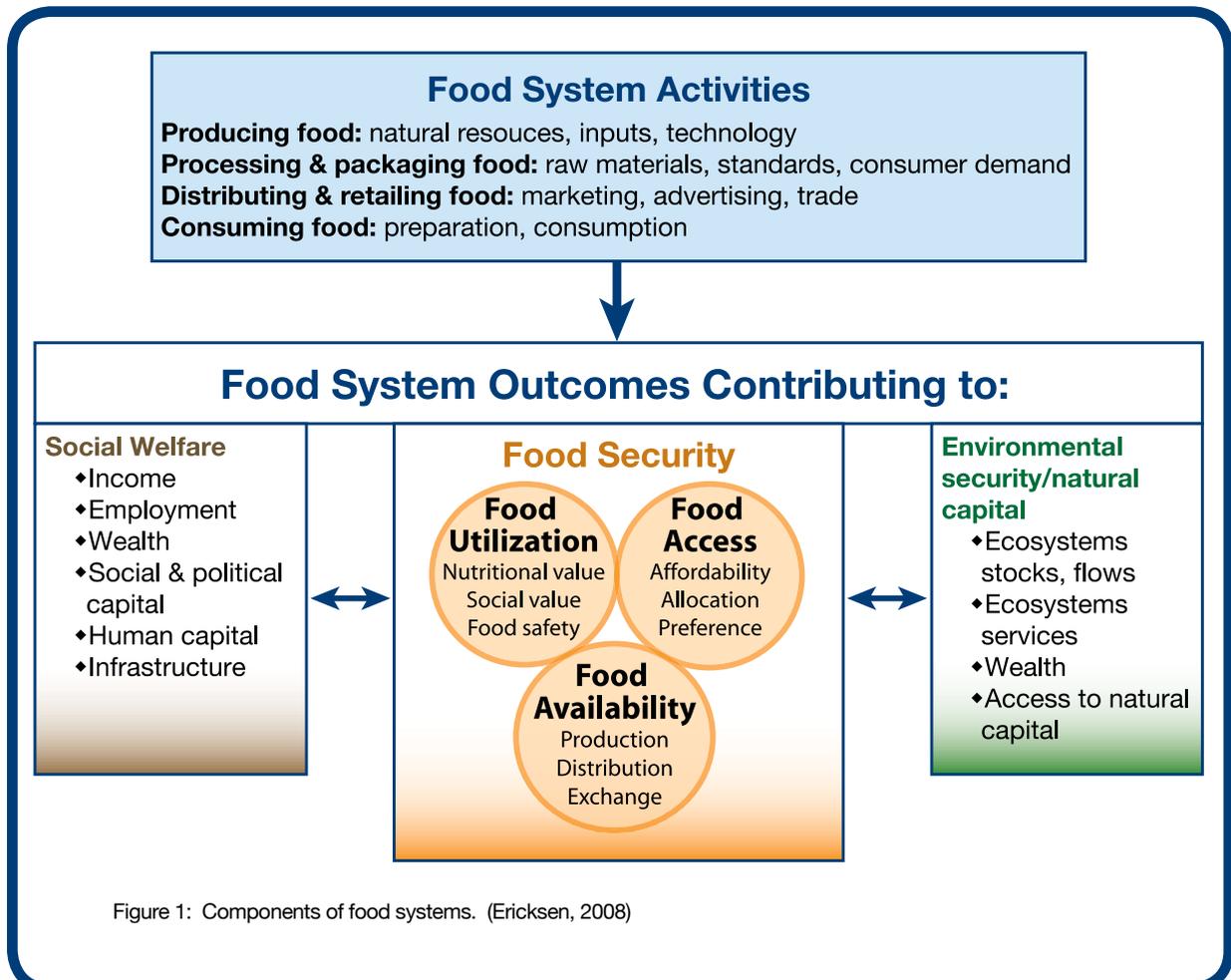
aspects of food systems that pose threats to social, economic and environmental goals and hence undermine food security. Food security for many people, particularly those in the poorer parts of Africa, Asia and Latin America, remains a difficult goal to achieve, due to a combination of social, economic and environmental stressors. Future global environmental change such as increased climatic variability, land degradation, and loss of biodiversity, in the context of social, political and economic changes, may bring unprec-

edented stresses to bear on food systems and food security.

To fully understand the impacts of global environmental change on food security, it is important to focus on food systems, not just agricultural production, because climate change affects food security through multiple paths, not just through the direct effects of climate change on crop yields, for example. Adaptation may occur at several points in food systems, not just at the place of production. Analysts of food security and food systems recognize that agriculture and food provisioning are only one component of food systems, and that food availability from production is only one dimension of food security [1].

Environmental change will affect not only food production but also livelihoods and

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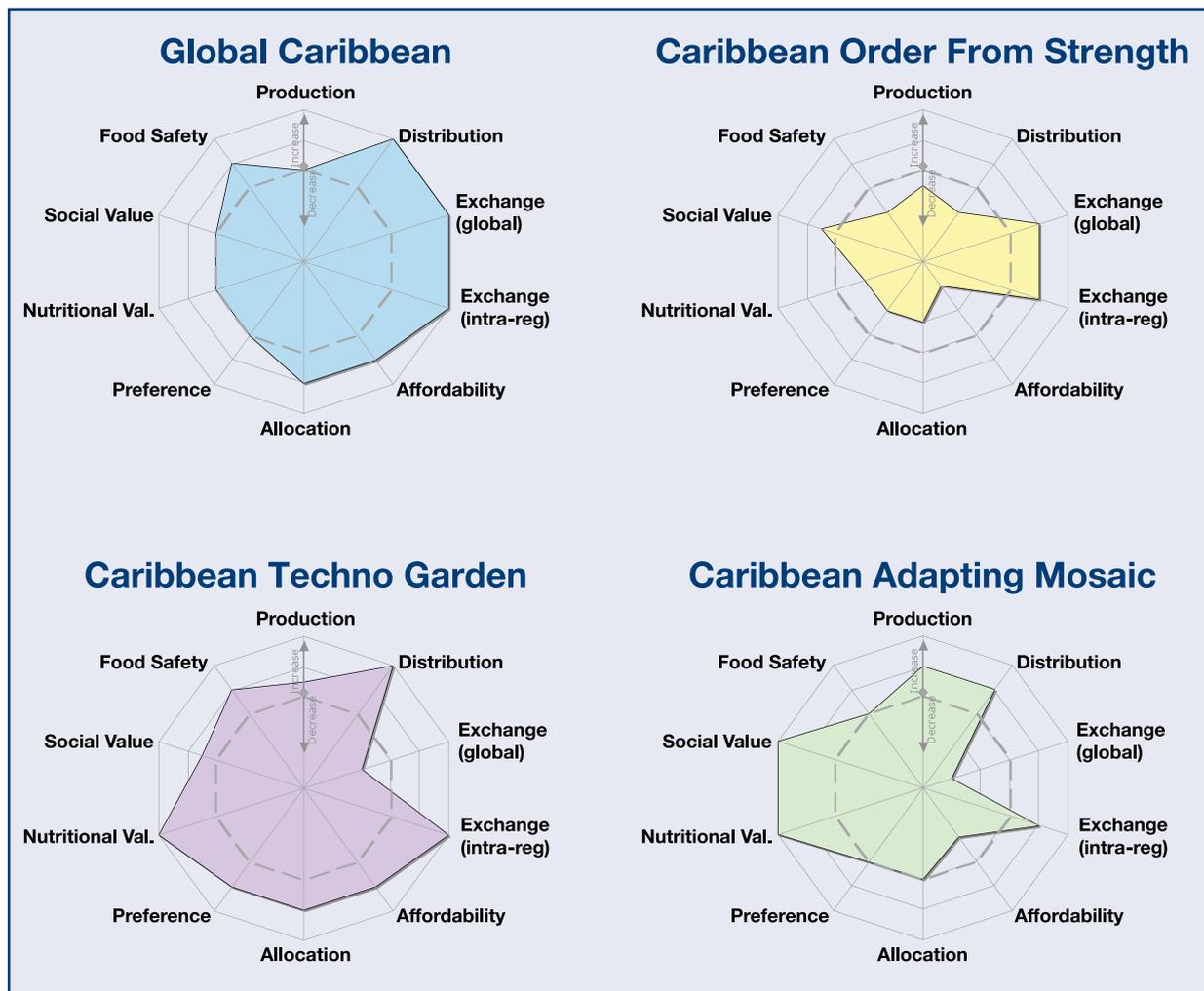


Figure 2: Food security outcomes under four different scenarios for the Caribbean [4].

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economies. Millions of people are already hungry, especially in Africa. The recently released UNDP Human Development Report states that 17% of the world's population are malnourished, and this increases to 36% of people in sub-Saharan Africa. Many of these people are hungry not (only) because crops may have failed, but because they do not have access to land to produce crops or graze animals or to jobs that provide incomes adequate for buying food. In Asia and Africa more than half of the labour force work in agriculture and have livelihoods dependent on the success not only of production but also of markets for agricultural produce [2]. At

a larger scale, many countries in the developing world derive more than 20% of their GDP from agriculture (India and Kenya for example) or are dependent on food aid for more than 5% of dietary consumption, especially for their poorest residents [3]. Natural disasters already provide important reminders of how extreme climates can devastate food systems – with floods such as those in Bangladesh and Mexico last year not only destroying harvests but also creating unemployment in agriculture and processing, damaging roads and other infrastructure essential for relief and trade, and spreading disease that intersects with food shortages to cause illness and death.

A food systems approach enables an analysis of how vulnerability of food systems to climate change arises as a function of social and environmental processes. Coping or adaptive capacity, which is largely determined by social, economic and institutional factors, varies greatly among households and communities. The approach used by the Global Environmental Change and Food Systems (GECAFS) programme helps to highlight whether or not there is sufficient adaptive capacity to buffer against a climatic stress at a variety of places in the food system (Figure 1). For example, GECAFS work in the Indo-Gangetic Plain shows how the nutritional value of food

is influenced by climate variability and that adaptation is inhibited by the lack of extension services. It also demonstrates how drought affects agricultural incomes, causing migration in the search for off-farm incomes (GECAFS unpublished results). The framework can be used to identify a range of adaptation options to ensure food security in the face of climate change, and to assess whether these options will have positive or negative feedbacks to the earth system and food security.

A holistic approach to food system and global environmental change interactions also allows consideration of food system feedbacks on the environment. For example, the major environmental concerns related to food production are increased demands on water availability for irrigation [5], an increase in pollution from agricultural inputs and soil loss [6], and a large increase in the energy demands throughout the food production sectors [7]. Recent studies [8, 9] agree that land use modification for food production has significant and wide-spread impacts on ecosystem functioning. Much of this impact, including feedbacks, has been negative, e.g. biodiversity losses have been recorded from land conversion, and water availability and access have been heavily modified for agricultural use [9, 10]. However, most studies of the impact of global environmental change, particularly climate change, have only looked at the potential consequences for crop production [11]. The interactions of the other components of food systems with environmental change remain largely unexamined. As discussed

above, food security outcomes are determined by many other factors besides production.

The key issue for many policy makers is how to choose between the inevitable trade-offs in food system outcomes. Simple spider diagrams illustrate how some food system outcomes may improve under future scenarios, while others will remain the same or even decrease. For example, under an adaptive diverse governance scenario in the Caribbean, regional stakeholders identified increases in production, within region trade and social and cultural values, but decreases in trade outside the region and in affordability. Using the same scenarios, stakeholders also identified which global environmental change concerns would increase or decrease in the future (Figure 2).

The challenges of ensuring food security whilst avoiding negative social and environmental feedbacks require an integrated research effort, with contributions from many disciplines. It also requires understandings and insights from local, regional and global studies. Finally, it requires tools such as scenarios to bridge the gaps between the scientific research and the policy making communities, so that research insights are brought to bear on decision and policy making processes. The GECAFS project invites the community of food security and earth systems researchers to join us in this endeavour.

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