Cambiamenti climatici

&

Sicurezza alimentare

Percezione del problema ancora molto debole

nonostante mutamenti molto rapidi

Lontananza nel tempo e nello spazio

Nostro sistema economico riflette i nostri valori

Non ci preoccupa il futuro ma solo problemi contingenti

Anche i tecnici lo ignorano anche se l'impatto umano

sull'ambiente già nel 1972 in una formula con 3 fattori:

Popolazione umana x Consumi x Fattore Tecnologico

COP21 Parigi Dicembre 2015

Sono già 21 anni che si cerca di limitare l'impatto antropico sul pianeta!
Aumentata la sensibilità al problema, accordo universale di 196 paesi
Ma il traguardo dei 2° pare utopistico
"Troppo tardi e troppo poco"

Se si contenesse l'aumento di 2°C fino al 2100 comunque mari e oceani si innalzerebbero di circa mezzo m.
Se si continua a non fare nulla si rischiano aumenti fino a 5°C E i mari possono innalzarsi anche di 1 m per fine secolo

Intanto la Terra perde biodiversità, suolo coltivabile, equilibri di P/N, integrità della fascia di ozono, gli oceani acidificano, aumenta l'inquinamento chimico e atmosferico, avanza il CC

Effetti dei CC sul **cibo** colpiranno popolazioni urbane e rurali in paesi ricchi e poveri

Nello scenario meno ottimistico rese agricole ridotte del 15% e prezzi aumentati del 30% per il **2050**

Siccità diffusa e innalzamento dei mari causano minore produzione e peggiore distribuzione di cibo

Fattori diretti e indiretti minacciano la sicurezza alimentare

Clima è il parametro più importante per l'agricoltura:

Colture adattate a modelli di T, pioggia, e durata delle stagioni

Danni alle Colture

CC causano lunghi periodi di siccità anche d'inverno.

Inizio 2016 ancora pochissima neve sulle Alpi

Più abbondante sugli Appennini al centro-sud

Anche freddo estremo e alluvioni

Studio di Nature dal Canada: analisi statistica dei danni globali

siccità e ondate di calore hanno ridotto quasi del 10%

produzione di cereali (1,8 mld tonn)

Calamità che colpiscono indistintamente Africa e California

Caso Studio

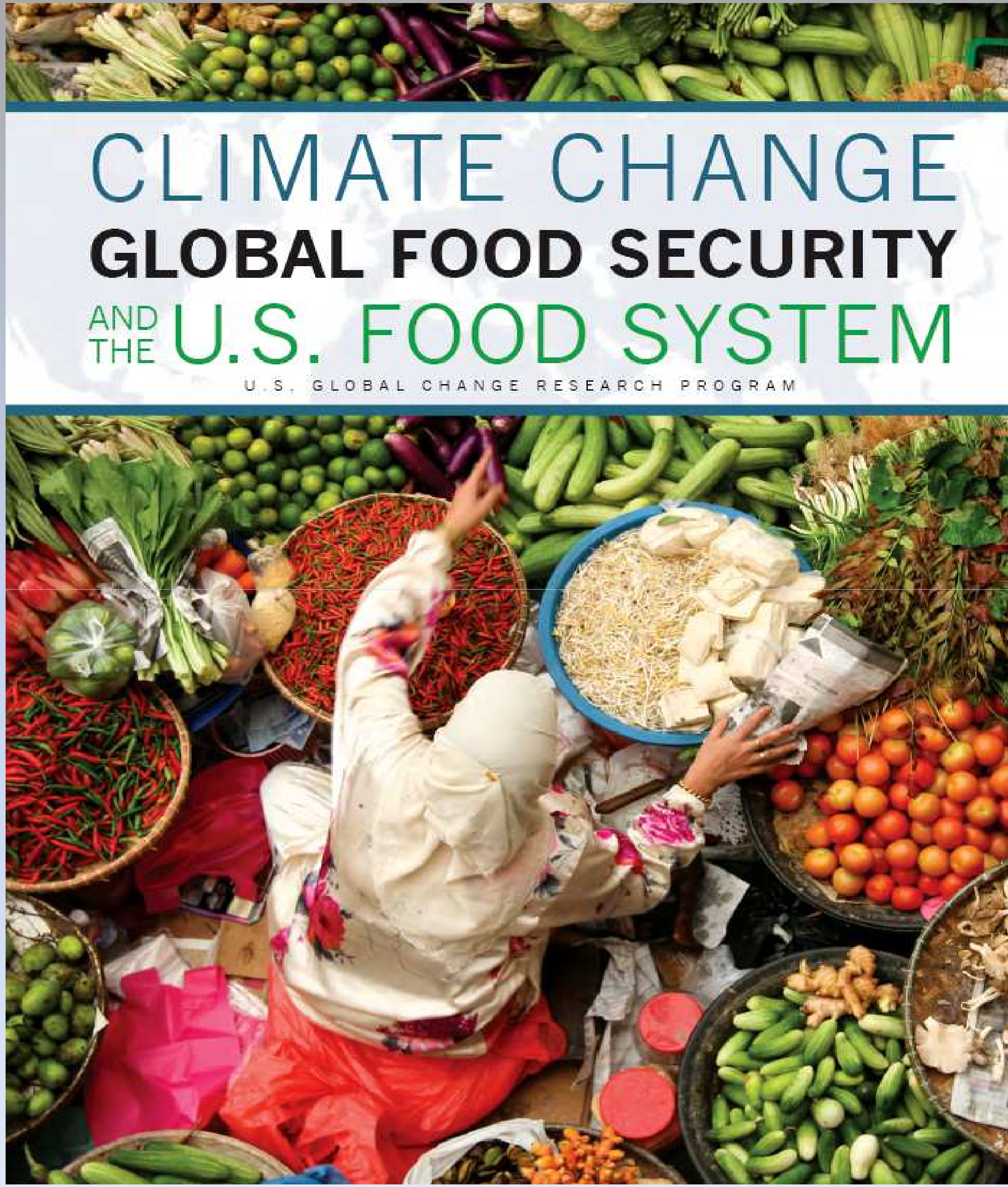
Produzione di grano in N-E Europa o di riso in Est Asia
Insieme 1/3 della produzione mondiale di cereali
Già spinta ai limiti estremi.
Aumento di Temperature: niente germinazione
Piogge e stagioni diverse alterano le colture

CC altera anche fasi di trasporto stoccaggio confezionamento e distribuzione
Minore produzione aumenta prezzi → solo mercati più ricchi
Se c'è poca disponibilità domestica chi potrà mangiare?
Es. in alcune aree dell'Africa bambini preferenzialmente rispetto a bambine

Caso Studio

gennaio 2016 **Impatto del Niño su regioni del Sud Africa**:
Zambia, Malawi, Madagascar, Zimbawe, Lesotho
per milioni di persone il Niño porta siccità anziché pioggia!
Numero di persone senza cibo sta aumentando
In SudAfrica la peggiore siccità in più di mezzo secolo.
In **California** finalmente pioggia ma poi allagamenti
mentre i campi in Africa sub-Sahariana si seccano.

WFP (World Food Programme): "siamo preoccupati che le piccole aziende agricole non raccolgano abbastanza per nutrire le famiglie, costrette a vendere il poco raccolto per coprire spese scolastiche e prime necessità domestiche"


CLIMATE CHANGE
GLOBAL FOOD SECURITY
AND THE U.S. FOOD SYSTEM
U.S. GLOBAL CHANGE RESEARCH PROGRAM

Food Security

State or condition "when all people at all times have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996, 2012). Globally, about 805 million people are food insecure (FAO 2014) and at least 2 billion live with insufficient nutrients. Paradoxically, about 2.5 billion people are overweight or obese, though not necessarily obtaining the necessary nutrients for development and health.

Food production is an important prerequisite for food security but is alone insufficient. Many other factors determine food security, including economic, social, political, and environmental ones.

Table 2.1: The Components of Food Security. *For food security to be achieved, all four components must be attained simultaneously. Adapted from FAO 2008d.*

Component	Definition
Availability	The existence of food in a particular place at a particular time. Addresses the "supply side" of food security, which is determined by food production, transportation, food stocks, storage, and trade.
Access	The ability of a person or group to obtain food. Economic access to food (including affordability) and allocation within society (including intranation and intrahousehold distribution) are integral to this component.
Utilization	The ability to use and obtain nourishment from food. This includes a food's nutritional value and how the body assimilates its nutrients. Sufficient energy and nutrient intake is also the result of biophysical and sociocultural factors related to food safety and food preparation, dietary diversity, cultural norms and religious practices, and the functional role of food in such practices.
Stability	The absence of significant fluctuation in availability, access, and utilization. When stable, food availability, access, and utilization do not fluctuate to the point of adversely affecting food security status, either on a seasonal or annual basis or as a result of unpredictable events. Weather, political unrest, or a change in economic circumstances may affect food security by introducing instabilities.

Food Insecurity

Is the absence of food security. It exists over different time horizons and affects people through **both under- and overconsumption**.

Food Systems

Food security depends not only on yields and trade but also on changes that affect food processing, storage, transportation, and retailing; the ability of consumers to purchase food; and food-consumption patterns.

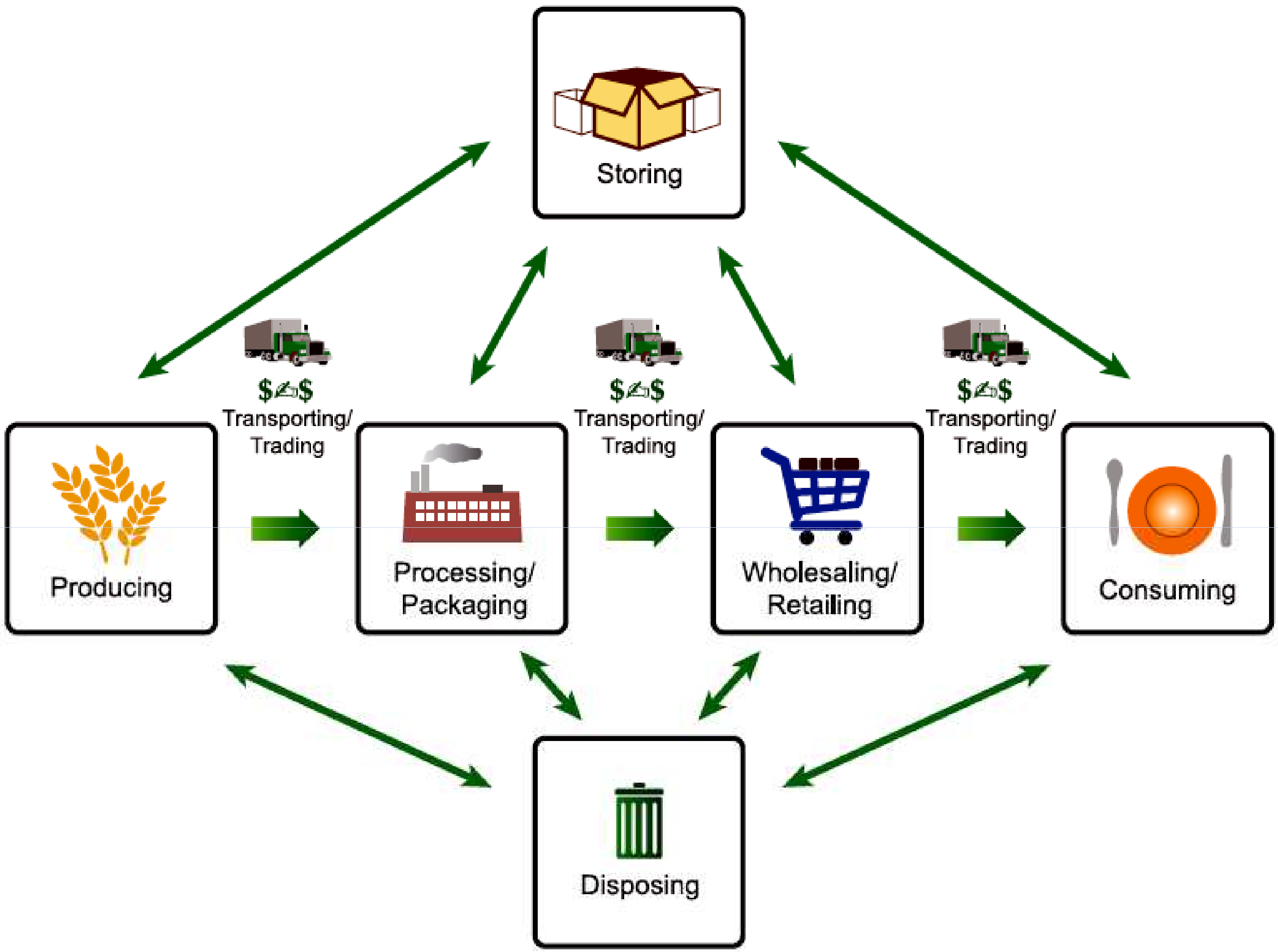


Figure 2.1. Food-system activities and feedbacks. *Food-system activities include the production of raw food materials, transforming the raw material into retail products, marketing those products to buyers and product consumption. Food transportation, storage and waste disposal play a role in each of these activities.*

Climate Change

Is identified by changes over an extended period in the average and/or variability of properties such as **temperature** and **precipitation**. Also elevated **atmospheric carbon dioxide** (CO_2) concentrations, which are a driver of climate change.

How past climate has influenced food-system activities and food security?

Effects of CC on agriculture tend to be gradual until a threshold is reached.

Food security, food systems, and climate change are multifaceted topics affected by a wide range of environmental and socioeconomic factors.

Chapter 4

Integrated Assessment Modeling of Agricultural and Food Systems

Key Chapter Findings

- Climate-change effects on overall global food production are likely to be detrimental, particularly later in the century, but these effects vary substantially by region.
- The most adverse effects are likely to occur in the tropics and subtropics, with some benefits possible at higher latitudes, due to differing biophysical and socioeconomic conditions.
- Technological, economic, and policy developments play important roles in the global food system. In the near term to mid-century, these factors are likely to be at least as important to food security as climate change for most emissions scenarios; under high emissions and later in the century, climate effects become much larger.

Chapter 5

Food Availability and Stability

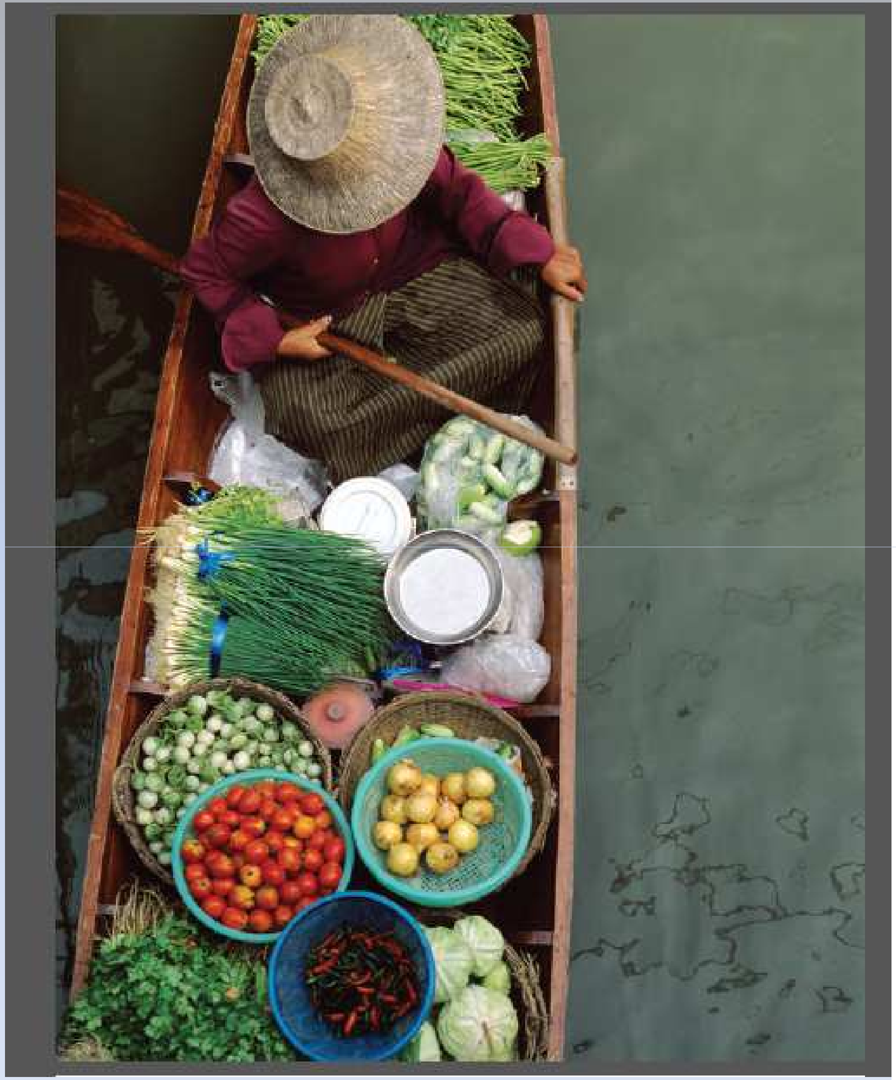
Key Chapter Findings

- Climate change influences food availability and stability through many components of the food system.
- The natural-resource base and adaptive capacity each greatly influence food-availability and stability outcomes.
- Climate influences on food production depend on the relative balance of changes being experienced within localized conditions; at the global scale, however, such changes are increasing the challenges to food security.

Disponibilità sufficiente di cibo coinvolge tutto il sistema
Tutte fasi vulnerabili ai Cambiamenti climatici

Agricoltura pluviale per 83% di terre coltivate e 60% del cibo
Grandi rese da rivoluzione verde (anni '60) da più terre coltivate
Oggi rese medie delle principali 4 colture (mais, riso, grano e soia) ridotte vs una domanda maggiorata del 60-100% per metà secolo

Clima influenza la produzione direttamente (Temperature, umidità del suolo, nutrienti, risorse idriche, CO_2 effetto serra) e indirettamente (parassiti, malattie)
Piogge più intense causano maggiori tassi di erosione del suolo
Maggiori temperature alterano durata e tempi delle stagioni
Oggi 30-50% del cibo viene sprecato, peggio con CC



Chapter 6

Food Access and Stability

Key Chapter Findings

- Climate and weather have demonstrable effects on food prices, and consequently food access and its stability.
- Food access is influenced by multiple factors, both inside and outside the food system; within the food system, trade and wholesaling/retailing of food each act to alter food access and stability, and are sensitive to changing climate factors.
- The adaptive capacity of food access to changes in climate is potentially very high but varies enormously between high-income and low-income countries and individuals, and between urban and rural populations.

Accesso al cibo

avere risorse necessarie per acquistare cibo nutriente

Cibo in abbondanza non garantisce sicurezza alimentare

Effetto dei CC sui prezzi lungo tutto il sistema

Per i poveri siccità, allagamenti, perdite di produzione aumentano i costi e riducono l'accessibilità

Danni fisici da uragani, piogge intense, fiumi in secca e riscaldamento danneggiano infrastrutture, stoccaggio, pesca e allevamenti

Volatilità dei prezzi alimentari e instabilità (come nel 2008)

Chapter 7

Food Utilization and Stability

Key Chapter Findings

- Biological contaminants in the food supply are highly sensitive to changing temperature and humidity, affecting food spoilage rates and human health.
- The adaptive capacity of food-system activities that influence food utilization and its stability is potentially very high but is also highly variable.
- Climate variability has already affected the stability of food utilization through extreme-weather events and their associated emergency responses.

Utilizzazione del cibo

in termini di effetti nutrizionali: **malnutrizione** o **denutrizione**

Blocco della crescita dei bambini 47% nel 1980, 29% nel 2010

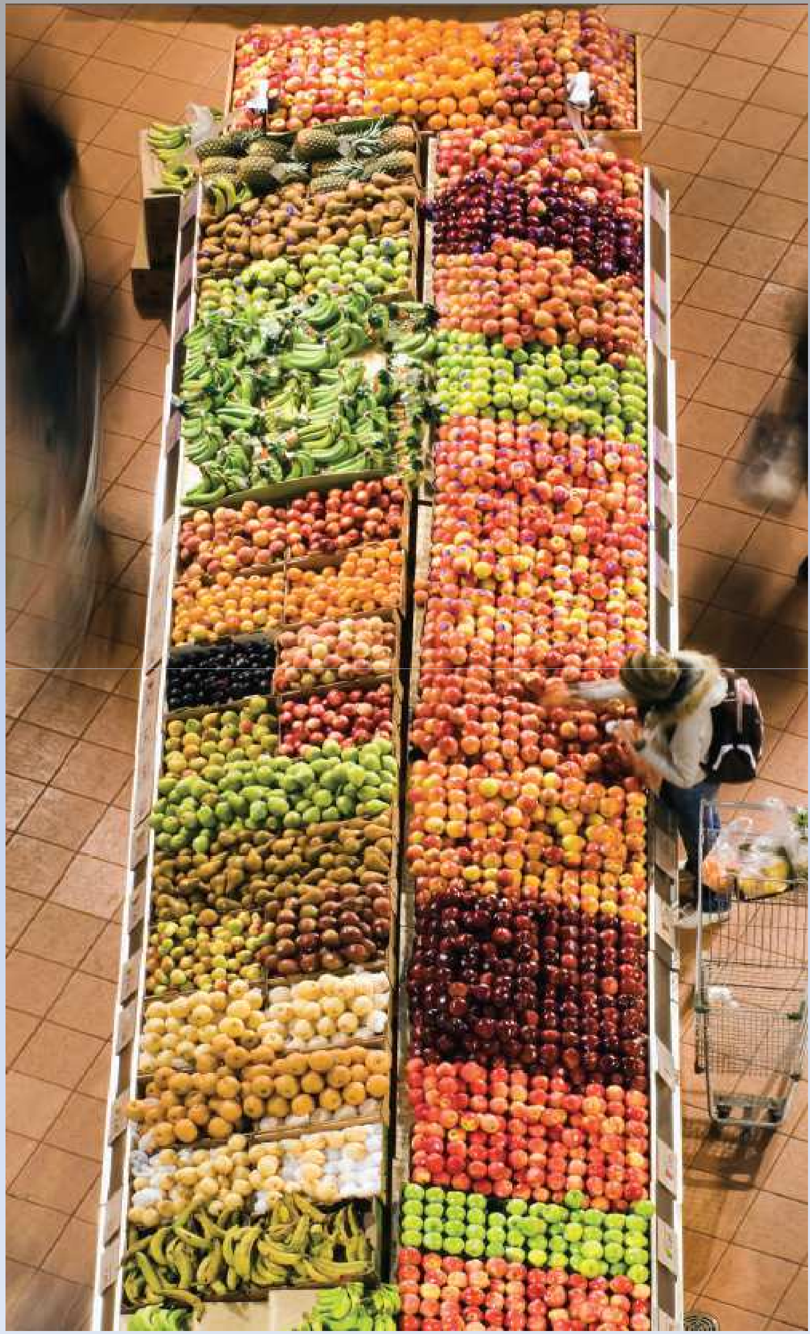
CC rischia di fermare questo progresso: Zn e Fe ridotto nel cibo ad alti tassi di CO_2 atmosferica, basso contenuto di proteine del latte per alte temperatura e umidità, micronutrienti alterati.

Aumenti di obesità infantile dagli anni '70 (N-America, Europa)

Food safety: micotossine per infezioni fungine di cereali o tossine prodotte da alghe (mari più caldi) contaminano i pesci

Qualità nutritive di importanti alimenti sono ridotte da CC

Enteropatie ambientali, contaminazioni da microrganismi




Chapter 8

Global Food Security, Climate Change, and the United States

Key Chapter Findings

- Many important connections that the United States maintains with the rest of the world, including trade, food and developmental assistance, and technological development, are essential for global food security and will be challenged by climate change.
- Climate change has the ability to disrupt food security by making it more difficult to get food from one region that is able to produce food to another region that wants to consume it, due to vulnerabilities in transportation infrastructure and related trade arrangements.
- The United States. will likely be directly and indirectly affected by changing global conditions and is expected to maintain strong food imports, exports, and assistance programs and be a source of innovative new technologies for addressing global food insecurity.

Box 8.1

Central American Coffee, the United States, and Climate Change—A Case Study

U.S. food imports provide an income source to exporting countries and can be important to the production choices, economic condition, and food security of those nations. High-value crops such as tropical fruits (e.g., bananas, pineapple) and coffee are examples. Coffee has recently demonstrated a sensitivity to changes in climate in Central America, the consequence of increasing temperatures and large production losses brought about by infestation of the fungal *Hemileia vastatrix* pathogen (coffee rust or *la roya*; Avelino et al. 2015).

Coffee was the eighth most traded agricultural commodity in the world in 2011 (FAOSTAT 2015b) and is important to many developing tropical economies. Global Exchange, a human rights organization, estimates that about 25 million people in 50 countries around the world currently depend upon the cultivation of coffee for their livelihoods (Global Exchange 2015), disproportionately represented by rural households.

Coffee leaf rust, Hemileia vastarix. (Smartse/Wikipedia Commons.)

The United States purchases over 40% of Central America's exported coffee, and as such, represents its primary market (USDA FAS 2015a). Imports from the combined countries of Central America (Guatemala, Costa Rica, Nicaragua, Honduras, El Salvador, and Panama—USD 1.05 billion) are approximately equivalent to those from Brazil (USD 1.1 billion), the largest individual source country of U.S. coffee (USTR 2015). Coffee is among the top three agricultural exports from each Central American country; the relative importance of agriculture to each economy and the domestic employment rate is listed in table below.

Changes in climate may have severe long-term effects for those who depend on coffee production. Arabica coffee, the most common variety, grows only in narrow climate conditions that require relatively constant temperatures and substantial rainfall. These conditions have existed in the mountainous regions of Central America, though climate projections suggest that farmers will be unable to continue to cultivate coffee in the same locations. In the short term, farmers may grow coffee at higher altitudes, tracking changing temperatures. Over the longer term, much of the suitable habitat in the region is expected to be lost entirely (Vermeulen et al. 2013).

Climate factors have been important drivers of the Central American *H. vastatrix* infestation. Temperature (a decrease in the diurnal thermal amplitude; Avelino et al. 2015), the seasonality of precipitation (Avelino et al. 2015), and higher humidity levels (Helfer 2013), consistent with anticipated changes in climate, are each implicated. Plants at higher altitudes were more vulnerable than in the past due to higher minimum daily

Climate Change Effects on Plant Disease: Genomes to Ecosystems

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Key Words

climate variability, disease ecology, ecological genomics, epidemiology, global warming

Abstract

Research in the effects of climate change on plant disease continues to be limited, but some striking progress has been made. At the genomic level, advances in technologies for the high-throughput analysis of gene expression have made it possible to begin discriminating responses to different biotic and abiotic stressors and potential trade-offs in responses. At the scale of the individual plant, enough experiments have been performed to begin synthesizing the effects of climate variables on infection rates, though pathosystem-specific characteristics make synthesis challenging. Models of plant disease have now been developed to incorporate more sophisticated climate predictions. At the population level, the adaptive potential of plant and pathogen populations may prove to be one of the most important predictors of the magnitude of climate change effects. Ecosystem ecologists are now addressing the role of plant disease in ecosystem processes and the challenge of scaling up from individual infection probabilities to epidemics and broader impacts.

Plant Pathology (2011) 60, 82–99

Doi: 10.1111/j.1365-3059.2010.0240

REVIEW

Soil organisms and global climate change

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Department of Biology, College of Charleston, Charleston, SC 29401, USA

Plant Pathology (2011) **60**, 100–112

Doi: 10.1111/j.1365-3059.2010.0241

REVIEW

Potential strategies and future requirements for plant disease management under a changing climate

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Eur J Plant Pathol (2012) 133:315–331
DOI 10.1007/s10658-011-9932-x

Comparative biology of different plant pathogens to estimate effects of climate change on crop diseases in Europe

Jon S. West • James A. Townsend • Mark Stevens •
Bruce D. L. Fitt

Eur J Plant Pathol (2012) 133:291–294
DOI 10.1007/s10658-011-9934-8

Are plant diseases too much ignored in the climate change debate?

Piet M. Boonekamp

Eur J Plant Pathol (2016) 144:655–670
DOI 10.1007/s10658-015-0804-7

Global climate suitability of citrus huanglongbing and its vector, the Asian citrus psyllid, using two correlative species distribution modeling approaches, with emphasis on the USA

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Susan P. Worner · Ariena H. C. van Bruggen