Preventing food losses and waste to achieve food security and sustainability

Edited by Professor Elhadi M. Yahia
Universidad Autónoma de Querétaro, Mexico
# Contents

Series list xvi
Foreword I xxii
Foreword II xxiv
Acknowledgements xxvii
Introduction xxviii

1 Food security and food waste: key issues 1
   Silvia Gaiani and Jorge Fonseca, Food and Agriculture Organization of the United Nations (FAO), Italy
   1 Introduction 1
   2 The evolution of the concept of food security 2
   3 Definitions and pillars of food security 3
   4 Recent measurements and data on food security 5
   5 The current food security policy framework 8
   6 Food security: key dimensions 10
   7 Case studies: food security in rural and urban areas 22
   8 The complex relationship between food loss and waste and food security 26
   9 Summary and future trends 27
   10 Where to look for further information 29
   11 References 30

Part 1 The problem of food losses and waste

2 Food losses and waste: terminology, definitions, quantification and causes 39
   Elhadi M. Yahia, Universidad Autónoma de Querétaro, México; and Camelia Bucatariu, Independent Researcher, Italy
   1 Introduction 39
   2 Food losses and waste: definitions and terminologies 40
   3 Food losses and waste: quantitative and qualitative losses 53
   4 Causes of food losses and waste 54
# Contents

5 Food losses and waste: methods for estimation and quantification .......................... 59
6 Estimates of food losses and waste ................................................................. 70
7 Conclusion and future trends ............................................................................ 72
8 Acknowledgment .............................................................................................. 74
9 References ........................................................................................................ 75

3 The role of food losses and waste in food insecurity ............................................ 83

Camelia Bucatariu, Independent Researcher, Italy

1 Introduction ........................................................................................................ 83
2 Food losses and waste and food insecurity: approach towards identification of direct linkages ................................................................. 84
3 How can food losses and waste reduction contribute to food security? ............... 94
4 Conclusion ........................................................................................................ 98
5 Where to look for further information ................................................................ 99
6 References ........................................................................................................ 99

4 The multidimensional socio-economic impacts of food losses and waste .......... 107

Abdallah Omezzine, University of Nizwa, Oman; Elhadi M. Yahia, Universidad Autónoma de Querétaro, Mexico; and Camelia Bucatariu, Independent Researcher, Italy

1 Introduction ........................................................................................................ 107
2 Characterizing the socio-economic impacts of FLW ........................................ 109
3 FLW socio-economic modelling ..................................................................... 113
4 A hypothetical value chain framework for assessing the economic impacts of FLW ................................................................. 114
5 The supply chain life cycle model .................................................................... 115
6 FLW economic impact analysis: impacts on farmers, retailers and consumers .... 117
7 Conclusions ...................................................................................................... 121
8 Where to look for further information .............................................................. 122
9 References ...................................................................................................... 123

5 The environmental impact of food loss and waste (FLW) .............................. 127

I. Higuera-Ciapara and R. Lugo-Melchor, Food Technology Unit, Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco, A.C. (CIATEJ), Mexico; and L. O. Noriega-Orozco, Centro de Investigación en Alimentación y Desarrollo A.C. (CIAD), Mexico

1 Introduction ...................................................................................................... 127
2 Problems in food waste accounting .................................................................. 131
3 The impact of food waste on natural resources .................................................. 133
<table>
<thead>
<tr>
<th>Contents</th>
<th>vii</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Food waste in North America</td>
<td>136</td>
</tr>
<tr>
<td>5 Urban food waste</td>
<td>138</td>
</tr>
<tr>
<td>6 Conclusions</td>
<td>142</td>
</tr>
<tr>
<td>7 References</td>
<td>142</td>
</tr>
<tr>
<td>6 The impact of food loss and waste on human nutrition and health</td>
<td>147</td>
</tr>
<tr>
<td>Jorge L. Chávez-Servín, Roberto A. Ferriz Martínez and Elhadi M. Yahia, Universidad Autónoma de Querétaro, Mexico</td>
<td></td>
</tr>
<tr>
<td>1 Introduction</td>
<td>147</td>
</tr>
<tr>
<td>2 Food, nutrition and health</td>
<td>149</td>
</tr>
<tr>
<td>3 Organic nutrients</td>
<td>151</td>
</tr>
<tr>
<td>4 Inorganic nutrients: minerals</td>
<td>159</td>
</tr>
<tr>
<td>5 Nutritional classification of food</td>
<td>162</td>
</tr>
<tr>
<td>6 Loss and waste of nutritional components (LWNCs) from food loss and waste</td>
<td>166</td>
</tr>
<tr>
<td>7 Reducing the LWNCs in food</td>
<td>174</td>
</tr>
<tr>
<td>8 Conclusion</td>
<td>177</td>
</tr>
<tr>
<td>9 Where to look for further information</td>
<td>178</td>
</tr>
<tr>
<td>10 References</td>
<td>179</td>
</tr>
<tr>
<td>7 The role of food safety in food waste and losses</td>
<td>187</td>
</tr>
<tr>
<td>Dima Faour-Klingbeil, Plymouth University, UK and DFK for Safe Food Environment, Germany; and Ewen Todd, Ewen Todd Consulting, USA</td>
<td></td>
</tr>
<tr>
<td>1 Introduction</td>
<td>187</td>
</tr>
<tr>
<td>2 Food safety regulations: a safeguard and promoter of food wastes and losses</td>
<td>190</td>
</tr>
<tr>
<td>3 Food safety gaps and their role in the food waste and losses along the food supply chain</td>
<td>192</td>
</tr>
<tr>
<td>4 Food fraud</td>
<td>207</td>
</tr>
<tr>
<td>5 Future trends</td>
<td>209</td>
</tr>
<tr>
<td>6 Conclusions</td>
<td>213</td>
</tr>
<tr>
<td>7 References</td>
<td>214</td>
</tr>
</tbody>
</table>

**Part 2 Causes of food losses and waste**

| 8 Improving supply chains to prevent food losses and waste: an overview | 229 |
| Hamid El Bilali, University of Natural Resources and Life Sciences (BOKU), Austria | |
| 1 Introduction | 229 |
| 2 Food losses and waste along the supply chain: main causes and reduction strategies | 230 |
### Contents

3 Reducing food wastage along the food supply chain: the need for a systems approach 237
4 Future trends and conclusion 241
5 Where to look for further information 242
6 References 242

9 Food losses during production of agricultural commodities 249
   Elhadi M. Yahia, Universidad Autónoma de Querétaro, Mexico;
   José de Jesús Ornelas-Paz, Centro de Investigación en Alimentación y Desarrollo A.C. (CIAD), Mexico; Puran Bridgemohan, University of Trinidad and Tobago, Trinidad; and Santiago Vergara, Universidad Autónoma de Querétaro, Mexico

   1 Introduction 249
   2 Genetic factors as potential causes of preharvest losses 253
   3 Environmental factors as causes of preharvest losses 259
   4 Agronomic practices and preharvest losses 263
   5 Diseases as a cause of preharvest losses 268
   6 Insects and pests as a cause of preharvest losses 271
   7 Chemical treatments to minimize preharvest losses 273
   8 Conclusions 280
   9 References 281

10 Food losses and waste during food processing 287
   Hanne Møller, Aina Elstad Stensgård and Ole Jørgen Hanssen, Ostfold Research, Norway

   1 Introduction 287
   2 Causes and measures 288
   3 Measures for the reduction of food waste - examples from Norway 291
   4 Conclusions and recommendations 298
   5 Where to look for further information 298
   6 References 299

11 Temperature deviations during transport as a cause for food losses 301
   Reiner Jedermann, Institute for Microsensors, Actuators and Systems (IMSAS), Germany; Ulrike Praeger and Martin Geyer, Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Germany; and Walter Lang, Institute for Microsensors, Actuators and Systems (IMSAS), Germany

   1 Introduction 301
   2 Transport losses as part of the problem 306
3 The omnipresence of temperature deviations 310
4 Shelf-life prediction 317
5 Identification, quantification and mitigation of temperature abuse 322
6 Remote monitoring and FEFO application 327
7 Future trends 331
8 Conclusion 334
9 Acknowledgement 336
10 References 336

12 Food waste at the consumer level 341
Elhadi M. Yahia, Universidad Autónoma de Querétaro, Mexico; and Marie Mourad, Center for the Sociology of Organizations (CSO), France

1 Introduction 341
2 Extent of consumer food waste across the world 342
3 Causes of consumer food waste 345
4 Strategies to reduce consumer food waste 352
5 Conclusions 357
6 References 358

13 Food waste in food services 367
Sampsa Nisonen and Kirsi Silvennoinen, Natural Research Institute Finland (LUKE), Finland

1 Introduction 367
2 Case studies 370
3 Conclusion 376
4 Future trends 377
5 Where to look for further information 378
6 References 379

Part 3 Food losses and waste in different commodities

14 Food losses and waste in cereal grains 385
Tadele Tefera, International Centre of Insect Physiology and Ecology, Ethiopia; and Esayas Mendesil, Jimma University, Ethiopia

1 Introduction 385
2 The extent of food loss and waste in cereal grains 386
3 The benefits of reducing food losses and waste in cereal grains 390
4 Methods to reduce food loss and waste in cereal grains 393
5 Conclusions 398
<table>
<thead>
<tr>
<th>15</th>
<th>Losses and waste in fruits and vegetables</th>
<th>407</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elhadi M. Yahia, Universidad Autónoma de Querétaro, Mexico; and Jorge M. Fonseca, Food and Agriculture Organization of the United Nations (FAO), Italy</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Introduction</td>
<td>407</td>
</tr>
<tr>
<td>2</td>
<td>The magnitude of losses and waste of fruit and vegetables</td>
<td>409</td>
</tr>
<tr>
<td>3</td>
<td>Causes of losses and waste</td>
<td>418</td>
</tr>
<tr>
<td>4</td>
<td>Primary and secondary causes of losses and waste</td>
<td>421</td>
</tr>
<tr>
<td>5</td>
<td>Under-explored factors in losses and waste</td>
<td>425</td>
</tr>
<tr>
<td>6</td>
<td>Issues in estimation of losses and waste</td>
<td>427</td>
</tr>
<tr>
<td>7</td>
<td>Strategies to prevent losses and waste</td>
<td>430</td>
</tr>
<tr>
<td>8</td>
<td>Conclusions</td>
<td>434</td>
</tr>
<tr>
<td>9</td>
<td>Where to look for further information</td>
<td>435</td>
</tr>
<tr>
<td>10</td>
<td>References</td>
<td>436</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16</th>
<th>Food losses and food waste in roots and tubers</th>
<th>445</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Martini Binti Mohammad Yusoff and Azizah Binti Misran, Universiti Putra Malaysia, Malaysia</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Introduction</td>
<td>445</td>
</tr>
<tr>
<td>2</td>
<td>Pre-harvest factors affecting root and tuber losses</td>
<td>449</td>
</tr>
<tr>
<td>3</td>
<td>Harvest and post-harvest factors affecting root and tuber losses</td>
<td>453</td>
</tr>
<tr>
<td>4</td>
<td>Losses during retail marketing and waste during consumption</td>
<td>457</td>
</tr>
<tr>
<td>5</td>
<td>Approaches to reduce losses and waste of roots and tubers</td>
<td>458</td>
</tr>
<tr>
<td>6</td>
<td>Conclusions</td>
<td>460</td>
</tr>
<tr>
<td>7</td>
<td>Where to look for further information</td>
<td>461</td>
</tr>
<tr>
<td>8</td>
<td>References</td>
<td>462</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>17</th>
<th>Food losses and waste in meats</th>
<th>467</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Salah El-Safty, Ain Shams University, Egypt; and Carlos F. Sosa-Ferreira, Universidad Autónoma de Querétaro, Mexico</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Introduction</td>
<td>467</td>
</tr>
<tr>
<td>2</td>
<td>On-farm poultry and ruminant meat losses</td>
<td>469</td>
</tr>
<tr>
<td>3</td>
<td>Losses in transport of live animals</td>
<td>472</td>
</tr>
<tr>
<td>4</td>
<td>Postmortem losses</td>
<td>473</td>
</tr>
<tr>
<td>5</td>
<td>Technologies and practices to reduce meat losses and waste</td>
<td>476</td>
</tr>
<tr>
<td>6</td>
<td>Conclusions</td>
<td>478</td>
</tr>
<tr>
<td>7</td>
<td>References</td>
<td>479</td>
</tr>
</tbody>
</table>
## Contents

<table>
<thead>
<tr>
<th>Page</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>483</td>
<td>18</td>
</tr>
</tbody>
</table>

* I. Higuera-Ciapara and R. Lugo-Melchor, Food Technology Unit, Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco, A.C. (CIATEJ), Mexico; and L. O. Noriega-Orozco, Centro de Investigación en Alimentación y Desarrollo A.C. (CIAD), Mexico

### Part 4 Reducing food losses and waste

<table>
<thead>
<tr>
<th>Page</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>509</td>
<td>19</td>
</tr>
</tbody>
</table>

* Pilar Santacoloma, Food and Agriculture Organization of the United Nations (FAO), Colombia; Laura Brenes, Agribusiness School Tecnológico de Costa Rica and Costa Rican FLW Network, Costa Rica; Sara Granados, Food and Agriculture Organization of the United Nations (FAO), Chile; Maria Fernanda Jimenez Morales, Agribusiness School Tecnológico de Costa Rica and Costa Rican FLW Network, Costa Rica; and Luis Saez, Universidad Santiago de Chile, Chile

### Part 4 Reducing food losses and waste

<table>
<thead>
<tr>
<th>Page</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>509</td>
<td>19</td>
</tr>
</tbody>
</table>

* Pilar Santacoloma, Food and Agriculture Organization of the United Nations (FAO), Colombia; Laura Brenes, Agribusiness School Tecnológico de Costa Rica and Costa Rican FLW Network, Costa Rica; Sara Granados, Food and Agriculture Organization of the United Nations (FAO), Chile; Maria Fernanda Jimenez Morales, Agribusiness School Tecnológico de Costa Rica and Costa Rican FLW Network, Costa Rica; and Luis Saez, Universidad Santiago de Chile, Chile

1 Introduction
2 Investment challenges to reach FLW reduction targets in the 2030 agenda
3 The private sector as a driver towards sustainable food systems: why investing in reducing FLW is a ‘business case’
4 Public sector: the role of governments in enabling the legal and regulatory environment for FLW prevention and reduction
5 Cases from Latin America and the Caribbean
6 Relevance of the PPP for FLW initiatives
7 Way forward: what is needed for FLW PPP planning, management and monitoring? Which type of alliances?
20 The role of food banks in food security and food loss and waste (FLW) prevention
Moez El Shohdi, Egyptian Food Bank/Food Banking Regional Network, Egypt; and Rasha El Shafei, Universities of Canada in Egypt, Egypt

1 Introduction 529
2 Food banks and the problem of food waste 530
3 The traditional food banking model 531
4 The contemporary food banking (CFB) model 532
5 Case study: The Egyptian Food Bank Food Loss and Waste (FLW) management program 536
6 Conclusion 539
7 Where to look for further information 540
8 References 540

21 Reusing and recycling of food waste
Jesús R. Rodríguez-Núñez, Universidad de Guanajuato, Mexico; and Armida Rodríguez-Félix and Tomás J. Madera-Santana, Centro de Investigación en Alimentación y Desarrollo A.C. (CIAD), Mexico

1 Introduction 543
2 Waste recycling and reuse 545
3 Reuse and recycling of vegetable processing waste 546
4 Reuse and recycling of livestock processing waste 551
5 Reuse and recycling of marine processing waste 552
6 Conclusion and future trends 555
7 Where to look for further information 555
8 References 557

22 Householder food waste prevention campaigns: contributions from psychology and marketing
Sandra Davison and Anne Sharp, University of South Australia, Australia

1 Introduction 567
2 Household food management 568
3 Social marketing food waste campaigns 569
4 The trans-theoretical model (TTM) 570
5 Trans-theoretical model (TTM) concepts explained 571
6 Case study: household food waste prevention 573
7 Implications 585
8 Where to look for further information 587
9 References 588

23 Reusing food waste: the importance of mycotoxin detection and decontamination 593
*F. Ascencio, Centro de Investigaciones Biológicas del Noroeste, Mexico; and T. Sandoval-Contreras, Instituto Tecnológico de Tepic, Mexico*

1 Introduction 593
2 Recycling and reuse of food waste 595
3 Mycotoxins, food production and food waste 598
4 Factors affecting mycotoxin growth 602
5 The problem of masked mycotoxins 604
6 Detection and modeling of mycotoxin contamination 606
7 Processing methods to inactivate mycotoxins 607
8 Biological degradation of mycotoxins and mycotoxin-adsorbing agents 610
9 Where to look for further information 612
10 References 613

Part 5 Regional case studies

24 Challenges and initiatives in reducing food losses and waste: United States 629
*Leigh Prezkop and Amanda Stone, World Wildlife Fund (WWF), USA; Gregory A. Baker, Santa Clara University, USA; Lisa K. Johnson, Independent Consultant, USA; and Jonathan Deutsch, Drexel University, USA*

1 Introduction 629
2 Production 632
3 Consumer-facing businesses 636
4 Consumers 644
5 Conclusion 647
6 Where to look for further information 647
7 References 648

25 Challenges and initiatives in reducing food loss and waste in Europe 653
*Camelia Bucatariu, Independent Researcher, Italy*

1 Introduction 653
2 An overview of food loss and waste data availability and quality in Europe and how it has improved over the past ten years 656
3 A European perspective on multi-actor food loss and waste policy development: from regional to local level 674
4 Where to look for further information 682
5 References 683

26 Food losses and waste in the Near East and North Africa region 693
Elhadi M. Yahia, Universidad Autónoma de Querétaro, Mexico

1 Introduction 693
2 Estimating FLW in the NENA region 698
3 FLW and regional food security 703
4 Improving food security in the NENA region through FLW reduction 706
5 Methods for reducing FLW in the NENA region 716
6 Conclusions 721
7 Acknowledgement 722
8 References 722

27 Challenges and initiatives in reducing postharvest food losses and food waste: sub-Saharan Africa 729
Tanya Stathers, Natural Resources Institute (NRI) – University of Greenwich, UK; and Brighton Mvumi, University of Zimbabwe, Zimbabwe

1 Introduction 729
2 Quantifying the postharvest food loss occurring in sub-Saharan Africa 735
3 Food waste in sub-Saharan Africa – what do we know? 742
4 Challenges and initiatives in reducing food losses and food waste 745
5 Conclusion and future trends 772
6 Where to look for further information 774
7 References 776

28 Challenges and initiatives in reducing food losses and waste: Latin America and the Caribbean 787
Laura Brenes-Peralta and María Fernanda Jiménez-Morales, Instituto Tecnológico de Costa Rica, Costa Rica; Murillo Freire Junior, Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Brazil; Walter Belik, Universidad Estadual de Campinas (UNICAMP), Brazil; Natalia Basso, Ministry of Agriculture Livestock and Fisheries, Argentina; Gustavo Polenta, Centro de Investigación de Agroindustria del Instituto Nacional de Tecnología Agropecuaria (INTA), Argentina; Catalina Giraldo, Cadenas de Valor Sustentables SpA (Sustainable Value Chains), Chile; and Sara Granados, Food and Agriculture Organization of the United Nations (FAO), Chile

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<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Introduction</td>
<td>787</td>
</tr>
<tr>
<td>2 The development of a regional FLW strategy</td>
<td>788</td>
</tr>
<tr>
<td>3 FLW reduction in Brazil</td>
<td>790</td>
</tr>
<tr>
<td>4 FLW reduction in Chile</td>
<td>791</td>
</tr>
<tr>
<td>5 FLW reduction in Argentina</td>
<td>793</td>
</tr>
<tr>
<td>6 FLW reduction in Costa Rica</td>
<td>794</td>
</tr>
<tr>
<td>7 Challenges and future trends in reducing FLW in the LAC region</td>
<td>796</td>
</tr>
<tr>
<td>8 Where to look for further information</td>
<td>797</td>
</tr>
<tr>
<td>9 References</td>
<td>798</td>
</tr>
<tr>
<td>Index</td>
<td>803</td>
</tr>
</tbody>
</table>
Foreword I

The issue of food loss and waste (FLW) has received considerable attention in recent years. With more than 820 million people estimated to be hungry in the world, growing concern about the high levels of global food insecurity and malnutrition has been one of the factors responsible for this trend. It is also being increasingly realised that food systems development is a major contributor to climate change, ecosystem degradation, biodiversity loss and unsustainable exploitation of water resources. Stemming FLW is considered by many as one of the ways through which humankind will be able to feed itself sustainably without further negative impact on the planet, in line with the 2030 Agenda for Sustainable Development.

This book therefore comes at an opportune moment. With contributions from experts working across various disciplines in different parts of the world, the document offers a comprehensive and holistic treatment of the topic of FLW. It begins by defining what is meant by FLW and then assesses current research on the economic, environmental and nutritional impact of FLW. The causes of FLW and solutions to prevent it at different stages in the supply chain from cultivation to retail and consumer use are then presented. The third part of the book looks at FLW for particular commodities, including cereals and grains, fresh fruit and vegetables, roots and tubers, oilseeds, meat and dairy products, and fish and seafood products. The final section reviews the effectiveness of campaigns to reduce FLW in regions such as North and Latin America, Asia and the Pacific, the Middle East, and sub-Saharan Africa.

As any other systems-level challenge, FLW can be best addressed through systems-based approaches that address the range of issues in a holistic and sustainable manner. On the other hand, achieving the ambitious goals under the 2030 Agenda requires concerted action, greater coordination across sectors, and collaboration by all stakeholders to achieve transformation at scale. The comprehensive and multi-dimensional approach adopted in the book will facilitate not only better understanding of the theoretical underpinnings of FLW and its inter-connections to other food security, environmental and socio-economic questions, but also the designing and implementation of practical interventions, including through lessons learned from experiences of other regions of the world. The publication will also support multi-stakeholder action as it contains information that can support the actions of different stakeholders concerned about and working on FLW reduction: academic and research institutions, private sector businesses; policy makers; civil society organisations; consumer associations; and development organisations.
It is my belief therefore that this volume will go a long way in helping us address FLW, as part of our common goal to develop sustainable food systems in line with the Sustainable Development Goals.

Divine Njie
Deputy Strategic Programme Leader
Food Systems Programme
Food and Agriculture Organization of the United Nations (FAO)
Rome, Italy
August 2019
The 2011 Food and Agriculture Organization of the United Nations (FAO) report *Global Food Losses and Food Waste* states that one-third of all food the world produces is lost or wasted every year. Food loss and waste (FLW) is devastating. FLW is perhaps the greatest impediment to adequately feeding the world’s population and addressing the wide-ranging issues created by hunger. It affects an individual’s health, development, productivity and overall quality of life. It influences a community’s economic growth, stability and security. FLW also has a profound effect on the environment. Global food production has the largest environmental impact of any human activity. This means that food waste has a high carbon footprint, accelerating climate change which, in turn, damages food production.

In general food losses and waste happen when food is discarded or diverted at any point in the food supply chain, including during cultivation, harvesting, sorting, transportation, distribution and consumption. Food waste, specifically, results from intentional decisions made by different stakeholders in the food supply chain, including consumers. However, although consumers are a cause of food waste, they are also part of the solution. As consumers have become more aware of the economic, social and environmental damage caused by food waste, consumer demands for the problem of FLW to be tackled has also increased.

At the Global Cold Chain Alliance (GCCA), we know that building and maintaining reliable cold chains is an important mechanism for combating FLW. Cold chains ensure proper temperatures of foods – maintaining quality and ensuring safety – from the point of origin through the distribution chain to the final consumer. Optimized cold chains reduce losses and waste and extend food’s shelf life, create increased food access, conserve environmental resources, reduce greenhouse gas emissions and increase economic returns.

In 2018, the GCCA partnered with the World Wildlife Fund (WWF), the University of California-Davis and Santa Clara University to release the report: *No Food Left Behind: Part 1: Underutilized Produce Ripe for Alternative Markets* (https://c402277.ssl.cf1.rackcdn.com/publications/1170/files/original/WWF_NoFoodLeftBehind820_2.pdf?1564432069). The report is the result of a US-based study to assess food loss after harvest. Given the size of the agricultural sector, US food supply chain partners have a responsibility to lead produce improvement and recovery efforts. The study clearly identified opportunities for the US food system to increase availability of fruits and vegetables without increasing negative effects on the environment. These opportunities span the entire food supply chain and, therefore, require
commitment from companies, governments, academics and individuals. Only
together can we really harness the combined power of the supply chain to
decrease food loss and waste, improve global access to adequate nutrition,
and reduce environmental impact.

This book on Preventing food losses and waste to achieve food security and
sustainability is a comprehensive examination of FLW that provides readers with
both the foundations for understanding the global FLW crisis and strategies
for reducing loss and waste in the food supply chain. The editor has brought
together an esteemed group of global experts to take-up the challenge of
informing and educating those who can prevent FLW and enable economic
and environmental sustainability.

Part 1 details the total effect of FLW on food security, economic and
environmental sustainability, human nutrition and health, and food safety.
Part 2 includes research and perspectives on the causes of FLW. Authors discuss
strategies to address identified issues with supply chain activities including
production, storage, processing, and transportation/distribution, as well as
issues at the consumer and food service levels. Part 3 explores FLW in the main
food commodities, each of which presents a unique set of challenges and
opportunities to address. Part 4 creates a roadmap for change. Authors explore
what is needed from policymakers and regulators, the private sector, food
banks, and consumers to reduce food loss and waste. In addition, this section
looks at supporting strategies related to re-using, recycling and optimizing
food waste. Finally, Part 5 presents regional case studies of the challenges and
initiatives in reducing food losses and waste in counties and regions such as
the United States, Europe, North Africa and the Middle East, Sub-Saharan Africa
and Latin America.

Like the 2011 FAO Global Food Losses and Waste report, Preventing food
losses and waste to achieve food security and sustainability can greatly influence
the global effort to reduce FLW. In providing a comprehensive understanding
of the problem and strategies required to address FLW, the editor and authors
establish a basis for collaboration and a foundation upon which to build.

Corey Rosenbusch, CAE, IOM is the President and CEO of the Global
Cold Chain Alliance (GCCA), which aims to forge a universally-strong cold
chain where every product retains quality and safety through each link in the
supply chain. Supporting this critical mission are GCCA’s (www.gcca.org) three
core partner trade associations, which provide relationships, resources and
recognition to members:

- International Association of Refrigerated Warehouses (IARW) is the third-
  party logistics, temperature-controlled warehouse industry’s association.
- International Refrigerated Transportation Association (IRTA) is the
temperature-controlled transportation and logistics industry’s association.
• Controlled Environment Building Association (CEBA) is the association for experts in the design and construction of temperature-controlled facilities.

The GCCA and its Core Partners also are supported by the World Food Logistics Organization (WFLO), a nonprofit foundation that develops education and research for the industry and provides cold chain advisory services that empower economic development and strengthen the global cold chain.

Corey Rosenbusch (CAE, IOM)
President and CEO of the Global Cold Chain Alliance
Introduction

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996).

Food insecurity is a serious global problem. Although global food production has improved significantly, especially over the last 50 years, food insecurity persists and more than 800 million people still go to bed hungry. In addition, over 2 billion people are food insecure. Food insecurity is not primarily a problem of rural poverty. About 1.2 billion people live in urban slums, of which 70% to up to 90% are food insecure. Hunger and food insecurity persist despite immense wealth, tremendous technological achievements, and a world that is more interconnected than ever with freer movement of people, capital and technology across borders. This emphasizes the economic disparity and the subsequent inequality that touches the most vulnerable.

Many and diverse factors lead to food insecurity and hunger, including armed conflicts, humanitarian crises, natural disasters like droughts such as those related to ‘El Niño‘ weather patterns, and other severe weather events, and record food prices in some vulnerable regions. Ongoing conflicts affecting millions in different parts of the world are causing increasing rates of food insecurity. The negative impact of conflicts on food security, good nutrition and agriculture is an uncontested and globally recognized phenomenon. Conflict interrupts production of food, destroys food and agriculture assets, and can slow economic development. Conflicts also make it more difficult for governments and humanitarian organizations to deliver food assistance. Additionally, conflicts that displace large populations can stress neighbor countries or host communities, whose food systems can be insufficient to support significant influxes of people. Unfortunately, droughts and conflicts are likely to continue, which will continue to pose higher risk of food insecurity in different regions of the world.

Huge efforts and resources have been invested in achieving food security over the last several decades, through investments in intensification and expansion of agricultural production, as well as mechanisms to improve people’s access to food. Millions of hectares of land, including forests and deserts, have been reclaimed as agricultural land. This has required a huge increase in the resources needed for agricultural production (water, fertilizers, chemicals, energy, labor, etc). Crop yields have been improved dramatically, and the quantities of food produced are at a historic high, with more than 5000 million metric tons of food produced annually. However, pressures such as
a rapidly growing world population and increased urbanization have led an increased demand for more and diverse food. This, and the fact that poorer, more vulnerable sections of the population are not able to access the available food, means that the numbers of hungry and food insecure people are still unacceptably high.

Several factors are exerting pressure on the global food sector, preventing the achievement of food security. Rising wealth is changing food demand towards higher-value and more perishable meats, dairy, and perishable products. Likewise, the growing influence of western diets (high in sugar, salt and fat contents) in developing countries are leading to a double- or triple-burden of malnutrition, obesity and growing rates of non-communicable diseases (so called diseases of affluence). Very significant rates of urbanization are influencing major shifts in the way cities engage with local and global food chains, in terms of marketing, diet habits, food retail and also related issues of food quality, food safety, nutrition, and how food is accessed or utilized by all different socioeconomic segments of society. The effects of climate change are already being felt, on top of growing natural resource scarcity, with greatest adverse impact for marginal and resource-poor food producers.

Yet amidst all these challenges, huge amounts of food are lost and wasted every year all over the world. The challenges to food security are complex and deserve a renewed focus on food systems and how they work, at global, regional and local levels, to sustainably deliver safe and nutritious food to all people at all times. Indeed, a major gap in the efforts to achieve food security has been the lack of attention to food systems, from preharvest to postharvest handling to their legal, economic, social frameworks and all of the actors involved in food chains. Food losses and waste (FLW) are the result of the way food systems function and, in this regard, can be in most cases as a measure of how inefficient they are.

FLW is a global problem. It has been estimated that at least one third of the food produced in the world (at least 1300 million metric tons) are lost and wasted every year. Not only do we lose and waste huge amounts of food in a world with two billion food insecure people, but FLW also lead to a tremendous loss of resources such as land, forests, water, fertilizers, chemicals, energy, labor, etc. The vast amounts of wasted food contribute to major environmental problems as they decompose in landfills and emit harmful greenhouse gases. Reducing FLW is considered as one of the key actions required to reduce accumulation of CO$_2$ in atmosphere.

With millions of households across the globe struggling to have enough to eat, and hundreds of millions of tons of food being tossed in the garbage every year, FLW are increasingly being seen as a serious global problem; ethically, economically, and environmentally, and intricately linked to the wider problem of world hunger. That is why global attention has started to focus more on how
to address the problem. The FAO SAVE FOOD initiative was established in 2011, followed by other global initiatives such as the high-level panel of experts of the Commission on Food Security (CFS) and the Zero Hunger Challenge. FLW now figures firmly in the UN 2030 Agenda and Sustainable Development Goals. With awareness rapidly rising, several countries and world regions have started to take action in developing policies and regulations to address this global complex challenge.

FLW reduction should not only be a goal in itself but as a key aspect of global food (in)security. FLW exacerbates the problem food insecurity: reducing food availability; wasting natural resources for which there is often already severe shortage, namely land and water; and creating major environmental problems. It is important to emphasize that most perishable foods (such as meat, dairy, fishery and horticultural products) are most vulnerable to FLW. This has direct links with malnutrition as these foods provide very important components for a healthy diet and for the prevention of disease. The underlying causes of FLW are closely related to the greatest challenges to food security: the need for sustainable production and consumption habits, the need to channel safe and nutritious food to growing, increasingly urban populations; the need for better use of natural resources such as water and land; and strategic planning and investment for sustainable food security for future generations.

FLW prevention is an opportunity to strengthen and achieve food security (directly or indirectly) in at least 3 major ways:

1. More efficient food systems that can sustainably deliver safe, nutritious food to the world population,
2. Preserving scarce natural resources, in particular water and land, but also all of the other resources (e.g. energy) used throughout the supply chains to handle, transform, and distribute food,
3. The opportunity for strengthened agriculture and food sectors to positively impact on rural livelihoods, by preserving the economic value of food and generating additional value through agro-processing and agribusiness activity.

As far as we know, this is the first textbook on the subject, particularly in its range, broad authorship and integrated perspective. It is meant to provide guidance to policy makers, international organizations, food producers and handlers, researchers, educators and students. Its aim is to review and suggest ideas to prevent FLW towards the goal of achieving sustainable global food security. It is also hoped it has arrived at the right time to help contribute to accomplishing the UN 2030 Agenda and Sustainable Development Goals.
The structure of the book reflects the fact that the subject is complex and multifaceted. Part 1 sets the scene by exploring the many dimensions of FLW. It reviews definitions of FLW, the links between FLW and food insecurity, the economic and environmental impacts of FLW as well as their impact on nutrition and food safety. Part 2 reviews causes of FLW at key stages in the food supply chain, from agricultural processing and harvesting, through postharvest storage, transport and processing, and on to the retail, food service and consumer stages for final consumption. Part 3 reviews FLW in major food groups with a focus on the challenges unique to each and how they can be addressed. Part 4 discusses key means to curb this global problem, including the need for i) cohesive policies and regulations, ii) investment, including that of the private sector, iii) improved ways to reuse/recycle food waste for humans, animals, plants and as energy, iv) efficient schemes of education, awareness and extension, and v) more holistic approaches of research and development. The final part of the book includes regional case studies on tackling FLW. In each part, best practices, case studies, and success stories are used to illustrate the potential options for FLW reduction. Although FLW is a global issue, there is a particular focus on developing countries (low to middle-income countries) where problems of food insecurity are particularly acute.

The effort of developing this book was only possible thanks to the great collaboration from the excellent global contributors for each chapter, and the strong support provided by the team at Burleigh Dodds Science Publishing, particularly Mr. Francis Dodds and Ms. Amanda Renwick.

I certainly hope that this book can serve as an excellent support to the efforts been invested by international organizations such as the United Nations, governments, and many experts and individuals to improve global food security.

It is certainly applicable to modify a proverb to: ‘If your plan is for one year plant rice. If your plan is for ten years plant trees. If your plan is for one hundred years, do not waste food’.

Elhadi M. Yahia
December 2019
1 Introduction

Food security is a topic of major interest to policymakers, practitioners, international organizations and academics around the world as it affects almost every facet of society. Food security can have repercussions in areas such as:

- government policy and political stability (e.g. the food price crisis and subsequent food riots in 2007–2008 highlighted the critical role of food security in maintaining political stability).
- aid decisions (e.g. the World Bank’s Global Agriculture and Food Security Program).
- the economy in general (a poorly nourished population is a less economically productive one).
- the environment (depletion of natural resources and climate change can influence food production and access to food).

Food security also matters from a moral perspective; it has been broadly agreed upon as a basic human right since 1948, under Article 25 of the Universal
Declaration of Human Rights: ‘Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care.’ On one hand, food security must be considered as a requirement for guaranteeing the availability of food to the growing population, especially in developing countries, and, on the other, the absolute quality and safety of the food produced and distributed must be guaranteed.

In order to understand the complexity of food security, a multi-disciplinary approach must be used which takes into account various aspects of the concept, including: food governance, economics, environment, government policies and society. For each aspect, a number of challenges are discussed. The chapter also includes case studies on interventions in rural and urban areas to enhance food security and introduces the complex relationship between food security and food loss and waste. Finally, the authors draw on current data to predict future trends and their consequences.

2 The evolution of the concept of food security

Despite its pivotal importance and because of its multi-disciplinary nature, food security is still a concept whose definitions and operationalization vary.

Indeed, the term ‘food security’ has evolved in diverse ways during the last 50 years. Even two decades ago, there were about 200 reported definitions (Maxwell and Smith, 1992). According to Maxwell (1996) and Shaw (2004), the concept has gone through several paradigm shifts. These shifts in conventional wisdom reflect changes, over time, in what have been considered to be the key issues informing food security research and food policy and practice.

Food security has gone from being defined:

1. From the global and the national level – with a distinct focus on supply and self-sufficiency – to the household and the individual level (1975–1985). One school of thought focussed on the household as the unit of analysis for food security (Sahn, 1989; Swift, 1989; Eide, 1990; Frankenberger and Goldstein, 1990), another placed intra-household power and resource-allocation issues in the front of analysis and focussed instead on individual food security. Following this logic, most current definitions of food security being with individual entitlement, though recognizing the complex inter-linkages between the individual, the household, the community, the nation and the international economy.

2. From a first food perspective to a livelihood perspective (1985–1990). The most food-insecure households are characterized by high sensitivity and low resilience. Oshaug identified three kinds of households,
‘enduring households’, which maintain household food security on a continuous basis, ‘resilient households’, which suffer shocks but recover quickly and ‘fragile households’, which become increasingly insecure in response to shocks. Livelihood security was identified as a necessary and often sufficient condition for food security (Maxwell, 1988, 1991, p. 22): it focuses on the long-term viability of the household as a productive and reproductive unit.

3 From objective indicators to subjective perception. The agenda regarding the treatment of food security in the 1990s suggested that: ‘Flexibility, adaptability, diversification and resilience are key words. Perceptions matter. Intra-household issues are central. Importantly, food security must be treated as a multi-objective phenomenon, where the identification and weighting of objectives can only be decided by the food insecure themselves’ (Maxwell and Smith, 1992, p. 4).

In recent years, the continuous evolution of food security has led to an operational concept which reflects the wider recognition of the complexities of the technical and policy issues involved. Now the focus of food security has been further expanded to include malnutrition in all its forms and its features have prominently become a part of the second Sustainable Development Goal (SDG) of the 2030 Agenda: ‘Ensuring access to safe, nutritious and sufficient food for all (Target 2.1) and eliminating all forms of malnutrition (Target 2.2)’.

This transformational vision embedded in the 2030 Agenda provides an imperative for new ways of thinking, acting and measuring. For example, the growing global epidemic of obesity, which is increasingly affecting lower-income countries and rapidly adding to the multiple burden of malnutrition and non-communicable diseases, also points to the need to re-examine how hunger and food insecurity are measured as well as their links with nutrition and health.

3 Definitions and pillars of food security

For many, the concepts of hunger, famine, undernourishment, undernutrition and food security are blurred and often used interchangeably. Hunger is usually understood as an uncomfortable or painful sensation caused by insufficient food energy consumption. Scientifically, hunger is referred to as food deprivation (FAO, 2008). A famine is a widespread scarcity of food, caused by several factors including war, inflation, crop failure, population imbalance, or government policies. This phenomenon is usually accompanied or followed by regional malnutrition, starvation, epidemic and increased mortality (Encyclopædia Britannica Online, 2017). Undernourishment is defined by the
FAO as the state ‘when caloric intake is below the minimum dietary energy requirement’. Undernourishment can be mainly attributed to persistent instability in conflict-ridden regions, adverse climate events and economic slowdowns that had affected more peaceful settings and worsened the food security situation (FAO, 2008).

Malnutrition refers to deficiencies, excesses, or imbalances in a person’s intake of energy and/or nutrients. The term malnutrition addresses three broad groups of conditions, namely:

1 undernutrition, which includes wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age);
2 micronutrient-related malnutrition, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and
3 being overweight, obesity and having diet-related non-communicable diseases (such as heart disease, stroke, diabetes and some cancers).

Malnutrition may be an outcome of food insecurity or related to non-food factors, such as inadequate care practices for children, insufficient health services and an unhealthy environment (WHO, 2016).

Multiple forms of malnutrition are evident in many countries. Poor access to food and particularly healthy food contributes to undernutrition as well as being overweight and obesity. Malnutrition increases the risk of low birthweight, childhood stunting and, in women of a reproductive age, anaemia. There is also a link between malnutrition and being overweight in school-age girls and obesity among women. This is especially evident in upper-middle and high-income countries. The link between malnutrition being overweight and obese is commonly referred to as the ‘double burden’ of malnutrition. Overweight and obese individuals can also be affected by micronutrient deficiencies, often called ‘hidden hunger’ because there may be no visible signs. Causes of malnutrition that can lead to being overweight and obese include patterns of bingeing or overeating when food is available (and continued availability uncertain), or choosing low-cost, energy-dense ‘comfort foods’ rich in fat, sugar and salt - which have been found to have psychological effects that reduce stress in the short term.

In this chapter, we adopt the definition of food security as provided by the World Food Summit, in 1993, which is the most useful definition today: ‘Food security, at the individual, household, national, regional and global levels [is achieved] 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.’ From this definition, four essential dimensions of food security can be identified:
• **Food availability**, which refers to the need to secure and sufficient quantities of the appropriate quality food, supplied through domestic production or imports (including food aid). Food availability addresses the ‘supply side’ of food security and is determined by the level of food production, stock levels and net trade.

• **Food access** is adequate income or entitlements of individuals to enable them to access appropriate food for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live (including traditional rights such as access to common resources).

• **Utilization of food** is adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security.

• **Stability** refers to the fact that, in order to be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity).

For food security objectives to be realized, all these four dimensions must be fulfilled simultaneously. For example, even if people have financial means (access), but there’s no food available in the market (availability), people are at the risk of food insecurity. Furthermore, food security is also about quality, as bodies must be healthy to enable the nutrients to be absorbed (utilization).

It is equally important to underline that access to food may be different within households. The distribution of food and resources within households is influenced by a number of cultural and social factors. Especially under conditions of scarcity, women and children are sometimes discriminated against in the distribution of food; mothers may subsequently adjust their food intake to buffer the effect of food insecurity on their children. Gender inequalities in society and women’s roles influence decision-making power and access to food within the household, with significant consequences for women’s own food security and nutrition as well as that of their children.

### 4 Recent measurements and data on food security

Evidence highlights a rise in food insecurity and world hunger in the last three years (2016–2019) based on a number of indicators (FAO, 2019).

Food security measurements either focus on food availability, access, utilization, the stability of food security over time, or some combination of these...
domains. Metrics are drawn from data at national, regional, household, and/or individual levels. Such tools vary from simple indicators, from which data can be quickly collected and easily analysed, to comprehensive measures that require detailed, time- and resource-intensive data collection and sophisticated analytic skills to yield results.

Food security measures rely either on data from hypothesized determinants of food security (e.g. the price of commodities) or on data from purported consequences of food security (e.g. child malnutrition). In short, the diversity of currently available food security measurement tools provides an array of options, such that it may not always be clear how the measures differ in their conceptualizations of food security and for what purpose a given tool may best be used.

The prevalence of undernourishment (PoU) is the traditional FAO indicator (FAO, 1998) used to monitor hunger at the global and regional level. It was developed at a time when very few national governments, particularly in lower-income countries, collected data regularly on food consumption. The methodology relies on aggregated country-level data, available for most countries, and occasionally data on food consumption, available for a few countries. It produces an estimate of the proportion of the population that does not have regular access to enough dietary energy for a healthy, active life.

It is based on 26 indicators which take into consideration the variations of the dietary energy supply and undernourishment measures (e.g. share of energy supply derived from cereals, roots and tubers; average supply of protein of animal origin; PoU considering energy needs for higher amounts of physical activity etc.) as well as information on food prices using data on country purchasing power parities, inflation rates and food deficits. Due to progress in the implementation of national household surveys, the number of countries able to provide information on the inequality of access to food in their population has increased. This period collection of data in many countries has been used to improve the FAO country-level PoU estimates. There are several weaknesses with this methodology associated with the fact that the frequency distribution per capita dietary energy consumption is not based on observed data but is derived using a model whose parameters are estimated on data or measures that are subject to errors of unknown magnitude and direction.

To complement the information provided by the PoU and to allow for monitoring SDG Target 2.1 globally in a more effective way, the FAO took inspiration from countries already using a different approach in measuring the food insecurity and scaled it up to the global level. The approach is based on asking people, directly in a survey, to report on the occurrence of conditions and behaviours that are known to reflect constraints on access to food. The Food Insecurity Experience Scale (FIES) survey module is composed of eight questions that have been carefully selected, tested and proven effective in
measuring the severity of the food insecurity situation of respondents in different cultural, linguistic and development contexts (see Fig. 1). Results can be disaggregated, thus helping to identify which subpopulations within a country are most affected by food insecurity. Second, it is possible to estimate the prevalence of food insecurity at different levels of severity. Someone experiencing severe food insecurity is likely to have gone entire days without eating due to lack of money or other resources.

FIE, while using a different approach and dataset, produces findings consistent with that produced the PoU. Having two alternative views of the hunger problem also provides an important opportunity to cross-check the values of the two indicators for given countries. With reference to the average over the period 2014–2017, the estimated PoU and of severe food insecurity can be compared across a number of countries (see Table 1).

According to the latest FAO estimates, in 2018, about 820 million people were exposed to severe food insecurity (FAO, 2019). At the regional level, hunger is on the rise in almost all African sub-regions, making Africa the region with the highest PoU, at almost 20%. Hunger is also slowly rising in Latin America and the Caribbean, although its prevalence is still below 7%. Western Asia shows a continuous increase since 2010, with more than 12% of its population undernourished today (FAO, 2019).

The worst food crises in 2018, in order of severity, were: Yemen, the Democratic Republic of the Congo, Afghanistan, Ethiopia, the Syrian Arab Republic, Sudan, South Sudan and north Nigeria. These eight countries accounted for two-thirds of the total number of people facing acute food insecurity amounting to nearly 72 million people (FAO, 2019). An additional 143 million people in a subset of 42 countries were found to be living in stressed conditions on the cusp of acute hunger. They risked slipping into crisis if faced with a shock or stressor. Nearly 151 million children were affected by stunting in 2017. In contrast, over 38 million children are overweight and approximately 672 million adults, one in every eight adults are obese (FAO, 2019).

![Figure 1](Food insecurity based on FIES. Source: FAO Statistics Division.)
The current food security policy framework

The international community has repeatedly asserted its commitment to support national governments in their efforts to combat hunger. Providers of international development assistance are many and varied. They range from individual donor countries, to multilateral international agencies, international and regional financing institutions, international NGOs and private-sector foundations. Organizations and agencies in the UN system are making a major effort to streamline and coordinate their assistance through the work of the UN Country Teams by joint programming and activities.

Table 1 Severe food insecurity measured with the food insecurity experience scale 2014–2017

<table>
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Source: adapted from FAO (2018a, b).
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</tr>
<tr>
<td>Aflatoxins</td>
<td>198, 199, 270, 392, 757</td>
</tr>
<tr>
<td>African Postharvest Loss Information System (APHLIS)</td>
<td>740–741, 773</td>
</tr>
<tr>
<td>African Swine Fever (ASF)</td>
<td>471</td>
</tr>
<tr>
<td>African Union Commission, Department of Rural Economy and Agriculture (DREA)</td>
<td></td>
</tr>
<tr>
<td>African Union Post-Harvest Loss Management Strategy (PHLMS)</td>
<td>89</td>
</tr>
<tr>
<td>AGPase. see ADP-glucose pyrophosphorylase (AGPase)</td>
<td></td>
</tr>
<tr>
<td>AgResults</td>
<td>756</td>
</tr>
<tr>
<td>Agricultural commodities production</td>
<td>249–253</td>
</tr>
<tr>
<td>breeding and</td>
<td>258–259</td>
</tr>
<tr>
<td>carbon dioxide influencing</td>
<td>263</td>
</tr>
<tr>
<td>crop density and</td>
<td>268</td>
</tr>
<tr>
<td>cultivar, variety, and genotype</td>
<td>253–256</td>
</tr>
<tr>
<td>irrigation and</td>
<td>264–265</td>
</tr>
<tr>
<td>light influencing</td>
<td>262</td>
</tr>
<tr>
<td>lodging and</td>
<td>268</td>
</tr>
<tr>
<td>mineral nutrition and</td>
<td>266–267</td>
</tr>
<tr>
<td>pruning, thinning and canopy management and</td>
<td>264</td>
</tr>
<tr>
<td>relative humidity influencing</td>
<td>262–263</td>
</tr>
<tr>
<td>rootstocks and</td>
<td>256–258</td>
</tr>
<tr>
<td>temperature affecting</td>
<td>261–262</td>
</tr>
<tr>
<td>weed management and</td>
<td>267–268</td>
</tr>
<tr>
<td>see also Preharvest losses</td>
<td></td>
</tr>
<tr>
<td>Agricultural partnership agreements</td>
<td>523</td>
</tr>
<tr>
<td>Agriculture Sector Wide Approach (ASWAP)</td>
<td>23</td>
</tr>
<tr>
<td>Agrilife</td>
<td>768</td>
</tr>
<tr>
<td>AIV. see Avian Influenza Virus (AIV)</td>
<td></td>
</tr>
<tr>
<td>Albania</td>
<td>671–672</td>
</tr>
<tr>
<td>Algeria</td>
<td>716</td>
</tr>
<tr>
<td>Alliances, for FLW reduction</td>
<td>793, 794, 795</td>
</tr>
<tr>
<td>Alternaria sp.</td>
<td>603</td>
</tr>
<tr>
<td>Ambient loading</td>
<td>314</td>
</tr>
<tr>
<td>Amino acids</td>
<td>152</td>
</tr>
<tr>
<td>Anaerobic digestion (AD)</td>
<td>354</td>
</tr>
<tr>
<td>Animal tissues</td>
<td>165</td>
</tr>
<tr>
<td>Anti-food waste law</td>
<td>677</td>
</tr>
<tr>
<td>Antinutritional compounds</td>
<td>177</td>
</tr>
<tr>
<td>APHLIS. see African Postharvest Loss Information System (APHLIS)</td>
<td></td>
</tr>
<tr>
<td>Arab Food Bank Regional Network</td>
<td>716</td>
</tr>
<tr>
<td>Archives method</td>
<td>62</td>
</tr>
<tr>
<td>Argentina</td>
<td>24–25, 138, 250, 789, 790, 793–794</td>
</tr>
<tr>
<td>Armenia</td>
<td>191, 672</td>
</tr>
<tr>
<td>Artificial ripening process</td>
<td>326</td>
</tr>
<tr>
<td>Ascorbic acid (vitamin C)</td>
<td>156, 159</td>
</tr>
<tr>
<td>ASF. see African Swine Fever (ASF)</td>
<td></td>
</tr>
<tr>
<td>Aspergillus sp.</td>
<td>597</td>
</tr>
<tr>
<td>A. flavus</td>
<td>270, 391, 602, 604</td>
</tr>
<tr>
<td>ASWAP. see Agriculture Sector Wide Approach (ASWAP)</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>130, 208, 344, 411, 419, 747</td>
</tr>
<tr>
<td>Austria</td>
<td>72, 134, 416</td>
</tr>
<tr>
<td>Austrian Waste Prevention Programme</td>
<td>667</td>
</tr>
</tbody>
</table>
Index

Auxins 274
Avian Influenza Virus (AIV) 469
Awareness for FLW reduction 792, 794-795
to reduce postharvest food loss and waste 745-747
Azerbaijan 94, 191

Bacillus sp. 597
B. thuringiensis 597
Bactofuge 297
Belarus 191
Belgium 130, 208, 211
Bellagio Statement on Postharvest Management 770
Bentonite 612
β-carotene 157
Better Training for Safer Food initiative 212
Bioactive compounds 597
Biochemical conversion methods 597
Bioeconomy 675
BioHAZ. see Biological Hazards (BIOHAZ)
Bio Intelligence Service (BIOIS) 237, 307
BIOIS study 307, 308
Biological Hazards (BIOHAZ) 681
Biopesticides 280, 597
Bio-resources, valorization of 676
Biosurfactants 597, 598
Biotin 155, 156
Blanching 169
Blockchain technology 213
‘Blue Ecological Flag Award’ 795
Bolivia 208
Bosnia and Herzegovina 260
Bovine spongiform encephalopathy (BSE) 200-201
Brassinosteroids 278
Brazil 128, 130, 138, 250, 269, 411, 451, 790-791
Brazilian Institute of Geography and Statistics (IBGE) 791
Breeds 471
BSE. see Bovine spongiform encephalopathy (BSE)
Burkina Faso 744
Burundi 208
Byproducts, from processing and packaging SFLW 494
Calcium 160, 161, 266, 267
Cameroon 96, 97
Canada 112, 129, 136, 138, 190, 191, 267
Canadian food bank 531
Canadian Food Inspection Agency (CFIA) 191
Canadian Meat Council 191
Canning 169
CAP. see Common Agricultural Policy (CAP)
Capacity building, to reduce postharvest food loss and waste 747-751
Cape Town Container Terminal 314
Carbon footprints 154-155, 173
Carbon footprint (CF) 134, 487
Cases study methodology 57
Cassava 448, 451, 456, 459
Cassava mosaic disease 451
CDC. see Centers for Disease Control and Prevention (CDC)
CELAC. see Community of Latin American and Caribbean States (CELAC)
Centers for Disease Control and Prevention (CDC) 194
Central America to Europe 303
Central Asia, estimates and main causes for FLW 657-659
Cereal grains, FLW in environmental benefits 392-393
extent of 386-390
financial benefits 392
food loss in 385
food safety benefits 391-392
food security benefits 390-391
food waste in 386
in Iraq 710
reducing methods 393-398
Cereals 698, 704
contamination 604
losses 702
and tubers 163, 164, 193
CF. see Carbon footprint (CF)
CFIA. see Canadian Food Inspection Agency (CFIA)
CFS. see Committee on World Food Security (CFS)
CGF. see Consumer Goods Forum (CGF)
Champions 12.3 648
Cheetah mobile phone app 762
Chile 91, 138, 250, 791-792
Chilean National Agriculture Research Institute (INIA) 792
Chilled poultry 477
Chilling injury 256, 762
China 28, 127, 138, 142, 207, 741
Chitin 495, 554
Chitosan 554
Chlorine 161
Cholesterol 152–153
Chowberry mobile phone app 771, 772
Chromatography 606
CIHEAM. see International Centre for
Advanced Mediterranean Agronomic Studies (CIHEAM)
CIMMYT. see International Maize and Wheat Improvement Centre (CIMMYT)
Circular Economy Package 189, 674, 676
and Action Plan 674
CKs. see Cytokinins (CKs)
Clay pot coolers 762
Climate-smart agricultural practices and food systems 23–24
CL/WPs. see Critical loss/waste points (CL/WPs)
CN-PDA. see National Committee for Food Loss and Waste Prevention and Reduction (CN-PDA)
COAG. see Committee on Agriculture (COAG)
Cobalamins (vitamin B12) 156
Codex Alimentarius 662
Cold-chain management 232
Coldhubs 762
Collagen 552
Collective storage 233
Colombia 790
Committee of Regions (CoR) 675
Committee on Agriculture (COAG) 789
Committee on Environment, Public Health and Food Safety (ENVI) 189
Committee on World Food Security (CFS) 88, 108, 655
Commodity Systems Assessment Methodology (CSAM) 429, 632
Common Agricultural Policy (CAP) 660
Communication, for FLW reduction 793–795
Community of Latin American and Caribbean States (CELAC) 90, 510, 788
Community of Practice (CoP) 682–683
Composition analysis method 62
Condemnation 474
Consciousness raising 575
Consumer food waste causes of 345–346 demographic and cultural factors 346–347
food and waste shaping individual practices 351–352
food planning, shopping, and storing behaviors 347–351
in developed countries 343–344
in emerging countries 344–345
global data 342–343
national estimates by weight 343
reducing strategies awareness campaigns 352–355 marketing, retail, and food service environment, role of 355–357
Consumer Goods Forum (CGF) 514–515
Contract farming 252
Controlled atmosphere (CA) 303, 309, 393–394
Cook-from-frozen, awareness campaign 638
CoolBot controller units 762
Cool chain simulation 325, 326
CoP. see Community of Practice (CoP)
Copenhagen Consensus (2012) 9
Copper 161, 266
CoR. see Committee of Regions (CoR)
CORFO. see Corporation for the Promotion of Production (CORFO)
Corporate Social Responsibility (CSR) 663
Corporation for the Promotion of Production (CORFO) 792
Costa Rica 130, 794–796
Costa Rican Food Loss and Waste Reduction Network 794
Counter conditioning 576
CPLs. see Critical loss points (CPLs)
Critical loss points (CPLs) 670
Critical loss/waste points (CL/WPs) 112, 673
Crop diversification 23, 24
CSAM. see Commodity System Assessment Methodology (CSAM)
CSR. see Corporate Social Responsibility (CSR)
Cylas spp. 450
Cytokinins (CKs) 275
Dairy sector 193
Danish Environmental Protection Agency 678
Data loggers 322–323, 324
DE. see Diatomaceous earth (DE)
Dead on arrival (DOA) 472
Definitional Framework of Food Loss 42
Democratic Republic of the Congo 7, 21
Denmark 72, 132, 210, 418, 678, 747
DG Sante 299
Diaries of food waste method 63
Diatomaceous earth (DE) 394
Dietary carbohydrate 154
Dietary fibers 154–155
Directive 2008/98/EC 676
Directive (EU) 2018/851 676
Direct weighing method 62
DOA. see Dead on arrival (DOA)
Do Good-Save Food initiative 771
DryCard™ 753
Dutch Nutrition Centre 678
East African Grain Council 767
EC. see European Community (EC)
ECA. see Europe and Central Asia Region (ECA)
Economic Cooperation Organization
Regional Coordination Centre for Food Security (ECO–RCC) 94
Economic growth and stability 711–716
Economic losses 59, 112, 601
Economist Intelligence Unit (EIU) 87
Economy 11–13
price volatility and 14–15
supply and demand 13–14
ECO–RCC. see Economic Cooperation Organization Regional Coordination Centre for Food Security (ECO–RCC)
Edible by-products of fisheries, definition of 52
Edible by-products of meat, definition of 52
Edible food losses, definition of 52
EESC. see European Economic and Social Committee (EESC)
EFSA. see European Food Safety Authority (EFSA)
Egypt 253, 716, 763
Egyptian Food Bank 531, 534, 535, 536, 539, 716
El Salvador 260
Enduring households 3
ENPARD. see European Neighbourhood Programme for Agriculture and Rural Development (ENPARD)
Entitlements, defined 5
ENVI. see Committee on Environment, Public Health and Food Safety (ENVI)
Environment 17–18
biophysical and drivers of 18–19
climate change and 19–20
Environmental Cooperation
Commission 136, 137
Environmental impact 127–131
food waste accounting problems and 131–133
natural resources and 133–136
in North America 136–138
urban food waste and 138, 141–142
Envirotainer 303
EPA. see US Environmental Protection Agency (EPA)
EPRS. see European Parliamentary Research Service (EPRS)
Erwinia sp. 451
E. carotovora 451
Essential nutrients 151
Estimation and quantification methods 59–68
limitations 68–70
Ethephon (ethrel) 277
Ethiopia 7, 21, 28, 412, 448, 732, 738
Ethylene 276–277
EU. see European Union (EU)
EU approach, to estimation and quantification methods 65, 67–68
EU Directive 2019/633 676
EU Food Donation Guidelines 681
EU Food Fraud Network 212
EU-funded FUSIONS Research project 352, 355, 369
Eurobarometer 661
Europe 287, 288, 330, 342, 356, 369
consumers’ food waste reduction 667, 669
Delegated Act 660
direct human consumption, recovered and redistributed for 656–657, 681
89Mt 660
estimates and main causes for 657–661, 668
FLW data availability and quality in 656–674
food production and consumption in 653
food security 654
food waste reduction targets 663
malnutrition 654, 655
Montenegro 666–667
multi-actor actions and multi-level data collection 669
multi-actor food loss and waste policy development 674–682
post-harvest loss terminology 657
quantitative and qualitative data 662
socio-economic and environmental impacts 653
2014 EU-wide review report 661
yearly per capita food waste 661
European Commission 132, 307, 349
on food loss and waste definitions 44–47
European Community (EC) 545, 660, 676
European Court of Auditors 188
Europe and Central Asia Region (ECA) 94
European Economic and Social Committee (EESC) 675
European Food Banks Federation (FEBA) 51
European Food Safety Authority (EFSA) 51, 681
European Neighbourhood Programme for Agriculture and Rural Development (ENPARD) 672
European Parliamentary Research Service (EPRS) 697
European Union (EU) 136, 188, 194, 344
Rapid Alert System for Food and Feed (RASFF) 199
Europol 207
Extrusion cooking 610

FAC. see Food Assistance Convention (FAC)
Famine 3
FAO. see Food and Agriculture Organization (FAO)
FAOSTAT data 307
Fatty acids 153–154
FCM. see Food contact materials (FCM)
FEBA. see European Food Banks Federation (FEBA); Federation of European Food Banks (FEBA)
Federal Food Date Labeling Act 646
Federation of European Food Banks (FEBA) 673
Feed 471
Feedstuffs 611
FEFO concept 330, 331, 335
Fermentation 551, 610
FIES. see Food Insecurity Experience Scale (FIES)
FIFCO 521–522
Fight Food Waste 587
Finance, to reduce postharvest food loss and waste 766–768
Finland 72, 134, 368, 369, 370, 375
Finnish studies 370, 371, 372
Fish discards, definition of 51
Fish fillets 498
Fish meal 497
Fish oil 497, 554
Fish waste 497, 552
Five Rome Principles for Sustainable Global Food Security 9
FLI. see Food loss index (FLI)
FLP. see Food Loss Percentage (FLP)
Fluctuating temperatures 320
Fluorine 161
FLW. see Food losses and waste (FLW)
FLWS. see Food Loss and Waste Standard (FLWS)
FMD. see Foot and mouth disease (FMD)
Folic acid (folate) 155, 156
Fome Zero (Zero Hunger) 791
Food, definitions of 39, 44–45
Food 2030 675
Food access 5, 19
Committee on Agriculture (COAG) 90
Conference 85
definition of FLW 41–44
Global Food Losses and Food Waste 87
War on Waste Campaign 85
Food Assistance Convention (FAC) 9
Food availability 5, 19
Food Banking Regional Network 531, 534
Food banks 530
contemporary food banking (CFB) model 532–533
economic pillar 533–534
environmental pillar 534–535
social pillar 534
Egyptian Food Bank FLW management program 536–539
overview 529–530
and the problem of food waste 530–531
traditional food banking model 531–532
Food commodities, NENA region 697, 703
in food supply chain components 698, 699, 702
magnitudes of FLW in 698, 700–701
Food contact materials (FCM) 58
Food donations 210-211
Food environment, definition of 90
Food Fraud Vulnerability Assessment and Food Fraud Prevention Strategy 212
Food governance 10–11
Food insecurity 83–84
and food loss and waste, direct linkage identification approach 84–94
Food Insecurity Experience Scale (FIES) 6–7
food insecurity based on 7, 8
Food Loss and Waste Accounting and Reporting Standard 60
The Food Loss and Waste Reduction National Committee of Chile 518–519
Food Loss and Waste Standard (FLWS) 587
Food losses 695
Food losses and waste (FLW) 100, 181, 287, 445, 467, 510, 593, 629, 647
in caloric terms 697, 702
causes 54-58, 304, 794
data availability and quality in Europe 656–674
definitions 40–48, 51–53
similar and different considerations between 48–50
estimates 70–72, 73
in industrialized Asia 342
issue of 390
MACS G20 683
negative implications 529
prevention and reduction 794
consumers’ food waste 667, 669
ex-ante impact assessment 654
ex-post impact assessment 654
food waste stream 680
general equilibrium model 669
monitoring mechanism 654
policy measures 668–669
at production level 662
primary and secondary causes of 717–718
reduction of 392, 408
regional, in terms of Kcal 343
in Turkey 670–671
washing, cutting and peeling 176
Food loss index (FLI) 410, 427, 789
Food Loss Percentage (FLP) 64
Food packaging 58
Food processing, losses and waste causes and measures 288-289
internal causes 289
occurring in value chain 289-290
prevention measures 290-291
reduction measurement, Norway composition and quantities 293-294
food sector agreement 291-292
method and data gathering 292-293
Q-Meieriene, case study 296-298
strategies and actions, companies survey 294-296
Food safety 187-190
fraud and 207-209
future trends 209-213
primary production stage 192-201
processing 201-204
regulations 190-192
retailers, wholesale and consumer stage 204-207
Food Safety and Standards Authority of India (FSSAI) 211
Food Safety Modernization Act (United States) 212
Food security 1–2, 467
definition of 3–5, 654
dimensions of 10–22
evolution of concept of 2–3
future trends 27–29
loss and waste 26–27, 94–98
and nutrition 682
pillars of 3–5
policy framework, current 8–10
recent measurements and data on 5–8
in rural and urban areas 22–25
Food Security, Nutrition and Hunger Eradication 2025 511, 788
Food services, FW in day-care centres 373
future trends 377-378
NENA region 702, 718
overview 367-370
percentage 371, 372, 373
per customer 371, 373, 375
scope and premise of food waste measurement studies 370-371
serving waste composition, in schools 374
student and workplace canteens 374
Food stability 5, 20
Food supply chains (FSC) 301, 302, 418, 425, 429, 593, 696
Food Sustainability Index 484
Food system ‘boundaries’ 696
Food Use for Social Innovation by Optimising Waste Prevention Strategies (FUSIONS) project 132, 288, 298, 306
Food use supply chain (FVC) 127
Food waste (FW) 287, 288, 298, 367-378, 546, 695
causes of 697
measurement 370, 376, 377
reduction goals 630
Food Waste Index (FWI) 65
Food Waste Reduction Alliance (FWRA) 545, 636
Foot and mouth disease (FMD) 470
‘4 E’s’ behavioural change model 669
Fragile households 3
France 188, 208, 212, 288, 344, 346, 356, 663-664, 677, 747
Freezing 169
Freight supervision unit (FSU) 327, 328
FreshBox 762
Fresh horticultural commodities 418, 419
FRISBEE tool 322, 327
Fruits and vegetables 163, 164, 193, 698
causes of 418-421
estimation issues
experiment-based 429
global and regional 427-428
single scenario-based analysis 428
standardize measurements/ assessments 429
indigenous species and cultivars 426
magnitude of 409-418
overview of 407-409
postharvest losses 412, 413-415
solutions to reduce 431
preharvest factors 425-426
prevention strategies 430-434
primary and secondary causes, of losses and waste 421-422
biological causes 422-423
environmental causes 422, 423
government regulations and legislations 424
inadequate marketing systems 423
inadequate transportation 424
lack of equipment 424-425
lack of information 425
poor maintenance, equipment 425
socioeconomic causes 423
small producers and shippers, logistics for 426
ugly fruits and vegetables concept 426
FUSIONS. see Food Use for Social Innovation by Optimising Waste Prevention Strategies (FUSIONS)
Future of Food report 87
FVC. see Food value supply chain (FVC)
FWI. see Food Waste Index (FWI)
FWRA. see Food Waste Reduction Alliance (FWRA)
G20 Food Security and Nutrition Framework 683
Gadda Law 680
Gamma radiation 169
Gastronomy 520-521
GCCA. see Global Cold Chain Alliance (GCCA)
General manufacturing practice (GMP) 197, 234
Georgia 191, 198, 672
German E.coli outbreak (2011) 195-196
German Society for International Cooperation (GIZ) 429
Germany 71, 72, 132, 136, 198, 288, 304, 666, 679
GFN. see Global Food Banking Network (GFN)
Ghana 17, 738, 739, 744, 758, 761, 763, 768, 772
Gibberellins (GAs) 274-275
GIZ. see German Society for International Cooperation (GIZ)
Global Cold Chain Alliance (GCCA) 632
Global Food Banking Network (GFN) 95, 531
Global Food Loss Index 64, 111
Global Food Safety Initiative (GFSI) 212
Global Hunger Index 704, 705
Global Initiative on Food Losses and Waste 407
Globalization 697
Global Panel on Agriculture and Food Systems for Nutrition 112
Global Report on Food Crises 20
Global Strategic Framework for Food Security and Nutrition 89
Global Strategy to improve agricultural and rural statistics (GSARS) 61
Global system for mobile communications (GSM) 323, 327, 328, 332
Globe Tracker® 333
Glycosylation reaction 604
GMA. see Grocery Manufacturers Association (GMA)
GMP. see General manufacturing practice (GMP)
GNI. see Gross national income
Good Samaritan Law 679
Governance, for FLW reduction 792–795
Grafting and rootstocks 257–258
Grain storage structures, in southwestern Ethiopia 395
Greece 208, 669–670
Green bananas 317, 319
Grenada Technical Declaration 789
Grocery Manufacturers Association (GMA) 202
Gross national income (GNI) 595
GSARS. see Global Strategy to improve agricultural and rural statistics (GSARS)
GSM. see Global system for mobile communications (GSM)
Hazard Analysis Critical Control Point (HACCP) system 201, 476, 681
Health 471
Hermetic storage bags 755–757
Hermetic storage systems 395–397
HFW. see Household level food waste (HFW)
Hidden hunger 4
High-Level Panel of Experts on Food Security and Nutrition (HLPE) 88, 90, 307, 309
HLB. see Huanglongbing (HLB)
HLPE. see High-Level Panel of Experts on Food Security and Nutrition (HLPE)
Holy Quran 347
Hormones and growth regulators 274–279
Hot-air drying 169
Householder food waste action stage 577
contemplators 575
decisional balance 578, 581–583
follow-up results 578–581, 582–583
food management 568–569
implications 585–587
maintenance stage 577–578
overview 567–568
participants and procedure 573
pre-contemplators 574–575
preparation stage 575–576
processes of change 584
self-efficacy 584–585
social marketing food waste campaigns 569–570
trans-theoretical model (TTM) 570–571
decisional balance 571–572
information development 574
processes of change 572
self-efficacy 572
stages of change 571
Household food security, stability of 705–706
Household food waste 665–666, 702, 703, 718
Household level food waste (HFW) 134
Housing 471
Huanglongbing (HLB) 269
Human nutrition and health 147–149, 166–177
food and 149–151
inorganic nutrients 159–162
nutritional classification of food and 162–166
organic nutrients and 151–159
Humidity sensors 333
Hungary 208, 666
Hunger 3, 13
Hydrated sodium calcium aluminosilicate 612
IAA. see Indole-3-acetic acid (IAA)
IADB. see Inter-American Development Bank (IADB)
IARC. see International Agency for Research on Cancer (IARC)
IB. see Infectious Bronchitis (IB)
IBGE. see Brazilian Institute of Geography and Statistics (IBGE)
Iceland 91
Table of Contents

ICTs. see Information communication technologies (ICTs)
IFAD. see International Fund for Agricultural Development (IFAD)
IFWC. see International Food Waste Coalition (IFWC)
IHL. see International Humanitarian Law (IHL)
IICA. see Inter-American Institute for Cooperation in Agriculture (IICA)
ILO. see International Labour Organization (ILO)
Immunoassays 606
IMPACT. see International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)
India 13, 28, 96, 97, 138, 208, 211, 270, 763
Indole-3-acetic acid (IAA) 274
Indonesia 208, 763
Infectious Bronchitis (IB) 469
Influential quality standards 420
Information, for FLW reduction 792
Information communication technologies (ICTs) 768
Infrastructure, to reduce postharvest food loss and waste 764–766
INIA. see Chilean National Agriculture Research Institute (INIA)
Inorganic compounds 611
Insecticides 394–395
Insect-resistant crop varieties 397–398
InspiraFarms model 763
Inter-Agency Expert Group 427
Inter-American Development Bank (IADB) 510, 790
Inter-American Institute for Cooperation in Agriculture (IICA) 429
Intercropping 453
Intergovernmental Panel on Climate Change (IPCC) 88
International Agency for Research on Cancer (IARC) 199
International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) 347
International Food Policy Research Institute 14
International Food Waste Coalition (IFWC) 667
International Fund for Agricultural Development (IFAD) 683
International Humanitarian Law (IHL) 21
International Institute of Refrigeration 232
International Labour Organization (ILO) 21
International Maize and Wheat Improvement Centre (CIMMYT) 397
International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) 14
Interviews method 63
Iodine 160, 161
IPCC. see Intergovernmental Panel on Climate Change (IPCC)
Iran 94, 198
Iron 161, 162, 266
Italy 128, 129, 188, 208, 212, 664, 679–680
James Beard Foundation 643
Japan 411
Jasmonates 277–278
Kazakhstan 94
Kenya 54, 93, 96, 97, 111, 198, 260, 756, 758–759, 763
Kitchen waste, definition of 53
Knowledge, for FLW reduction 792
Kroger Co. 637, 640
Kyrgyz Republic 94
LAC region. see Latin America and the Caribbean (LAC) region
LAC region, FLW reduction 791–795
challenges and future trends 796–797
overview of 787–788
regional FLW strategy, development of 788–790
Lactose 155
Lagos 761
LCAs. see Life cycle assessments (LCAs)
Lean manufacturing 511
Legumes 163, 164
Life cycle analysis (LCA) 58
Life cycle assessments (LCAs) 633
Lipids 152–154, 173
Liposoluble vitamins 157
Lithuania 208, 288
Long-range (LoRa) 333
Long-range wide-area-network (LoRaWAN™) 332, 333
LoRa. see Long-range (LoRa)
LoRaWAN™. see Long-range wide-area-network (LoRaWAN™)
Loss and waste of nutritional components (LWNCs) 166–168

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due to thermal treatment and pH change 170–172
during food selection and storage 168, 170
by oxidation and isomerization of fatty acids 172–174
reduction, in food 174–177
during washing, cutting, and peeling 170
from wastage of by-products 174
Lo Valledor Market Food Recovery Program 517
Love Food Hate Waste 353, 355, 771
LWNCs. see Loss and waste of nutritional components (LWNCs)
MA. see Modified atmosphere (MA)
Macro approach 60–61
Macronutrients 150
MACS. see Meeting of Agricultural Chief Scientists (MACS)
Magnesium 161, 162, 266
Malabo Declaration 89, 390, 768, 773
Malawi 93, 251, 738, 748
small family farm crop diversification in 23–24
Malaysia 208
Malnutrition 4, 12–13
double burden of 4
Manganese 161
Manual harvesting 454, 455
Marine Stewardship Council (MSC) 489
Market dynamics 636
Market-pull mechanisms 756
Markets 472
Masked mycotoxins 604, 605
Mass balance method 63
Meat, fish and dairy 698
Meat and meat products 193
Meats losses and waste
on-farm poultry 469–472
overview 467–469
postmortem losses 473–476
ruminant meat losses 469–472
technologies and practices 476–478
transport losses, live animals 472–473
Meeting of Agricultural Chief Scientists (MACS) 683
Meloidogyne 450
Member Nations of the Near East and North Africa Region 89
MENA. see Middle East and North Africa (MENA)
Mexico 128, 129, 136, 137–140, 260, 269
MFarms 768
Micro approach 61
Microbial bioprocessing 597
Microbial cell walls 612
Micronutrient-related malnutrition 4
Micronutrients 150
Middle East and North Africa (MENA) 200, 345
Milan Urban Food Policy Pact (MUFPP) 680–681
Milk and derivatives 165, 166
Millennium Development Goal 13
Minerals 159–162
Ministry of Agriculture and Livestock (MAG) 794, 796
Ministry of Economic Affairs 678
Missing quantities, definition of 53
Mixed MSW 667
Mobile ethylene sensors 333
Modified atmosphere (MA) 309, 333, 393–394
Moldova 191
Monounsaturated fatty acids 153
MOST® device 323
MPTF. see Multi-Partner Trust Fund (MPTF)
MSC. see Marine Stewardship Council (MSC)
MSW. see Municipal solid waste (MSW)
MUFPP. see Milan Urban Food Policy Pact (MUFPP)
Multi-Partner Trust Fund (MPTF) 525
Municipal solid waste (MSW) 667
Myanmar 260
Mycotoxins 198–199, 270, 757–758
adsorbing agents 610–612
biological degradation 610–612
contamination 390, 392
detection and modeling 606–609
factors affecting growth 602–604
food production and waste 598–602
masked mycotoxins problem 604–606
overview 593–595
processing methods, inactivate mycotoxins 607, 610
recycling and reuse of food waste 595–598
NAD 155, 158
NADP 155, 158
National Cereals and Produce Board (NCPB) 759
National Committee for Food Loss and Waste Prevention and Reduction (CN-PDA) 792
National Day on Food Waste 664
National Gastronomy Plan 521
National Nutrient Database for Standard Reference 167
National Pact against Food Waste (France) 212
National Petroleum Agency (NPA) 554
National School Lunch Program (NSLP) 639
Natural Resources Defense Council (NRDC) 253, 353, 411
NCPB. see National Cereals and Produce Board (NCPB)
NDV. see Newcastle disease virus (NDV)
Near East and North Africa (NENA) 233, 237
NENA. see Near East and North Africa (NENA)
NENA region. see Near East and North Africa (NENA) region
NENA region, FLW in estimation in 694–695, 698–703
farm holding sizes in 712, 715
fertilizer losses 710–711
food import 693
food production, limited 693
food security improvement increasing agriculture sector’s contribution 711–716
increasing food system efficiency 706–707
using natural resources 707–711
food subsidies 715–716
food supply in 705
intermediate system 706
land losses 711
population growth rates in 704
quantitative and qualitative reduction 695, 716–717
data gathering and analysis 717
policies and regulations development 719
raising awareness and promoting good practices 717–719
stimulating private sector and promoting investment 720–721
strengthening collaboration, coordination and networking 719
women’s role in 712, 715
and regional food security 703–706
socioeconomic and cultural factors 712–714
water losses 708–710
water scarcity 707
Netherlands 130, 678
Newcastle disease virus (NDV) 469
New Zealand 91
NFD. see Nutritional Functional Diversity (NFD)
Niacin 155, 156, 158
Nieto Center 520
Nigeria 13, 758, 761, 771
1996 FAO Rome World Food Summit 654
Nitrogen 266, 267
Nixtamalization 607
Non-edible food loss, definition of 53
Non-essential nutrients 151
Non-perishable foods 697
Nordic countries 663
North America 342, 345
North American Initiative on Food Waste Reduction and Recovery 136
North Carolina 635
North Carolina Department of Agriculture and Consumer Services 195
North Nigeria 7, 21
Norway 72, 91, 136, 288, 291–292, 663
NPA. see National Petroleum Agency (NPA)
NRDC. see Natural Resources Defense Council (NRDC)
NSLP. see National School Lunch Program (NSLP)
Nutrient deficiencies 705
Nutritional Functional Diversity (NFD) 93
Nutritional loss 175–176
Nutritional value 54
Obesity rates 705
OIE. see World Organization for Animal Health (OIE)
Oil crops and pulses 698
Oilseeds 163, 164
Optimum grain moisture content 393
Optimum plant density 452
ORBCOMM™ 328, 329
Organic compounds 612
Organic waste, definition of 53
Oryzaephilus surinamensis 394
Overconsumption 695, 697
PACA. see Partnership for Aflatoxin Control in Africa (PACA)
Pacific Coast Collaborative (PCC) 639
Index

Paclobutrazol (PBZ) 278–279
Pakistan 94, 167, 260
Pale, soft and exudative (PSE) meat 552
Pantothenic acid 156, 158
Paraguay 250
Paris Declaration on Aid Effectiveness 9
Partnership for Aflatoxin Control in Africa (PACA) 768–769
Pasteurization 169
PAT 611
PBZ. see Paclobutrazol (PBZ)
PCC. see Pacific Coast Collaborative (PCC)
Pectin 597
Perishable foods 697
Peru 13, 138
Pesticides 279–280
PGR. see Plant growth regulators (PGR)
Phenolic compounds 254–255, 597
Philippines 260
PHL. see Post-harvest losses (PHL)
PHLMS. see African Union Post-Harvest Loss Management Strategy (PHLMS)
Phosphorus 161, 162
Phyllosilicates 611
Physiological disorders, in agricultural commodities 256
PICS. see Purdue Improved Crop Storage (PICS) bags
Plan for Food Security, Nutrition and Hunger Eradication 2025 788–789
Planned action theory 420
Planned behavior theory 347
Plansan 2016–2019 791
Plant growth regulators (PGR) 274
‘Plato Lleno’ 795
Pleocoma fimbriata 450
Policies and institutions 20
conflict, food crisis and food emergencies 20–21
safety nets 21
social justice and 22
Polyamines 277
Polyphenol oxidase (PPO) 455
Polyunsaturated fatty acids 153
Pomace 550, 551
Portugal 136, 254, 678
Portugal National Strategy and Action Plan 678
Post-harvest losses (PHL) 386, 387, 388, 389, 390, 392, 398, 702
definition of 51
Post-harvest physiological deterioration (PPD) 456
Postharvest technology 717, 718
formal education and training on 719
Potassium 161, 266, 267
Potato 253
Potentially edible food losses, definition of 52
PoU. see Prevalence of undernourishment (PoU)
Poverty 12–13
PPD. see Post-harvest physiological deterioration (PPD)
PPO. see Polyphenol oxidase (PPO)
PPPs. see Public-private partnerships (PPPs)
Practice theory 346
Pre-cooling 314, 315, 324, 459
Predictive mycology 606
mathematical models 608–609
Preharvest losses agronomic practices and 263–268
chemical treatments to minimize 273–280
disease as cause of 268–271
environmental factors as causes of 259–263
genetic factors as potential causes of 253–259
insects and pests as cause of 271–273
Premature tuber sprouting 457
Pre-store waste, definition of 52
Prevalence of undernourishment (PoU) 6, 7
Private sector, investment needs and role cases from Chile 517–518
cases from Costa Rica 519–522
as a driver towards sustainable food systems 513–515
FLW PPP 523–524
investment challenges 512–513
legal and regulatory environment 515–517
overview 509–512
PPP relevance, FLW initiatives 522–523
public-private partnerships 518–519
Prostephanus truncatus 396, 397, 398
Proteins 151–152, 173
Proxy data method 63
PSE. see Pale, soft and exudative (PSE) meat
Public policy, for FLW reduction 792
Public-private partnerships (PPPs) 512, 517, 522
Purdue Improved Crop Storage (PICS) bags 755
Putrescible waste, definition of 53
Pyridoxine (vitamin B6) 155, 157
Qatar 198, 347
QTLs. see Quantitative trait loci (QTLs)
Qualitative FLW 696
Qualitative losses 53-54
Quantitative FLW 696, 705
Quantitative losses 53-54, 408, 409
Quantitative trait loci (QTLs) 397
Radio frequency identification (RFID) 323, 32, 334
Ralstonia solanacearum 451
Rapid loss appraisal tool (RLAT) 429
RCM. see Remote container monitoring (RCM)
RDI. see Reference Daily Intake (RDI)
Reactive oxygen species (ROS) 456
Recalled foods 202-204
classifications 202
volumes, linked to foodborne disease outbreaks 203
Recent developments 50-53
Recorded in-store waste, definition of 52
Recovery and redistribution of safe and nutritious food, definition of 53
RecuperaLab 518
‘Recycle’ (Pathway C) 353, 354
Recycling 545
‘Reduce’ (Pathway A) 353, 354
REDUCE project 664-665
ReFED. see Rethink Food Waste Through Economics and Data (ReFED)
ReFED Roadmap to Reduce U.S. Food Waste By 20 Percent 58
Reference Daily Intake (RDI) 151
Refrigerated trucks 303
Refrigeration 169
Regional food losses and waste 343
Regional Strategic Framework for Reducing Food Loss and Waste 89
Reinforcement management 577
Remote container monitoring (RCM) 328, 329, 335
Research, technology and knowledge, for FLW reduction 793
Research and innovation, for FLW reduction 794-796
Resilient households 3
Retail food waste, definition of 52
ReTain 277
Rethink Food Waste Through Economics and Data (ReFED) 253, 347, 356, 630, 636, 648
Reuse, defined 545
‘Reuse’ (Pathway B) 353, 354
Reusing and recycling, FW future trends 555
livestock processing waste 551-552, 553
marine processing waste 552-555
overview 543-545
vegetable processing waste 546-551
waste recycling and reuse 545-546
RFID. see Radio frequency identification (RFID)
Rhyzopertha dominica 394
Riboflavin (vitamin B2) 155, 157
Rice 251, 267-268
seeds 265
RLAT. see Rapid loss appraisal tool (RLAT)
Rockefeller Foundation 641, 643
Rodents 273
Romania 208
Roots and tubers 193, 698
Roots and tubers, food losses and waste in harvest and post-harvest factors 453-457
overview of 445-448
precautionary practices 458-460
pre-harvest factors
agronomic practices 452-453, 459
environmental factors 451-452
pests and diseases 449-451
retail marketing and waste 457-458
ROS. see Reactive oxygen species (ROS)
Rosario (Argentina) 24-25
Rukai 518
Russia 192
Rwanda 765
SA. see Salicylic acid (SA)
Saccharomyces cerevisiae 597
Safe and nutritious food, recovery and redistribution of 681
Salicylic acid (SA) 278
Saturated fatty acids 153
Saudi Arabia 198, 345
SAVE FOOD COSTA RICA 519
SBP. see School Breakfast Program (SBP)
School Breakfast Program (SBP) 639
SDG 12 408, 524
SDG 12.3 657, 663, 664, 666, 675, 678, 795

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SDGs. see Sustainable Development Goals (SDGs)
SDI. see Suggested Daily Intake (SDI)
Seafood loss and waste (SFLW) 487-491
distribution and marketing strategies 497-499
fishery/production stage 491-492
overview 483-485
post-harvest and handling stages 492-493
primary level strategies 496
processing and packaging stages 493-495
processing level strategies 496-497
production 485-487
retail and consumer level strategies 499-500
Seafood Watch Program 489
Secretary of Food and Bio economy 793
Selenium 161
Self-liberation 575
Semi-passive loggers 323
Senegal 744, 758
Seven Wastes 511
SFA. see Sustainable Food Alliance (SFA)
SFLW. see Seafood loss and waste (SFLW)
Shatter bruise 455
Shell-life (SL) 593
labels and food waste 211-212
modelling 325
temperature 320
Shrimp consumption 495
Side flow, definition of 49
#SinDesperdicio Platform 790
Sitophilus sp.
S. oryzae 394
S. zeamais 394, 396, 397, 398
SL. see Shelf-life (SL)
Slaughterhouse wastewater 551
Small and medium enterprises (SMEs) 750
Small-scale fisheries 19
SMART. see Specific, Measurable, Achievable, Relevant and Timebound (SMART)
Smart packaging 500
SMEs. see Small and medium enterprises (SMEs)
Social liberation 576
Society 15
health and 16-17
migration and 17
world population dynamics and changing diets and 15-16
Socio-economic impacts 107-109, 115-117
characterizing 109-113
hypothetical value chain framework 114-115
of loss, at farm level 117-119
of loss, at retailer level 119-120
modelling 113
of waste, at consumer level 120-121
Sodium 161
Soil erosion 18
South Africa 112, 417, 735, 743-744
South Korea 208
South Sudan 7, 21
Spain 254, 665-666
Specific, Measurable, Achievable, Relevant and Timebound (SMART) 10
SSA. see Sub-Saharan Africa (SSA)
Standard and Protocol 72, 73
Starch 154, 550
Starch phosphorylase 457
State of World Fisheries and Aquaculture 91
Statistical models method 63
Stimulus control process 572, 576
‘Stop Wasting Food’ initiative 210
Streptomyces sp. 597
Sub-Saharan Africa 16, 730-733
challenges and initiatives in food loss and waste reduction in 745-772
FLW in 733-735
food waste in 742-745
future trends 772-774
postharvest food loss and waste information systems in 740-742
postharvest loss comparisons 738-740
postharvest loss direct measurements 736-737
postharvest loss perceptions and guestimates 737-738
Sub-Saharan Africa (SSA) 386
Substandard products 235
Sudan 7, 21, 208
Suggested Daily Intake (SDI) 151
Super Grain bags 395, 396
Supply chain improvement 229-231
agriculture production and harvesting and 231-232
consumption and 236-237
distribution, retail, and marketing 235
food processing and 234-235
future trends 241
strategies 435
systems approach need 237-241
transport, handling, and storage and 232-234
Supply chain life cycle model 115-117
Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan 674
Sustainable Development Goals (SDGs) 3, 9, 40, 46, 66, 107, 341, 407, 408, 427, 467, 655, 789
12.3 61, 64-65, 87, 88, 132, 229
Sustainable Food Alliance (SFA) 678
Sustainable tourism 520-521
Sweden 72, 130, 666, 680
Sweet potato weevil (Cylas formicarius) 449, 450, 452, 453, 459
harvesting of 454
mixed intercropping of 453
rodent infestation, losses by 450
skin, damaged by Pleocoma fimbriata 450
Switzerland 134, 135, 308, 368
Synthetic adsorbants 612
Syrian Arab Republic 7, 21
Tajikistan 94
Tanzania 111, 732, 738, 748, 758
TEC. see Technological Institute of Technology (TEC)
Technological Institute of Technology (TEC) 52, 796
Technology, to reduce postharvest food loss and waste 751-752
for durable crops 752-760
form perishable crops 760-663
scaling 764
Tectosilicates 611
Temperature deviations during transport actions, to minimise losses 305-306
banana chain 304
future trends
alternative sensors 333-334
communication 332-333
intelligent packing 334
research prototypes 332
identification, quantification and mitigation
cool chain and handling improvement 323-324
improving cooling performance 324-325
observed temperature variation vs. shelf-life variance 325-327
temperature monitoring hardware 322-323
omnipresence of air supply method 310-311
average temperature offset 312
cool-down time 314-315
probe locations 311-313
temperature heterogeneity 315-317
temperature out-of-range and power interruptions 314-315
percentage quality loss 304-308
remote monitoring and FEFO application
applying intelligent stock rotation 330-331
detecting actual problems and finding remedies 329-330
intelligent container 327-328
link to wireless temperature loggers 329
remote container monitoring 328-329
shelf-life prediction 317-318
advanced models 321-322
basic shelf-life model 319-321
biological variance 318-319
limiting attributes 318
transport losses
amount of FLW 306-308
causes, besides temperature 308-309
cool chain ruptures 309-310
lack of data 308
Thailand 208
Thermal treatments 176-177
Thiamine (vitamin B1) 155, 157
Time–temperature integrators 334
Togo 208
The tomato case 522
Total renewable water resources (TRWR) 707, 709
Transforma Alimentos 519
Transportation 472
Trans-theoretical model (TTM) 570-571, 572, 575, 585
Trawling 496
Tribolium castaneum 394, 396
Triple Profit Strategy 521
Tropical fruit waste 595
Trussel Trust Food Bank 531
TRWR. see Total renewable water resources (TRWR)
TTM. see Trans-theoretical model (TTM)
Tunisia 253
Turkey 94, 198, 670-671
Turkey's Zero Waste Initiative 670
Turkmenistan 198
2019 EU Delegated Act 660, 663
2019 Turkey Greenhouse Gas Inventory Report 670
2030 Agenda 3, 40, 46, 83, 107, 229
2030 Food Loss and Waste Reduction Goal’ 132
UAE. see United Arab Emirates (UAE)
Uganda 93, 112, 738, 748
UK. see United Kingdom (UK)
Ukraine 191, 192, 197, 672-673
ULD. see Unit load devices (ULD)
UN. see United Nations (UN)
UN Decade of Action on Nutrition 10
Undernourishment 3-4
Undernutrition 4
UNEP. see United Nations Environment Programme (UNEP)
UN/FAO 407, 427
UNICEF 9
Unilever–Food solutions 515
Unilever Processing Plant, Costa Rica 521
United Arab Emirates (UAE) 198, 345, 347
United Kingdom (UK) 43, 57, 112, 128, 129, 132, 134, 135, 208, 252, 288, 368, 418, 664, 747
United Nations (UN) 341, 407, 409
United Nations Committee on Food Security 307
United Nations Decade of Action on Nutrition 655
United Nations Environment Programme (UNEP) 298
United Nations General Assembly 407
United Nations Millennium Development Goal 191
United Nations System Standing Committee on Nutrition (UNSCN) 88
United States Department of Agriculture (USDA) 48, 416, 484, 485, 630
United States Environmental Protection Agency 48
Unit load devices (ULD) 303
Universal Declaration of Human Rights 1-2
Universal recovery strategy 595
Unrecorded in-store waste, definition of 52
UNSCN. see United Nations System Standing Committee on Nutrition (UNSCN)
UN Sustainable Development Goal 12.3 291
Urbanization 367
Urbanization, in NENA 697, 704
Urban mining 673
Uruguay 250
US. see United States (US)
US, FLW in consumer-facing businesses consumers 643-644
hospitality 641-643
restaurants 643-644
retail 636-639
schools 639-641
consumers 644-647
overview 629-632
production 632-636
USDA. see United States Department of Agriculture (USDA)
US Department of Agriculture food recall classifications 202
US Environmental Protection Agency (EPA) 630
Food Recovery Hierarchy 631
Uzbekistan 94
Vaccination programs 472
VAD. see Vitamin A Deficiency (VAD)
‘Valoremos los Alimentos’ 793
Vascular streaking 457
Verigo™ Pod (United States) 323
Vietnam 232, 251
Vitamin A Deficiency (VAD) 54
Vitamins 155-159, 173
WA. see Water activity (WA)
Warehouse receipt systems (WRS) 767-768
Waste and Resources Action Programme (WRAP) 205, 298, 352, 353, 356, 663, 674
Waste Not, Want Not’ report 95
Water activity (WA) 602
Week of Agriculture and Food: Future Challenges for Latin America and the Caribbean 789
West London Love Food Hate Waste Campaign 669

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WFP. see World Food Programme (WFP)
WHO 9, 10
Wireless multi-gas sensor system 333
Wireless temperature loggers 323
World Food Programme (WFP) 683
World Food Summit 4
World Organization for Animal Health (OIE) 470
World Resources Institute (WRI) 298, 342, 345, 429
World Summit on Food Security 9
WRAP. see Waste and Resources Action Programme (WRAP)
WRI. see World Resources Institute (WRI)
WRS. see Warehouse receipt systems (WRS)
WWF. see World Wildlife Fund (WWF)
Yam 453, 458
Yemen 7, 21
Zambia 208, 758
ZECC. see Zero energy cooling chambers (ZECC)
Zeolites 612
Zero energy cooling chambers (ZECC) 762
‘Zero-Food Waste Forums’ 795
Zero Hunger Challenge 88
Zero Losses of Raw Material in Agroindustry 519
Zero Losses Program 519
Zero-waste approach 595
‘Zero waste in agro-industry raw materials’ programme 792
Zimbabwe 748
Zinc 160, 162, 266