

With Climate Chaos... Who Will Feed Us? The Industrial Food Chain/The Peasant Food Web



The Food Systems We Don't Know We Don't Know – Fifty years ago, at the first World Food Congress in June 1963, the UN was told that, “*We have the means, we have the capacity, to wipe hunger and poverty from the face of the earth in our lifetime – we need only the will.*” These words have been the mantra of every food conference since. Yet governments still face major gaps in their knowledge about our food supply and consumption. This became horribly apparent in 2007 when governments failed to recognize that a global food crisis was at hand. Fifty years after policymakers committed to end hunger they need to sort out why governments don't have the *means*, the *capacity*, or the *will* to end hunger.

We don't know we don't know for two related reasons: first, because we have spent half a century immersed in the largely uncontested presumption that the prevailing Western model of food production, processing and consumption (the “Industrial Food Chain” in this poster) is inevitable; virtually everything we think about our food security is based upon this premise; second, we have become dependent upon the limited statistics and interpretations volunteered by agribusiness. Even as we are told that “agribusiness as usual” is unstoppable, less and less information about the reality of markets and market share is made public. ETC Group began tracking agribusiness markets in the late 1970s. Over the decades, individual companies and industry analysts have grown more secretive. This is, in part, because the number of analysts is consolidating as rapidly as agribusiness itself. As a result, policymakers accept that increases in meat and dairy consumption, obesity, and the need for fertilizers and pesticides are unchallengeable realities. The demands of “paying customers” are sacrosanct; the demands of the hungry are negotiable. We hope this poster will promote a debate over the conventional wisdom surrounding the Industrial Food Chain.

Two Solitudes? So, is everything “black and white”? Do policymakers only have a choice between the Industrial Food Chain and the Peasant Food Web? Not necessarily; peasant producers often participate to varying degrees in both systems. But, there is a clear distinction in starting premises: one perspective is that the current Western production paradigm – based on multinational agribusiness – is the only credible starting point. The other perspective is that smallholder producers (i.e., peasants) must be at the center of all local, national and global food policies. This poster unapologetically presents the case for the peasants' perspective.

Peasant Food Web? Many prefer to talk about “farmers” or “smallholder producers” and are concerned that “peasants” is patronizing or pejorative. In this poster, we use “peasant” to describe all those who produce food mostly for themselves and their communities whether they are rural, urban, or peri-urban farmers, ocean or freshwater fishers, pastoralists, or hunters and gatherers. Many peasants fit all of these categories. Small farmers often have fishponds and livestock. They often hunt and gather – especially in the sometimes-difficult weeks before harvest. Many peasants

move back and forth between city and countryside. When we say “Web” we are talking about the complex of supportive interconnections shared by peasants and communities. Conversely, the “Chain,” although complex, locks in each link and rarely takes into account the “hidden harvest” gathered seasonally from forests, roadsides and savannas. The bounty from urban farming (crops, fish and livestock) is seldom considered.

The mix of peasant food sources renders statistical estimates difficult. To complicate things further, peasants grow around 7,000 crops but industrial food chain “bean counters” focus on about 150 crops. The world does not have accurate figures. The poster offers our best estimate of the share of the food supply that comes from forests, fish, urban production, etc., but it is only a calculation. We invite others to help with this essential research.

The Web works hard not to waste food or the resources to produce food. Where there is “loss” it is almost exclusively due to problems of storage or transportation – not from overconsumption, cosmetic concerns or neglect. Food that is deteriorating is often rescued for livestock or fertilizer. Would this were true for the Chain!

Neither is the Web a pseudonym for agroecology, organic farming, permaculture, or any other production system. Peasants make their decisions about synthetic fertilizers or pesticides for economic, environmental, or access reasons and some use chemicals for their commercial produce and avoid them for their own consumption. The bottom line is, however, that much/most of what peasants produce is de facto “organic.”

Industrial Food Chain? It is also hard to calculate what food is produced – and how much is consumed – in the Chain. Much has been written about the food waste that comes from discarding cosmetically imperfect fruits and vegetables; from the problems of long-distance transportation; from good quality foods discarded by supermarkets; and the amount that consumers throw away after purchase. Statisticians have spent less time estimating the quantity, health cost, and opportunity cost of overconsumption. The calculation is complicated: how much of the 80% of the world’s agricultural land and fertilizers that goes to animal feed – that turns into meat and dairy products – becomes “waist” as some consumers eat several times the amount recommended by health authorities? The poster attempts to calculate all of these forms of waste and we conclude that the Chain delivers only about 30% of the food that people both eat – and need. The Chain is not capable of reaching those who are hungry and malnourished.

Fifty years later, we must recognize that peasants have the *capacity* and the *will* to feed the hungry – they need only the *means*: Food Sovereignty.

1. Who feeds us today?

Chain: Provides 30% of all food consumed (crops, fish, etc.) but uses about 70-80% of world's arable land to grow 30-40% of crop-derived food;¹ accounts for >80% of fossil fuels² and 70% of water³ used in agriculture; causes 44-57% of emitted GHGs annually;⁴ deforests 13 million ha⁵ and destroys 75 billion tons of topsoil⁶ each year; controls almost all of the food that is traded internationally (i.e., 15% of all the food produced in the world)⁷ and dominates the \$7 trillion commercial grocery market,⁸ while leaving almost 3.4 billion either undernourished or overweight.⁹

Web: Provides >70% of total food eaten by people:¹⁰ 15-20% via urban agriculture;¹¹ 10-15% from hunting and gathering;¹² 5-10% from fishing;¹³ and 35-50% from farms (harvests 60-70% of food crops

¹ See Grain, 2013 (forthcoming).

² GRAIN, "Food and Climate Change, The Forgotten link," 28 September 2011, p.4: <http://www.grain.org/article/entries/4357-food-and-climate-change-the-forgotten-link>.

³ United Nations, "Facts and Figures from the World Water Development Report 4: Managing Water under Uncertainty and Risk," World Water Assessment Programme, 2012, p. 1: <http://unesdoc.unesco.org/images/0021/002154/215492e.pdf>.

⁴ GRAIN, "Food and Climate Change, The Forgotten link," 28 September 2011, p. 4.

⁵ Food and Agriculture Organization (FAO), "Global Forest Resources Assessment 2010," Rome, 2010, p. 16.

⁶ David Pimentel, "Soil Erosion: A Food and Environmental Threat," *Environment, Development and Sustainability* 8: 119–137, 2006, p. 123; DOI 10.1007/s10668-005-1262-8.

⁷ See ETC Group, *Who Will Feed Us?*, 2009: <http://www.etcgroup.org/content/who-will-feed-us>; see also Jan Douwe van der Ploeg, *The New Peasantries: Struggles for Autonomy and Sustainability in an Era of Empire and Globalization*, Earthscan, 2008, pp. 289-290. According to van der Ploeg, for example: "... only 6% of the total world production of rice is traded across borders... In the case of wheat, which is the world's biggest export crop among the cereals, only 17% is exported (p. 289). Meat is exported in growing quantities, facilitated by global cooling chains, which allow long- distance trading. Nevertheless, meat exports still represent less than 10% of total world production. This minor share, however, does not exclude that the total value of global food exports (in 2000) was estimated by the World Trade Organization (WTO) at US\$442.3 billion, representing 9% of world merchandise trade and 40.7% of world exports in primary products. Over the last 15 years exports of food products have been growing more quickly than total world production..." (p. 290). The 2013 Meat Atlas agrees that just 10% of the meat produced worldwide is traded internationally, but adds that meat accounts for 17% of the total value of all international agricultural trade: Heinrich Böll Foundation, Friends of the Earth Germany and Le Monde diplomatique, *Fleischatlas*, 2013, p. 14.

⁸ The global market for grocery spending topped \$7.18 trillion in 2009. The figure was provided by Planet Retail and published by ETC Group: ETC Group, *Who Will Control the Green Economy?*, 2011, p. 37.

⁹ FAO, "The state of food insecurity in the world," Rome, 2012, p. 4 and WHO, "Obesity and overweight," Fact sheet No. 311, Geneva, Switzerland, 2012: <http://www.who.int/mediacentre/factsheets/fs311/en/>.

¹⁰ ETC Group, *Who Will Feed Us?*, 2009. Conventional sources of food consumption data, such as FAO, IFPRI, WHO, etc., are not clear on the share of global food consumption that is provided by smallholder producers. Our 70% estimate attempts to take into account the peasant contribution to global food consumption derived from crops, livestock, fish and other aquatic foods, hunting and gathering, and urban food production by peasants. In our estimate of the share of food consumption contributed by the industrial food chain, we have also subtracted the food waste caused by overconsumption.

¹¹ FAO, "Urban Agriculture: For sustainable Poverty Alleviation and Food Security," 2008, p. 22: http://www.fao.org/fileadmin/templates/FCIT/PDF/UPA_-WBpaper-Final_October_2008.pdf.

¹² Ian Scoones, Mary Melnyk, Jules N. Pretty, *The hidden harvest: wild foods and agricultural systems: a literature review and annotated bibliography*, Sustainable Agriculture Programme, International Institute for Environment and Development, vol. 256, 1992. There is no precise figure estimating the share of the world's consumed foods that comes from hunting and gathering, but the editors do provide extensive examples where hunting and gathering contributes 30% or more of the food requirements of small and large communities in the global South. We hope that our rough estimate will prompt other researchers to investigate further.

from 20-30% of arable land);¹⁴ accounts for <20% of fossil fuel¹⁵ and 30% of water used in agriculture;¹⁶ nurtures and sustainably uses diversity and dominates the 85% of the world's food grown and consumed within national borders;¹⁷ is the major (often sole) provider of the food that reaches the 2 billion hungry and undernourished.¹⁸

¹³ ETC Group, *Who Will Feed Us?*, 2009, p. 26. Although there are many estimates for the number of people or percentage of the world's population dependent upon fish protein, we have not been able to find reliable global estimates for the overall value of aquatic food sources. Again, we offer this rough estimate in the hope that other researchers will be encouraged to seek additional information.

¹⁴ See Grain, 2013 (forthcoming).

¹⁵ This is an estimate. We note that UNEP estimates that almost 80% of fertilizers are used to produce livestock feed. We regard this as part of the chain. Similarly, most pesticide use comes from the chain and the chain is a major user of fossil fuels for mechanized farming and commercial fishing.

¹⁶ More than 70% of freshwater-use in agriculture (including production, processing, transport, etc.) relates to food that is traded internationally and we assume that this – plus some domestic production – is part of the Chain. Thus, no more than 30% of freshwater used in agriculture can be ascribed to the Web.

¹⁷ Based on van der Ploeg's estimate of rice, wheat and meat in international trade and concluding that at least 85% of food production remains within national borders.

¹⁸ ETC Group, *Who Will Feed Us?*, 2009. This estimate is based on the assumption that 80% of arable land is used by the Chain – much of it for pasture and to produce crops for livestock – and that the world's hungry have very little access to meat and dairy products. Further, we agree that the Chain loses between 33% and 40% of food production through waste. Finally, 25% of the Chain's food (that reaches consumers) amounts to overconsumption. Even taking into account food aid shipments, the world's hungry must receive the vast majority of their calories – even though insufficient – from the Web.

2. Who produces more food per hectare?

Chain: In a normal year and on good soils, high-yielding varieties of any major commercial crop monoculture will produce more marketable mass of that crop per ha than peasant-bred varieties of the same crop – but at much greater cost including health, livelihood and environmental damages; organic farming, for example, could increase global crop yields by 132%.¹⁹

Web: In a normal or abnormal year, on good or poor soils, multi-cultures bred by women and men of diverse crops, fish and livestock (intercropping) will produce more food per ha,²⁰ which is also more nutritious, than any Chain monoculture, at a fraction of the cost and with employment and environmental benefits; adopting new agro-ecology tools in the 1990s, 9 million peasants in 52 countries increased crop yields 93% – not counting gains from fish ponds and household livestock.²¹

3. Who will feed us tomorrow (2030)?

Chain: With “agribusiness as usual:” urban share of global population rises to 70%;²² obesity doubles;²³ meat and dairy production rise 70%;²⁴ total food demand grows 50% and water demand grows 30%;²⁵ agricultural GHG emissions increase 60%.²⁶

Web: With land and rights: rural population holds at 50% or increases; nutrition and food availability doubles; obesity rates drop; GHG emissions cut by at least 60% and water demand by 50%; agricultural fossil fuel-use reduced by 75-90%.²⁷

¹⁹ Nadia El-Hage Scialabba, “Organic Agriculture and Food Security,” FAO, 2007, p. 5: <ftp://ftp.fao.org/paia/organicag/ofs/OFS-2007-5.pdf>.

²⁰ Peter Rosset, “On the Benefits of Small Farms,” *Food First*, 1999: <http://www.foodfirst.org/pubs/policybs/pb4.html>.

²¹ Jules N. Pretty, “Agroecology in Developing Countries: The Promise of a Sustainable Harvest,” *Environment: Science and Policy for Sustainable Development*, 45:9, November 2003, pp. 13-14. See also, the follow-up article that includes data covering 37 million ha: J. N. Pretty, A. D. Noble, D. Bossio, J. Dixon, R. E. Hine, F. W. T. Penning de Vries and J. I. L. Morison, “Resource-Conserving Agriculture Increases Yields in Developing Countries,” *Environmental Science & Technology* 40 (4), 2006, pp. 1114–1119: DOI: 10.1021/es051670d.

²² UN Department of Economic and Social Affairs, Population Division, *World Urbanization Prospects: The 2011 revision, File 2: Percentage of Population residing in Urban Areas by Major Area, Region and Countries, 1950-2050*: <http://esa.un.org/unup/CD-ROM/Urban-Rural-Population.htm>.

²³ Charlotte Howard, “The big picture,” *The Economist*, 15 Dec 2012: <http://www.economist.com/news/special-report/21568065-world-getting-wider-says-charlotte-howard-what-can-be-done-about-it-big>.

²⁴ John Beddington, “Food, energy, water and the climate: A perfect storm of global events?” Report, Government Office for Science, UK, 2009: www.bis.gov.uk/assets/goscience/docs/p/perfect-storm-paper.pdf; John Beddington, “The future of food and farming,” *International Journal of Agricultural Management* 1(2): 2–6.

²⁵ Ibid.

²⁶ Jelle Bruinsma (ed.), “World Agriculture: Towards 2015/2030: An FAO Perspective,” FAO, Rome, 2003, p. 334; Mark. W. Rosegrant, Ximing Cai and Sarah A. Cline, “Water and Food to 2025: Dealing with Scarcity,” International Food Policy Research Institute, Washington, 2002, p. 90: <http://www.ifpri.org/sites/default/files/publications/water2025.pdf>.

²⁷ ETC Group’s own projections based on our understanding of the capacity of the Web to respond to positive incentives and the removal of barriers.

4. What policy changes will get us there?

Chain: Accelerate land-grabs; strengthen agribusiness-biased trade agreements; accept broader patent monopolies; acquiesce to cartel practices (e.g. 3 companies account for >50% of commercial seed sales and 10 companies control 95% of the pesticide market²⁸); end seed-saving; access to cheaper fossil fuels; transfer more food-safety costs to consumers and peasants.

Web: Food Sovereignty, encompassing: right to land and water; restoration of the right to exchange and breed seeds and livestock; repatriation of seeds; elimination of regulations blocking local markets and diversity; fair trade; reorientation of public R&D to promote agro-ecology and address peasants' needs.

²⁸ ETC Group, "Gene Giants Seek 'Philanthropopoly,'" *Communiqué* no. 102, p. 2.

5. Who will breed our food crops?

Chain: Grows 150 crops but 12 species are key²⁹ (e.g. 45% of seed-related R&D focused on maize³⁰); >80,000 varieties bred since 1960s (59% ornamentals);³¹ average cost to develop a GM variety is \$136 million;³² yet only 10–20% of the South’s seeds come from commercial sector.³³ NB: commercial emphasis is on breeding with 700 wild relatives of major crops to adapt to climate change.³⁴

Web: >2.1 million varieties of 7,000 species bred since 1960s (some ornamentals);³⁵ no commercial costs to produce new varieties; 80-90% of seeds are sourced outside commercial markets. NB: has access to 50,000-60,000 species of wild crop relatives.³⁶ Chain values crop wild relatives at \$115 billion a year.³⁷

²⁹ Sam Fujisaka, David Williams and Michael Halewood, “The impact of climate change on countries’ interdependence on genetic resources for food and agriculture,” FAO, Commission on Genetic Resources for Food and Agriculture, Background Study Paper No. 48, 2011, p 7: <ftp://ftp.fao.org/docrep/fao/meeting/017/ak532e.pdf>.

³⁰ K. O. Fuglie, P. W. Heisey, J. L. King, C. E. Pray, K. Day-Rubenstein, D. Schimmelpfennig, S. L. Wang and R. Karmarkar-Deshmukh, “Research Investments and Market Structure in the Food Processing, Agricultural Input, and Biofuel Industries Worldwide,” USDA, Economic Research Report No. 130, December 2011, p. 39.

³¹ ETC Group, Who Will Feed Us?, 2009, p. 1 derived from International Union for the Protection of New Varieties of Plants (UPOV), “PVP Statistics for the period 2003-2007,” prepared by the office of UPOV, October 19, 2008 (CD-ROM).

³² Phillips McDougall Consultancy, “The cost and time involved in the discovery, development and authorisation of a new plant biotechnology derived trait,” A Consultancy Study for CropLife International, September 2011, p. 14.

³³ D.I. Jarvis, B. Sthapit and L. Sears (eds.), *Conserving agricultural biodiversity in situ: A scientific basis for sustainable agriculture*, International Plant Genetic Resources Institute, Rome, Italy, 2000. See especially chapter VII, Seed supply systems; data collection and analysis. See also CIAT, “Understanding Seed Systems Used by Small Farmers in Africa: Focus on Markets,” Practice Brief 6.

³⁴ FAO, *The Second Report on The State of the World’s Plant Genetic Resources for Food and Agriculture*, Commission on Genetic Resources for Food and Agriculture, FAO, Rome, 2010, p. 34: “Taking a broad definition of CWR as any taxon belonging to the same genus as a crop, it has been estimated that there are 50-60 000 CWR species worldwide. Of these, approximately 700 are considered of highest priority, being the species that comprise the primary and secondary gene pools of the world’s most important food crops...”

³⁵ *Ibid.*, p. 54: “... it is estimated that about 7.4 million accessions are currently maintained globally, 1.4 million more than were reported in the first SOW report. Various analyses suggest that between 25 and 30 percent of the total holdings (or 1.9-2.2 million accessions) are distinct...” In the same chapter of this report, FAO advises that CGIAR and AVRDC gene banks collectively have 3,446 species in storage but this includes an undetermined number of wild species. Jose T. Esquinas-Alcazar and others consistently estimate that peasants have domesticated 7,000 species. Roughly speaking, probably only half of the 7,000 domesticated species are represented in major gene banks making the estimate of 2.1 million peasant-bred varieties conservative; Noel Kingsbury, *Hybrid: The History and Science of Plant Breeding*, University of Chicago Press, 2009, p. 408.

³⁶ FAO, *The Second Report on The State of the World’s Plant Genetic Resources for Food and Agriculture*, Commission on Genetic Resources for Food and Agriculture, FAO, Rome, 2010, p. 34.

³⁷ Susan McCouch, et al. “Feeding the Future,” *Nature* 499, 4 July 2013, pp. 23–24: http://www.nature.com/nature/journal/v499/n7456/full/499023a.html?WT.ec_id=NATURE-20130704-auth-10.

6. Who will breed our livestock?

Chain: Works with 5 species and <100 breeds;³⁸ fewer than a dozen corporate breeders dominate R&D in livestock (poultry, swine and cattle) genetics (e.g. 4 companies account for 97% of poultry genetics R&D; 4 companies account for >65% of pig genetics R&D³⁹); Europe and North America have highest proportion of endangered livestock breeds.⁴⁰

Web: Breeds with 40 species⁴¹ and maintains >7,000 local breeds;⁴² 640 million peasant farmers and 190 million pastoralists are guardians of the world's livestock diversity;⁴³ two-thirds of rural livestock keepers are women;⁴⁴ rural and urban South households earn between one-third and one-half of their income from livestock.⁴⁵

³⁸ FAO Commission on Genetic Resources for Food and Agriculture, "The Use and Exchange of Animal Genetic Resources for Food and Agriculture," Background Study Paper No. 43, July 2009.

³⁹ K. O. Fuglie, P. W. Heisey, J. L. King, C. E. Pray, K. Day-Rubenstein, D. Schimmelpfennig, S. L. Wang and R. Karmarkar-Deshmukh, "Research Investments and Market Structure in the Food Processing, Agricultural Input, and Biofuel Industries Worldwide," USDA, Economic Research Report No. 130, December 2011, chapter 7, pp. 90-106.

⁴⁰ FAO Commission on Genetic Resources for Food and Agriculture, "Status and Trends of animal genetic resources – 2012," CGRFA-14/13/Inf.16 Rev.1, 14th Session of the CGRFA, Rome 15-19 April 2013, p. 9: <http://www.fao.org/docrep/meeting/027/mgo46e.pdf>.

⁴¹ FAO Commission on Genetic Resources for Food and Agriculture, "The Use and Exchange of Animal Genetic Resources for Food and Agriculture," Background Study Paper No. 43, July 2009, p. 4: According to the paper the domesticated animal species are: Alpaca, ass, Bactrian camel, buffalo, cattle, chicken, Chilean tinamou, deer, dog, dromedary, dromedary x bactrian camel crosses, duck (domestic), domestic duck x Muscovy duck crosses, goat, goose (domestic), guinea fowl, guinea pig, horse, llama, Muscovy duck, ñandu, ostrich, partridge, peacock, pheasant, pig, pigeon, quail, rabbit, sheep, swallow, turkey, vicuña, yak (domestic).

⁴² FAO Commission on Genetic Resources for Food and Agriculture, "Status and Trends of animal genetic resources – 2012," CGRFA-14/13/Inf.16 Rev.1, 14th Session of the CGRFA, Rome 15-19 April 2013, p. 5: <http://www.fao.org/docrep/meeting/027/mgo46e.pdf>.

⁴³ FAO, "Invisible Guardians - Women manage livestock diversity," FAO Animal Production and Health Paper, No. 174, Rome, Italy, 2012: <http://www.fao.org/docrep/016/i3018e/i3018e00.htm>; Helena Paul, Stella Semino, Antje Lorch, Bente Hessellund Andersen, Susanne Gura and Almuth Ernsting, "Agriculture and climate change: Real problems, false solutions," Bonn Climate Change Talks, June 2009, p. 29: http://www.fao.org/fileadmin/user_upload/rome2007/docs/agriculture-climate-change-june-2009.pdf.

⁴⁴ FAO, "Invisible Guardians - Women manage livestock diversity," FAO Animal Production and Health Paper, No. 174, Rome, Italy, 2012, p. 6: <http://www.fao.org/docrep/016/i3018e/i3018e00.htm>.

⁴⁵ M. Herrero, D. Grace, J. Njuki, N. Johnson, D. Enahoro, S. Silvestri, M.C. Rufino, "The roles of livestock in developing countries," *Animal* 7 (Supplement s1): 3-18, 2013: <http://hdl.handle.net/10568/24883>.

7. Who will conserve our aquatic harvest?

Chain: Catches 363 marine species and 600 species raised in captivity (but 101 breeding programs focus on just 25 species);⁴⁶ overfishing has driven 20% of freshwater species to extinction;⁴⁷ 30% of ocean fish stocks are overexploited and an additional 57% are at maximum exploitation;⁴⁸ today's trawlers catch just 6% of what their counterparts caught 120 years ago.⁴⁹

Web: Harvests >15,000 freshwater species⁵⁰ and unknown thousands of marine species; 1.5 billion people (one-fifth of world population) depend on fish as primary protein source;⁵¹ women make up 33% of the rural aquaculture workforce in China, 42% in Indonesia and 80% in Viet Nam.⁵²

⁴⁶ T. Gjedrem, N. Robinson, M. Rye, "The importance of selective breeding in aquaculture to meet future demands for animal protein: A review," Vols. 350-353, 2012, Table 12, p. 123.

⁴⁷ United Nations Department of Public Information (DPI/2293B), "Water: A Matter of Life and Death," Fact Sheet, December 2002.

⁴⁸ Refers to the 600 marine fish stocks monitored by FAO. See FAO, "The State of World Fisheries and Aquaculture – 2012," FAO Fisheries and Aquaculture Department, Rome, 2012, p. 53: <http://www.fao.org/docrep/016/i2727e/i2727e.pdf>. China was recently discovered to have extracted almost 12 times more marine fish from other countries than reported: see D. Pauly, D. Belhabib, R. Blomeyer, W. W. W. L. Cheung, A. M. Cisneros-Montemayor, D. Copeland, S. Harper, V. W. Y. Lam, Y. Mai, F. Le Manach, H. Österblom, K. M. Mok, L. van der Meer, A. Sanz, S. Shon, U. R. Sumaila, W. Swartz, R. Watson, Y. Zhai and D. Zeller, "China's distant-water fisheries in the 21st century," *Fish and Fisheries*, 2013: doi: 10.1111/faf.12032.

⁴⁹ Callum Roberts, *The Ocean of Life: The Fate of Man and the Sea*, Viking Press, 2012, p. 45.

⁵⁰ Sam Fujisaka, David Williams and Michael Halewood, "The impact of climate change on countries' interdependence on genetic resources for food and agriculture," FAO – Commission on Genetic Resources for Food and Agriculture, Background Study Paper No. 48, 2011, p 49: <ftp://ftp.fao.org/docrep/fao/meeting/017/ak532e.pdf>.

⁵¹ Nick Nutall, "Overfishing: a threat to marine biodiversity," UNEP, accessed 15 June 2013: <http://www.un.org/events/tenstories/06/story.asp?storyid=00>; FAO, "The State of World Fisheries and Aquaculture – 2012," Rome, 2012, p. 84: <http://www.fao.org/docrep/016/i2727e/i2727e.pdf>.

⁵² FAO, "Men and Women in Agriculture: closing the gap," n. d.: <http://www.fao.org/sofa/gender/did-you-know/en/>.

8. Who will protect our forest foods?

Chain: \$186 billion market for all primary wood products focuses R&D on 0.5% (450 species) of known forest species⁵³ (e.g. in Central America, land conversion for feed and fodder destroyed almost 40% of forests in 40 years;⁵⁴ 75% of deforested land in the Brazilian Amazon is occupied by cattle ranchers);⁵⁵ up to 90% of the tropical timber trade is conducted illegally.⁵⁶

Web: 80,000 species are important to 80% of people in the South for purposes other than timber and fuel;⁵⁷ forests and savannas provide 10-15% of the world's food;⁵⁸ 1.6 billion people depend on forests for their livelihoods⁵⁹ and so-called "underutilized" lands generate approx. \$90 billion per annum.⁶⁰ Half the world's farmland is at least 10% forest with vital role in conservation and GHG storage.⁶¹

⁵³ FAO Commission on Genetic Resources for Food and Agriculture, "Report of the second session of the intergovernmental technical working group on forest genetic resources," CGRFA-14/13/10, Rome, 23-25 January 2013, pp. 7-8: <http://www.fao.org/docrep/meeting/027/mf950e.pdf>.

⁵⁴ Henning Steinfeld, Pierre Gerber, Tom Wassenaar, Vincent Castel, Mauricio Rosales, Cees de Haan, "Livestock's long shadow – environmental issues and options," FAO, Rome, 2006: <ftp://ftp.fao.org/docrep/fao/010/a0701e/a0701e.pdf>.

⁵⁵ Sergio Margulis, "Causes of Deforestation of the Brazilian Amazon," World Bank Working Paper no. 22, 2004, p. XVIII.

⁵⁶ Christian Nellemann, INTERPOL Environmental Crime Programme (eds), 2012. *Green Carbon, Black Trade: Illegal Logging, Tax Fraud and Laundering in the World's Tropical Forests: A Rapid Response Assessment*, United Nations Environment Programme, Norway, 2012, p. 6: "Recent studies into the extent of illegal logging estimate that illegal logging accounts for 50–90 per cent of the volume of all forestry in key producer tropical countries and 15–30 per cent globally."

⁵⁷ FAO Commission on Genetic Resources for Food and Agriculture, "Report of the second session of the intergovernmental technical working group on forest genetic resources," CGRFA-14/13/10, Rome, 23-25 January 2013, pp. 7-8: <http://www.fao.org/docrep/meeting/027/mf950e.pdf>.

⁵⁸ ETC Group's estimate based on available data in Ian Scoones, Mary Melnyk, Jules N Pretty, *The hidden harvest: wild foods and agricultural systems: a literature review and annotated bibliography*, Sustainable Agriculture Programme, International Institute for Environment and Development, vol. 256, 1992.

⁵⁹ United Nations, "Forests for People: Fact Sheet," 2011, p. 1: http://www.un.org/en/events/iyof2011/wp-content/uploads/2011/10/Fact_Sheet_ForestsandPeople.pdf.

⁶⁰ D. Pimentel, M. McNair, L. Buck, M. Pimentel and J. Kamil, "The value of forests to world food security," *Human Ecology*, Vol. 25, No 1, pp. 91-120.

⁶¹ Robert. J. Zomer, Antonio Trabucco, Richard Coe and Frank Place, "Trees on Farm: Analysis of Global Extent and Geographical Patterns of Agroforestry," World Agroforestry Centre, 2009, p. 12.

9. Will processed foods harm or help us?

Chain: Processing was to prevent spoilage but commercial goal is to homogenize, transport and concentrate ingredients in \$1.37 trillion market;⁶² since 1950, intensification of food processing has lowered nutritional profiles, homogenized diets, reduced diversity, and increased rates of obesity-related chronic diseases.⁶³

Web: Continues to process/preserve food for local consumption, with 2 billion people in the South relying on local artisanal food fermentation/processing for an important part of their food supply.⁶⁴

⁶² ETC Group, *Who Will Control the Green Economy?*, 2011. The figure was provided by Leatherhead Food Research.

⁶³ The link between processed foods and obesity is well-accepted. As one example, see Harvard School of Public Health's "Obesity Prevention Source:" <http://www.hsph.harvard.edu/obesity-prevention-source/obesity-causes/diet-and-weight/>.

⁶⁴ FAO Commission on Genetic Resources for Food and Agriculture, "Key Issues in Micro-Organisms and Invertebrates," Item 6 of the Provisional Agenda, 14th Regular Session, Rome, April 2013, p. 6: <http://www.fao.org/docrep/meeting/027/mf808e.pdf>.

10. Who has the land, and how is it used?

Chain: Land-grabbed 15% of farmland since 2001⁶⁵ and another >2% of farmland for biofuels⁶⁶; uses 70-80% of arable land;⁶⁷ uses 176 million tonnes of nutrients in synthetic fertilizer per year⁶⁸ and loses 75 billion tonnes of soil at a cost of \$400 billion;⁶⁹ 78% of agricultural land is used for livestock production (feed, fodder, pasture);⁷⁰ 80% of synthetic fertilizer is used for meat production – to fertilize crops/pastures that feed livestock – but less than half of applied fertilizer reaches the crops.⁷¹

Web: Uses 20-30% of global arable land,⁷² at least 50% farmed without synthetic fertilizers⁷³ (e.g. 23% of nitrogen in mixed farming supplied by manure);⁷⁴ mostly peasants make possible an estimated 70–140 million tonnes of nitrogen fixed by soil micro-organisms annually, equivalent to \$90 billion of nitrogen fertilizers.⁷⁵

⁶⁵ Landgrab estimates range considerably from a low of 4% of farmland to a high that exceeds 15% if figures are extrapolated between 2001 and 2013. While the World Bank's estimate is the highest per annum, Oxfam's estimate is the highest covering the entire decade between 2001 and 2011. Grain provides a more cautious estimate for the years since 2007. According to Grain: 10 million hectares of land have been grabbed by foreign companies on average every year since 2007. There is a data set with 416 recent, large-scale land grabs that covers nearly 35 million hectares of land in 66 countries, e.g. 10% (5.2 million ha) of Guinea has been taken, mostly community-held forests. That makes it about 60 to 70 million hectares since 2007 = more than 4% of the global cropland. See <http://www.grain.org/article/entries/4479-grain-releases-data-set-with-over-400-global-land-grabs>, <http://www.grain.org/article/entries/4164-land-grabbing-and-the-global-food-crisis-presentation>, <http://www.grain.org/article/entries/4576-slideshow-who-s-behind-the-land-grabs> In September 2011, Oxfam released the most recent report on land grabbing. According to this report, approximately 227 million hectares of land, mostly in Africa, have been leased and/or sold to international investors since 2001. The report added that most of these deals happened in the last two years. Prior to the Oxfam report, the World Bank, in its report released in April 2011, estimated that approximately 56 million hectares of farmland were leased or sold in the year 2009 alone:

http://www.entwicklungshilfe3.de/fileadmin/entwicklungshilfe/img/Land_grab_article.pdf.

⁶⁶ It is estimated that the land used for bioenergy production increased between 2004 and 2008 from 13.8 to 33 million ha, representing about 2.2% of global cropland. See Monika Bertzky, Valerie Kapos and Jörn P.W. Scharlemann, "Indirect Land Use Change from biofuel production: implications for biodiversity," Joint Nature Conservation Committee Report No. 456, August 2011, page 1: <http://www.cbd.int/agriculture/2011-121/UNEP-WCMC-JNCC%20report-sep11-en.pdf>.

⁶⁷ See question 1, above, and Grain, 2013 (forthcoming).

⁶⁸ FAO, *Current world fertilizer trend and outlook to 2016*, 2012.

⁶⁹ H. Eswaran, R. Lal and P.F. Reich, "Land Degradation: An overview" in E. M. Bridges, I.D. Hannan, L.R. Oldeman, F.W.T. Pening de Vries, S.J. Scherr, and S. Sompatpanit (eds), *Responses to Land Degradation. Proc. 2nd. International Conference on Land Degradation and Desertification*, KhonKaen, Thailand, Oxford Press, New Delhi, 2001.

⁷⁰ Institution of Mechanical Engineers, *Global Food:Waste Not, Want Not*, January 2013, p. 10.

⁷¹ Anon., "Fertiliser makes another reason to eat less meat," *New Scientist*, 20 February 2013: <http://www.newscientist.com/article/mg21729054.500-fertiliser-makes-another-reason-to-eat-less-meat.html>.

⁷² See Grain, 2013 (forthcoming).

⁷³ M. Herrero, D. Grace, J. Njuki, N. Johnson, D. Enahoro, S. Silvestri, M.C. Rufino, "The roles of livestock in developing countries," *Animal* 7 (Supplement s1): 3-18, 2013: <http://hdl.handle.net/10568/24883>.

⁷⁴ Jimmy Smith, Keith Sones, Delia Grace, Susan MacMillan, Shirley Tarawali, and Mario Herrero, "Beyond milk, meat, and eggs: Role of livestock in food and nutrition security," *Animal Frontiers*, January 2013, Vol. 3, No. 1, p. 9: <http://www.animalfrontiers.org/content/3/1/6.full.pdf>.

⁷⁵ S. Fujisaka, D. Williams and M. Halewood, "The impact of climate change on countries' interdependence on genetic resources for food and agriculture," FAO Commission on Plant Genetic Resources for Food and Agriculture, Background Study Paper No. 48, April 2011, p. 39.

11. Who can reduce agriculture's GHG emissions?

Chain: Livestock methane emissions are projected to increase 60% by 2030;⁷⁶ non-organic farms emit an additional 637 kg/ha of CO₂ per annum;⁷⁷ trawlers scrape a seabed-area equivalent to half the world's continental shelves annually,⁷⁸ which contributes to the destruction of 1.5% of oceans' meadows and releases 299 million tonnes of carbon into the atmosphere.⁷⁹

Web: Maintains the pasture, breeds and microbial diversity to reduce methane and nitrous oxide emissions (e.g. organic farms in Germany store 402 kg/ha of CO₂⁸⁰); organic and peasant agro-ecological agriculture with soil restoration can store an additional 3-8 tons of carbon per ha,⁸¹ reducing up to 60% of GHGs;⁸² organic farms cut CO₂ emissions by 48% to 60%;⁸³ artisanal fishers don't destroy seagrass meadows.

⁷⁶ IPCC, "IPCC Fourth Assessment Report: Climate Change 2007," Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Chapter 8.3.2 Future global trends, 2007: http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch8s8-3-2.html.

⁷⁷ Björn Küstermann, Maximilian Kainz and Kurt-Jürgen Hülsbergen, "Modeling carbon cycles and estimation of greenhouse gas emissions from organic and conventional farming systems," *Renewable Agriculture and Food Systems*, Vol. 23, Special Issue 01, March 2008, pp. 38-52:

<http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=1739604>.

⁷⁸ Callum Roberts, *The Ocean of Life – The Fate of Man and the Sea*, Viking Press, 2012, p.50.

⁷⁹ Michael Slezak, "Mowing down seagrass meadows will cut loose carbon," *New Scientist* electronic edition, May 26, 2012: <http://www.newscientist.com/article/dn21825-mowing-down-seagrass-meadows-will-cut-loose-carbon.html#.Uc3bU-sVxyU>

⁸⁰ Kurt-Jürgen Hülsbergen and Björn Küstermann, "Optimierung der Kohlenstoffkreisläufe in Öko-Betrieben," *Ökologie und Landbau*, Vol. 145, 1/2008, pp. 20-22.

⁸¹ United Nations, "Best Practices for Organic Policy: What developing country Governments can do to promote the organic agriculture sector," prepared under the CBTF Project "Promoting Production and Trading Opportunities for Organic Agricultural Products in East Africa," United Nations, New York and Geneva, 2008, p. iii: http://www.unep-unctad.org/cbtf/publications/Best_Practices_UNCTAD_DITC_TED_2007_3.pdf.

⁸² GRAIN, "Earth Matters: Tackling the climate crisis from the ground up," 2009: <http://www.grain.org/article/entries/735-earth-matters-tackling-the-climate-crisis-from-the-ground-up>.

⁸³ Nadia El-Hage Scialabba, "Organic Agriculture and Food Security," FAO, 2007, p. 8: <ftp://ftp.fao.org/paia/organicag/ofs/OFS-2007-5.pdf>.

12. Who's using the water?

Chain: 76% of the water that crosses national borders was used to grow crops and to make crop-derived products (e.g. trade in soybeans account for 20% of total international water flows);⁸⁴ trade in animal and industrial products contributed 12% each;⁸⁵ a meat-oriented diet needs up to 5 times more water than a vegetarian diet;⁸⁶ water used for the production and processing of food ultimately wasted could meet the domestic needs of 9 billion people.⁸⁷

Web: The amount of nitrates leaching into groundwater is four times less on non-chemical farms;⁸⁸ 20 million ha are irrigated with urban waste water in 50 countries;⁸⁹ roughly 1 billion people consume agricultural products initially grown with waste water;⁹⁰ water from a city of 1 million can irrigate 1,500-3,500 ha of semi arid land⁹¹ (e.g. 15–20% of global food supply comes from urban areas⁹²); vegetarian diet requires about 5 times less water than meat-based diet.⁹³

⁸⁴ M. M. Mekonnen and A. Y. Hoekstra, "National Water Footprint Accounts: The green, blue and grey water footprint of production and consumption," Vol. 1: Main Report, UNESCO Research Report Series No. 50, 2011, p. 20: <http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf>.

⁸⁵ Ibid., p. 20.

⁸⁶ John Vidal, "Meat-eaters soak up the world's water," *The Guardian*, 23 August 2004: <http://www.guardian.co.uk/environment/2004/aug/23/water.famine>.

⁸⁷ Tristram Stuart, "Food Waste Facts, 2009: <http://www.tristramstuart.co.uk/FoodWasteFacts.html>

⁸⁸ Nadia El-Hage Scialabba, "Organic Agriculture and Food Security," FAO, 2007, p. 10: <ftp://ftp.fao.org/paia/organicag/ofs/OFS-2007-5.pdf>.

⁸⁹ C. A. Scott, N. I. Faruqui, L. Raschid-Sally, "Wastewater Use in Irrigated Agriculture: Management Challenges in Developing Countries," in C. A. Scott, N. I. Faruqui, L. Raschid-Sally (eds), *Wastewater Use in Irrigated Agriculture: Confronting the Livelihood and Environmental Realities*, CAB International in association with the International Water Management Institute and the International Development Research Centre, p. 6.

⁹⁰ Pay Drechsel and Alexandra E. V. Evans, "Wastewater use in irrigated agriculture," *Irrigation and Drainage Systems*, Vol. 24, 2010, p. 1.

⁹¹ WHO, *Wastewater Use In Agriculture*, Vol. 2, 2006, p. 5.

⁹² FAO, "Urban Agriculture: For sustainable Poverty Alleviation and Food Security," 2008, p. 22: http://www.fao.org/fileadmin/templates/FCIT/PDF/UPA_WBpaper-Final_October_2008.pdf.

⁹³ John Vidal, "Meat-eaters soak up the world's water," *The Guardian*, 23 August 2004: <http://www.guardian.co.uk/environment/2004/aug/23/water.famine>.

13. Who needs more energy?

Chain: Consumes large amounts of fossil carbon (for fuel, fertilizer and pesticides) contributing to environmental degradation and GHG emissions (e.g. chemical fertilizers and pesticides account for half of the energy used to grow wheat;⁹⁴ the manufacture of synthetic nitrogen accounts for 90% of the energy used in the fertilizer industry⁹⁵).

Web: Peasants are vastly more energy efficient: It takes 2.7 Mcal of external energy for the Chain to produce a kg of rice but only 0.03 Mcal for the Web (e.g. for maize, the energy cost for the Chain is 1.4 Mcal; 0.04 Mcal for the Web).⁹⁶ It takes 33% less energy per ha to grow organic maize and 56% less for biodynamic maize in temperate regions.⁹⁷

14. Where is the waste?

Chain: 33-40% of the Chain's food is lost or wasted during production, transportation, processing and through household waste;⁹⁸ 25% lost through over-eating;⁹⁹ per capita food waste in Europe and North America is 95-115 kg/year;¹⁰⁰ despite this, less than 5% of agricultural R&D addresses post-harvest losses;¹⁰¹ industrial fishing fleets throw out about 7 million tonnes per annum,¹⁰² not including the 40 million sharks killed each year for their fins.¹⁰³

Web: Household food waste in sub-Saharan Africa and South Asia is 6-11 kg per person (less than 10% of the losses in industrialized states); losses and waste add up to 120-170 kg per person in sub-Saharan Africa and

⁹⁴ Institution of Mechanical Engineers, *Global Food: Waste Not, Want Not*, January 2013, p. 5: "In the modern industrialised agricultural process – which developing nations are moving towards in order to increase future yields – energy usage in the making and application of agrochemicals such as fertilisers and pesticides represents the single biggest component. Wheat production takes 50% of its energy input for these two items alone."

⁹⁵ Johannes Kotschi/AGRECOL – Association for AgriCulture and Ecology, "A soiled reputation: Adverse impacts of mineral fertilizers in tropical agriculture," WWF Study commissioned by the Heinrich Böll Stiftung, 2013, p. 33.

⁹⁶ FAO, "The Energy and Agriculture Nexus," Environment Natural Resources Working Paper No. 4, FAO, Rome, 2000, chapter 2: <http://www.fao.org/docrep/003/x8054e/x8054e05.htm>: "This energy statistic does not account for the quantity of human effort used in developing countries for agriculture. In drawing conclusions, it is also important to consider the equity and sustainability considerations when comparing energy use data."

⁹⁷ Nadia El-Hage Scialabba, "Organic Agriculture and Food Security," FAO, 2007, p. 5:
<ftp://ftp.fao.org/paia/organicag/ofs/OFS-2007-5.pdf>.

⁹⁸ J. Gustavsson, J., C. Cederberg, U. Sonesson (Swedish Institute for Food and Biotechnology), with R. van Otterdijk and A. Meybeck (FAO), "Global food losses and food waste," Food and Agriculture Organization and Swedish Institute for Food and Biotechnology, Rome, 2011:
<http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>.

⁹⁹ Natural Resources Defense Council, "Your Scraps Add Up: Reducing food waste can save money and resources," Food Facts, 2012: http://www.nrdc.org/living/eatingwell/files/foodwaste_2pgr.pdf.

¹⁰⁰ FAO, "Save Food: Global Initiative on Food Losses and Waste Reduction," *Key Findings*, 2013:
<http://www.fao.org/save-food/key-findings/en/>.

¹⁰¹ UNEP, *Towards a Green Economy*, 2011, p. 37:
http://www.unep.org/greeneconomy/Portals/88/documents/ger/2.0_Agriculture.pdf.

¹⁰² K. Kelleher, "Discards in the world's marine fisheries: An update," FAO Fisheries Technical Paper, No. 470. Rome, 2005: <ftp://ftp.fao.org/docrep/fao/008/y5936e/y5936e00.pdf>.

¹⁰³ [Henry Nicholls](#), "When humans attack: The fallout of the shark slaughter," *New Scientist*, 1 May 2012.

Southeast Asia, in contrast to 280-300 kg per person in Europe and North America;¹⁰⁴ much of the crop and food waste fertilizes soils or goes to fish ponds and livestock feed.

¹⁰⁴ FAO, “Save Food: Global Initiative on Food Losses and Waste Reduction,” chapter 3, 2011, p. 5: <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>.

15. Who protects crop pollinators?

Chain: Commercial beehives service one-third of the crops in industrialized countries;¹⁰⁵ dramatic declines in honeybee populations linked to insecticide-use threaten \$200 billion in productivity.¹⁰⁶

Web: 71 of world's 100 major food crops are bee-pollinated (primarily wild bees);¹⁰⁷ wild pollinators are protected by peasants partly dependent on the same habitats for food and medicine.

16. Who safeguards microbial resources?

Chain: Genetically-uniform crops and livestock, combined with synthetic fertilizers and pesticides, have decimated beneficial agricultural microbes – damaged soils, hindered feed efficiency and weakened animals;¹⁰⁸ in response, industry is collecting and conserving ex-situ 1.4 million microbial strains;¹⁰⁹ less than 2% of microbial diversity has been identified.¹¹⁰

Web: Conserves agricultural microbial diversity with healthy soils and diverse livestock and crops; gastrointestinal microbes, varying between breeds and feeds, support feed efficiency and reduce methane emissions.¹¹¹

¹⁰⁵ USDA Agricultural Research Service, “Honey Bees and Colony Collapse,” 7 May 2013: <http://www.ars.usda.gov/News/docs.htm?docid=15572>.

¹⁰⁶ [G. Lebuhn, S. Droege, E. F. Connor, B. Gemmill-Herren, S. G. Potts, R. L. Minckley, T. Griswold, R. Jean, E. Kula, D. W. Roubik, J. Cane, K. W. Wright, G. Frankie, F. Parker, “Detecting Insect Pollinator Declines on Regional and Global Scales,” *Conservation Biology*, 27, 2013, pp. 113–120. doi: 10.1111/j.1523-1739.2012.01962.x.](#)

¹⁰⁷ FAO, “Protecting the pollinators,” 2005: <http://www.fao.org/ag/magazine/0512sp1.htm>.

¹⁰⁸ N. Nakhro and M.S. Dkhar, “Impact of Organic and Inorganic Fertilizers on Microbial Populations and Biomass Carbon in Paddy Field Soil,” *Journal of Agronomy*, Vol. 9, 2010, pp. 102-110: <http://scialert.net/fulltext/?doi=ja.2010.102.110&org=11>; Ana M. Primavesi, “Soil life and chemical fertilizer,” ILEIA newsletter, Vol. 6, No. 3, October 1990:

<http://www.agriculturesnetwork.org/magazines/global/complementary-use-of-external-inputs/soil-life-and-chemical-fertilizers>; Jan Dirk von Elsas, Janett K. Jansson and Jack T. Trevors, “Modern Soil Microbiology,” CRC Press, 1997; L. R. Bulluck, M. Brosius, G.K. Evanylo and J.B. Ristaino, “Organic and synthetic fertility amendments influence soil microbial, physical and chemical properties on organic and conventional farms,” *Applied Soil Ecology*, Vol. 19, 2002, pp. 147-160:

http://projects.cals.ncsu.edu/ristaino/cmsperception/sites/default/files/AppSoilEcol_article.pdf; Greg Evanylo, “Effects of organic and chemical inputs on soil quality,” *Crop and Soil Environmental News*, December 1997:

<http://www.sites.ext.vt.edu/newsletter-archive/cses/1997-12/1997-12-03.html>; Brian Halweil, “Still No Free Lunch: Nutrient levels in the U.S. food supply eroded by pursuit of high yields,” Critical Issue Report, The Organic Center, September 2007: <http://www.organic-center.org/reportfiles/Yields2Pager.pdf>; Dave Barber, “The vital role of rumen microbes,” Department of Agriculture-Fisheries and Forestry – Queensland Government, February 2013: http://www.daff.qld.gov.au/27_16621.htm; Virginia Ishler, “From Feed to Milk – Understanding Rumen Function,” *Extension Circular 422*, Pennsylvania State University, 1996: <http://pubs.cas.psu.edu/freepubs/pdfs/ec422.pdf>.

¹⁰⁹ FAO Commission on Genetic Resources for Food and Agriculture, “The Use and Exchange of Microbial Diversity,” Background Study Paper no. 46, p. 7.

¹¹⁰ *Ibid.*, pp.20-21.

¹¹¹ See sources cited in fn 108.

17. Whose technologies will feed us?

Chain: ‘High-tech’ system deploys micro-inventions to macro-environments (e.g. lab or genetic changes for global crops) via monopolies, resulting in high uniformity and disease vulnerability.

Web: ‘Wide-tech’ system applies macro-solutions to micro-environments (landscape multi-dimensional changes for farm ecosystem); non-proprietary; benefiting from shared research and traditional knowledge systems.

18. Who protects our work and health?

Chain: Has reduced the number of family farms in industrialized countries by at least half in the last half-century;¹¹² has slashed wages for agricultural workers in the UK by 39% over the last 30 years;¹¹³ pesticides cause 3 million severe illnesses and 220,000 deaths every year;¹¹⁴ for every \$1 spent in sub-Saharan Africa on pesticides, the region loses another >\$3 (\$6.3 billion per annum) on medical costs and lost productivity caused by pesticide illnesses.¹¹⁵

Web: 80% of households in rural South (often led by women) grow some food; 2.6 billion people depend on farming, fishing and pastoralism;¹¹⁶ organic farms employ 30% more workers than non-organic farms;¹¹⁷ although the number and size of peasant farms is not well documented,¹¹⁸ peasant farming is more productive¹¹⁹ and produces more nutritious food (e.g. a peasant-bred Peruvian potato has 28 times more cancer-fighting phytonutrients than its industrial cousin¹²⁰). Tortillas made from indigenous varieties of blue maize contain >20% more protein and are more easily digested than tortillas made from commercial corn.¹²¹

¹¹² USDA, “Agricultural Fact Book,” 2003, p. 24: <http://www.usda.gov/factbook/chapter3.pdf>

¹¹³ Nadia El-Hage Scialabba, “Organic Agriculture and Food Security,” FAO, 2007, p. 13: <ftp://ftp.fao.org/paia/organicag/ofs/OFS-2007-5.pdf>.

¹¹⁴ Juliana Santilli, *Agrobiodiversity and the Law: Regulating genetic resources, food security and cultural diversity*, Earthscan, 2012, p. 20.

¹¹⁵ UNEP, “Costs of Inaction on the Sound Management of Chemicals,” 2013, p. 59: http://www.unep.org/hazardoussubstances/Portals/9/Mainstreaming/CostOfInaction/Report_Cost_of_Inaction_Feb2013.pdf; BBC Research, “Global Market for Biopesticides,” 2012:

<http://www.bccresearch.com/pressroom/report/code/CHM029D>; UNEP, “Regionally Based Assessment of Persistent Toxic Substances,” Global Report 2003, p. 34: http://www.chem.unep.ch/pts/gr/Global_Report.pdf.

¹¹⁶ UNEP, “The Green Economy Report,” 2011, p. 38:

http://www.unep.org/greeneconomy/Portals/88/documents/ger/2.0_Agriculture.pdf.

¹¹⁷ Nadia El-Hage Scialabba, “Organic Agriculture and Food Security,” FAO, 2007, p. 13: <ftp://ftp.fao.org/paia/organicag/ofs/OFS-2007-5.pdf>.

¹¹⁸ Oksana Nagayets, “Small Farms: Current Status and Key Trends,” Information Brief prepared for the Future of Small Farms Research Workshop, Wye College, June 26–29, 2005, p. 356:

<http://www.ifpri.org/sites/default/files/publications/sfproc.pdf>.

¹¹⁹ Ibid.

¹²⁰ Jo Robinson, “Breeding the Nutrition Out of Our Food”, *The New York Times*, May 25, 2013: http://www.nytimes.com/2013/05/26/opinion/sunday/breeding-the-nutrition-out-of-our-food.html?pagewanted=all&_r=0.

¹²¹ Juan Pablo Hernández-Urbe, Edith Agama-Acevedo, José Juan Islas-Hernández, Juscelino Tovar and Luis A Bello-Pérez, “Chemical composition and in vitro starch digestibility of pigmented corn tortilla,” *Journal of the Science of Food and Agriculture*, no. 87, 2007, p. 2733.

19. How much food goes “to waist”?

Chain: Despite cost and waste, 2 billion people have micronutrient deficiencies (868 million are hungry) and 1.4 billion are overweight (500 million are obese);¹²² meat consumption in rich countries (with high energy use, GHG emissions and land costs) is almost 2.2 times the recommended level;¹²³ obesity will double by 2030; the lost productivity and health care costs of malnutrition and overconsumption exceed \$4 trillion per annum, or more than half of the global food retail market.¹²⁴

Web: Is the primary provider of the food that does reach the hungry and undernourished; avoids crop and livestock monocultures and encourages genetic diversity; nutrient-rich dietary diversity is the safest, most affordable way (could save the world up to \$4 trillion per annum) to overcome micronutrient deficiencies;¹²⁵ crop nutritional values, due to genetic diversity, can vary 1000-fold (e.g. 200g of rice per day can represent 25% or >65% of protein requirement; 1 banana can provide 1% or >200% of daily vitamin A requirement).¹²⁶

20. Who encourages cultural diversity?

Chain: Regards cultural diversity as an obstacle to market monopoly and is contributing to the projected wipeout of an estimated 3,500 of the world’s 7,000 languages (and cultures) in this century (e.g. one-third of South American soils have no inhabitant speaking an indigenous language).¹²⁷

Web: Sees cultural diversity as inherent and central to agricultural diversity. If these cultures are lost, our generation may be the first generation in history to lose more knowledge than it gains.

“Who will feed us?” may have more than one answer, but the presumption that we can count on the industrial food chain to offer solutions to climate change and food crisis is not statistically credible. In fact, the Chain is not only not the solution; it’s a big part of the problem. Support for peasant-based and agro-ecological food systems is urgent. More research, informed debate and diversity are needed to dispel the myths that hinder just and healthy food systems.

¹²² FAO, “State of Food and Agriculture Report – Food Systems for better Nutrition,” Rome, 2013, p. 3: <http://www.fao.org/publications/sofa/en/>.

¹²³ FAO, “Meat consumption,” 25 September 2012: <http://www.fao.org/ag/againfo/themes/en/meat/background.html>.

¹²⁴ FAO, “State of Food and Agriculture Report – Food Systems for better Nutrition,” Rome, 2013, p. IX: <http://www.fao.org/publications/sofa/en/>.

¹²⁵ Francesco Burchi, Jessica Fanzo and Emile Frison, “The Role of Food and Nutrition System Approaches in Tackling Hidden Hunger,” *International Journal of Environmental Research and Public Health*, Vol. 8(2), 2011, pp. 358–373: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3084466/>.

¹²⁶ FAO Commission on Genetic Resources for Food and Agriculture, “Review of Key Issues on Biodiversity and Nutrition,” 2013, pp. 2-3.

¹²⁷ Pat Mooney, “The ETC Century: Erosion, Technological Transformation and Corporate Concentration in the 21st Century,” *Development Dialogue*, Dag Hammarskjöld Foundation, 1-2, 1999: <http://www.dhf.uu.se/publications/development-dialogue/the-etc-century-erosion-technological-transformation-and-corporate-concentration-in-the-21st-century/>.