Lecture 1 – Intro and food mega trends (24/07/17)

21st Century problems

- Population:
    - Water, urbanisation, biofuels, food wastage, hunger and policy and governance

Feeding the Population

- 1/8 = food insecurity
- 35% of planets surface devoted to food production
- Our food choices rival transportation as the human activity with the greatest impact on the environment
- Impossible to separate agricultural practices from the health of rivers, wetlands, forests and the living environment

Animal Protein

- Many more people could be fed by the grain used to feed the cattle themselves
    - This is because productive energy is diminished with each trophic level

Water

- 2.5% of all the Earth's water is freshwater
    - 1.2 of this is accessible, surface water
- Irrigation can lead to water shortages
- Hotter climate will reduce yield

Food waste

- 25-50% of food is wasted globally along the supply chain through:
    - Crops not harvested
    - Losses during transportation
    - Discarded by marketers or retailers
    - Household waste
- Causes include:
    - Over-production and rejection at farm-gate
    - Long distance transportation
    - Retailer power and market forces
    - Food safety and litigation concerns

Sustainable Food system

- Requires:
    - Governance of land, markets, access, livelihoods, food utilisation
    - Demand management
    - Sustainable Intensification
    - Reduction of food losses and waste
    - Family planning

Lecture 6 – Sugar and Salt (9/08/17)

Role of Carbs in Food Processing

- Sweetness
- Texture and body
- Browning
- Preservative
- Thickening
- Bulk

Role of Carbs in the body

- Energy
- Protein/fat sparing
- Dietary fibre
- Build macromolecules

Carbs: Diet and Disease

- Dental caries
- Obesity
- T2D
- Non-Alcoholic Fatty Liver Disease

Salt

- Ancient times/Hunters and gatherers:
    - Salt consumption < 0.25mg Sodium/day
- Salt enabled:
    - Preservation (microorganisms need water to survive) = Consistent food supply = Improved human health

Blood Pressure

- The measurement of force applied to artery walls
- Studies show that salt intake has the greatest impact on BP when there is:
    - Older age
    - Overweight/obesity
    - Metabolic syndrome
    - Low K and calcium diet
    - Genetics
    - Ethnicity
- Prolonged high NaCl intake effects:
    - Glomerular injury and renal failure (kidneys)
    - Increased arterial pressure (blood vessels)
    - Cardiac hypertrophy, systolic/diastolic dysfunction (heart)
    - Oxidative stress and fibrosis (blood vessels)

How much salt should we eat?

- **NEED =** 1.2 – 2.5g per day, **CAN HAVE =** up to 6g a day for a healthy adult

Lecture 9 – Understanding how people pay attention to health risks in food is a key skill for food marketing, and for the assurance of food safety (21/08/17)

Why is this gulf of values a problem?

- Unscientific human opinions and intuitions can easily be manipulated e.g. by advertising and by political ideology
- Better communication of scientific understanding of the world is crucial for success in improving human health, but scientists generally do not communicate with empathy
- Both empathy and understanding of ordinary human thinking styles by scientists, as well as the best science, is needed by people who want to achieve the best human welfare and safety outcomes from nutrition and medicine

Scientists use very different methods to those leading to success in everyday life

- They work mainly on invisible and seemingly abstract things
- They often rely on falsification of explanations which seems offensive to outsiders

Fast natural thinking (System I)
- System I is extremely rapid and unconscious

It often relies on effortless association of concepts completely out of your control

Halo effect – what is beautiful is good (exaggerated emotional coherence)

Problems with fast decisions (after Kahneman)

- A machine for jumping to conclusions
- Directly influenced by unconscious emotions
- Neglects ambiguity and suppresses doubt
- Humans are biased to believe and confirm claims
- Humans have exaggerated emotional coherence (called the Halo effect)
- Humans rely on coherence of a story as a measure for credibility

What advertising the industry exploits (Causes and Consequences at Cognitive Ease)

- Related experience/clear display/primed idea/good mood → ease → feels familiar/feels true/feels good/feels effortless

* "Natural foods" can be exploited by food marketers. An illustration of this is the substitution of pure flavouring chemical sodium glutamate with a "natural" source of the same flavour, Japanese dried seaweed kombu (Bonsoy soymilk in 2009)

* sodium glutamate associated with numbness at neck and arms – but no rigorous stats

What is Hepatitis A?

- Caused by a virus, not a bacterium
- It spreads via human faeces

Lecture 10 – Scientific investigation leading to prevention of harm from food (23/08/17)

To prevent harm

- Identify potential causes of harm (hazards)
- Systematically prevent them from affecting food consumers (including using good hygienic practices and documented, preventative food safety programs)
- *Hazard (risk) reduction steps* (control measures) such as steam treatment of cans, pasteurisation of milk, as well as treatment of washing and irrigation water used on fruit and veg

Hazards

- Substances
    - Components of food – e.g. iodine in kombu, arsenic in rice, lectins in beans
    - Chemical contaminants
- Biological agents and their product toxins
    - Bacteria, viruses, bacterial toxins, fungus toxins
- Processes in the food chain
    - Temperature abuse
    - Restaurant staff who are allowed to work while suffering from gastric infection
    - Unanticipated errors and omissions

Learning opportunities

- The scientific record (toxicology, microbiology, chem and bio, epidemiology)
- The food industry record – risks revealed by public health surveillance and audits of business operations

* DNA and RNA signatures – genetic fingerprinting – enables links to disease to be established by identifying patterns in the genetic code

Control (harm-reduction) steps need to be identified

- Examples:
    - Milk – pasteurisation
    - Canned meat – steam under pressure
    - Milk – cold storage to prevent growth
    - Canned meat – intact and sealed container to prevent recontamination
    - Salami – preservative action
    - Tomatoes – washing and irrigation water

The problem broken down

- Shiga toxin producing Escherichia coli causes damaging gastrointestinal and kidney disease
    - Strain is a hybrid
    - A decisive tool for identifying that there was a common source of infection among many different illnesses were *modern methods for germ DNA analysis and STRAIN DNA FINGERPRINTING*
    - It's very difficult to detect low STEC contamination levels in seeds and sprouts and there is no validated method up to now

Lecture 11 – Food economics (4/09/17)

Analytical approach

- Economic models which include:
    - Food supply chain: farm inputs; farm; processors, storage, transporters and distributors; human consumption
    - Demand for food by households to farm products
    - Supply of food
    - The effects of changes in available resources, climate, technology, population, income and government policy forces on demand and supply
    - Outcomes for quantities, prices, food security, incomes
- Applications of these models to:
    - Explain history and the current story
    - Forecast the future
    - Assess how and where markets and government policies might be adjusted to achieve better outcomes

Food Security

- When all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meet their dietary needs and food preferences for an active and healthy life
- Food security involves a combination of:
    - An ability to purchase food (income, food availability and price, issues of distribution and equity)
    - More than just nutrition – a pleasurable experience
    - A production issue – includes competition with alternative uses of limited natural resources, labour, capital and materials

Food Security and Duration

- Food insecurity may be:
    - CHRONIC i.e. as in much of Sub-Saharan Africa and parts of South Asia
    - TRANSITORY i.e. short term, when caused by:
        - Periodic drought
        - Floods (Bangladesh)
        - War/civil strife
        - Short term high world prices (i.e. in 2011)

Some measures of Food Security

- Food security rests on three pillars of food:
    - Availability
    - Access AND
    - Utilisation
- Macro economy wide indicators e.g.
    - Food expenditure and dietary diversity by nation on average per capita
    - Micro and individual indicators e.g. distribution by individuals and households, including population shares
        - Hunger: weight-for-age, weight-for-height

Lecture 15 – Global Food and Nutritional Security (18/09/17)

Triple burden – Nutritional security and sensitivity

- Undernutrition – low calories/protein (-1bn)
- Malnutrition – lack of important nutrients – trace, vitamins (2bn)
- Overnutrition – excessive consumption of calories (1bn+)

Ag impact on environment

- 37% land used for ag
- 70% water used for ag
- 25% emission from ag

Grand Challenges

- <u>Loss and Degradation of our natural resources</u>
  - Soil health is critical
  - Conservation agriculture is important
  - Water stress will increase in many agricultural areas by 2025 due to growing water use and higher temperatures
  - Cotton > beef > sheep > goat > chickens all use a lot of water
  - Pressure to reduce GHG emissions → 70% from ag by 2060
  - WHAT NEEDS TO BE DONE (NATURAL RESOURCES)
    - Integrated policy development across water-ag-food-energy-environment-population nexus
    - Clear strategy and policy framework on land planning particularly for URBAN AND PERI-URBAN agri-food production
    - Increased emphasis on soil health
    - Conservation ag – zero till, soil mulch, diverse systems, input use efficiency
    - R&D
- <u>Adaptation to Climate Change</u>
  - Greater variability – seasons, rainfall, temp
  - More extreme events – heat, drought, floods, fires, frosts
  - Changing weather patterns – rain
  - Warming and drying
  - Elevated atmospheric CO_2
  - WHAT NEEDS TO BE DONE (CC)
    - Strategies produced through the 'lens' of CC
    - Sustainable long-term, patient, co-investment in adaptation by public and private sectors
    - Farming systems that are more resilient and adaptable – sustainable intensification
    - Infrastructure that both helps adaptation and is itself adapted to CC
- <u>Nitrogen Use (In)efficiency</u>
  - Environmental costs
  - N fertiliser = 50%+ protein in diets
  - Dependency on N fertilisers and demise of legumes
  - A tonne of urea (containing 46% nitrogen) takes 4 barrels of oil to produce