1. INTRO

FOOD RESTRICTIONS

- driven by water, climate change, energy, CO2
  - genetic modification
  - animal cloning
  - obesity, food security, fast food, allergy, population

1) **food and environment**
   - challenges to food production
   - way people change environment

2) food for health
   - consequences of over-eating and diet-related diseases

3) food security
   - history of famine, global food demand, fallacies about food supply and demand

4) food issues
   - biofortified foods, GM foods, causes of food waste

GREEN REVOLUTION

- **Borlaug** — the Green Revolution developed drought and disease resistant strains
  1. develop high-yield varieties HYV crops (corn, rice, wheat)
  2. large inputs of fertilisers, pesticides, water
  3. increase number of crops grown per year on plot of land (more crop, less land)
  - still needs lots of water, fuels, machinery, pesticides, fertilisers (10% worlds oils)

Major stressors for future food production

- Land use and degradation
- Climate Change
  - hotter climate reduces yield — affects developing regions
    > rising intensities of storms, forget fires, droughts, flooding and heat waves
  - extensive damage to coral reefs — rising number of species extinction
  - NO, CO2, CH4 all increasing
  - 2-3ºC higher, 25-35 higher — threatens major cities
- Water usage and melting ice caps
- Peak oil and energy requirements, Urbanisation (expected to increase 55% —> 68%)
- Food Waste, Food security, Conflict over food
- food production — production is the main cause of environmental change and degradation
- limited amount of agricultural land in the world

LIMITED AND DECLINING WATER SUPPLIES

- **2.5% - freshwater, 1.2% freshwater** = useable — 60% use for irrigation
  - most from glaciers permanent snow cover, fresh groundwater
  - ground ice/permafrost, freshwater lakes, soil moisture
  - atmospheric water vapour, marshes, wetlands, rivers, biota
- 2050— ~10 billion suffer from chronic water shortages
- water taking over from oil — cause of conflict
- drought + risk of floods
- ice melting — mountain glaciers (irrigation water — wheat and rice)
- groundwater: reservers diminishing — fracking, recharge is slow (finite)
  - 36% portable water, 42% irrigation, 24% industrial

Phosphorus - vital for growing food

- might run out in 50-100 yrs
- demand: efficiency (mining, fertilizers, food chain, diets)
- supply: reuse (food, crop residues, human excreta, manure, phosphate rock)

2. CLIMATE CHANGE AND GLOBAL FOOD SECURITY

CLIMATE CHANGE

- atmosphere: Co2= 75% impact, ch4 = 15%, N2O = 10%
- global temperatures rising faster than in any time in human history
  - cool years now **0.5ºC hotter** than before
  - Australia has warmed >1ºC in past century
  - Murray Darling Basin warming even faster
    > 14% of Australia, 2 million people, 60% of Australia's food
- april-october rainfall decreasing over past 20 years
  - 11% decrease in rainfall in S Aus
  - hotter + dryer (mediterainan climate)
  - warmer souther, more rainfall north
  - impacts on food production
- Climatic patterns are changing
  - alters the frequency of extreme temperature events
  - very warm monthly temperatures occurred just very 2% of time over period ago vs 1% of the time
  - frequency of very cool monthly nighttime temperature declined by ~1/3

CAUSES

- greenhouse gas molecules blocks IR radiation
  - Co2, CH4, H2O, N2O
  1. 1/2 sun penetrates Earth's surface
     > either reflected back into space by atmosphere or absorbed
  2. solar energy warms land and oceans
  3. land and oceans release heat in form of IR radiation
  4. GG absorbs some radiation to warm lower atmosphere
     - keeps surface and planet warm enough to sustain life (greenhouse effect)
     - 1/2 to atmosphere
     - 1/2 to forest (plants like Co2)
     - 4% ocean
     - 50% plants and ocean
     - rest to atmosphere as heat
  5. Without heat trapping gases in atmosphere:
     - -18ºC on average rather than +15ºC

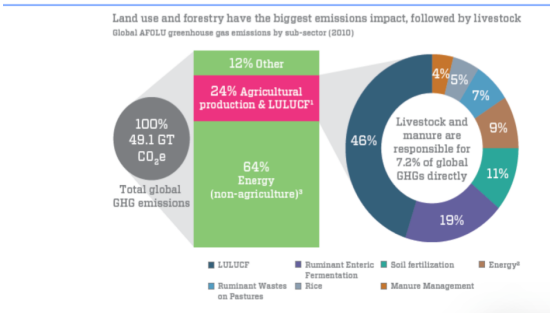
  pure atmosphere (O2 and N2) does nothing to block IR radiation
- trace amounts absorbed radiation: warmth = life
- major GG Co2 rising increasing rate
- Emissions growth rate is heading 4-6ºC in 2100 on current path (no emissions = 1.3-1.9ºC)
  - hotter on land than on oceans
  - warms more at higher latitudes than equator
  - no country spared
  - influences hydrologic cycles
  - more floods, more droughts
  - **Paris agreement** to reduce emission

RESPONSES OF AGRICULTURAL SYSTEMS TO CLIMATE CHANGE

- **CO2** — plants respond to elevated levels
  - may increase crop yields
- **temperature**
  - timing
  - high temperature damage
  - increased water loss
  - frost
- **water**
  - irrigation water + higher water requirement
- **changed disease risks**
  - Queensland fruit fly — now endemic in Victoria

IMPACT OF CLIMATE CHANGE ON WORLD FOOD SUPPLY

- yields in **mid to high latitudes:** towards poles
  - **increase**
- yields in **low** latitudes: towards equator
  - **decrease**
- region of greatest risk: Africa
- disparity tends to become larger
- agricultural regions may shift
- population moveents/environmental refugees
- Australian wheat yields have remained constant 25 yrs
  - BUT potential wheat yield decline from 4.4 -3.2 tonnes per hectare since 1990
  - yields decline due to
    - > decreasing rainfall (-83%)
    - > increasing temperature (-17%)
    - > increasing Co2 (+4%)
  - climat changes since 1990:
    - > 28% decline in rain
    - > max daily temp increase by 1.05°C
  - **actual yields have been constant due to farmer uptake of new technology** (but how long?)



- changes our capacity to produce food (% impact per decade globally for major cereal crops)
  - wheat,rice and maize decrease, soy increase
- food production contributes to climate change
- Global agricultural emissions:
  - 5.2 billion tonnes 1990
  - 6.1 billion tonnes 2005
  - 9.8 billion tonnes 2030 (60% increase)
- Animal production: high emission costs
  - ruminant animals (cows)
    - > are able to digest cellulose (grass)
    - > utilize world's grasslands
    - > methane = by product of cellulose digestion
- lifestyle choices can reduce emissions
  - vegetarian diet saves 1-1.5 tonnes year
  - transport choices can also save
  - SUV —> Prius/Camry (3.6/2.5 tonnes) —> prius (1.1 tonnes)

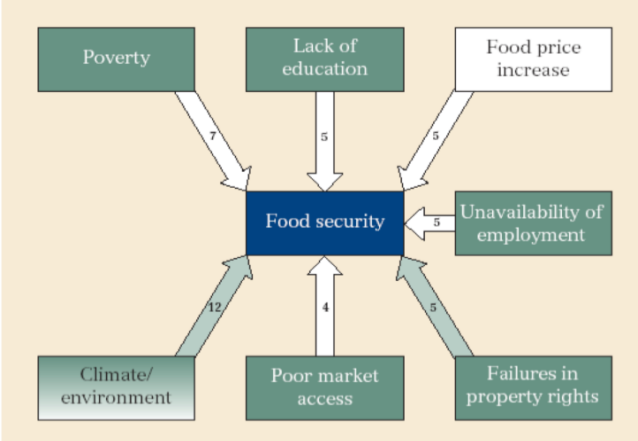
3.FOOD AND FUEL SECURITY

APPETITE

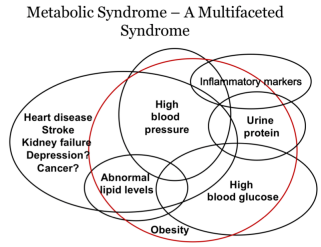
- global meat production has increased more than fivefold since 1950
  - poultry, pig, beef
  - demands expected to increase to 100 million
- GDP and animal protein consumption
  - as calories increase, GDP per capita also increases exponentially (square root function)
- Controversy over using grain to feed cattle
  - more people could be fed by grain used to feed cattle vs fed by cattle themselves
- plant based meat
  - still driven by taste, not as energy efficient as claimed (production of fake meat)
- urbanisation in % per total population —> expected to continue to increase by 2050
  - less producers, more consumers
  - asia>africa
  - America > Europe > Oceania
- significant share food intended for human consumption is lost/wasted between farm and fork
  - 32% global food supply by weight
  - 24% of global supply by energy content (calories)
- **Food is lost/wasted along entire value chain**
  1. Production
     - during/immediately after harvesting on farm
  2. Handling/Storage
     - produce leaves farm for handling, storage, transport
  3. Processing/Packaging
     - during industrial or domestic processing/packaging
  4. Distribution and market
     - during distribution to markets, including losses at wholesale/retail markets
  5. consumption
     - losses in home/business of consumer, including restaurants and caterers

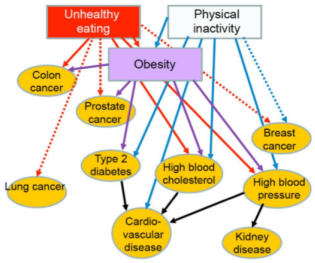
PREVALENCE OF HUNGER

- 854 million people: 1/7 lack access to sufficient food — africa
- poor families spend up to 50-70% of income on food
  - when prices increase, suffer more
- access is critical to food security



- **hungry planet is not sustainable planet**
- hungry ppl= poor, depend on natural resources — natural degradation — livelihood threatened
  - poverty eradication and sustainable management of planet must work together
  - food shortage — collapse of civilisations
    > failing t reverse trends undermining good security while adding new stresses
    > accumulating problems + consequences may overwhelm more and more governments accelerating spread of state failure
    > underlying cause of conflicts such as syrian civil war — potential for conflict
- obesity epidemic (USA> australia > englnad > mauritius > brazil)
  - Atherosclerosis (CVD)
  - Epidemiological transition (non communicable disease)
    - connection between diet and chronic disease
    - by 2020, estimated to account for 73% of all deaths
  - more people overweight than undernourished (65% live whereas obesity kills, levels expected to INC)
    > cancer, diabetes, stroke, heart attack, CVD (Atherosclerosis)— all NONcommunicable
    > over 80% CVD deaths are in low-middle income countries
    > 5/10 leading causes of deaths relate to dietary habits (CVD = number 1 globally)





4. CLIMATE CHANGE AND GLOBAL FOOD SECURITY

FOOD SECURITY- what does it mean to be food secure?

- **exists when all people at all times have physical + economic access to enough safe + nutritious food to meet dietary needs + food pref for active + healthy lifestyle (**World Food Summit 1996). MUST BE:
- **available**: amount can be affected by climate, disaster, war, civil unrest, population, agricultural practices, social status and trade
- **affordable**: shortage = prices increase (rich people ok, poor people suffer)
- **utilised**: so people can grow up normally, meet energy needs, avoid disease, no waste
- food responds to political, financial and physical situations, war, etc

MEGA TRENDS FOR GLOBAL FOOD SECURITY- what drives global food security?