

Feeding an increasing world population sustainably.

Sustainability : Takes account of --Producing enough food for the increasing population while minimising the energy used in production , transport and storage.

Sustainability – seek ways to provide food, water and energy that are long lasting and have less environmental impact.

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Population - the predictions

- Past 50 years -- increase in global agriculture has been 2.5 to 3.00 times - so far keeping pace with population increase and calories required globally if not locally.
- Population now 7.4 billion predicted to rise to 9.1 billion by 2050 - then to level out . Much of this increase is due to those already born living longer Birth rates/family size globally continues to reduce. (UN)
- UN (FAO) assumes approx 1 billion remain chronically hungry / malnourished - but -- 100% food production increase required in the developing world to meet this population increase and remove hunger.
- More of us worldwide are better off - and when we are so far we all tend to eat more meat.

WOW

- If the whole world lived the European lifestyle - we would need 2.5 planets worth of resources. (BBC quick guide)
- Agriculture is responsible for 13.5 % of greenhouse gases
- 12% of world land is given over to agriculture -- there are a lot of deserts and mountains !

Land and water pressures

- Land degradation (productivity loss) is a global problem - especially in so called 'dryland' regions e.g. sub Sahara / east Asia / parts USA.
- 30% of population live in the dryland areas.
- Irrigated agriculture takes 70% of water from aquifers , rivers , lakes – **crop per drop** will need to improve everywhere.
- 'Rainfed' agriculture- takes up 80% of agricultural land - produces 60% of world food.-- In Africa this produces 97% of so called staples.

Science and Technology (S and T)- a brief agricultural history

- Plant breeding started 9000 years ago in Mexico – early maize. – Plant and animal husbandry / biodiversity have been practiced since antiquity.
- Soil and water management also have a long history - dams , ponds, canals etc.

2: S and T - more recent history

- - Key contributions through plant breeding (JIC etc) - notable improved varieties of maize, rice and wheat. 'Green revolution'.
- Developing synthetic pesticides and fertilizers.
- Mechanisation farming from field to fork. – climate implications.
- Mid 20th Century - Particularly in Asia and S. America these have caused substantial increases in food production and yields.
- 1965 - 2000 – globally: Wheat up 208%, Rice 109%up , Maize up 157% Potato up 78% Casava up 36%. - **cause is a mix of science AND policy / educational changes mainly in the developing world.**
- The Green Revolution demonstrates that Science and Technology has had the ability to avoid large scale famine -- and to spare not so much land being converted to 'cropland'.
- Famine now mostly due to failed states bad government

Science - does it have a solution ?

- Science says -- GM/GE – crops can deliver higher yields require fewer nutrients and pesticides and cope with poorer soil and less irrigation.
- Critics say - GM not proven to be safe , allows multinationals to increase control system and to dis-empower farmers.
- Science based training / support of small farmers in developing world does improve yields significantly.

Increasing food production by 100% is required in developing countries . Expected detrimental effects

- Rising energy prices. As increasing agriculture competes for energy - more tractors and trucks
- Depletion of aquifers – some running out so yields will reduce
- Loss of land to urbanisation - move to cities.
- Less stable weather // climate change. Reduces yields
- Govts trying to reduce greenhouse gas - agriculture – especially Nitrous Oxide – from fertiliser and methane from cattle (organic or not).

All are interrelated and complex

What is GM? WHO (UN) definition

- Genetically modified (GM) foods are foods derived from organisms whose genetic material (DNA) has been modified in a way that does not occur naturally, e.g. through the introduction of a gene from a different organism.

- Most existing genetically modified crops have been developed to improve yield, through the introduction of resistance to plant diseases or of increased tolerance of herbicides.

- In the future, genetic modification could be aimed at altering the nutrient content of food, reducing its allergenic potential, or improving the efficiency of food production systems.

How safe is GM as a technology ?

- **GE crops currently on the market are safe to eat.**

European Commission Joint Research Centre, European Food Safety Authority, The American Medical Association, the National Academy of Sciences, and the World Health Organization)

- **The processes of genetic engineering and conventional genetic modification pose similar risks of unintended consequences.**
- **The risks and benefits of new traits in crops depend upon the traits themselves and not the means of their introduction, whether through GE or conventional means.**

2: GM safe and /or productive

- Planting of herbicide tolerant (HT) crops has reduced the environmental impact of herbicide use. This is because the reduced tillage associated with planting of HT crops has led to reduced soil erosion and reduced greenhouse gas emissions.
- GE crops are just one of the many tools that can be used to enhance the sustainability of farms.
- Consumption of Golden Rice, within the normal diet of rice-dependent poor populations, could provide sufficient vitamin A to substantially reduce the 6,000 deaths caused every day by vitamin A deficiency and save the sight of several hundred thousand people per year in a cost efficient manner.

Eating meat

- **Eating less meat and climate-saving actions**

Over a year:

- If you eat one less burger a week, it's as if taking your car off the road for 320 miles or line-drying your clothes half the time.
- If your four-person family skips meat and cheese one day a week, it's like taking your car off the road for five weeks – or reducing everyone's daily showers by 3 minutes.
- If a four-person family skips steak once a week, it's like taking your car off the road for nearly three months.
- If everyone in the U.S. ate no meat or cheese just one day a week, it would be like not driving 91 billion miles – or taking 7.6 million cars off the road.

What about Fish? (Nat. Geographic)

- Efficient fishing fleets and growing demand for seafood have pushed many of the world's fisheries to the brink. 70 % are exploited, overexploited, or have already suffered a collapse. -- North Sea Cod !!!
- Thriving ocean ecosystems are important for the health of the entire planet. Back to climate change.
- Sustainable fisheries target plentiful species, including those smaller and lower on the food chain, because they can reproduce quickly to sustain their populations.
- Sustainable wild fisheries must be well managed, with accurate population monitoring and regulations that can track seafood from the fishing boat to the dinner table.
- Aquaculture is a big part of the picture. **Fish farms produce half of all the seafood the world eats**—but not all of them are sustainable . True sustainable operations minimize environmental impacts like pollution, disease, and other damage to coastal ecosystems on which wild species depend. They also avoid using wild-caught fish as feed, a practice that puts enormous additional stress on wild fish stocks.

Is organic an answer ?

- If we need to produce more food to feed more people is organic one way to go ?
- Organic farming in developed countries produces 20% lower yields (Prof J Ragnold pub Nature) than conventional farming.
- On biodiversity 'organic' has much to recommend it - 'On climate change (sustainability)it is a more mixed picture.
- More organic here means the yield 'shortfall' causes more land to be turned over to crops elsewhere to produce the same calories.
- UK Food Standards Agency (2009) '**no important differences in the nutrition content or any additional health benefits of organic food when compared to conventionally produced food**'.

Food miles ,Locally grown is not always the most sustainable

- Globally it is often more sustainable to grow crops where there is the best land and climate for that crop and then move it to where it is eaten.
- Using similar inputs - fertilizer / pesticides /fuel and then transport - Apples from NZ (eaten in UK) have a much lower carbon footprint than home grown. NZ produce 50 tons per acre UK 14tons per acre.
- NZ lamb - UK has slightly higher yield per acre but uses 13 X more fertilizer – It is complex and there are lots of examples !
- Prof Benton Carneigie Mellon Uni 'If you want to wipe out (the equivalent) all the food miles in what you eat just move from red to white meat one day each week'.

Meat - how sustainable ?

- **All Meat is Not Created Equal**
- Different meats and different production systems have varying health, climate and other environmental impacts.
- Lamb, beef, cheese, pork and farmed salmon generate the most greenhouse gases. With the exception of salmon, they also tend to have the worst environmental impacts, because producing them requires the most resources – mainly chemical fertilizer, feed, fuel, pesticides and water – and pound for pound, they generate more polluting manure

Conclusions

- **This is very very very complex.**
- There are more people on earth with more money who currently aspire to a western style meat rich diet.
- In future we should look to eat less red meat, less cheese - more veg along with sustainable and farmed fish/seafood.
- Food production and climate change are VERY closely linked.
- Local is not always best. – look at the detail.
- GM technology is safe and proven - but proceed with caution with the commercial / social aspects.