Soil – Food & Biofuels
Is this sustainable?

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Outline

1. Introduction – Biomass and Biofuel
2. Global Population and Food Demands – Past, Present and Future
3. Land Quality and Availability
4. Resource Use to produce Biofuel
5. Are First Generation Biofuels the answer?
6. Conflicts – Food-Fuel-Environment
7. Conclusions

Introduction

Biomass Production

Universally recognised as one of the key **functions** of soil.

Until recently the principal focus of Biomass production was on **food production and fodder for animals**, although fibre production, timber for building and wood for fuel was also important.

Biomass for Fuel

There is increasing pressure for biomass to be used as a source of fuel.

For example: In the 1970s Brazil, faced with a rising fuel prices and limited national energy resources developed a programme of ethanol production from sugar cane. This was supported with aid for specialised car manufacture grants.

Biofuel production

Until the late 1900s biofuel production was limited, but from that time there has been rapid growth:-

a. Ethanol – grain, sugar cane, other plant materials.
b. Biodiesel – rape (canola), soybean, palm oil.

Consequences of demand for Biofuels

The increased consumption of grain, sugar cane, rape seed, soy bean, palm oil, etc. for biofuel production, resulted in:-

a. Dramatic increase in global food prices
b. Possible impacts on food security

Politics and Biofuel Production

This growth in agricultural production for biofuels is a new trend.

It is almost exclusively induced and driven by politics, linked to concerns related to:-

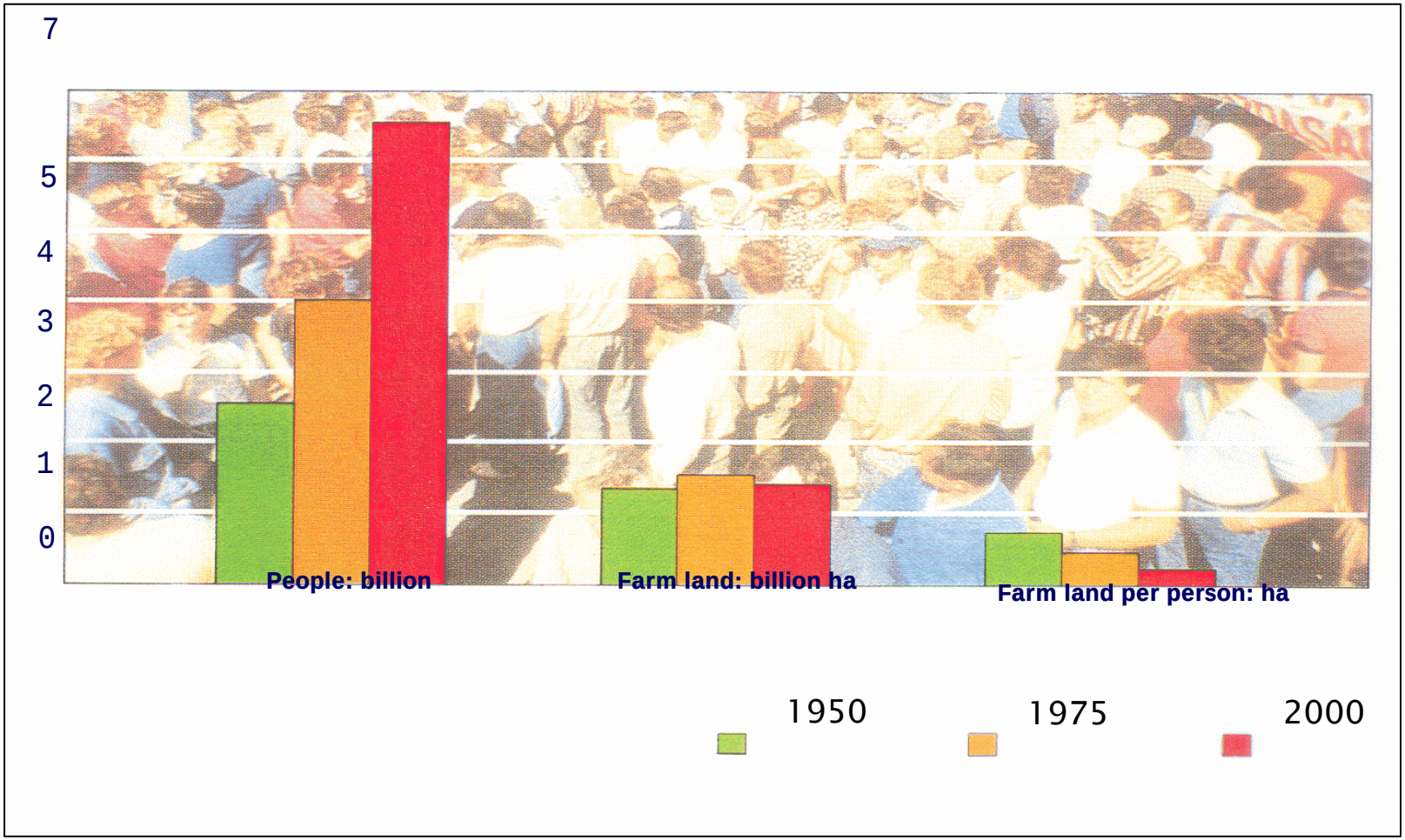
a. Carbon budgets
b. Fuel ‘independence’

Population Growth

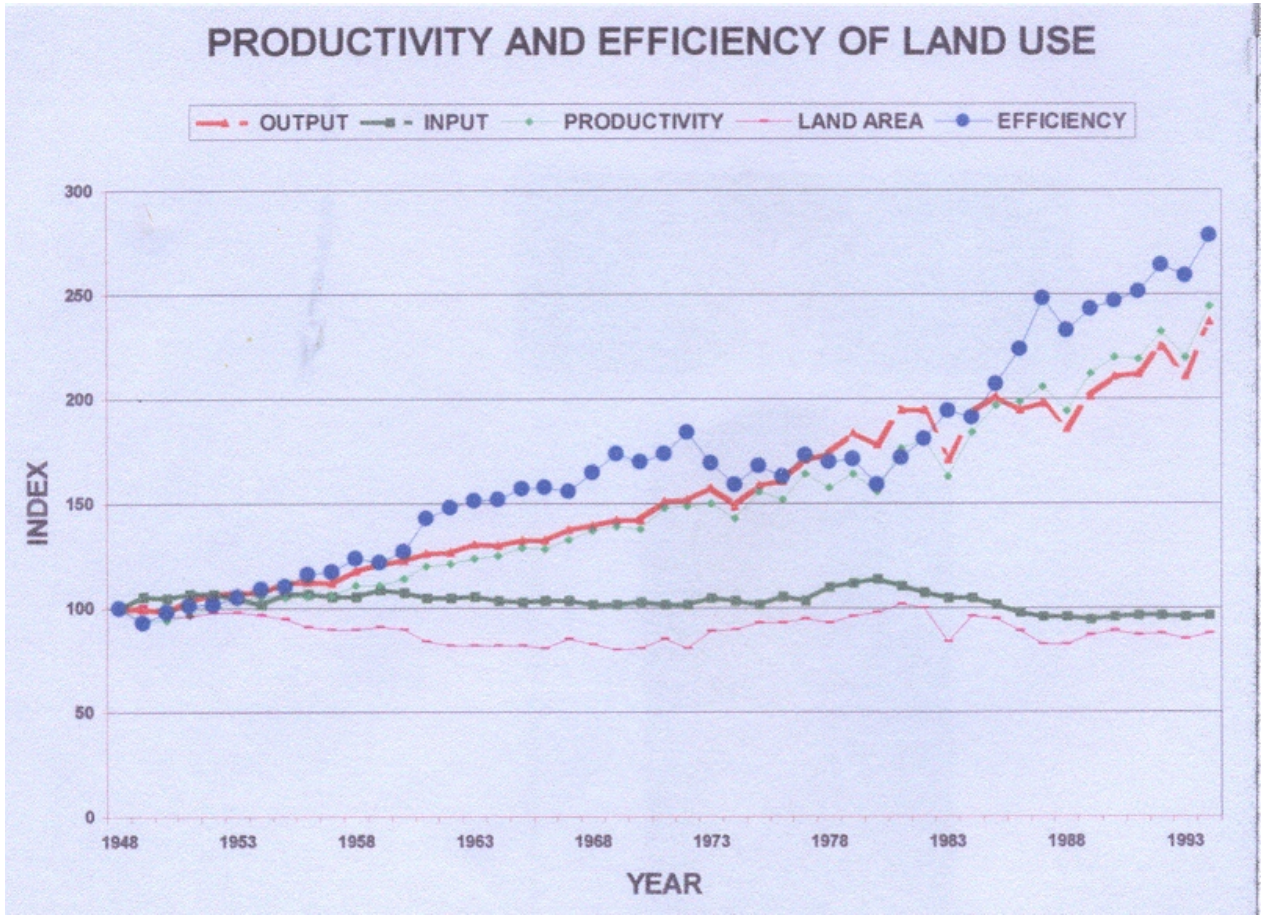
Underpinning all of this we must consider the driver for many of our current problems – population growth.

Year	World Popⁿ Millions	Ann. Growth Rate %
1 AD	200-300	<0.1
1500	400-500	<0.1
1850	1200	0.2
1900	1600	0.6
1950	2500	0.8
1990	5300	1.8
2000	6000	1.5
2011	7000	1.4

People and available land



Increases in soil productivity and land use efficiency



Note- A great deal of this productivity increase is a result of fossil fuel use

Food demands in the future

The predictions are that by 2050 we shall need a further 70-100% increase in food production.

Driven in part by population growth but also changes in food consumption as population becomes more economically affluent (switch from grain to meat).

Do we have the land?

Whilst we have increased production per hectare we have also seen dramatic losses in land through:-

a. Sealing (land take) by industrial and urban development
b. Degradation by erosion, compaction, contamination, loss of organic matter, loss of biodiversity, salinisation and landslides

‘Land Grabbing’

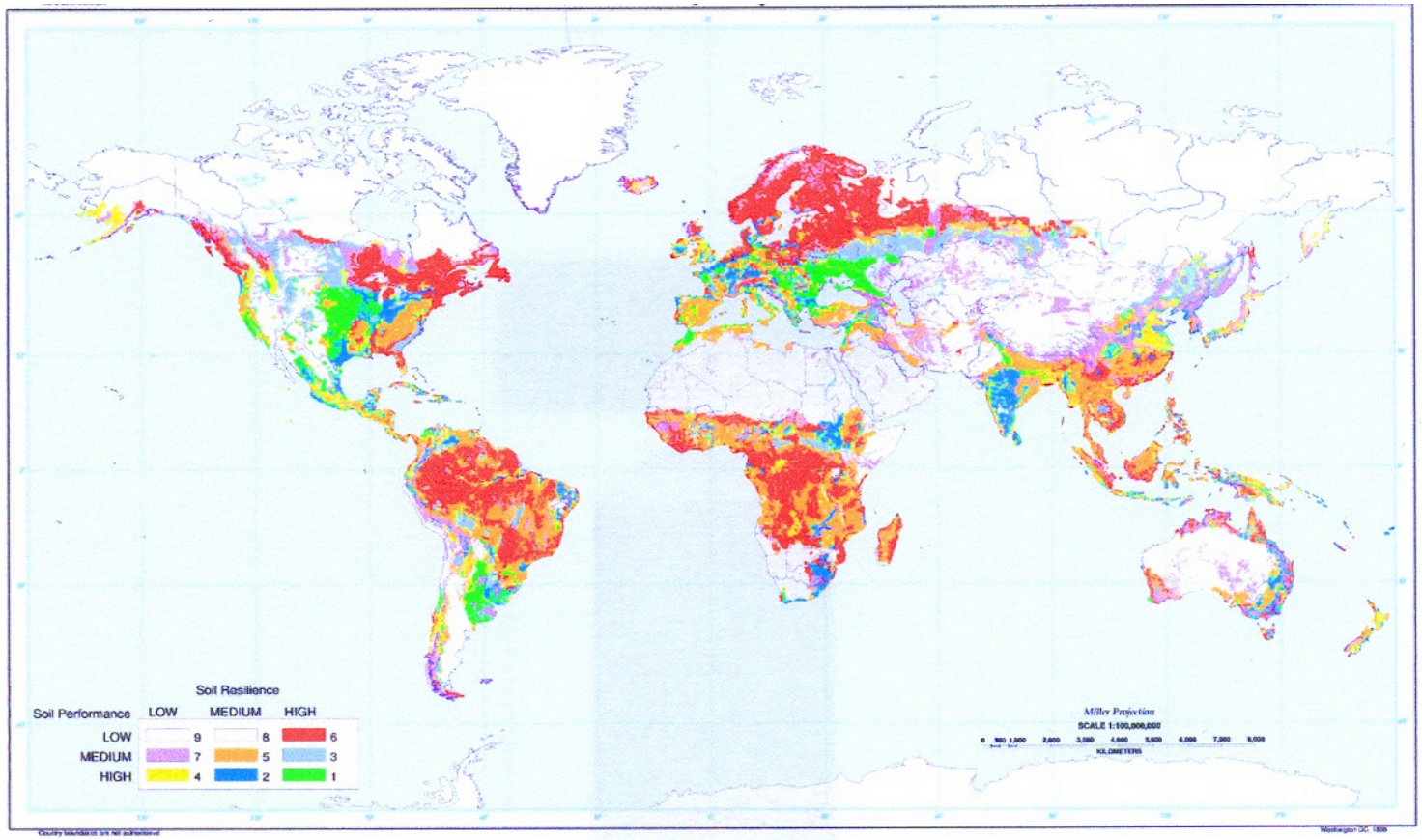
Some countries, are addressing their shortage of land/food by purchasing land (‘land grabbing’) in Africa and other continents to secure food production and bioenergy production for their populations.

Reminiscent of the colonial actions of the Europeans in the 19th Century!

Continuing increases in food demand

1. Global Population continues to increase (80 million p.a.)
2. Increased social and economic wealth results in a shift from grain to meat consumption.
3. Migration from rural to urban environments
4. Losses of fertile land through sealing and degradation (within the EU the daily losses by sealing are c. 12 km^2, globally it is estimated to be 200-300 km^2 per day)

Global distribution of Land



Land Quality and Agricultural Production

Of the global land surface:-

A - 12% is suitable for food and fodder production.

B - 24% can be used for grazing

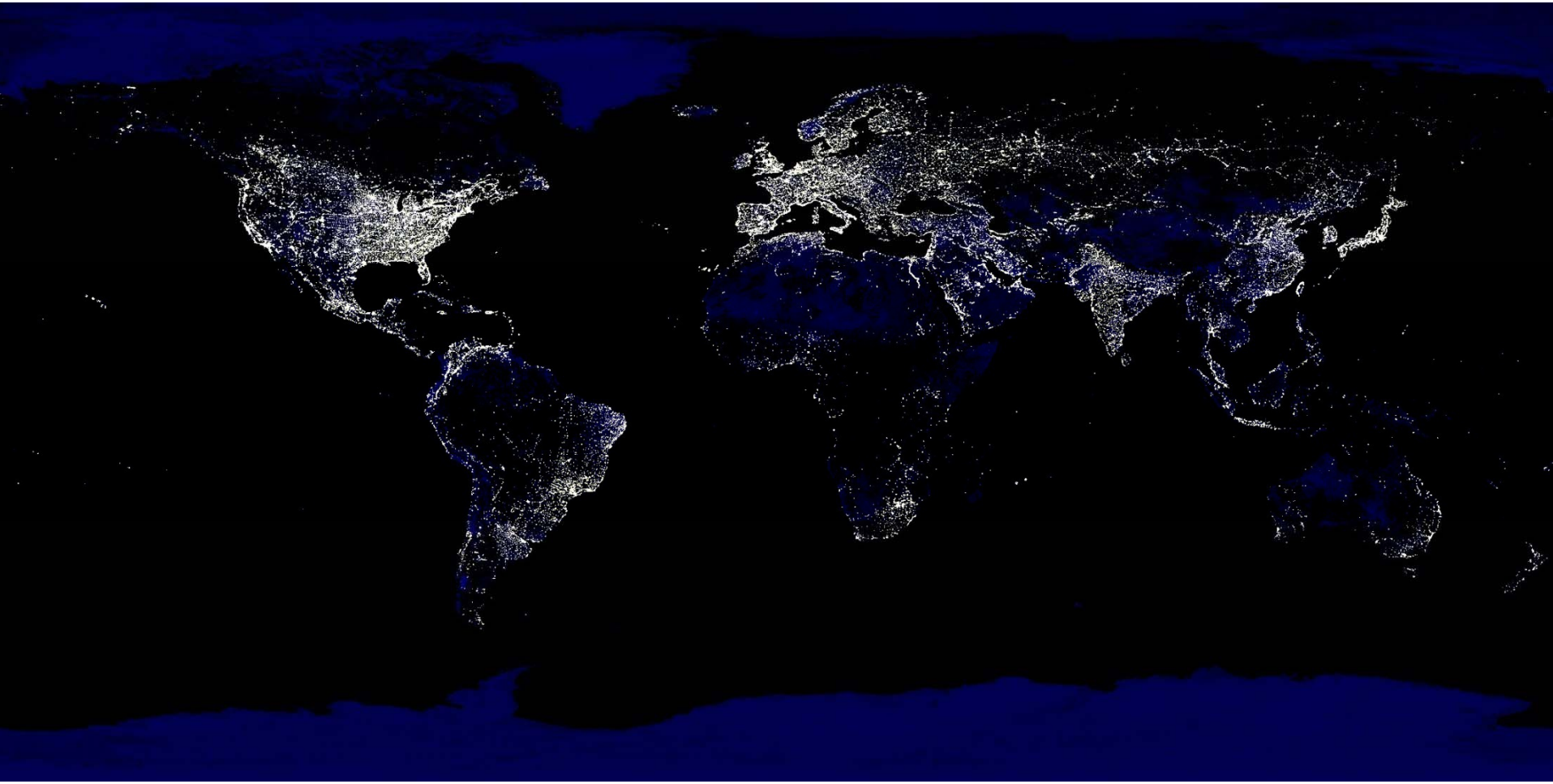
C - 31% can produce forest products

D - 33% not suitable for any kind of sustainable use/

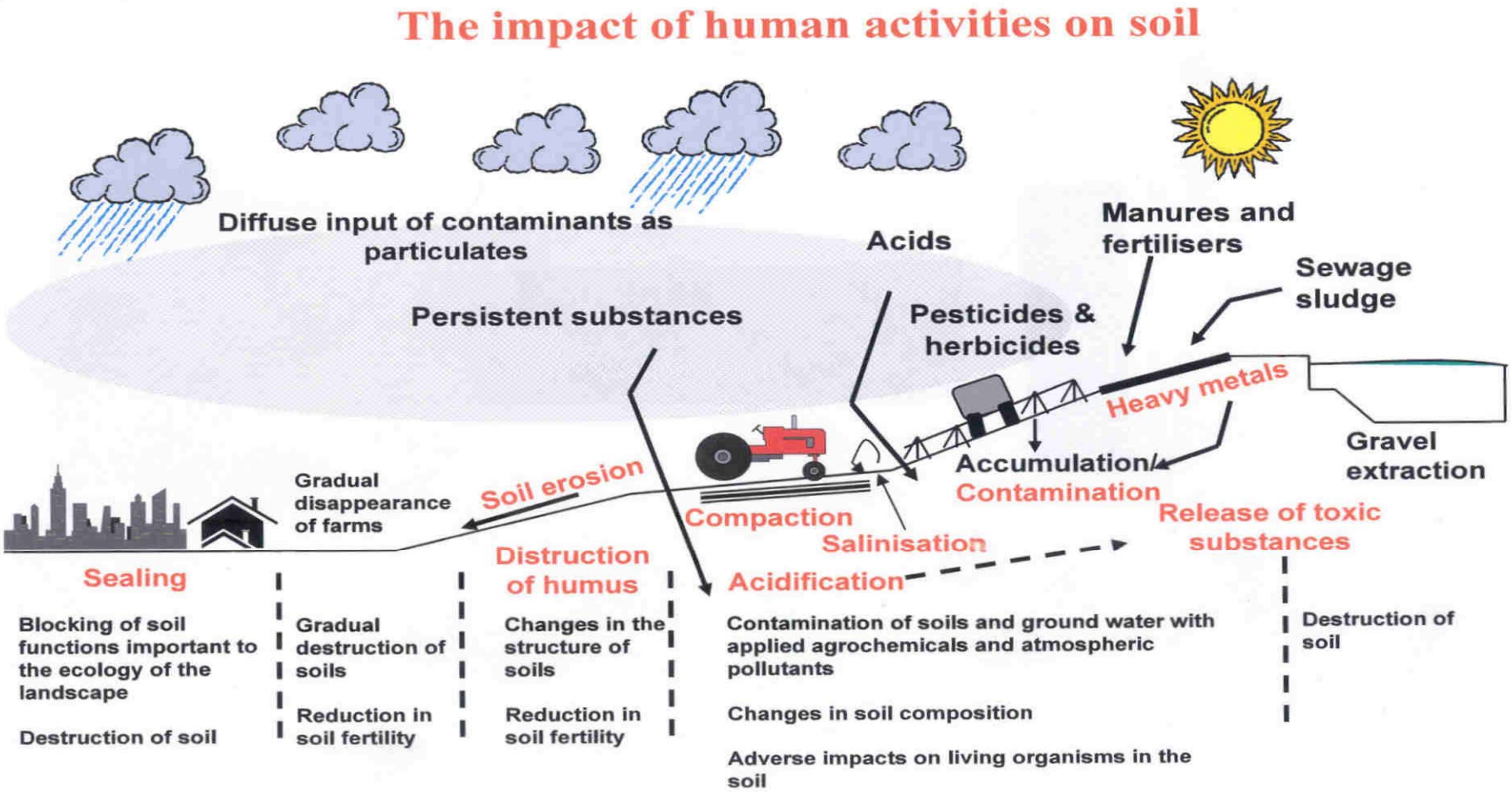
Population and Land Quality

Land Quality	Total Land Surface %	% of World Population
A	12	25
B	24	48
C	31	15
D	33	12

Sealing of highest quality soils



Other threats to soil



Renewable Bioenergy

Renewable Bioenergy can be categorised as follows:-

Biofuel – replacing fossil fuel

Biogas – replacing fossil fuel

Solid organic materials – wood, straw, etc. by combustion and incineration

Biofuels

First Generation

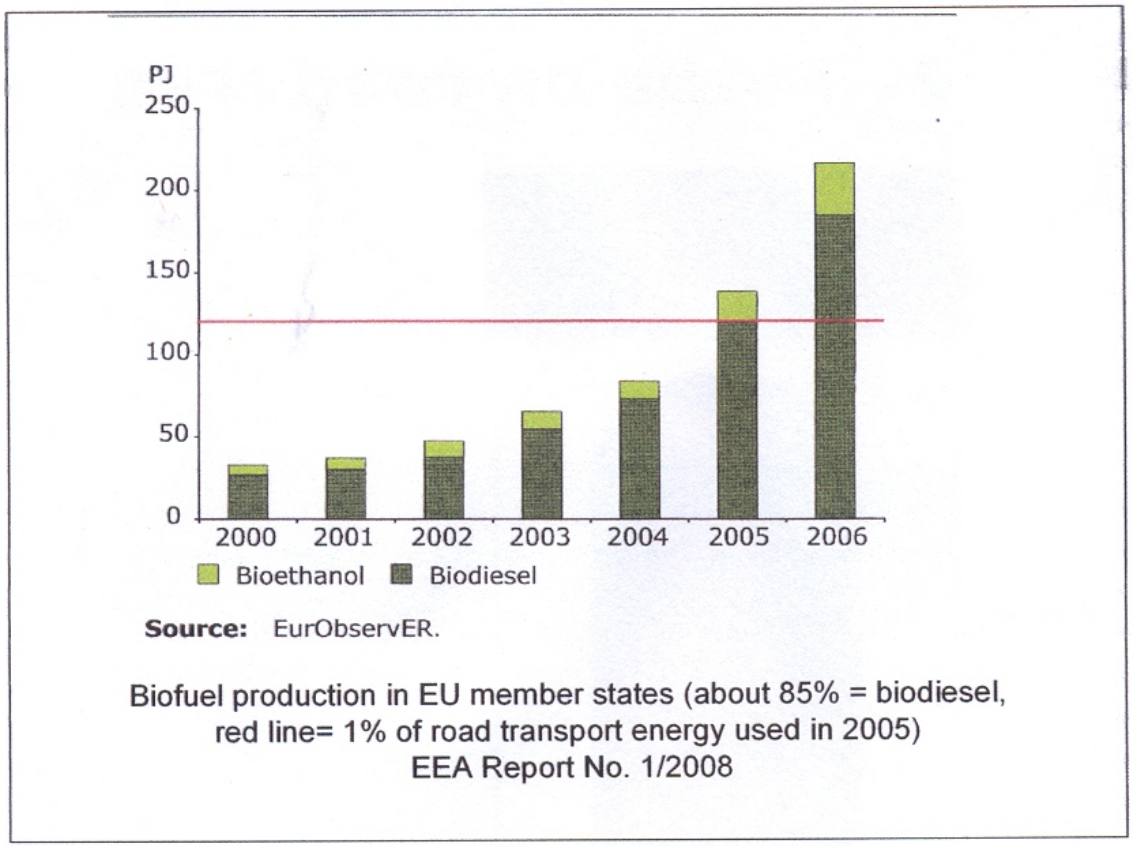
Biodiesel from oil plants, e.g. rape seed, soy bean, oil palm and others.

Ethanol from carbohydrates from agricultural plants, e.g. grain, sugar cane, etc.

Second Generation

The use of cellulose and lignin for the production of fuel through pyrolysis or fermentation.

EU Biofuel consumption



Source: EurObservER.

Biofuel production in EU member states (about 85% = biodiesel, red line= 1% of road transport energy used in 2005)
EEA Report No. 1/2008

Note: In the context of the EU much of this fuel is currently derived from imported materials

First generation Biofuels - observations

1. Probably not economically viable
2. Not ecologically equilibrated
3. Compete with agricultural products which provide food.

Current EU policy of seeking to set biofuels at 10% of fuels by 2020.

This seems unrealistic in that to achieve this target 15% of the land used for agricultural production would be required!

The threat to food production

In 2010 Pascal Lamy of the WTO, using figures from FAO and OECD suggested that:-

Ethanol production will consume

15% of global grain production

30% of global sugar cane production

Biodiesel production will consume

10% of global vegetable oil production

Is biofuel production efficient?

Current biofuel production on good quality land (per hectare)

1500 litre biodiesel from rape

2500 litre ethanol from grain

In contrast 4000 litre produced in the Biomass to Liquid process from wood (grown on lower quality land) Cellulosic Ethanol Production

Ecological concerns over biofuel production (1)

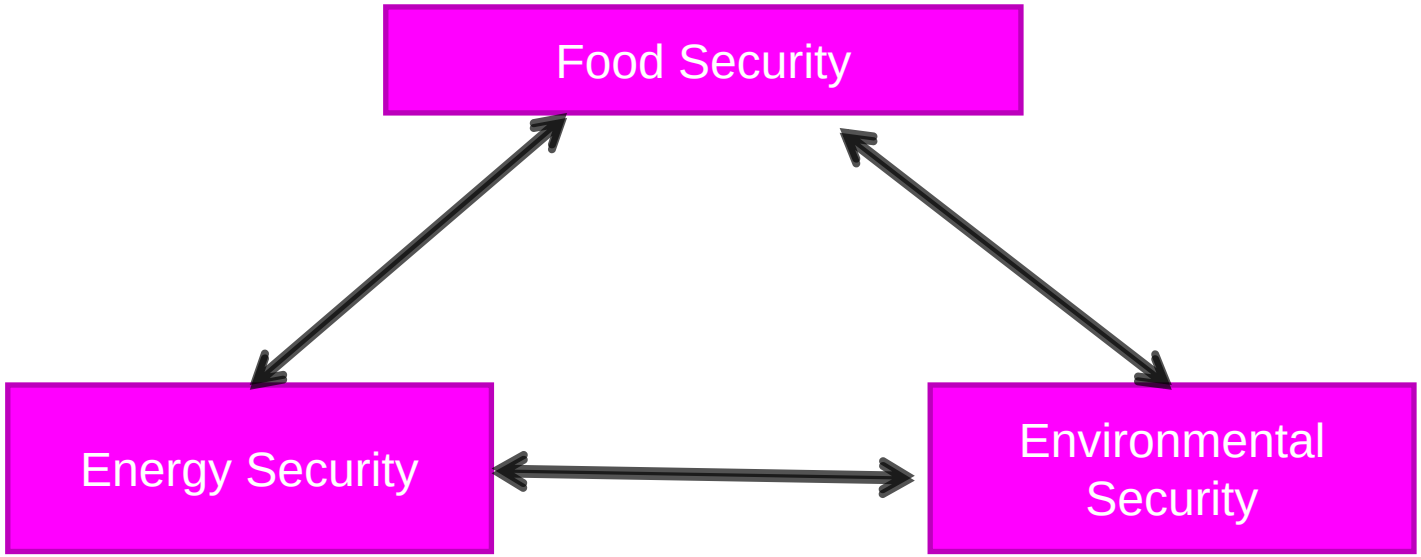
1. Greenhouse Gas Emissions during Land Use Conversion may be significant.
2. Loss of Biodiversity due to changes in production systems, conversion of pastures/woodlands to arable systems, increased use of agrochemicals.
3. Loss of soil quality as a result of poor soil management – decline in SOM, decline in soil structure (reduction in OM recycling, increased use of mechanical harvesting). With wider environmental influences, for example soil erosion.

Ecological concerns over biofuel production (2)

4. Impacts on the quality and quantity of ground water available for other uses.
5. Human health – There may be increased use of agrochemicals without the normal controls when crops are part of the food cycle.
6. High Nitrogen demands of crops (particularly oil producing crops) if high productivity is to be achieved and maintained.
7. Possible increase in use of GMOs.

The 'Trilemma'

This gives rise to the trilemma which we have to address:



Water use

In addition to shortage of land there are concerns about water scarcity:

Example:

1kg of maize needs c. 770 litres of water

3kg of maize produces 1 litre of ethanol

3kg of maize requires 2.3m^3 water

1 m^3 of water is priced at €0.4

Hence cost of water for 1 litre of ethanol is €1

To fill an SUV with 100 litre ethanol need to produce 300kg maize

The cost of water for this maize is €100

Water Use (continued)

Waste Water

Whilst there is a degree of reluctance to use waste water derived from sewage and other waste disposal systems to meet the demands of food crops, their potential for use in non-food crops is considerable, with likely fewer objections.

Food versus biofuels

To fill an SUV with 100 litre ethanol need to produce 300kg maize

300kg of maize is enough to feed 1 person for a year!

Conclusions/Reflections

We must address the trilemma

food security / energy security / environmental security

First generation biofuels are inefficient.

Bioenergy production under current conditions is often environmentally damaging.

Second (plus) generation biofuels are more efficient and possibly less environmentally damaging.

Thankyou!

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