Water - the new carbon?

Presentation to
University of the Third Age

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Purpose of Presentation

To give an overview on:

- what's happening with freshwater internationally; and
- what this means for New Zealand.

Water – the new carbon?

Outline of presentation:

1. World population statistics
2. Water statistics – for both the world and for New Zealand
3. Water use locally and internationally
4. Trends in water demand and supply
5. Virtual water and water footprinting
6. Food supply and demand
7. Conclusion

1: World Population Statistics

- World population has been increasing exponentially over the last 200 years
- Currently 6.91 billion
- Projected to be 50% higher than this within the next two generations
- While rates of increase have peaked, the total population isn't projected to stabilise until 2150

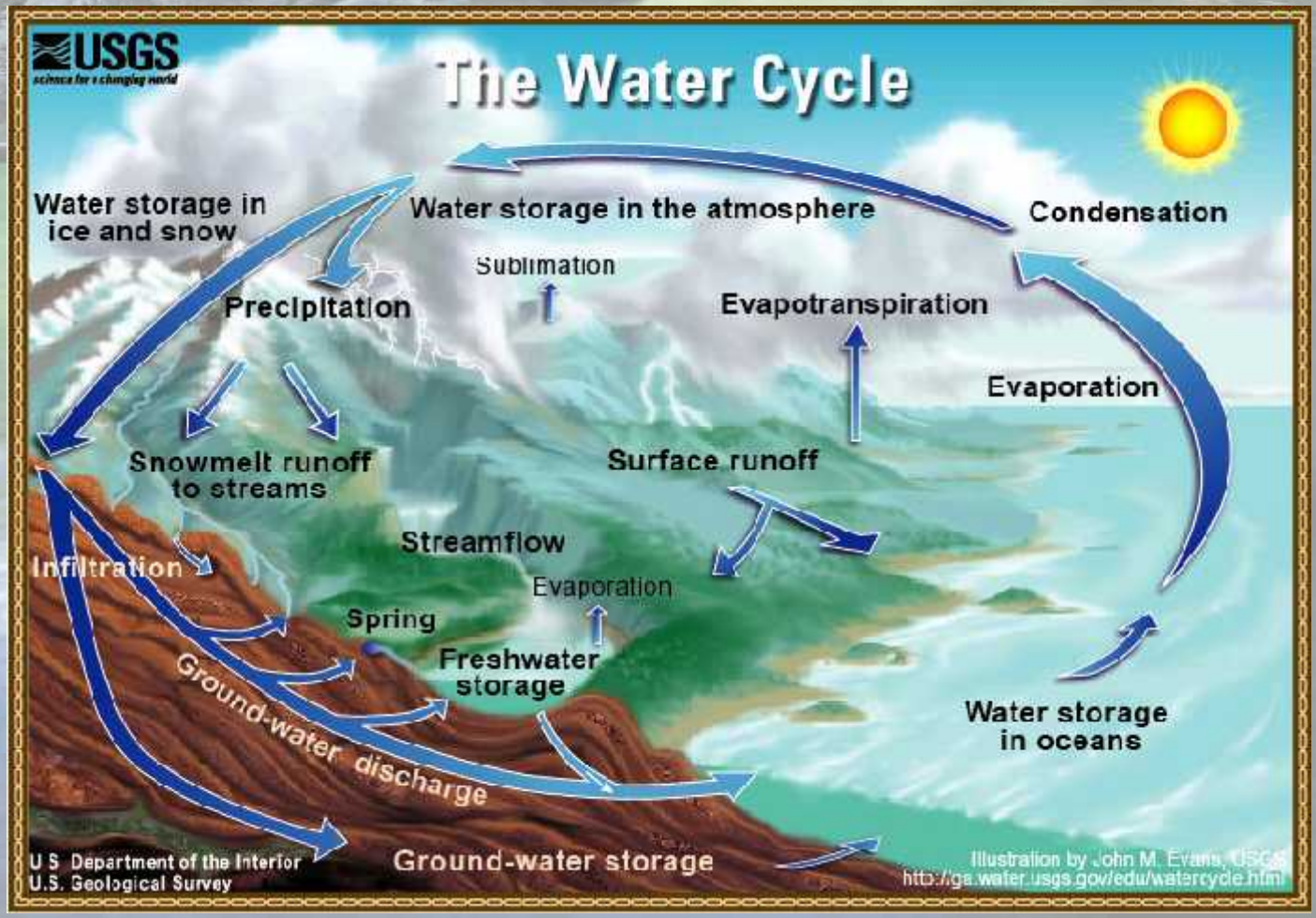
2: Water Statistics – for both the World and for New Zealand

- 97.5% is seawater
- Only 2.5% is freshwater – an increasingly scarce and sought-after resource

Of the freshwater:

- 68.9% is held permanently as ice and snow and is not available
- 30.8% is held as groundwater
- Only 0.3% is held in lakes, rivers and in the atmosphere

The Water Cycle



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Freshwater Storage NZ c.f. World

	World	New Zealand
Snow and Ice	69.7%	6%
Groundwater	30%	**61.5%**
Surface water (lakes, rivers etc)	0.3%	**32.5%**

New Zealand has proportionately ***twice*** as much of its water below ground and ***100 times*** above ground c.f. world averages

Water Stock Account New Zealand

- 500 km^3 falls on New Zealand annually as rain or snow
- Equivalent to the total volume of water that falls on the Australian land mass annually; 2.5 times the volume of water falling on the British Isles (population 65 million) each year
- 390 km^3 of water per annum runs off into the sea
- 110 km^3 of water is returned to the atmosphere by evaporation and transpiration

Water Stock Account New Zealand

- 613 km^3 stored as groundwater
- 320 km^3 stored in lakes
- 60 km^3 stored permanently as snow and ice

NZ c.f. the rest of the World

- World precipitation averages 800mm per annum
- NZ precipitation averages 2000mm per annum
- NZ has 2.5 more rainfall compared to the rest of the world
- Annual water runoff per person across globe averages 7100m^3
- Annual water runoff per person in NZ averages 80,000m^3

3. Water use locally and internationally

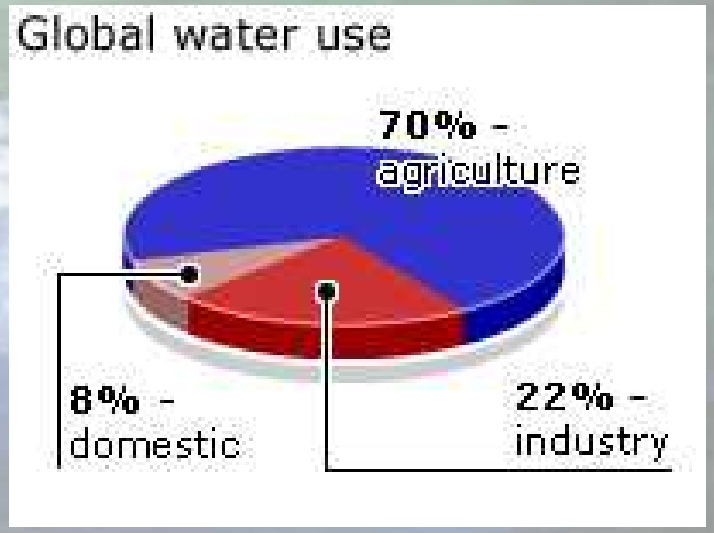
~2.5% of New Zealand's water runoff is abstracted annually – 10 cu km c.f. 10% internationally

- 77% is used for irrigation – mainly in Canterbury
- 11% is used for industrial purposes
- 9% is used for public water supplies
- 3% is used for stock water

New Zealand is water rich

Water Use Internationally

- Across the world ~ a third of water runoff is abstracted c.f. New Zealand ~ 2.5%
- 70% is used for agriculture – mainly irrigation
- 22% is used in industry
- 8% is used for domestic purposes - cooking, cleaning, and drinking

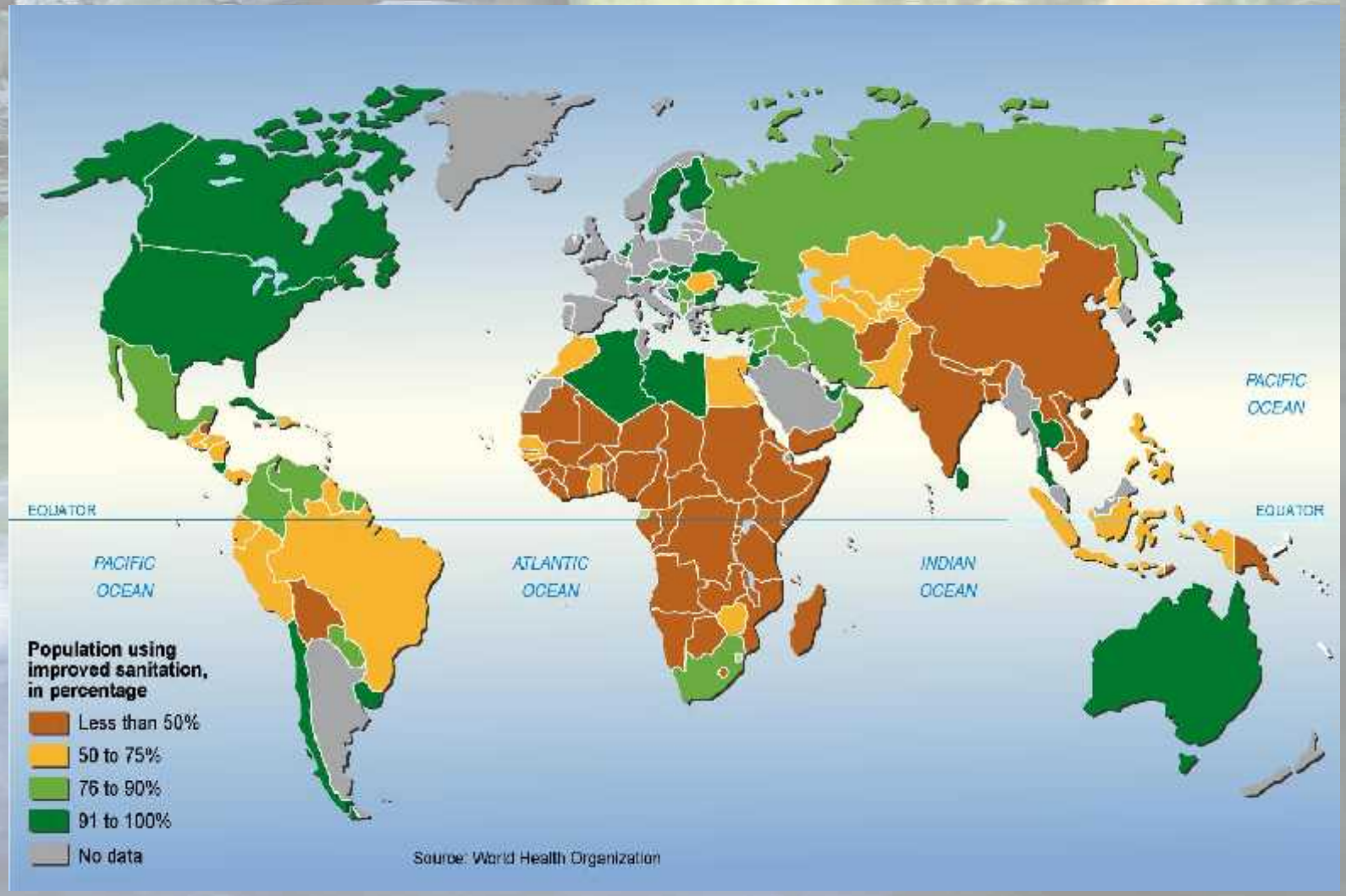


Domestic Water Access and Use

The UN recommends a minimum threshold of 50 litres per person per day. Actual figures for use are:

- 10 - 20 litres in sub Sahara Africa
- 200 litres in Europe
- 400 litres in the USA
- <200 litres in metered jurisdictions in New Zealand
- >700litres in some non-metered jurisdictions in New Zealand

Domestic water access and use



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Agricultural Use of Water

- 1 litre of water is required to produce a calorie of food
- Only about 2–5 litres of water is required for drinking each day
- 1 kg of wheat requires 1 metre^3 of water
- 1 kg of paddy rice requires 3 metres^3 of water
- 1 kg of grain fed beef requires 15 metres^3 of water

Irrigation

- Worldwide 15% of cultivated land is irrigated producing 40% of the world's food
- The bulk of irrigated land is in the most densely populated countries
- Without irrigation we could not feed 6.91 billion people

4: Trends in Water Demand and Supply

Drivers for increased water demand are:

- increasing urbanisation
- increasing population
- increasing wealth

Since 1900 the world population has increased three fold but water demand has increased six fold

Increasing Urbanisation

- Urban populations can't grow their own food, and require reticulated water supplies and wastewater services
- Both factors increase the demand for water
- World's population is becoming increasingly urbanised
- In 2009 for the first time more people lived in urban rather than rural communities
- 60% of the world's population will be urbanised by 2030

Increasing Population

- Increasing populations increases the demand for water
- Average water requirement per person across the globe is 1243 metres^3 per annum
- More people = more demand for water

Increasing Wealth

As living standards increase per capita use of water goes up due to:

- increased consumption of manufactured goods and services
- improved nutrition
- changing dietary habits – increased consumption of meat and dairy products

Overall Trends in Water Demand

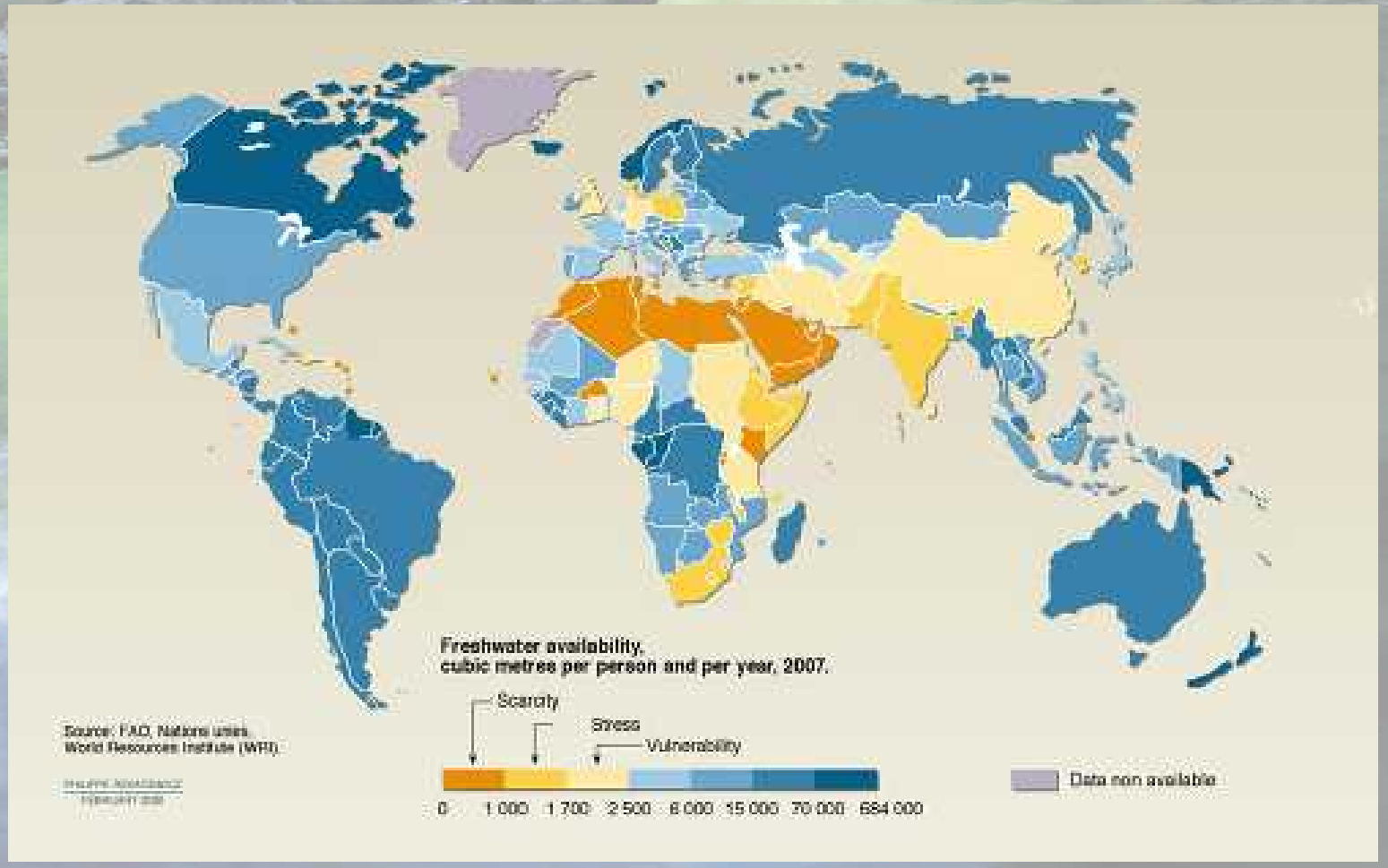
- Global water use rose six fold between 1900 and 1995 - twice the rate of increase in population
- Demand for food will rise by 50% over next 20 years
- Demand for food will double during the next 50 years
- The amount of water consumed in agriculture is predicted to increase by 70 – 90% by 2050

Trends in Water Availability

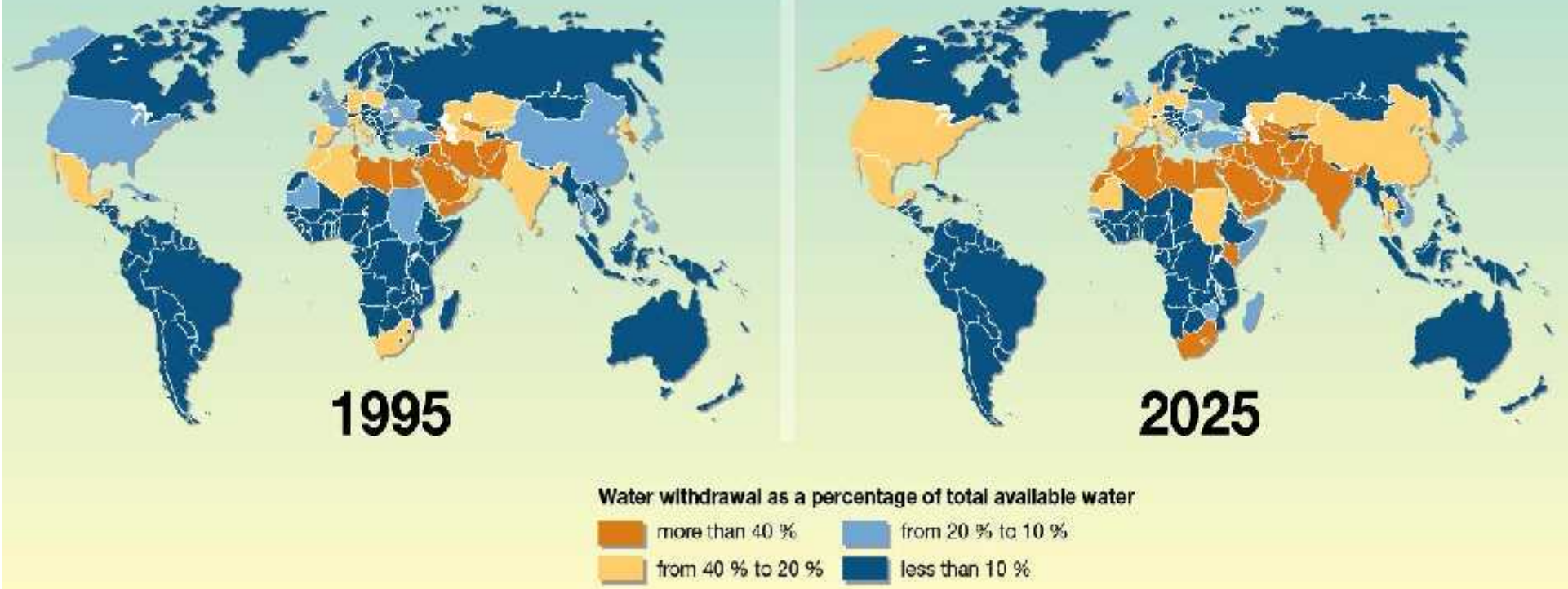
Overall water availability worldwide is declining because of:

- declining water tables
- desertification and salinisation
- pollution
- climate change

Freshwater Availability



Decreasing Availability



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Declining Water Tables

- Two types of aquifers - replenishable and non-replenishable (or fossil) aquifers
- Many countries are overpumping aquifers for irrigation
- Fossil aquifers are being mined and water tables are dropping
- Problem is worst in densely populated countries – China and India
- Once fossil water runs out agricultural production will decline or even cease

Desertification

Desertification

- Desertification is widespread and is taking land out of production
- Loss estimated to be between 6 and 12 million km^2 c.f. total world land area of 148 million km^2
- Increasing annually by 200,000km^2
- Almost 1/3 of the world's cropland has been abandoned in the past 40 years

Salinisation

Salinisation of Soils

- One of the most devastating causes of declining soils quality
- Mainly due to irrigation
- Estimates of the amount of soil lost to salinisation vary
- FAO estimates annual loss to be 20,000 to 30,000 km^2 worldwide
- The USDA puts the land loss at 100,000 km^2 annually

Salinisation of Soils

- Very limited research done to quantify economic impact of irrigation induced salinisation
- Quantitative measurements limited to the amount of land affected or abandoned
- Estimates of the area affected have ranged from 10% to 48% of worldwide total irrigated area

Pollution

Water Pollution

- Water pollution is a complex subject
- Overall water quality is declining worldwide, mainly from intensification of land used for agriculture
- Rates of decline are more rapid in developing countries
- Quantification of the effect of pollution on limiting water availability is not possible

Climate Change

- Uncertainty over the effects of climate change
- A close connection between temperature and the hydrological cycle
- Rising temperatures increase evaporation leading to increased precipitation
- Overall, the global supply of freshwater is predicted to increase slightly

Climate Change

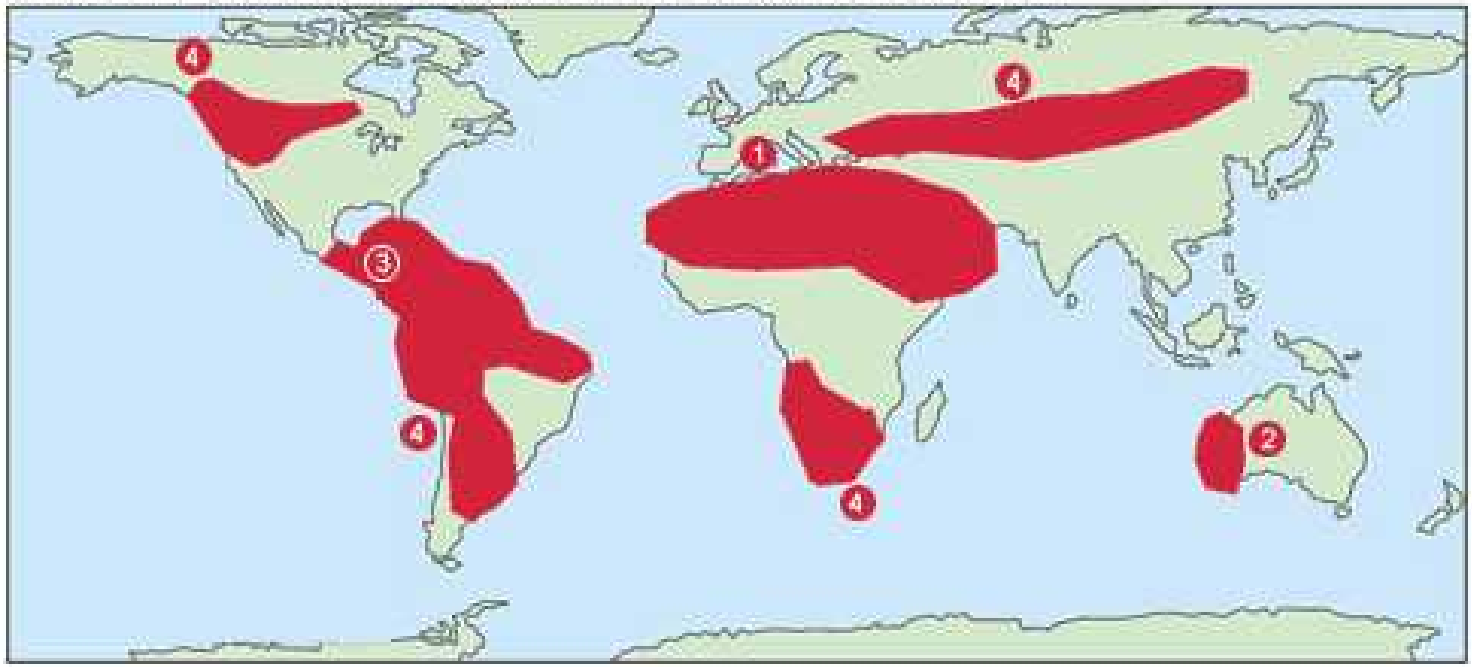
- Dry areas are predicted to get drier and wet areas to get wetter
- More water stored as ice and snow will melt
- Runoff will occur earlier in snow-fed river systems, increasing the risk of winter and spring flooding, while reducing water availability in the late summer and early autumn
- Oceans will become more acidic

Climate Change

Water stress and drought risk

1. Large decreases in river flow up to 70% by 2071-2100 across west Asia, the Middle East and Mediterranean basin
2. Large decreases in river flow 40-60% by 2071-2100
3. Large decreases in river flow up to 70% by 2071-2100
4. Severe increases in Palmer Drought Severity Index (PDSI) 2000-2046

Met Office



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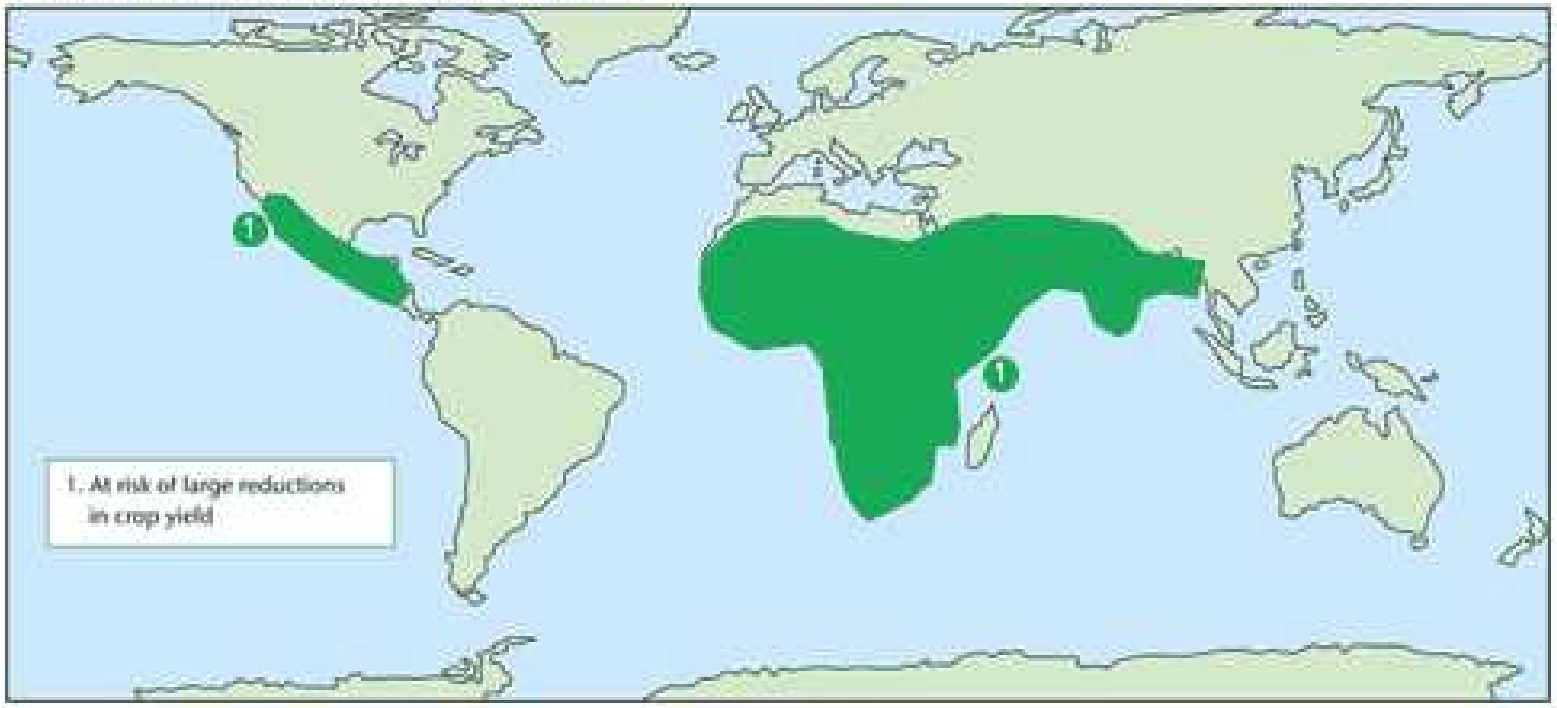
Climate Change

Crop yield reduction risk

1. At risk of largereductions in crop yield

Met Office



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Overall Trends in Water Demand and Supply

- Demand is going up
- Supply is going down
- One third of the world's populations living in water stressed areas and this figure is increasing

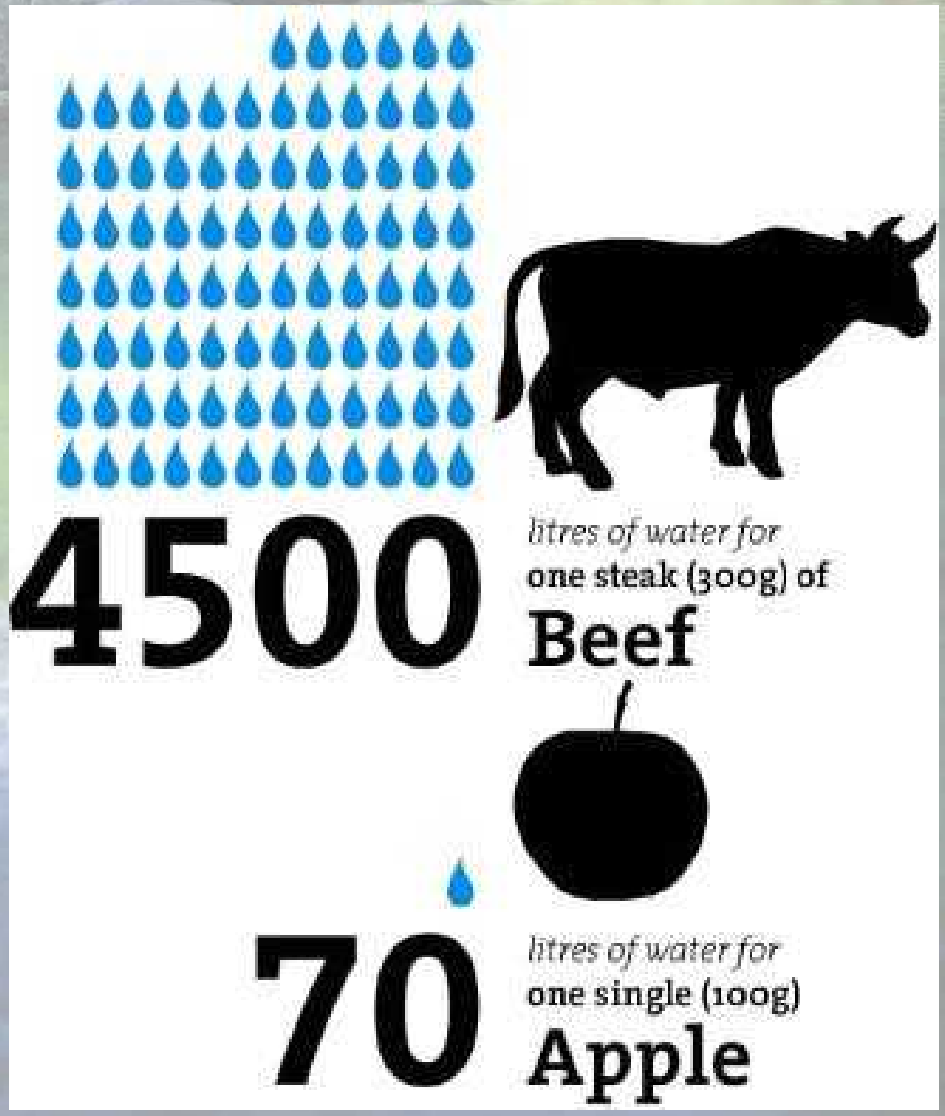
5. Water Footprinting and Virtual Water

Water footprint = the amount of water used per person per year

Virtual water = the 'embedded water' contained in exports and imports, i.e. the water used in the production of a good or service that is traded

- New Zealand exports virtual water
- Japan and Britain import virtual water

Virtual Water



6: Food Supply and Demand

- Over the past 40 years supply has exceeded demand and food prices have dropped
- A greater percentage of the world's population are now adequately nourished than ever before
- Living standards in developing world are increasing rapidly
- Demand is expected to double over the next 40 years
- Can supply keep up with demand?

World Food Inventory

- World's food inventory is now at lowest level recorded:

Post World War II	350-400 days
2003	133 days
2009	38 days

- There are real supply side constraints associated with available energy, land and water
- Falling water tables and climate change are now adversely affecting grain production

Food Supply and Demand

- The FAO says supply can be increased to match demand
- Britain's chief science advisor says 'no'
- Markets are freeing up internationally – FTA's
- Productivity will have to increase significantly to match demand
- Trend towards acquisition of land overseas to secure local food demand – e.g. Kuwait into Cambodia

7: Conclusion – Water – the New Carbon?

- There are very significant supply side constraints on increasing food production
- The main limiting factor is likely to be water, which is coming under increasing pressure internationally
- Significantly increased productivity is required to meet increased demand
- As a net food exporter with an abundance of water, New Zealand is very well placed

Conclusion

Water may become the new carbon

It is New Zealand's key strategic asset