

University of Melbourne  
School of Land and Environment  
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Dean's Lecture Series: 2008

# Food or Environment



**...who will be the winner?**

John Williams  
NSW Natural Resources Commissioner  
And Member the Wentworth Group of Concerned Scientists

# Acknowledgements

- **Ms Fiona McKenzie**
  - Wentworth Group of Concerned Scientists
- **Dr Andrew Stoeckel**
  - Centre for International Economics



# References

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Kiers, E. T., Leakey, R. R. B. , Izac, A., Heinemann, J. A., Rosenthal, E., Nathan, E. and Jiggins, J., 2008. 'Agriculture at a Crossroads' in *Science*, Vol 320, 18April 2008, 320-321,

von Braun, J., 2007. *The world food situation: new driving forces and required actions*. Food Policy Report. International Food Policy Research Institute. Washington DC.

# **Food or Environment – who will be the winner?**

- **unequal distribution of food**
- **conflict over control of the world's dwindling natural resources**  
**present a major political and social challenge to governments and policy makers likely to reach crisis status**
- **as climate change advances**
- **world population expands.**
- **energy , fertilizers and pesticides increasingly expensive**

# Food or Environment

- **Essentially, global agricultural production must be increased substantially to meet rising demand,**
- **but it must be achieved with a decreasing impact on natural resources and the environment.**

Food for extra 70  
million people  
EACH YEAR

- Water resources/rivers stressed
- Loss of production due to land degradation is 19 millions tons grain PER YEAR

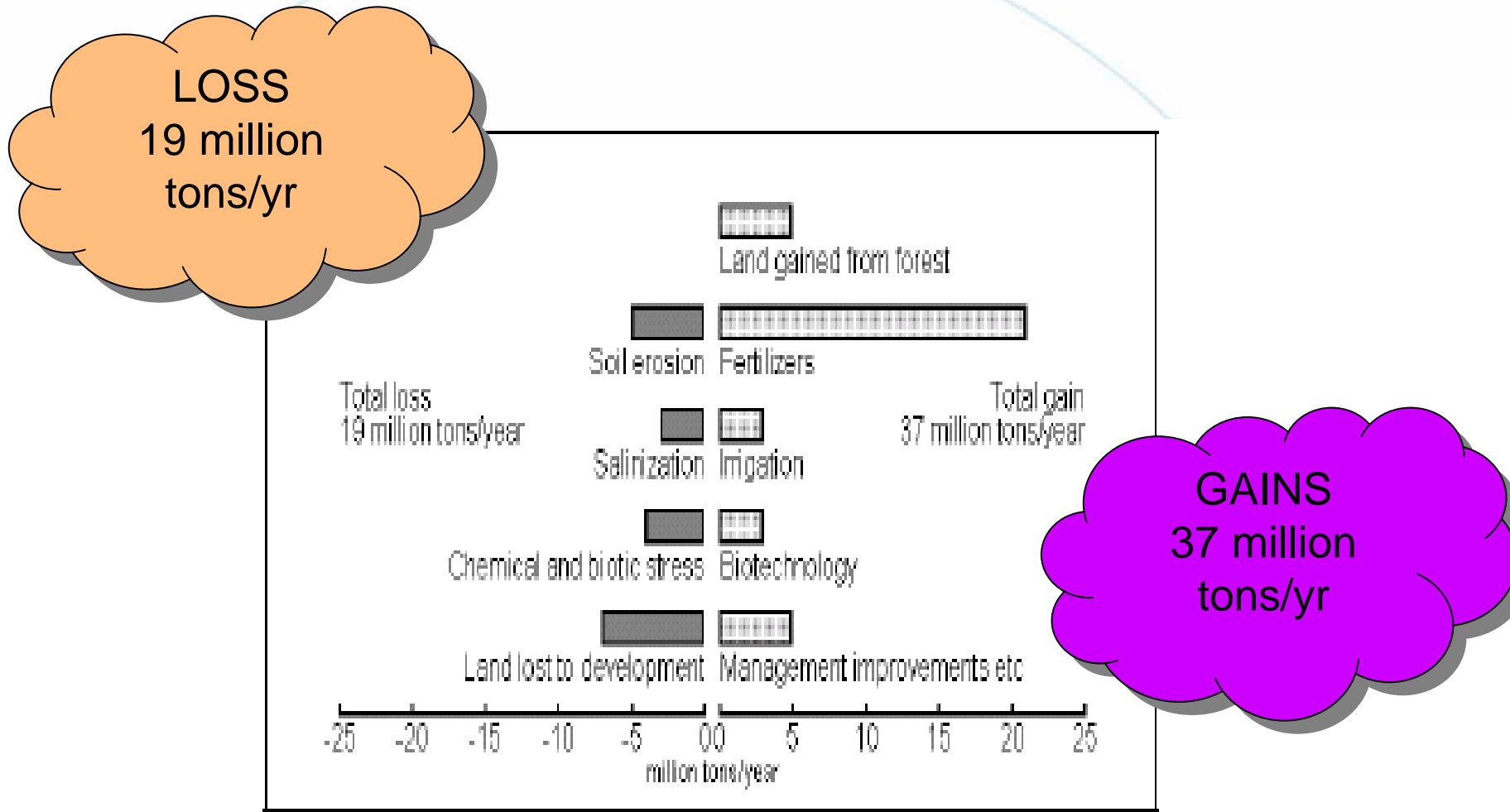


Figure 2. Schematic gains and losses balance out to yield the global food production. (Doos undated)

Source: Williams et al., (2004)

# Food or Environment

**To avoid the emerging food crisis  
without further and increased  
damage to the environment.....**

- **at a time of rising costs for energy**
- **within a spectre of climate change**

**This is perhaps the  
greatest challenge yet  
to face agricultural  
science**



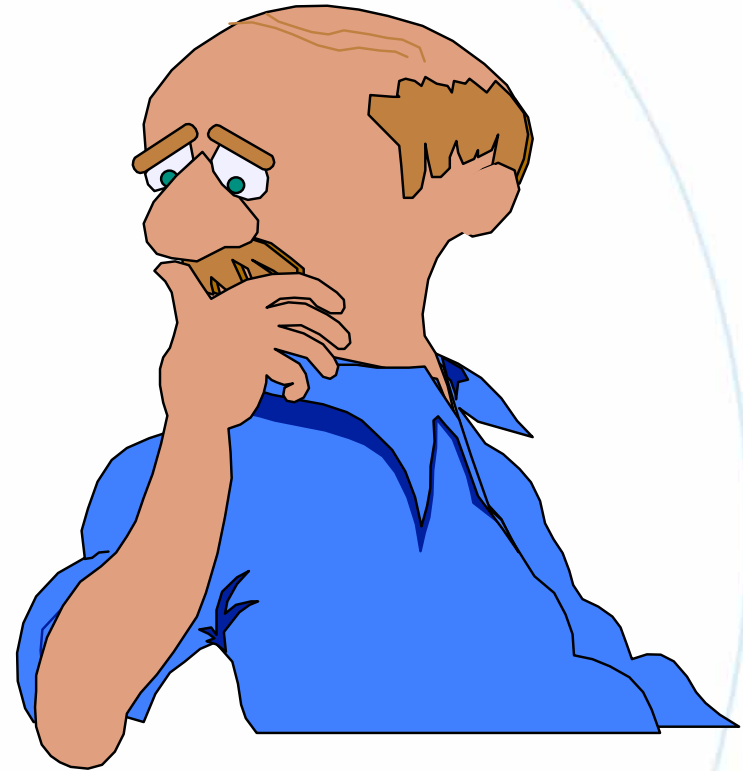
# Food or Environment

**we need substantial reform**

- **to the nature of the agricultural sciences**
- **coupled with a major injection of both national and international investment in these reformed sciences**

# Food or Environment

- **This urgent need has apparently slipped from our gaze**

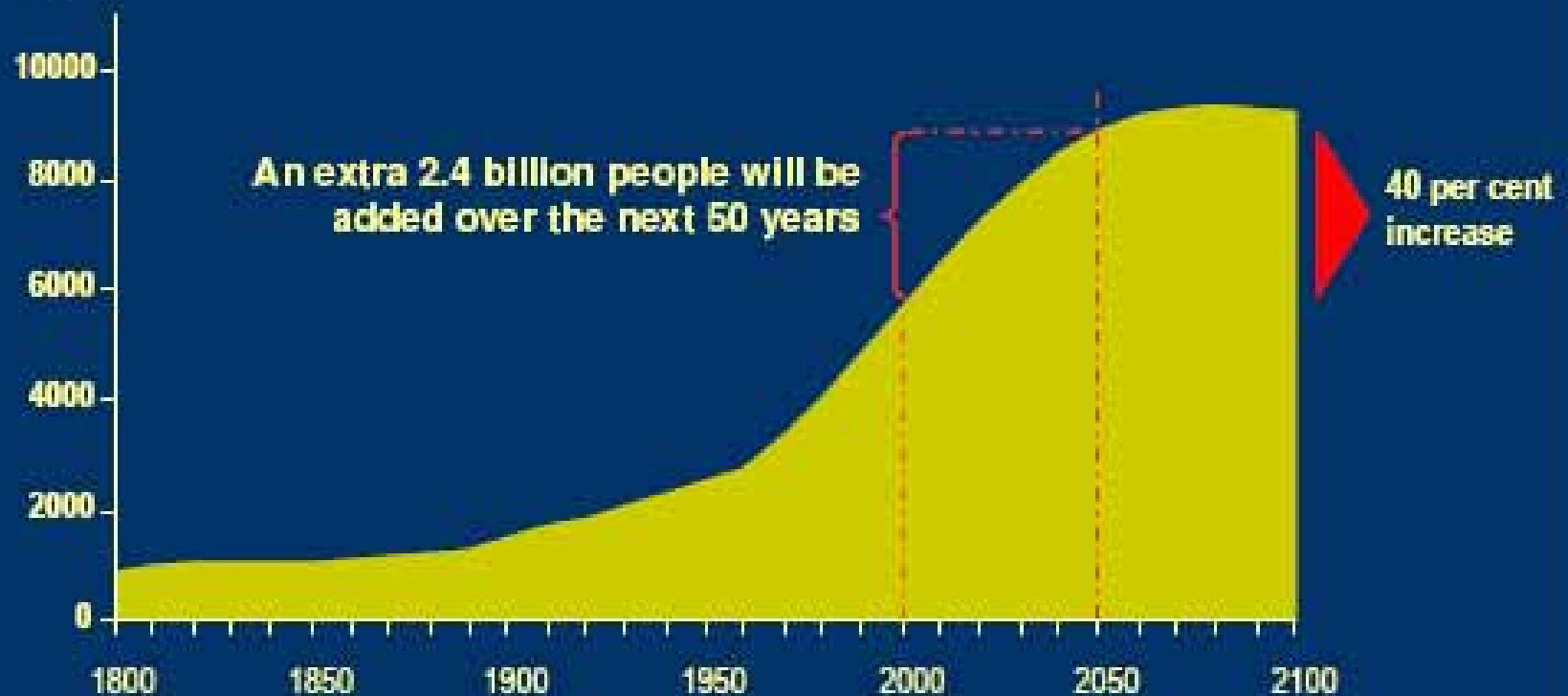




[Source: ACIAR at [www.aciar.com.au](http://www.aciar.com.au)]

# The dimension of the problem

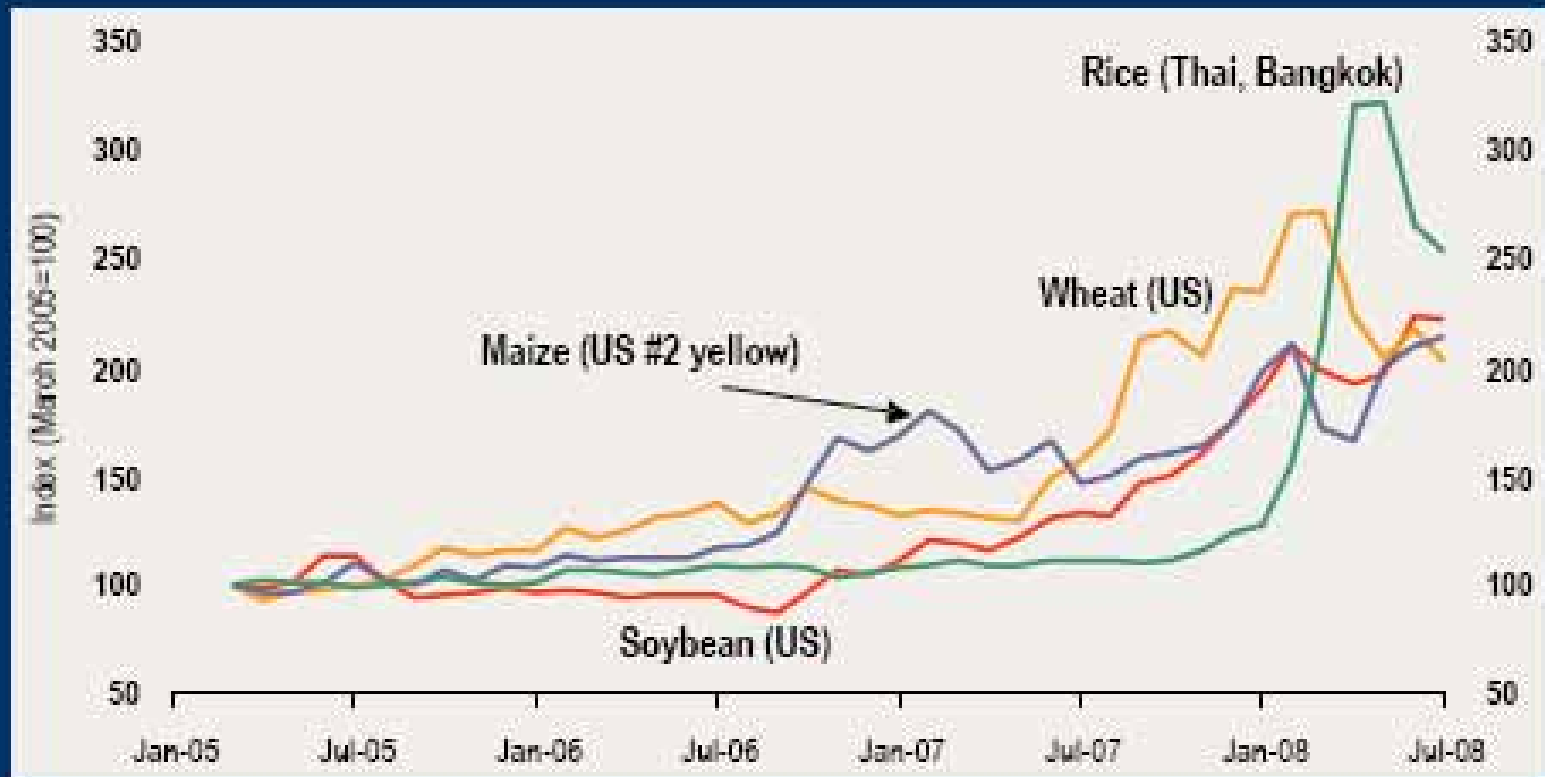
Population in millions



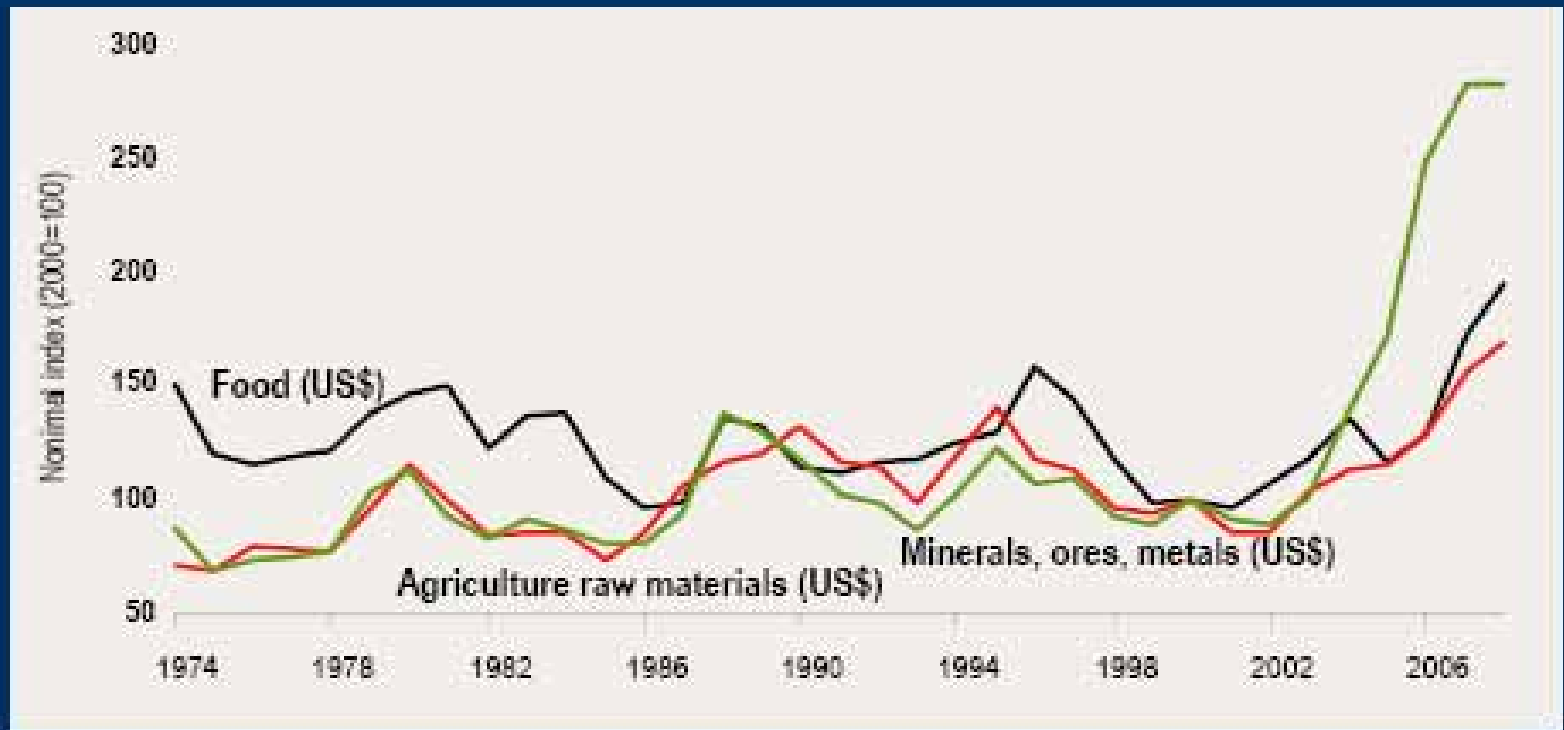
Data source: United Nations World Population Prospects Database: 2005 revision



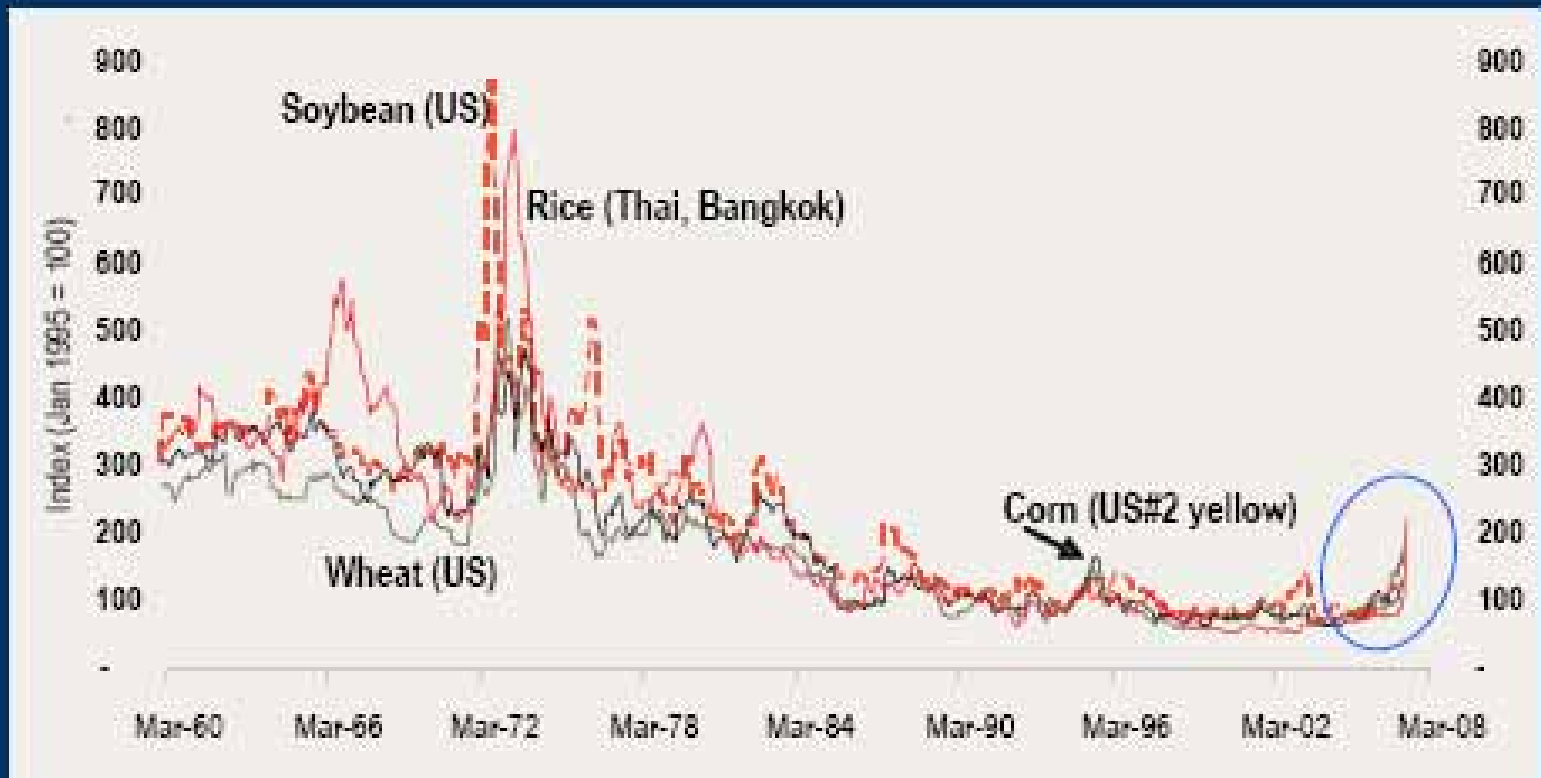
# Food prices over last three years (nominal SDR terms)



# Long-run nominal commodity prices (US\$)



# Long-run food prices — real SDRs index

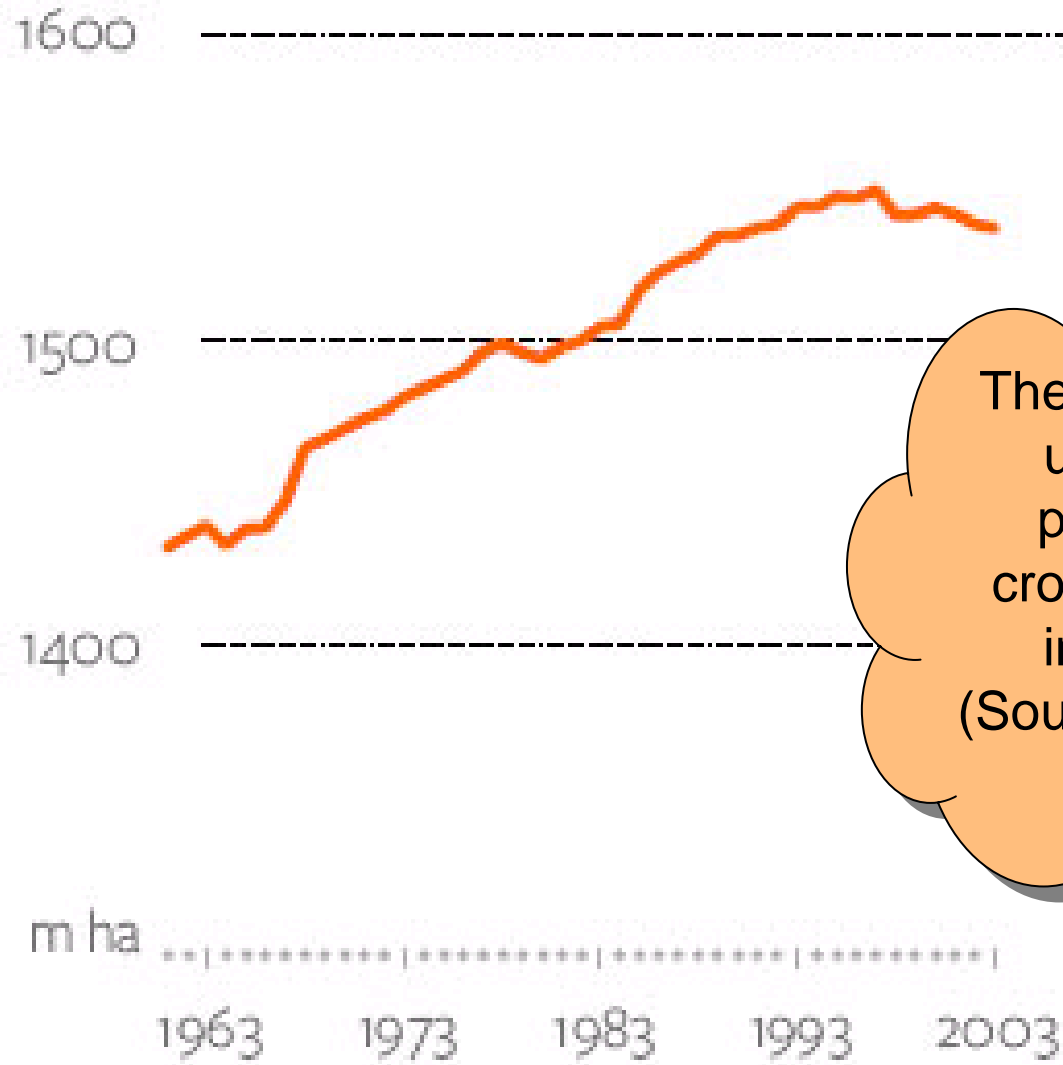


# Water Scarcity



Food production under irrigation faces increasing competition for water as more water will need to be returned to damaged rivers and estuaries and climate change threatens declining snow and rainfall in river catchments. Photo: John Williams

# world utilised arable and permanent crop area

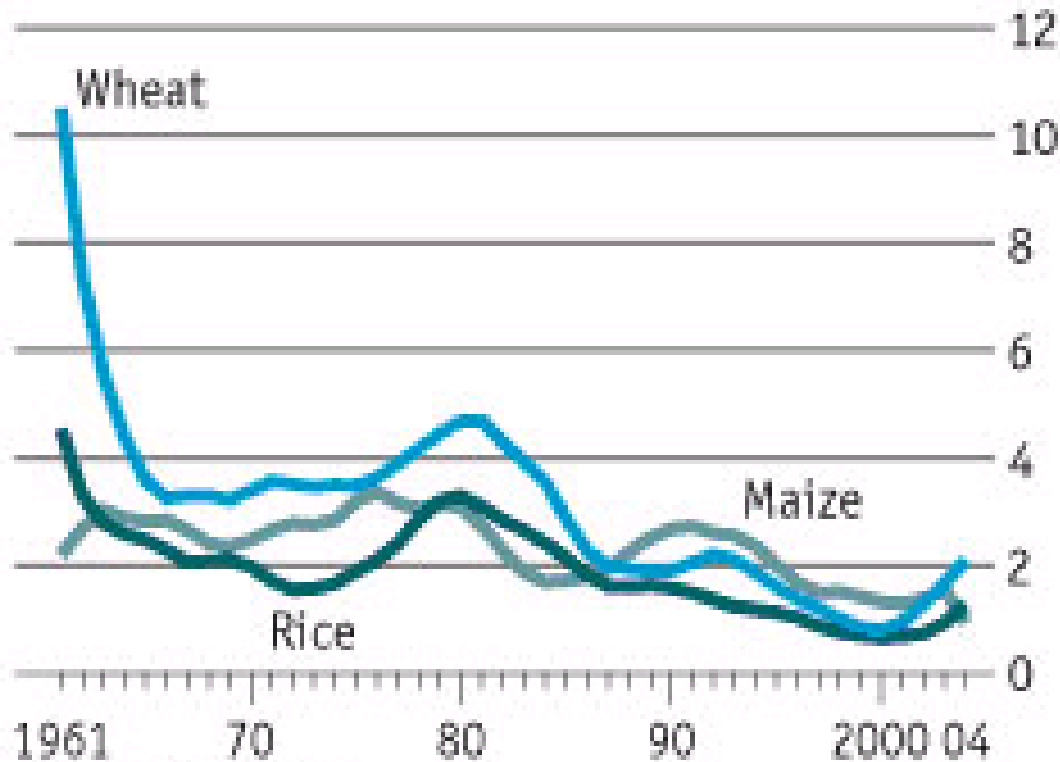


The arable land utilised for permanent cropping is not increasing (Source: ABARE)

## Diminishing returns

2

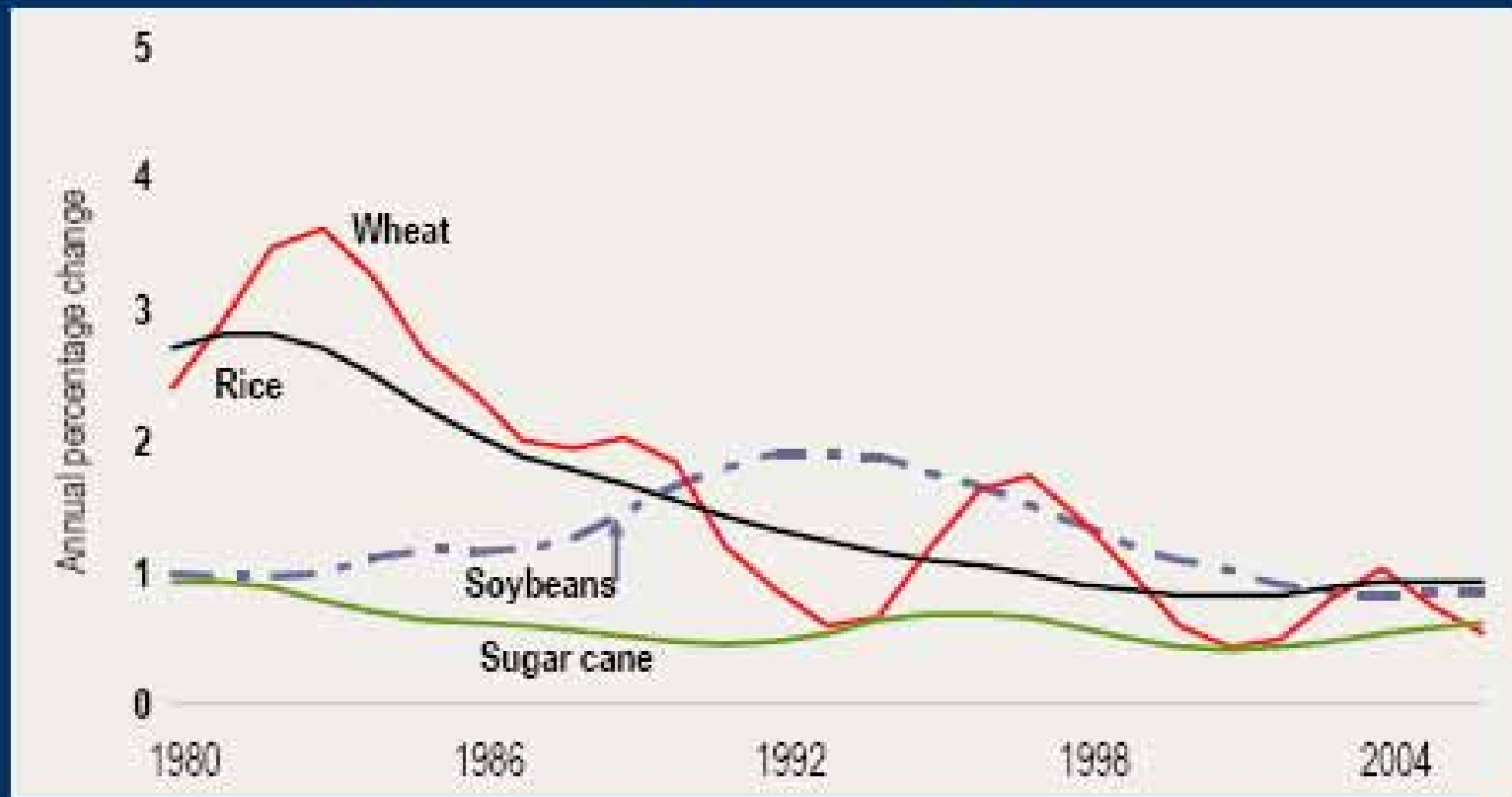
Crop yields in developing countries  
Annual average growth rate, %



Source: World Bank

The average annual yield increase in developing countries has stopped increasing

# Trends in global yields (tonnes per hectare) for the major food crops — annual percentage changes



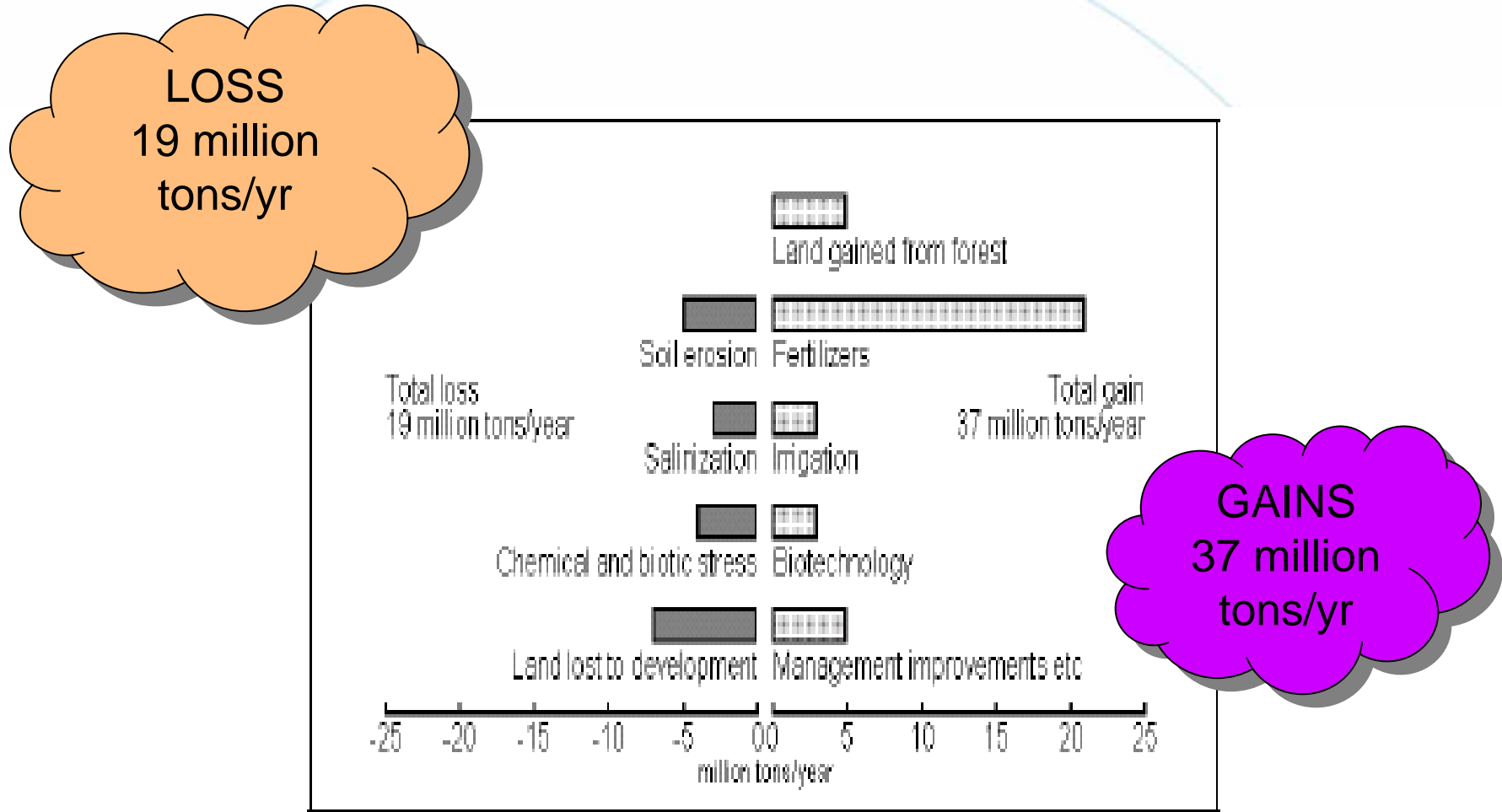


Figure 2. Schematic gains and losses balance out to yield the global food production. (Doos undated)

[Source: Williams et al., (2004)]

# DECLINE IN PRODUCTIVITY GAINS MUST REVERSED

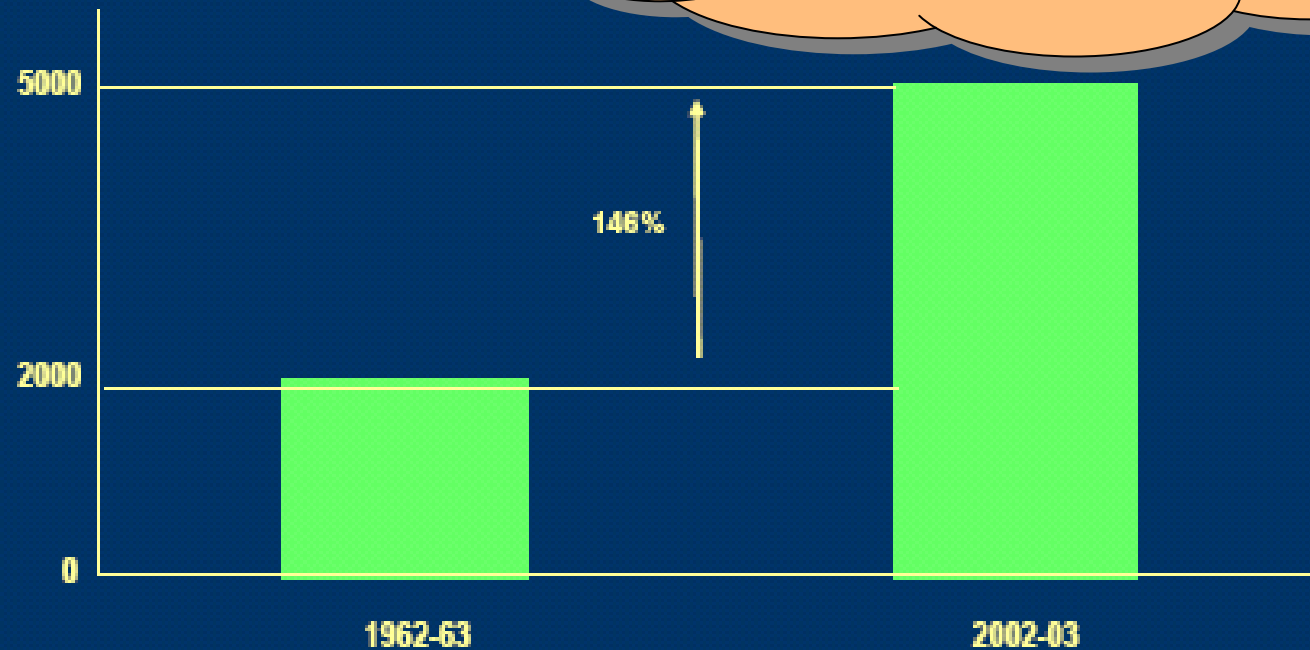
Over 40 years = 1.75% pa  
Currently = 1% pa

**NEEDS TO BE BETWEEN 2-3% pa**

# Milk yields per cow: Australia

BUT ....  
Did we get RESILIENCE  
and NRM Right?

Milk yield per cow (L)



[Source: Andrew Stoeckel CIE]

# “Green Revolution” Is Fading?

The solution was based on high  
input systems..

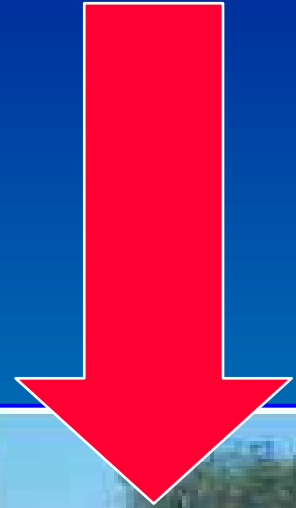
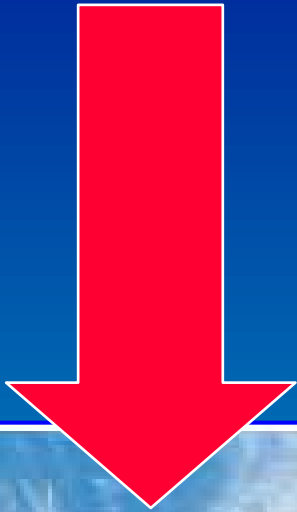
- ....suite of new genetics
- ....sustained by pesticides
- ....fertilizers and water

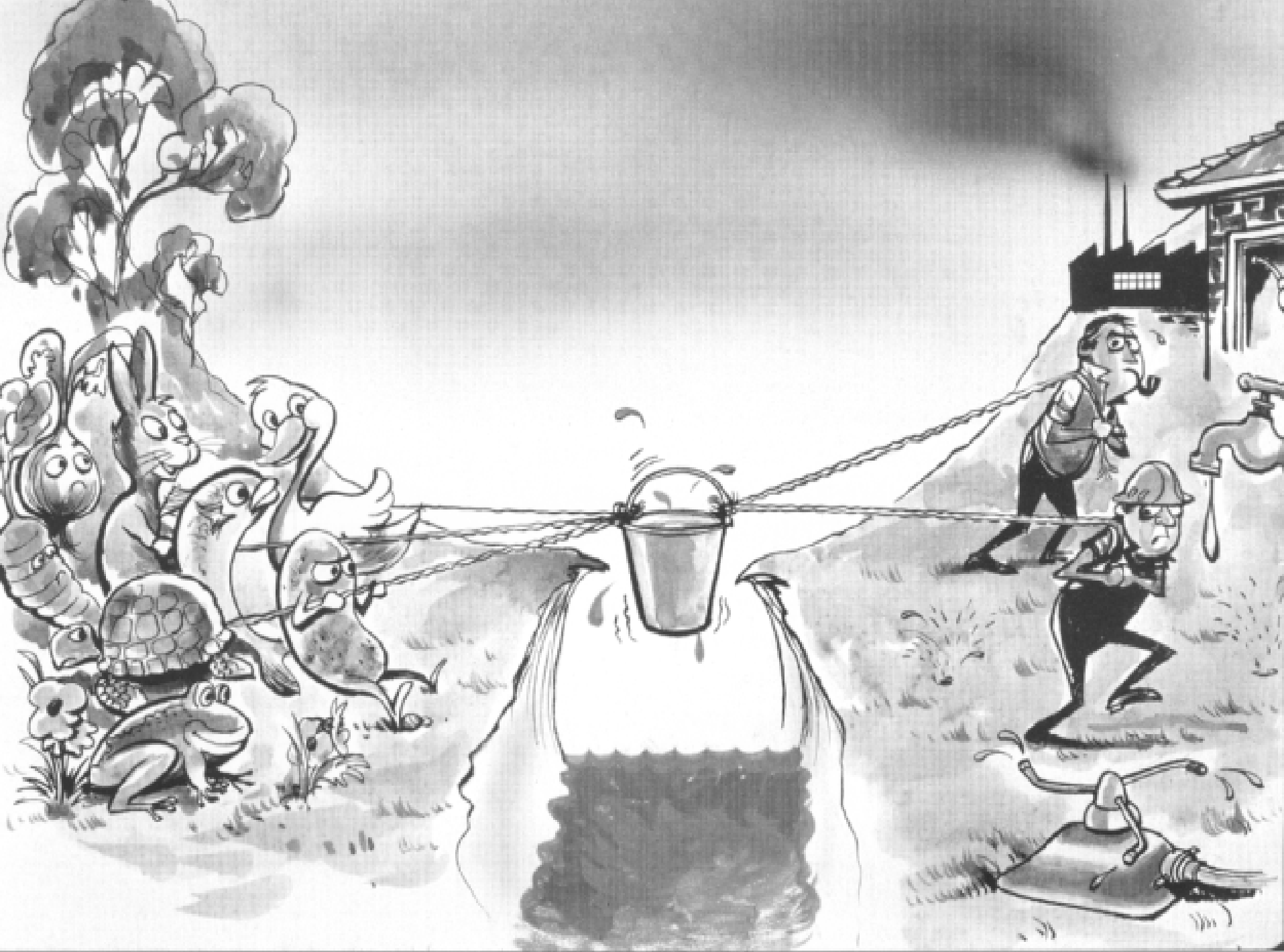
# Food or Environment

**Evidence is mounting that the productivity of these systems cannot be maintained**

- **Productivity is being undermined by water pollution, salinization, soil degradation, pest and weed build-up.**
- **Today 2 billion hectares and 3 billion people are adversely affected by land degradation.**
- **The Green Revolution won't give us the get of jail free card again.**
- **Just as we need to increase productivity again the land and water we rely on is under threat**

# Tension between water extraction and water for river health

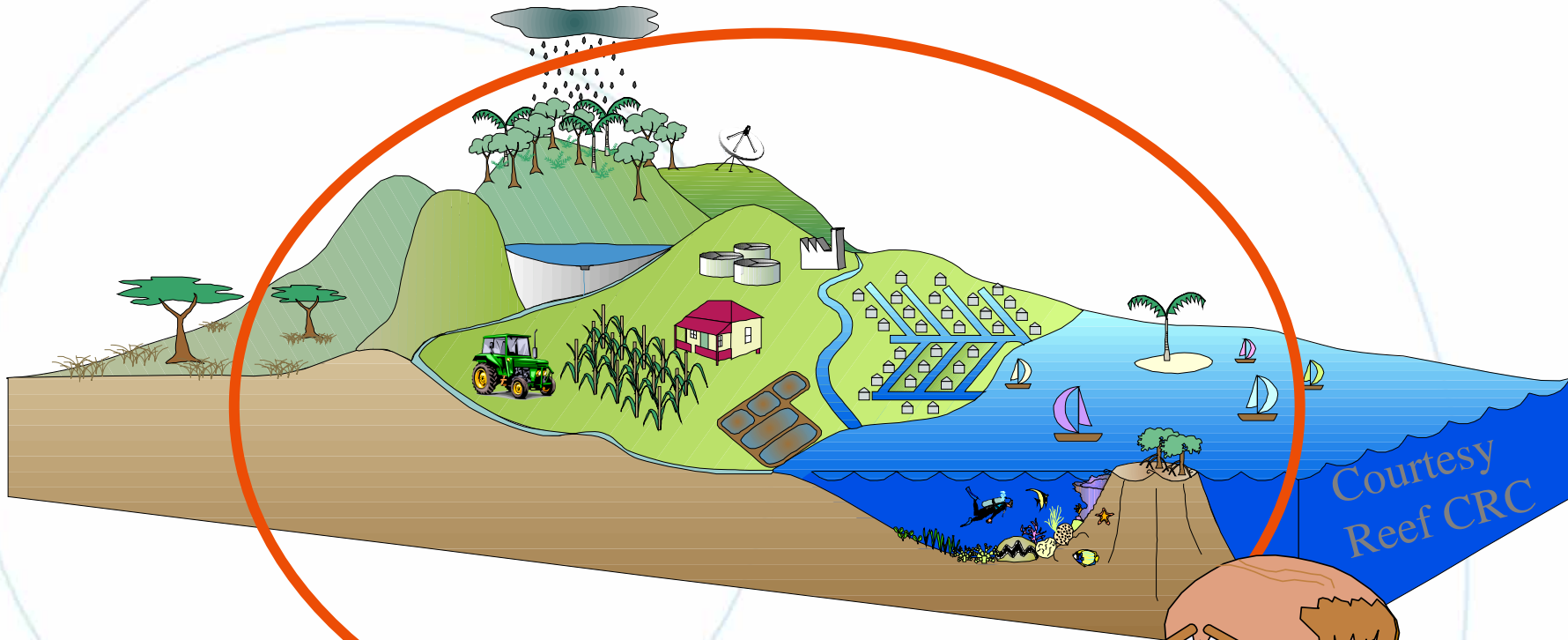




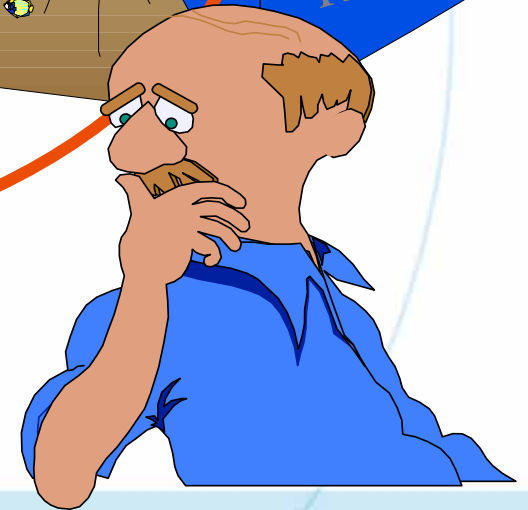
# Whole Systems Science Solutions

## Urgent

- **We've got to look at ecological, energy and water systems as a whole to appreciate the impacts or the footprint of our food on our natural resource base.**
- **This was a core message from the recent International Assessment of Agricultural Science & Technology (IAASTD) report**



**WHOLE SYSTEM  
PLEASE**



# River and Water Resource Management

Water in  
•Irrigation  
•River & Wetlands  
•Groundwater  
ARE ONE

Solutions to  
whole complex  
system  
are needed !!!

Wetlands  
\$

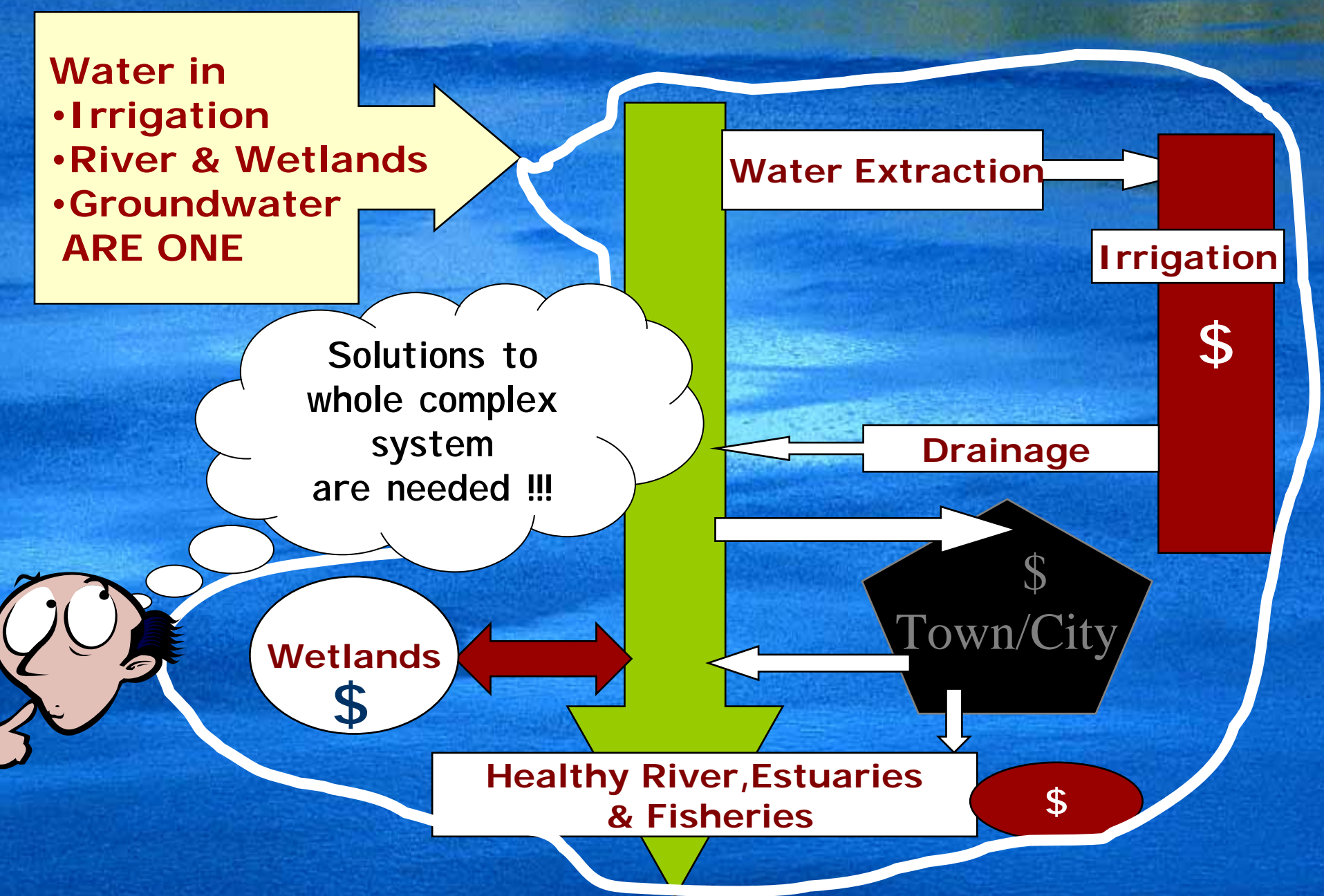
Water Extraction

Irrigation  
\$

Drainage

Town/City  
\$

Healthy River, Estuaries  
& Fisheries  
\$



# Whole Systems Science Solutions

## Urgent

- **It's clear that business as usual is not an option.**
- **For too long, the emphasis of agricultural science has been on delivering innovation and technologies to increase farm-level productivity.**
- **Too little attention has been paid to a more holistic integration of natural resource management with food and nutritional security (IAASTD, 2008).**
- **Fortunately, there is increasing recognition that this current mode of operation requires revision.**

# Whole Systems Science Solutions

## Urgent

- **we need science and technology systems that enhance sustainability whilst maintaining and increasing productivity.**
- **we desperately need improved understanding of the landscape function in which we farm.**
- **we need to better appreciate soil-plant-water/nutrient dynamics and the agro-ecological function of mosaics of crops and natural habitats.**

# Pricing Food for Sustainability

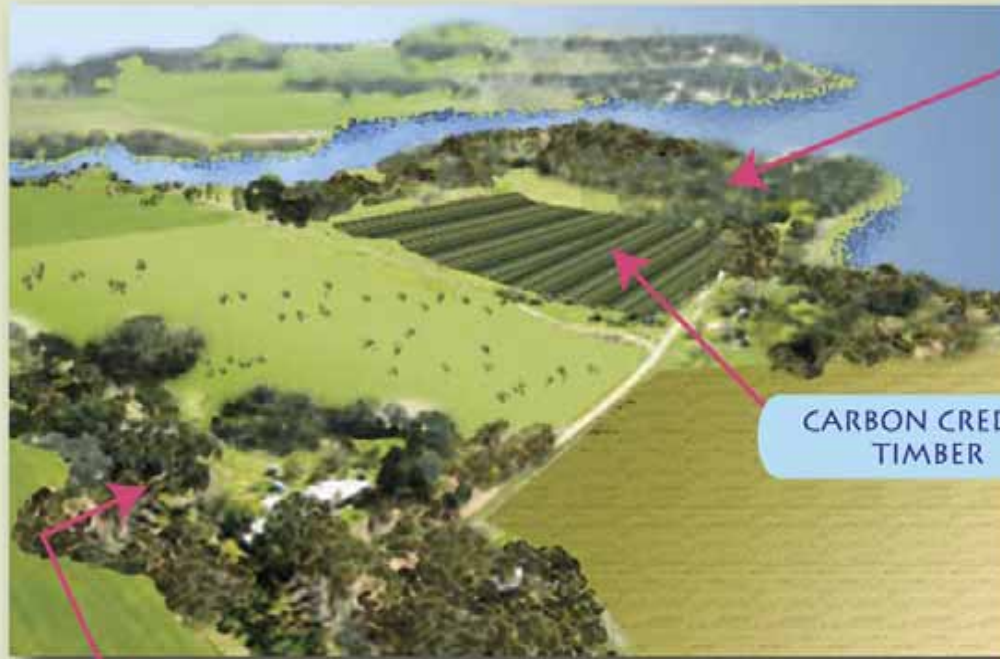
- **We need governments to adopt policies that create incentives for sustainable practices and costs to the environment being internalised.**
- **Traditionally, food prices do not include the cost of environmental damage. The natural resource base (land, water, biodiversity) for agriculture continues to suffer.**
- **We can't afford to keep running down the systems that feed us.**

# Pricing Food for Sustainability

- **For as long as the cost of maintaining and improving the natural resource base in agricultural systems is not included in the price of food, farmers will never be able to farm sustainably and profitably.**
- **We need market and trade policies that remove perverse subsidies.**

# Pricing Food for Sustainability

- **Rewarding the provision of ecosystem services is a good start**
- **We need investment in the economic valuation of ecosystem services**
- **With a market for these services, farmers in the future will not only be paid for the goods they produce but also for the services they deliver through the management of healthy landscapes, rivers, wetlands and estuaries for the public good**



BIODIVERSITY CREDITS

CARBON CREDITS  
TIMBER

WATER MANAGEMENT/  
SALINITY CREDITS

RENEWABLE ENERGY

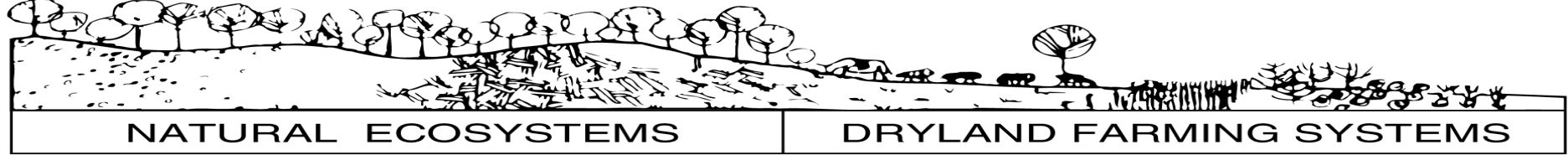


COMMODITY	BUSINESS SHARE %	CLIENT
WHEAT	40	WORLD MARKET
WOOL	15	WORLD MARKET
TIMBER	10	PULP WOOD, BIOMASS ENERGY, SPECIALTY TIMBER
CARBON CREDITS	7.5	STEEL MILL
SALINITY CREDITS	7.5	COST SHARING FOR CATCHMENT MANAGEMENT
WATER SUPPLY MANAGEMENT	15	WATER SUPPLY COMPANY
BIODIVERSITY CREDITS	5	PUBLIC/PRIVATE TRUSTS

# A future form of sustainable agriculture

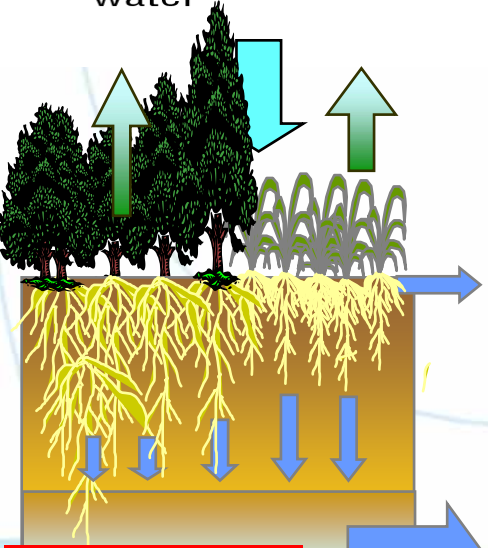
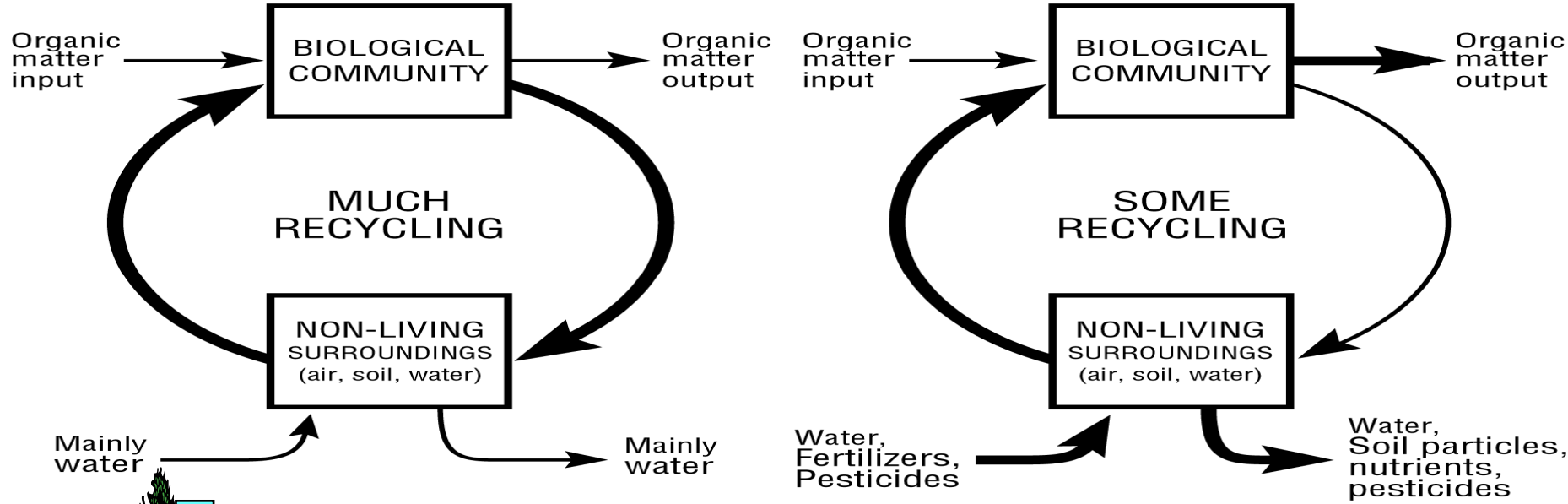
# Challenges for Agricultural Science

- **Agriculture, by its very nature, exploits the natural resource base.**
- **The nutrients in our food were once part of an ecosystem.**
- **We need a system that has a closed loop,**
  - **we can't afford to leak nutrient /carbon**
- **We need one that is resilient, however...that can cope with a certain amount of nutrient harvesting and yet stays healthy.**

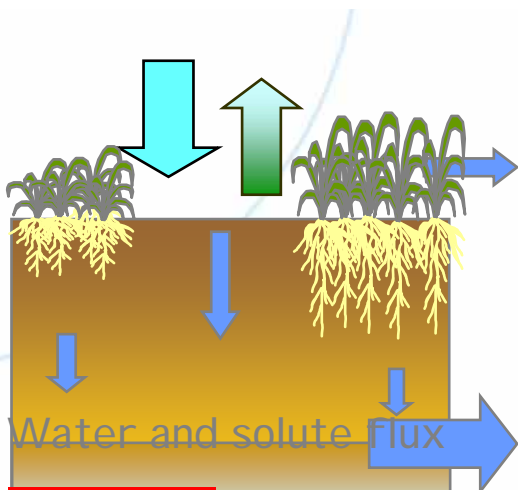


NATURAL ECOSYSTEMS

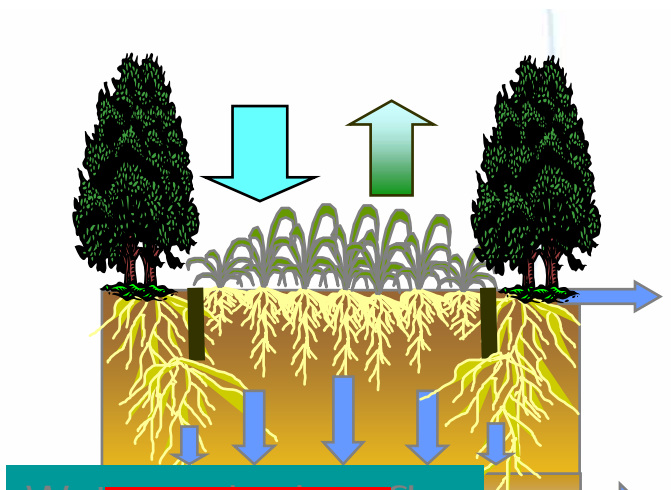
DRYLAND FARMING SYSTEMS



Segregate



Rotate



Integrate

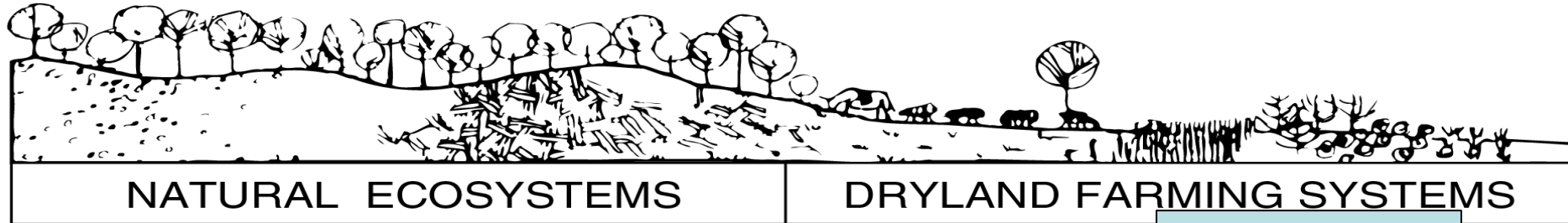
# Challenges for Agricultural Science



Sorghum established with minimum tillage and a trash blanket is an example of improved farming practice to cope with climate variability and improve soil health. Development like this is needed to increase food security and reduce damage to the environment. Photo: Matt McKenzie

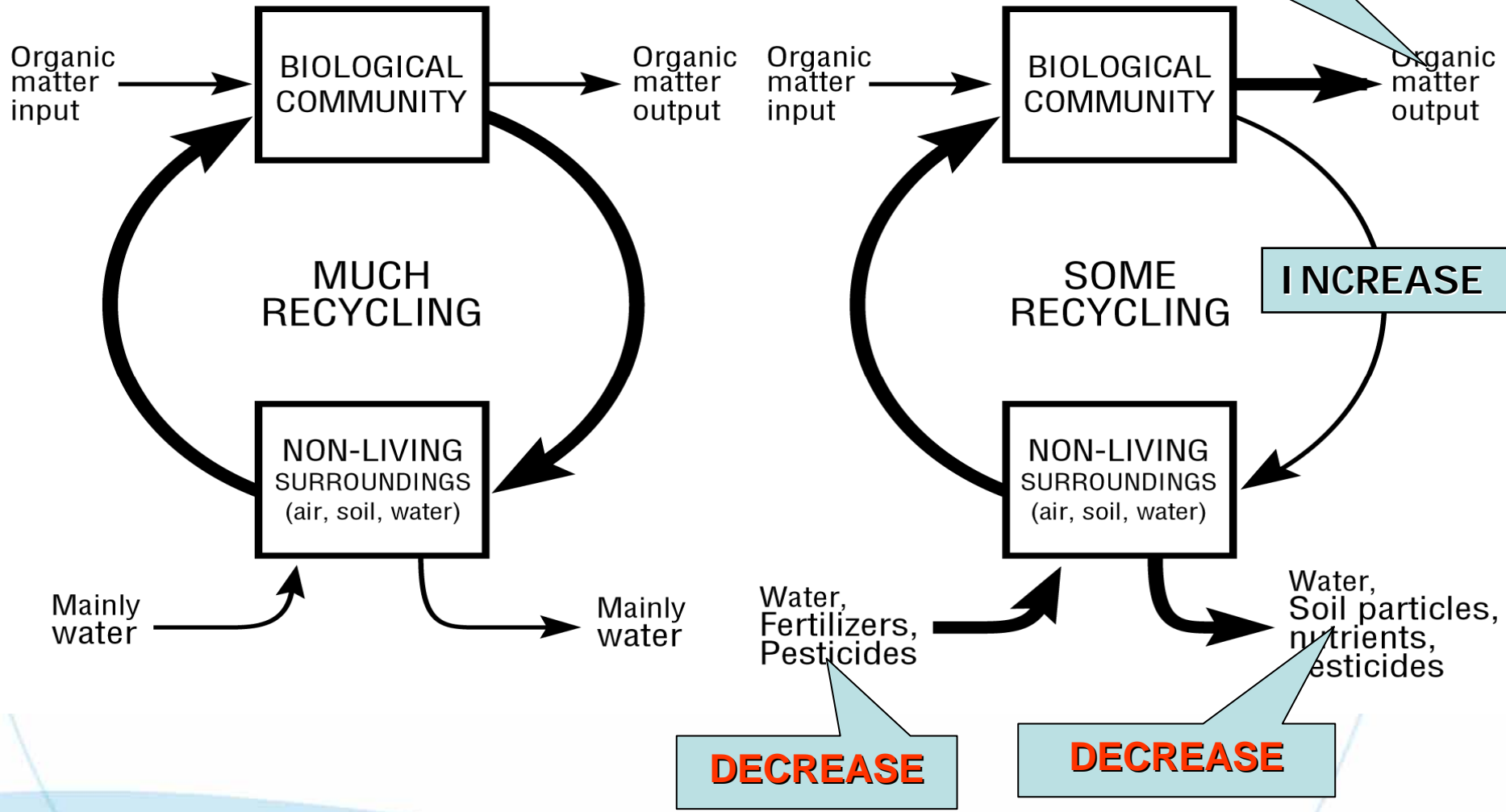


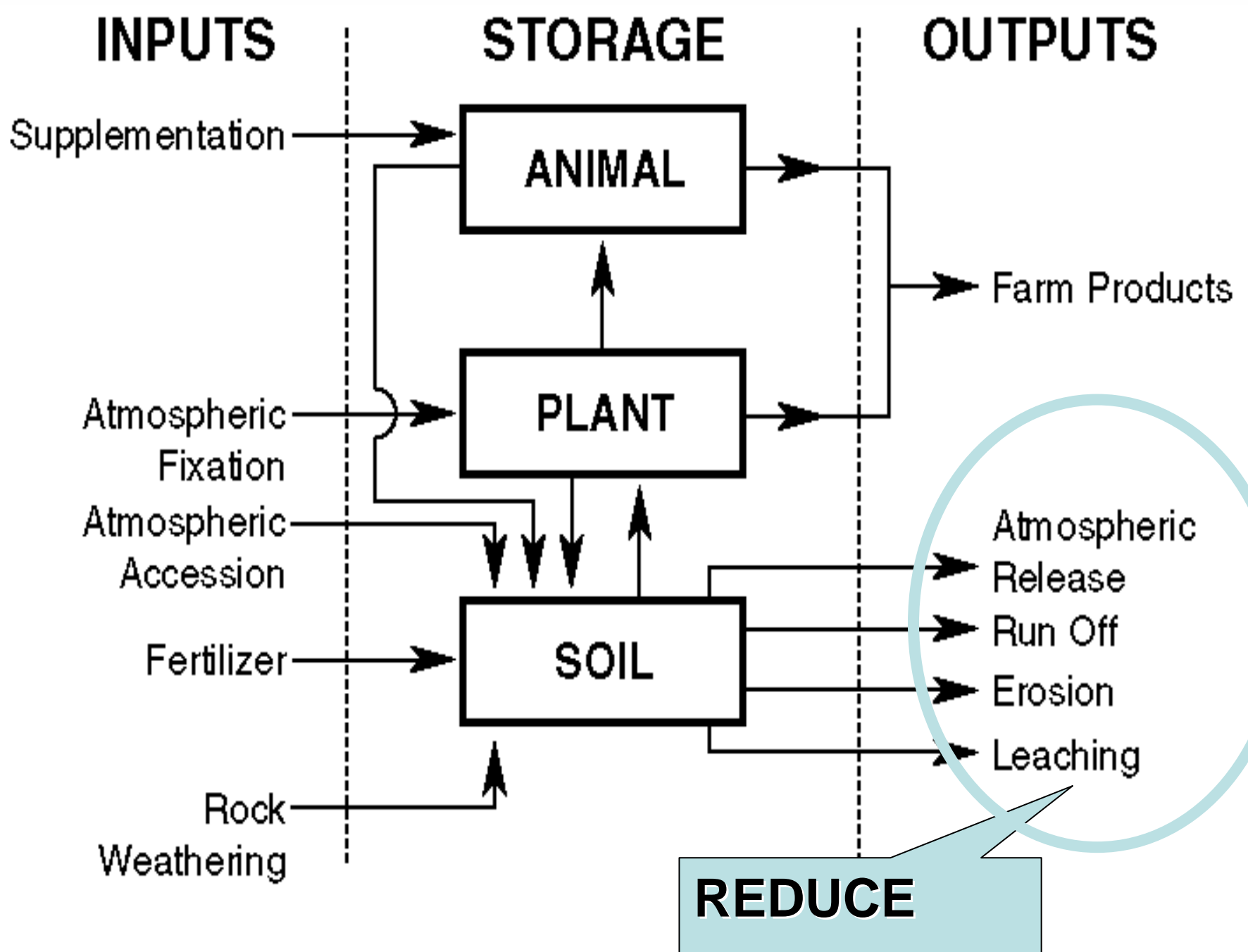
Millet sown into native pasture, helps to integrate productivity with the ecological processes of the landscape. Photo: Matt McKenzie



**NATURAL ECOSYSTEMS**

**DRYLAND FARMING SYSTEMS**





# Challenges for Agricultural Science

- **Stepping off the treadmill is hard but it is necessary if we are to have both healthy and productive landscapes.**
- **Can we find new and maybe rediscover agroecosystems where nutrient loss beyond that in the food or fibre is zero?**
- **Does achieving such agroecosystems mean a lower rate of productivity to close this loop?**
- **Is this a measure of the cost of food when the resource base is maintained?**

# Challenges for Agricultural Science

- **Advances are being made in tapping nutrient sources that do not depend on fossil fuels but there is much more to be done .**
- **We need biological substitutes for agrochemicals and biocontrols of current and emerging pests and pathogens.**
- **We must address agricultural production as an agro-ecosystem that is part of the larger-scale ecosystem and landscape processes.**

# Challenges for Agricultural Science

- **New crop and forage species that are bred for specific conditions will continue to be important.**
- **BUT...Improved genetics for yield cannot be expressed if nutrient, water and disease are constraints.**

# Challenges for Agricultural Science

- **Finding solutions to biophysical problems posed by building a resilient agriculture are scientifically demanding**
- **They require new ways of doing science within the imperatives of rural communities facing radical environmental, social and economic changes.**
- **the need for the research and development of farming systems that integrate productive land uses into the landscape in a way that is compatible ecological, hydrological and biogeochemical processes**

# Some Ways Forward


- **Serious food crisis in world**
- **Supply and demand side factors responsible**
- **Hits poorest hardest**
- **Reform agricultural research to improve BOTH**
  - **Field productivity and**
  - **farm to catchment NRM**
- **Needs of large and small scale farming**

# Some Ways Forward

- **Expand this reformed R&D effort**
- **Australian Science has important place to play**
- **Reform of markets and regulations to ensure cost of food includes the costs to natural resources and environment**
- **Orientate to a more market-based system of production, distribution and consumption of food**

# **Conclusion**

- **It is a time of Change.**
- **We cannot afford to be “asleep at the wheel!”**
  - **It is a time for turning Challenges into Opportunities. We will have to make choices. It will pay to be on the front foot.**
- **Adaptation and innovation will be important.**
  - **It is not the time to panic!**
  - **But it is the time to think and change.**



**It is possible to build resilient agriculture  
that is in harmony with the planets  
ecosystems and landscapes**