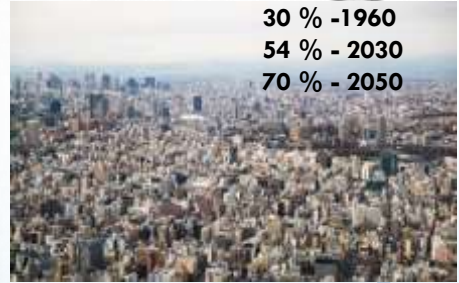
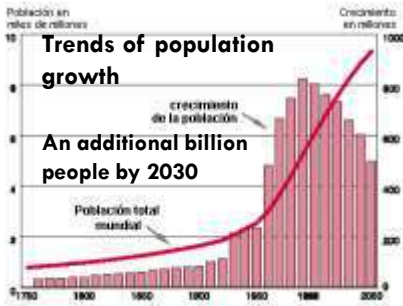


International Commission on Irrigation and Drainage

NEXUS WATER – ENERGY – FOOD

Dra. Margarita M. González Brambila



Increasing urbanization +



Climate change

Water, Food, Energy





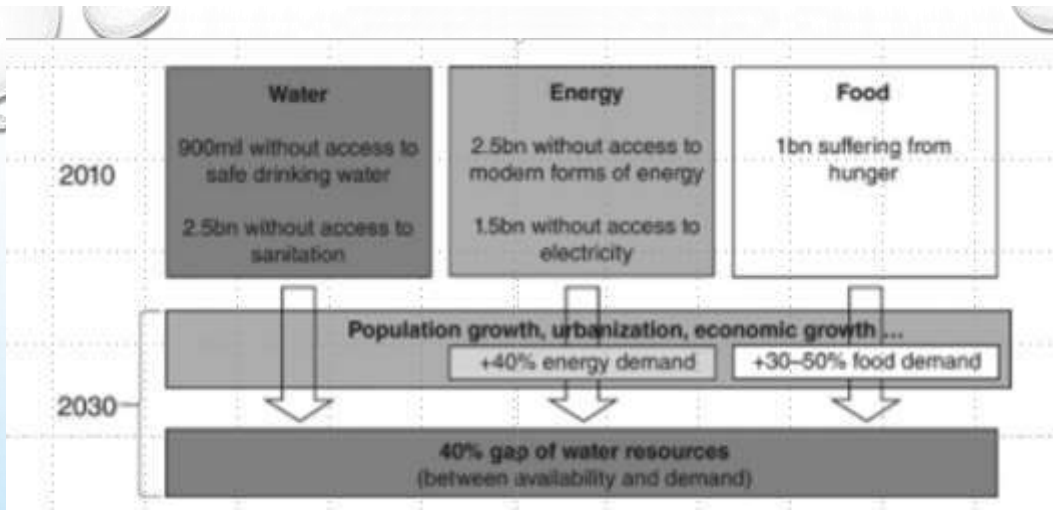
- 1.1 BILLION – ACCESS TO SAFE WATER
- 1.0 BILLION – UNDERNOURISHED
- 1.5 BILLION – ACCESS TO MODERN FORMS OF ENERGY

Single sectors approaches limiting our ability to provide basic water, food and energy services to the poorest in the world, as well as failing to cope with the climate change.



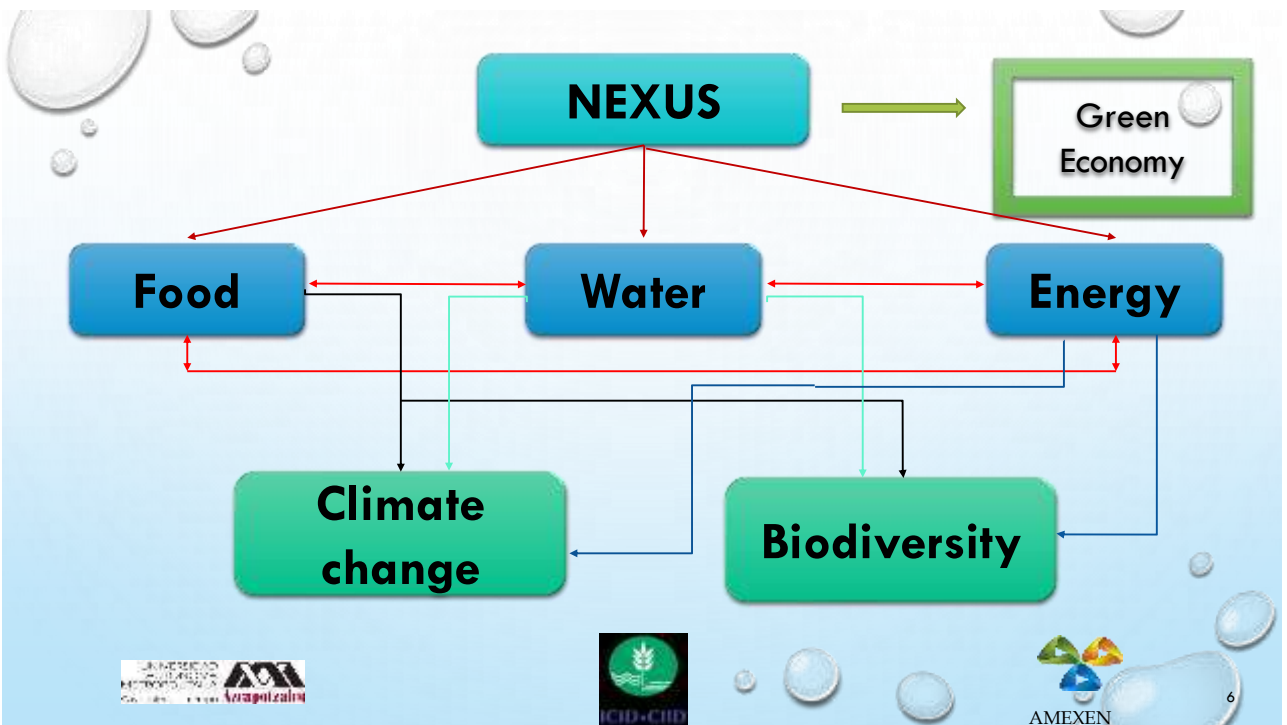
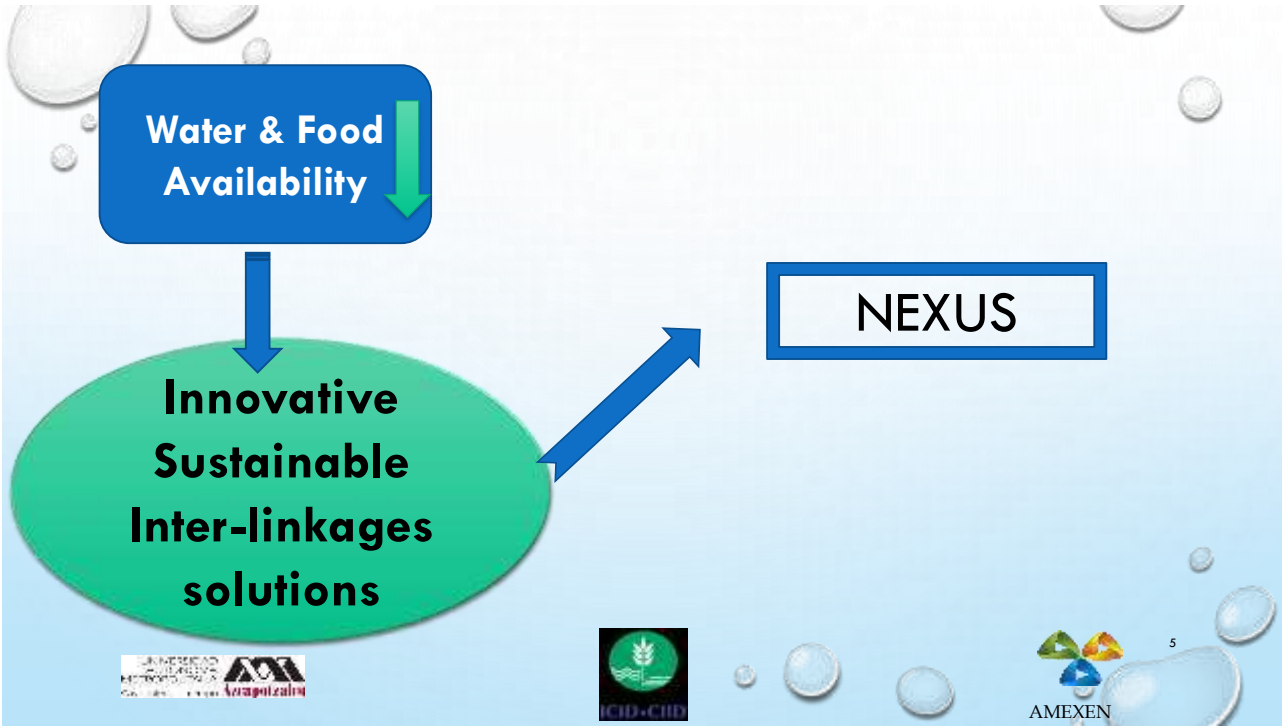
Interlinked and interdependent process

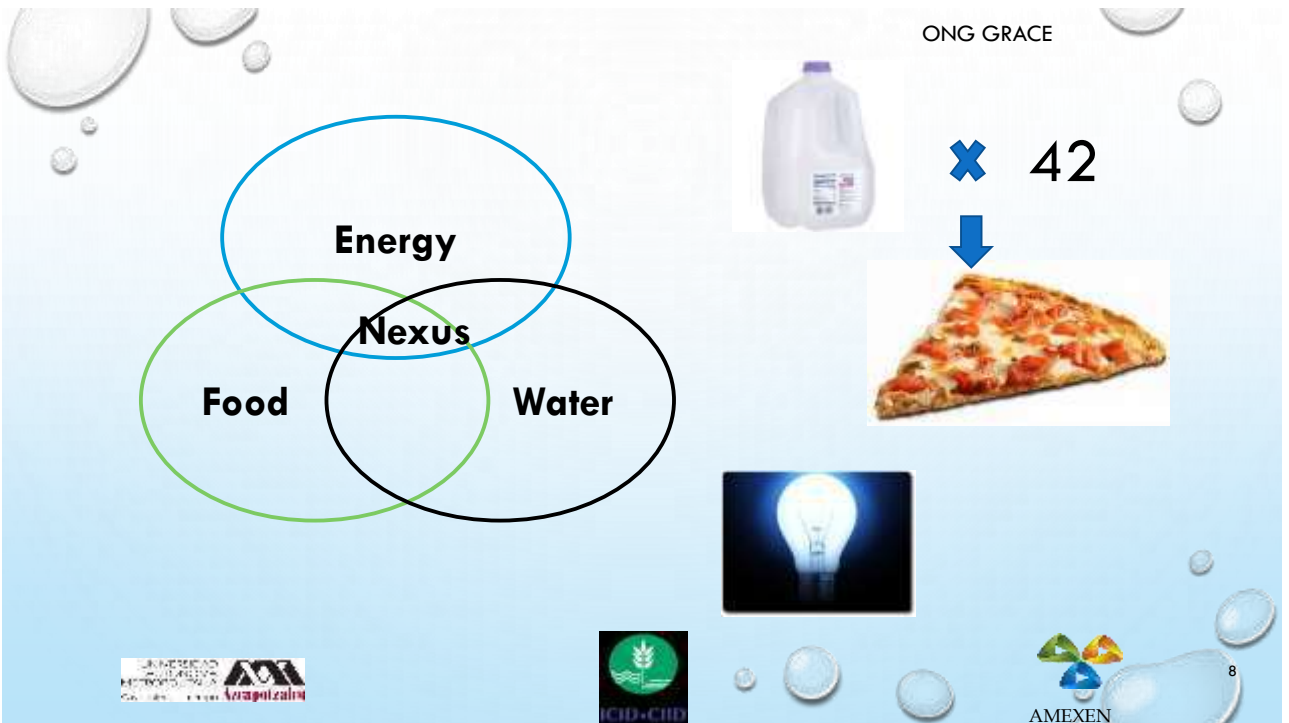
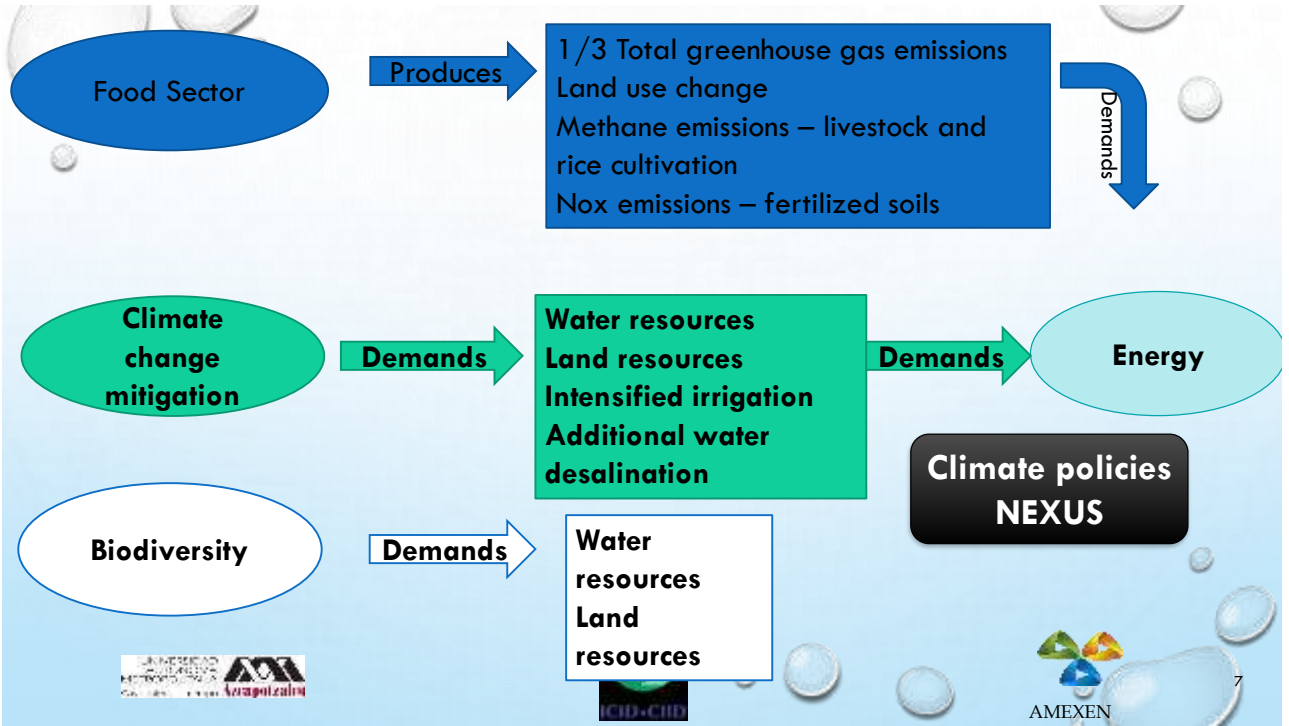
Innovative and sustainable solutions

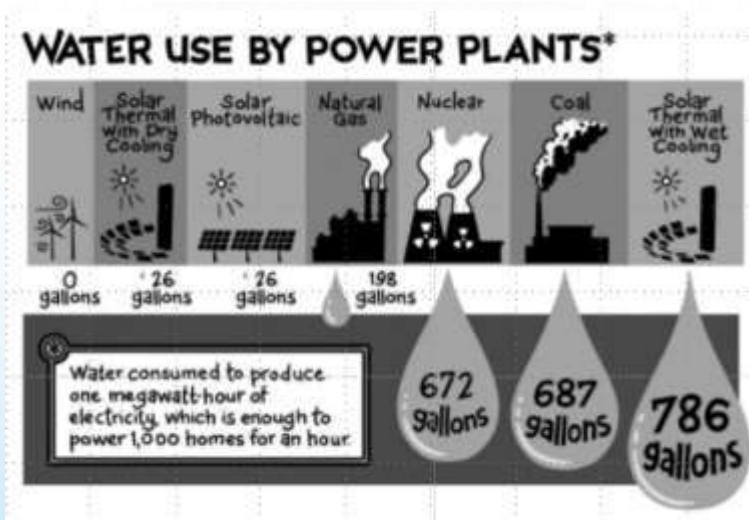


The Water, Food, Energy and Climate Nexus, Dodds, Bartran, 2016

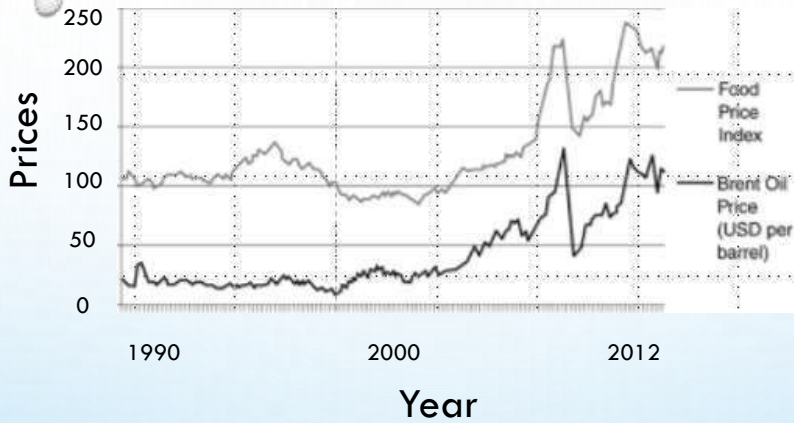








National renewable energy laboratory, illustration by Andy Warner






FAO Food Price Index, EIA Brent Oil Price






SOME INTER-LINKAGES BETWEEN CLIMATE, LAND/FOOD, ENERGY AND WATER

Impacts of on	Climate	Land/food	Energy	Water
Global warming	Increase global temperature	Decrease agriculture productivity and increase water demand	Increase the energy needs for cooling and heating, and impacts the power potential	Decrease water availability and increase the droughts and floods frequency
Land use/Food production	Increases greenhouse gas emissions. Fertilizer and pesticide production		Energy is needed for water pumping, fertilizer and pesticide production, agricultural machinery and food transport	Increased water demand due to intensification of agriculture and affects the N/P cycles

CLEW NEXUS INTER-LINKAGES

Impacts of on	Climate	Land/food	Energy	Water
Energy	Fuel combustion produces Greenhouse gases emissions and air pollution	Land use for biofuels and renewable energy technologies. Crop/oil Price correlation		Change in river flow, evaporation in power plant, biofuels crop irrigation, fossil fuel extraction
Water	Changes in hydrological cycles affect local climates	Changes in water availability for agriculture and growing competition for it affect food production	Water availability for biofuels, energy use for desalination and storage of renewable energy	

- **AGRICULTURAL, WATER, ENERGY, INDUSTRIAL AND CLIMATE POLICIES INFLUENCE EACH OTHER AND JOINTLY DETERMINE OUTCOMES FOR PEOPLE AND THE ENVIRONMENT, CREATING COMPLEX SOLUTIONS AND POTENTIAL SYNERGIES (RINGLER ET AL ., 2013).**
- **WATER–ENERGY–FOOD SECURITY (WEF) NEXUS IS A CONCEPTUAL FRAMEWORK THAT RECOGNIZES SUCH INTERCONNECTIONS AMONG THESE BROAD DOMAINS AND SEEKS TO DEVELOP JOINT SOLUTIONS THAT MITIGATE THE PROBLEMS AND PROMOTE SYNERGIES AMONG THEM (HOFF, 2011).**



13

NEXUS SCIENTIFIC RESEARCH THINKING

Multidisciplinary Research

Combine insights from different knowledge areas

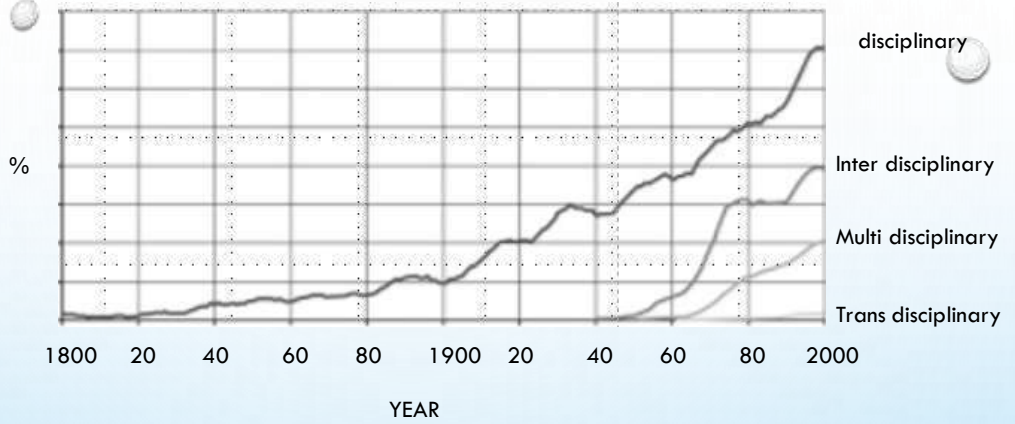
Interdisciplinarity Research

Integrate different disciplines more closely through collaboration and mutual cross-fertilization of concepts, methods and data. Crossing boundaries between disciplines

Trans-disciplinarity Research

A step further than interdisciplinary research by also embracing the inputs and ideas from relevant, non scientific, stakeholders into research agenda





Types of research by their disciplinary

The Water, Food, Energy and Climate Nexus, Dodds, Bartran, 2016



Land degradation



1/3 of global land area



Food, energy, land, water, mineral and financial markets

→ affecting

2 billion people



=

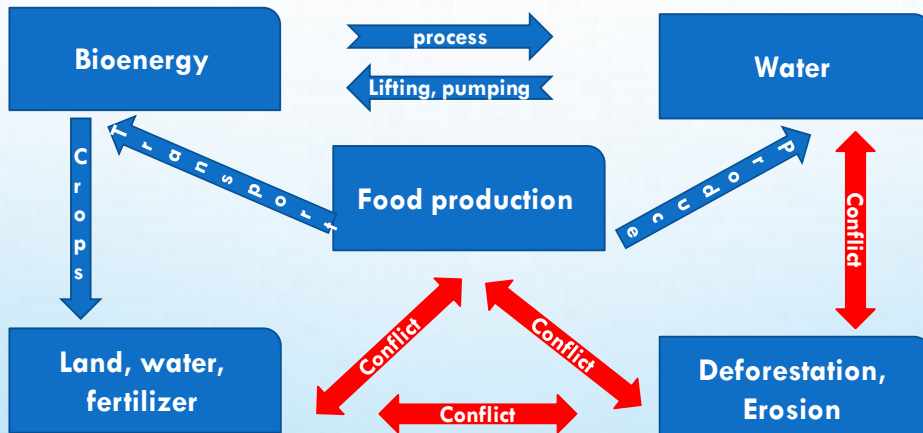


EXTERNALITIES

Research on how economies would be shaped into a post fossil fuel age



An example. Bioenergy



NEXUS FUNDAMENTALS

- **PROVIDE A FRAMEWORK TO ORGANIZE, FROM BOUNDARIES AROUND THE ENQUIRY, SET GENERAL RELATIONSHIPS, DEFINE SCOPES AND LEVELS OF THE RESEARCH**
- **OPTIMIZE PUBLIC POLICY & PUBLIC INVESTMENTS ACROSS SECTORS.**
 - **IDENTIFY INCENTIVES AND REGULATORY REGIMES**
 - **REMOVING MARKET FAILURES**
 - **MINIMIZING TRANSACTION COSTS & NEGATIVE EXTERNALITIES**

TRANSACTION COSTS

- SEARCH AND INFORMATION COSTS
- BARGAINING COSTS
- MONITORING AND ENFORCEMENT COSTS

EXTERNALITIES

- COSTS OR BENEFITS AFFECTING AN UNRELATED THIRD PART
- COULD BE POSITIVE OR NEGATIVE

NEXUS FRAMEWORK

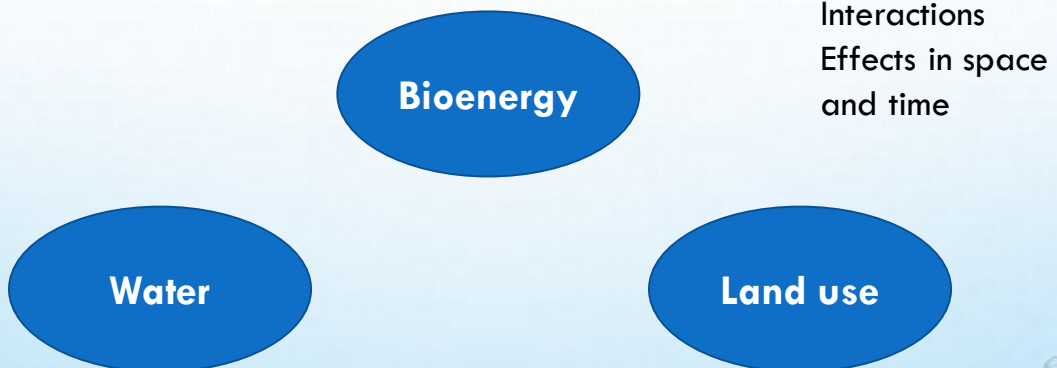
- MINIMIZE TRANSACTION COST AN NEGATIVE EXTERNALITIES
- PROMOTE SYNERGIES BOOSTING POSITIVE EXTERNALITIES

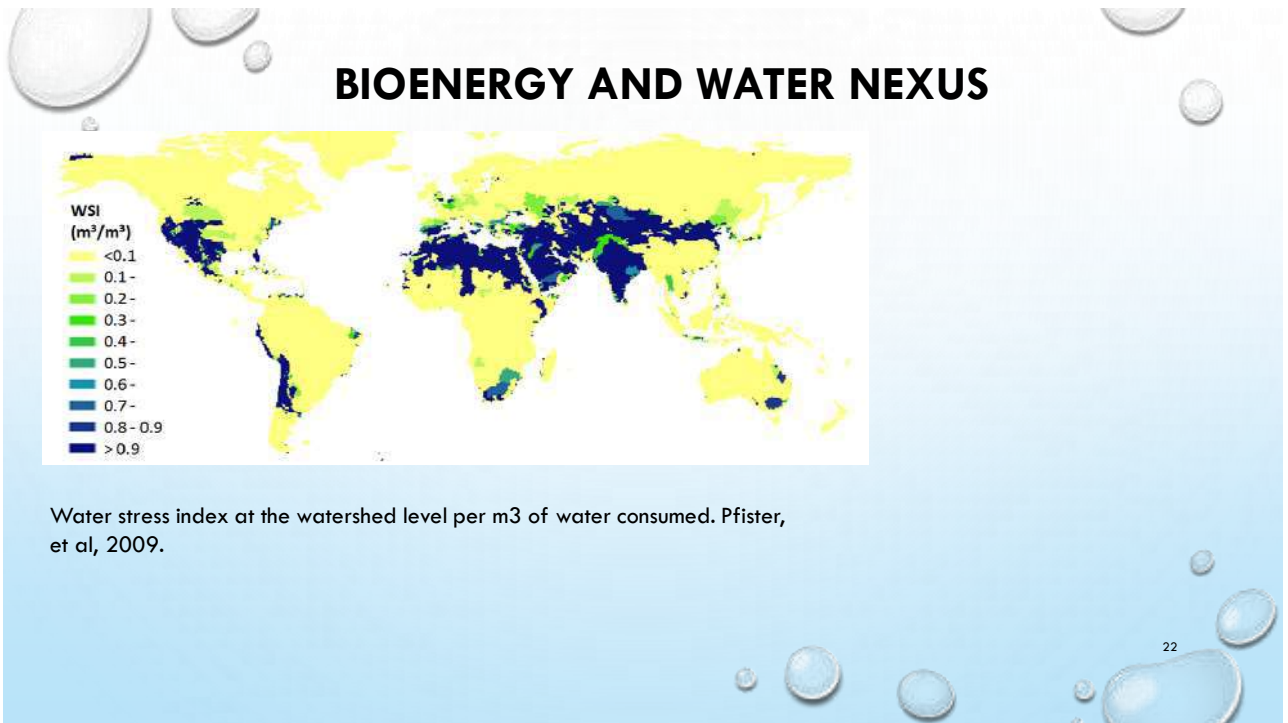
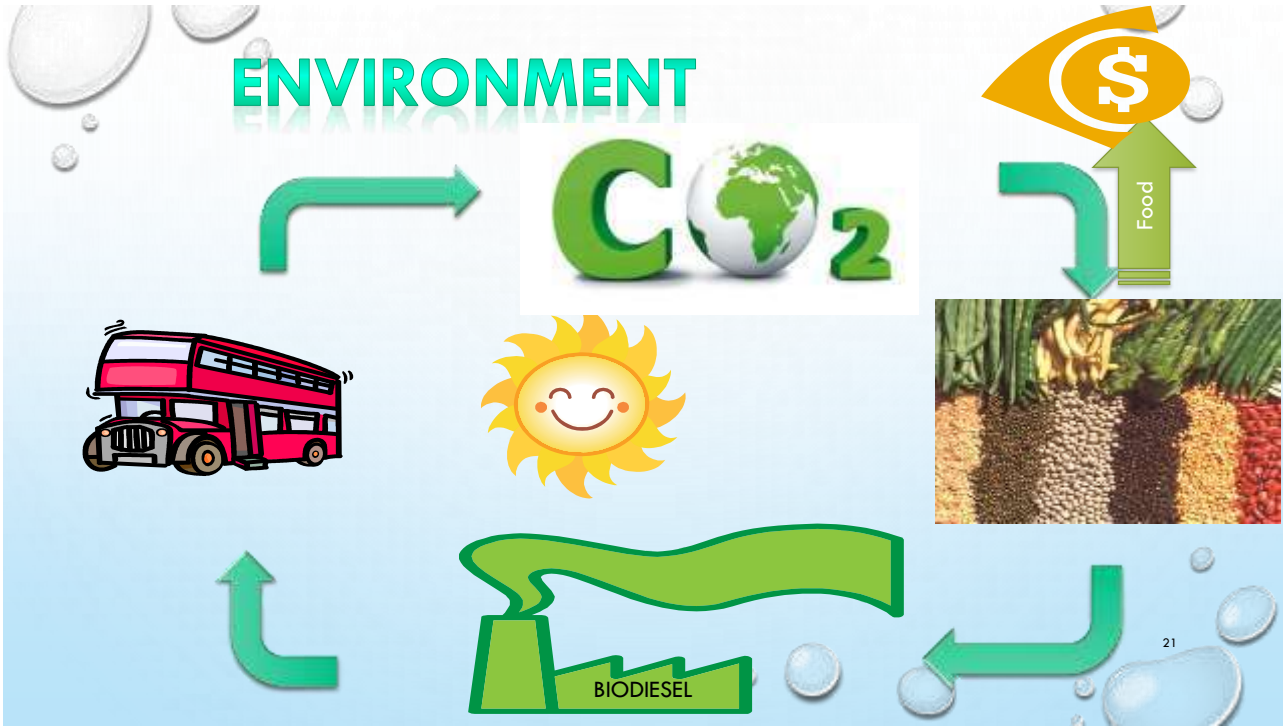
KEY ELEMENT

- FOCUS ON SOLVING SUSTAINABLE DEVELOPMENT WITH PEOPLE AT THE CENTER OF ITS PREOCCUPATIONS



BIOENERGY AND WATER NEXUS





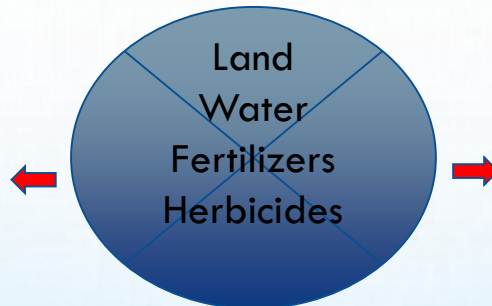
Biofuels – FIRST GENERATION



Food



23



24

Biofuels – SECOND GENERATION

Raw material – Lignocellulosic materials

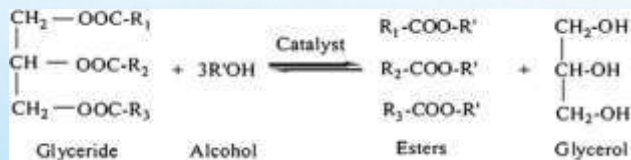
Some in research development
now

- Biohydrogen
- Biomethanol
- Dimetil formamida (C₃H₇NO)
- Dimetil éter
- Biohydrogen – diesel Mixes
- Alcoholes mixes
- Diesel of wood

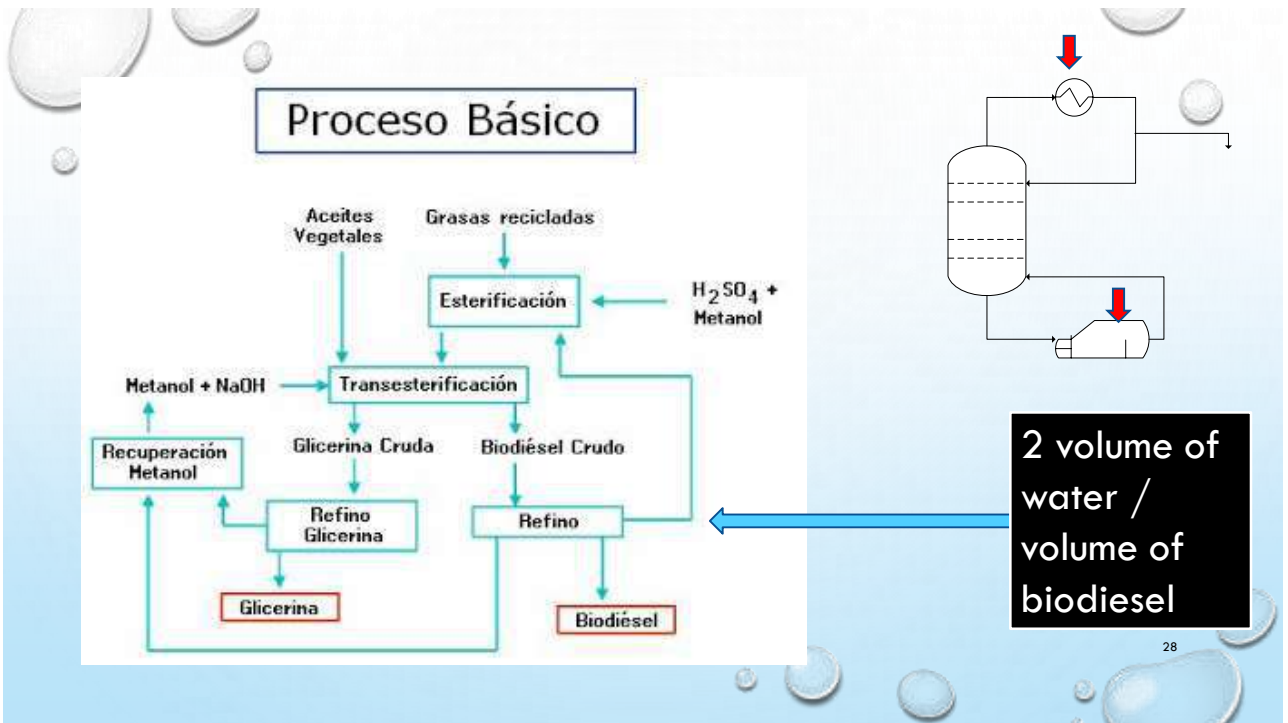
Bagasse	Crop stubble	Wood & forest residues	Landfill wastes
			
The stem residue remaining after crushing to remove sugar-rich juice from sugar cane	The residue remaining after the harvest of crops such as wheat, barley and lupins	Bark, sawdust, pulpmud (wood used for processing into paper and related products) and harvest residues	Includes municipal, commercial and industrial solid wastes, as well as construction and demolition wastes

25

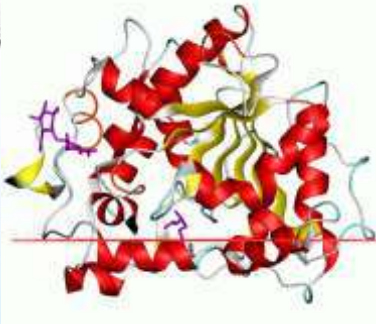
Biodiesel



26

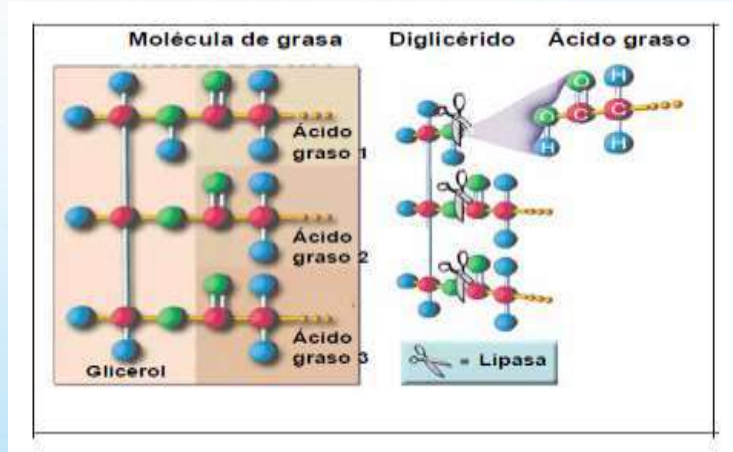


Enzimatic reaction

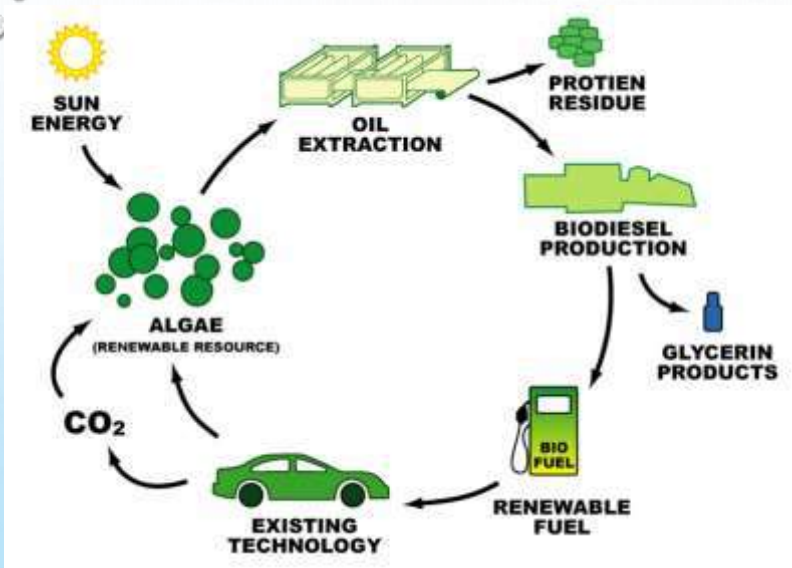


Lipase enzyme

Yields are lower
 Bio reaction is slower
 Enzymatic deactivation
 Enzymatic immobilization



Biofuels – 3rd GENERATION



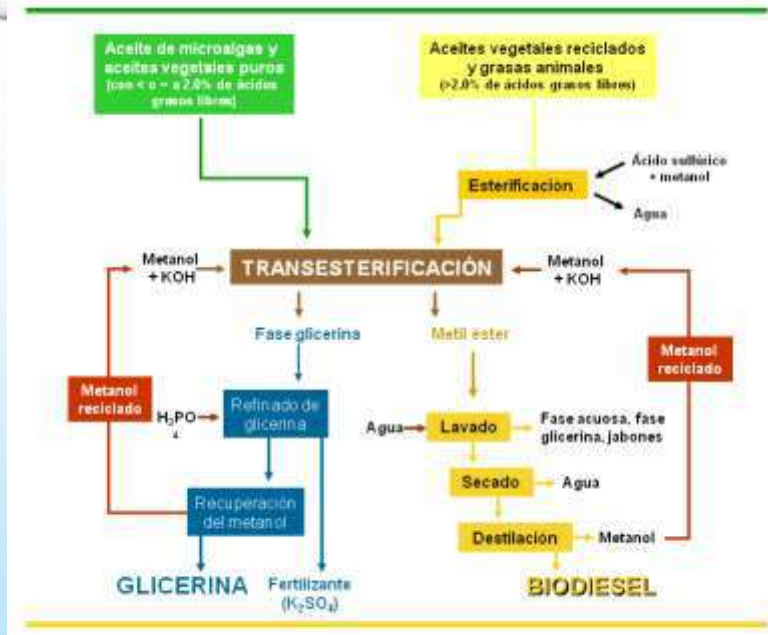
We need water, but we can use marine algae (sea water).

CONCLUSIONS

- THE WATER-ENERGY-FOOD SECURITY NEXUS IS A CONCEPTUAL FRAMEWORK THAT RECOGNIZES INTRICATE INTERCONNECTIONS AMONG THESE.
- SEEKS TO DEVELOP JOINT SOLUTIONS THAT MITIGATE THE PROBLEMS RELATED AND PROMOTE SYNERGIES.
- IT IS REALLY IMPORTANT TO IDENTIFY THE PROBLEMATIC WE ARE TRYING TO SOLVE, WITH ALL THE APPROACHES NEXUS GIVE US.
- IT IS REQUIRED TO OVERVIEW SCIENCE ORGANIZATION AN MANAGEMENT, INCLUDING SCIENCE TRAINING, SCIENTIFIC PUBLISHING AND SCIENCE FUNDING.
- NEXUS PRACTICE REQUIRE OPTIMIZING INVESTMENTS IN NEXUS RATHER TAN MAXIMIZING ISOLATED SOLUTIONS.
- AND IT NEEDS THE PARTICIPATION OF ALL OF US



Thank you very much



33