Agro-Bio Innovations for Regional Growth

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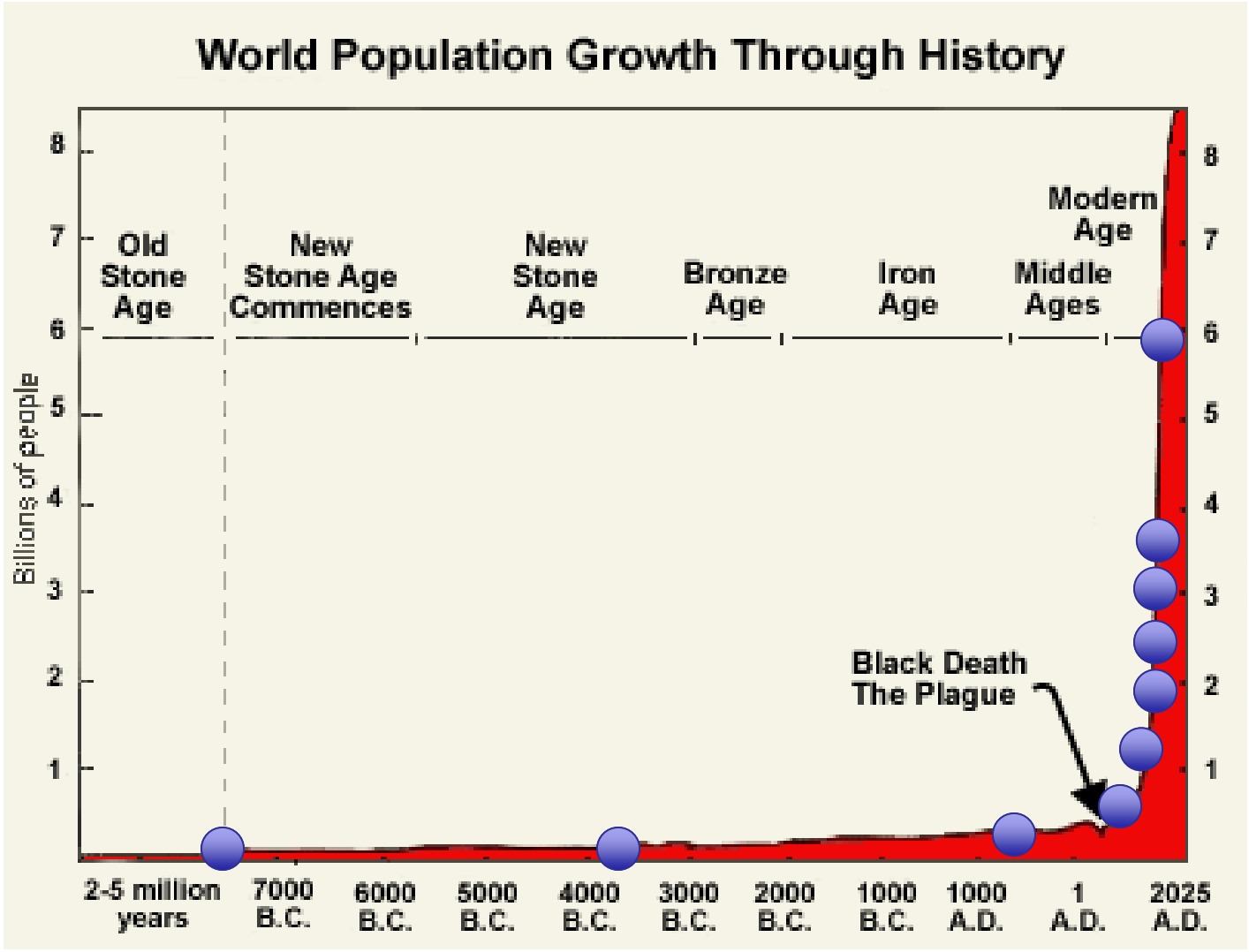
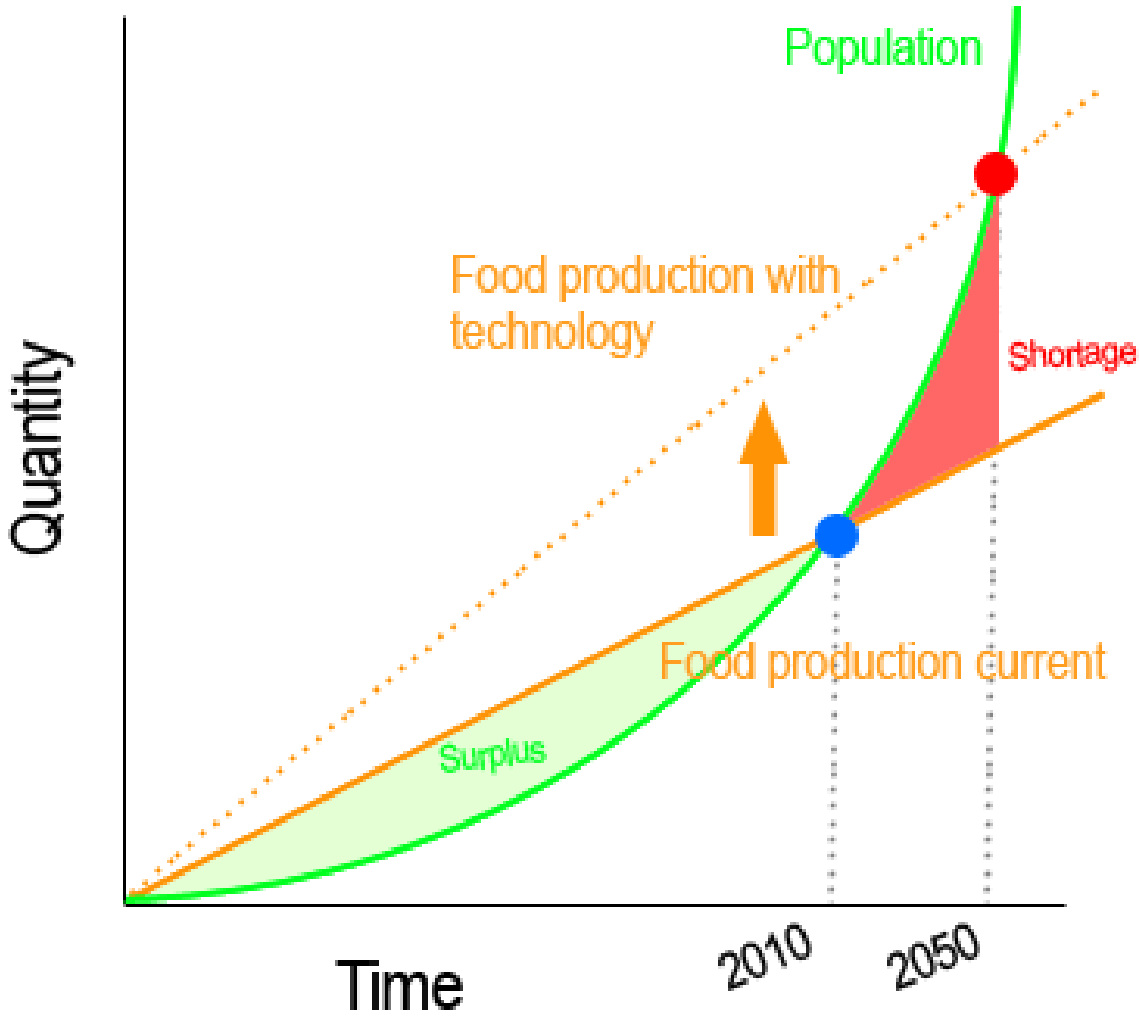
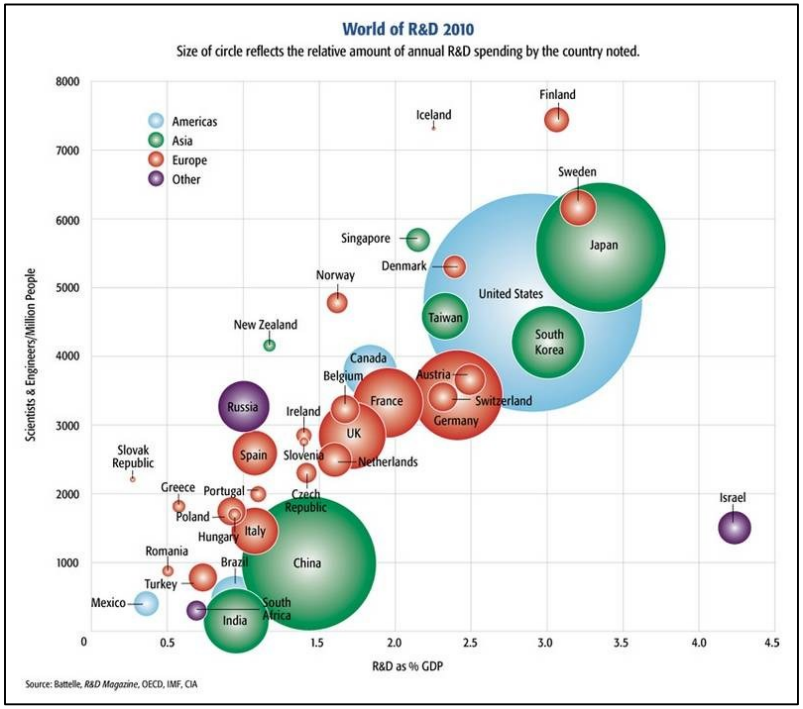
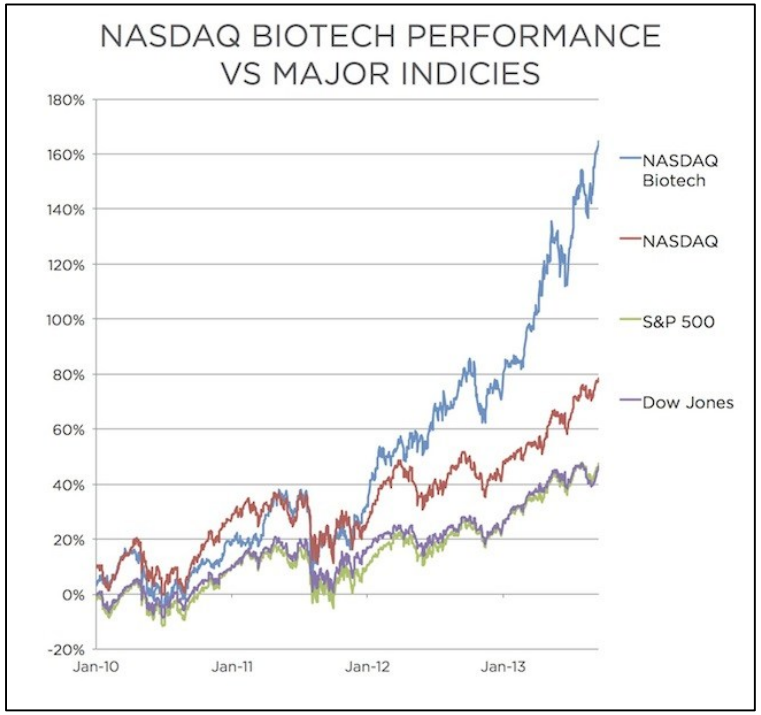

World Population Growth Through History
Billions of people
8
7
6
5
4
3
2
1
Old Stone Age
New Stone Age Commences
New Stone Age
Bronze Age
Iron Age
Middle Ages
Modern Age
Black Death The Plague
2-5 million years
7000 B.C.
6000 B.C.
5000 B.C.
4000 B.C.
3000 B.C.
2000 B.C.
1000 B.C.
1000 A.D.
1 A.D.
2025 A.D.
genomics
high speed computers
discovery DNA
chemical crop protection
penicillin
mechanisation
artificial fertilisers
rail roads
start industrial revolution
start agriculturial revolution
time (years)

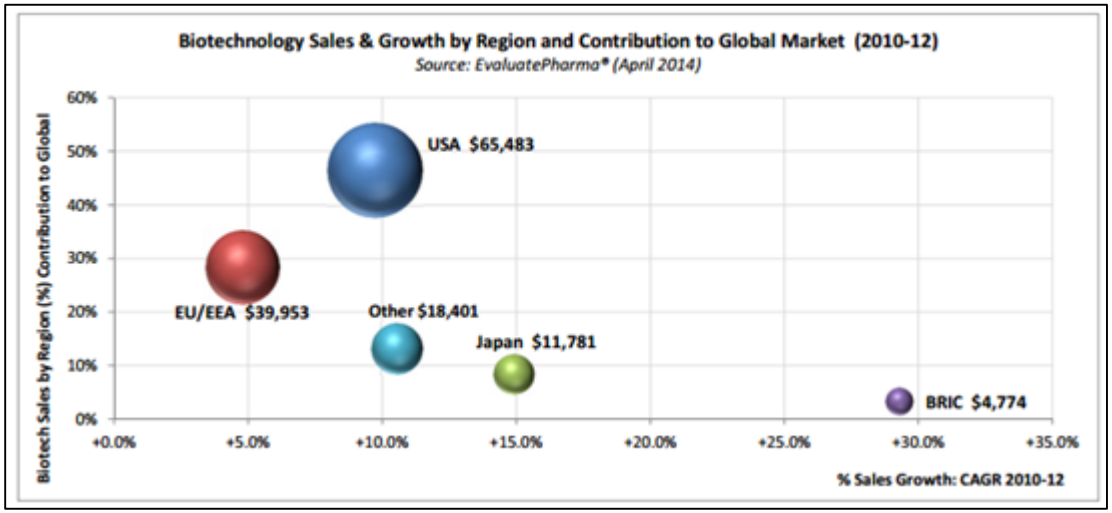
Food

Current Food Production vs. Future Food Production In Relation to Growing World Populations Over Time




World of R&D 2010
Size of circle reflects the relative amount of annual R&D spending by the country noted.
Americas
Asia
Europe
Other
Scientists & Engineers/Million People
R&D as % GDP
Finland
Iceland
Sweden
Japan
Singapore
Denmark
Norway
United States
Taiwan
South Korea
New Zealand
Canada
Belgium
Austria
France
Switzerland
Germany
Russia
Ireland
UK
Spain
Slovenia
Netherlands
Slovak Republic
Greece
Portugal
Czech Republic
Poland
Hungary
Italy
Israel
Romania
Brazil
China
Turkey
Mexico
South Africa
India
Source: Battelle, R&D Magazine, OECD, IMF, CIA


NASDAQ BIOTECH PERFORMANCE
VS MAJOR INDICIES
NASDAQ Biotech
NASDAQ
S&P 500
Dow Jones
Jan-10
Jan-11
Jan-12
Jan-13


Biotechnology Sales & Growth by Region and Contribution to Global Market (2010-12)
Source: EvaluatePharma® (April 2014)
Biotech Sales by Region (%) Contribution to Global
USA $65,483
EU/EEA $39,953
Other $18,401
Japan $11,781
BRIC $4,774
% Sales Growth: CAGR 2010-12

THE EUROPEAN KNOWLEDGE-BASED BIOECONOMY

NUTRITION (nutrigenomics) - PATHOGENS
CONTAMINANTS - ALLERGENS

CONSUMER CHOICE

STABILITY - BIODEGRADABILITY
FUNCTIONALITY (Chirality)

SAFE HEALTHY & DIVERSE FOOD SUPPLY "Fork to Farm"

BIOBASED MATERIALS FOR HEALTH INDUSTRY & ENERGY

TRACEABILITY SYSTEMS
ADVANCED FOOD TECHNOLOGIES

PROCESSING

WHITE BIOTECH
CLEAN BIOPROCESSES
RAW MATERIALS/WASTE

LOW INPUT FARMING - BIODIVERSITY
ANIMAL HEALTH - RURAL DEVT.

PRODUCTION

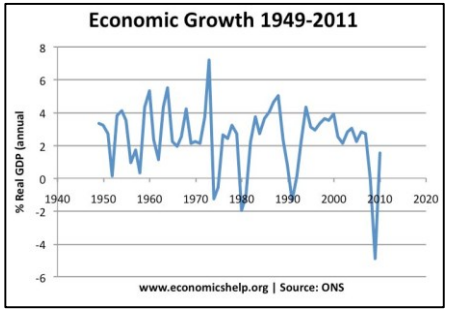
GREEN / BLUE BIOTECH
OPTIMISED RAW MATERIALS

SUSTAINABLE MANAGEMENT OF BIOLOGICAL RESOURCES

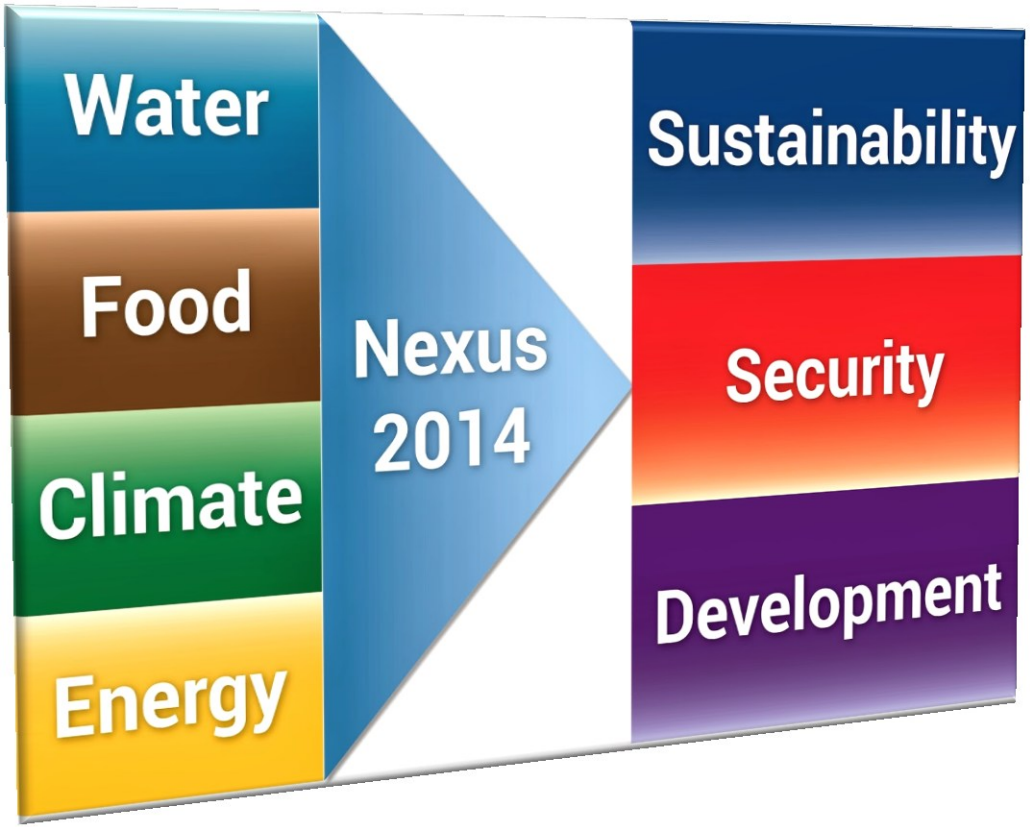
(LAND, FOREST, MARINE)

Innovation drivers

- Environmental
- Economic
- Social
- Technology
- Policy



EUROPEAN COMMISSION
DG Regional Policy


Water
Food
Climate
Energy
Nexus 2014
Sustainability
Security
Development

Agri-Food Challenges

Food security

Water Scarcity and Climate Variability

Post-Harvest losses

Food Insecurity and Rising Health Care Costs

Where to innovate

1. Smart and sustainable farming systems including new approaches to avoid erosion of natural capital and develop eco-friendly and energy-efficient production procedures for farming.

2. Water-saving and treatment and waste re-use techniques in agri and aqua-culture.

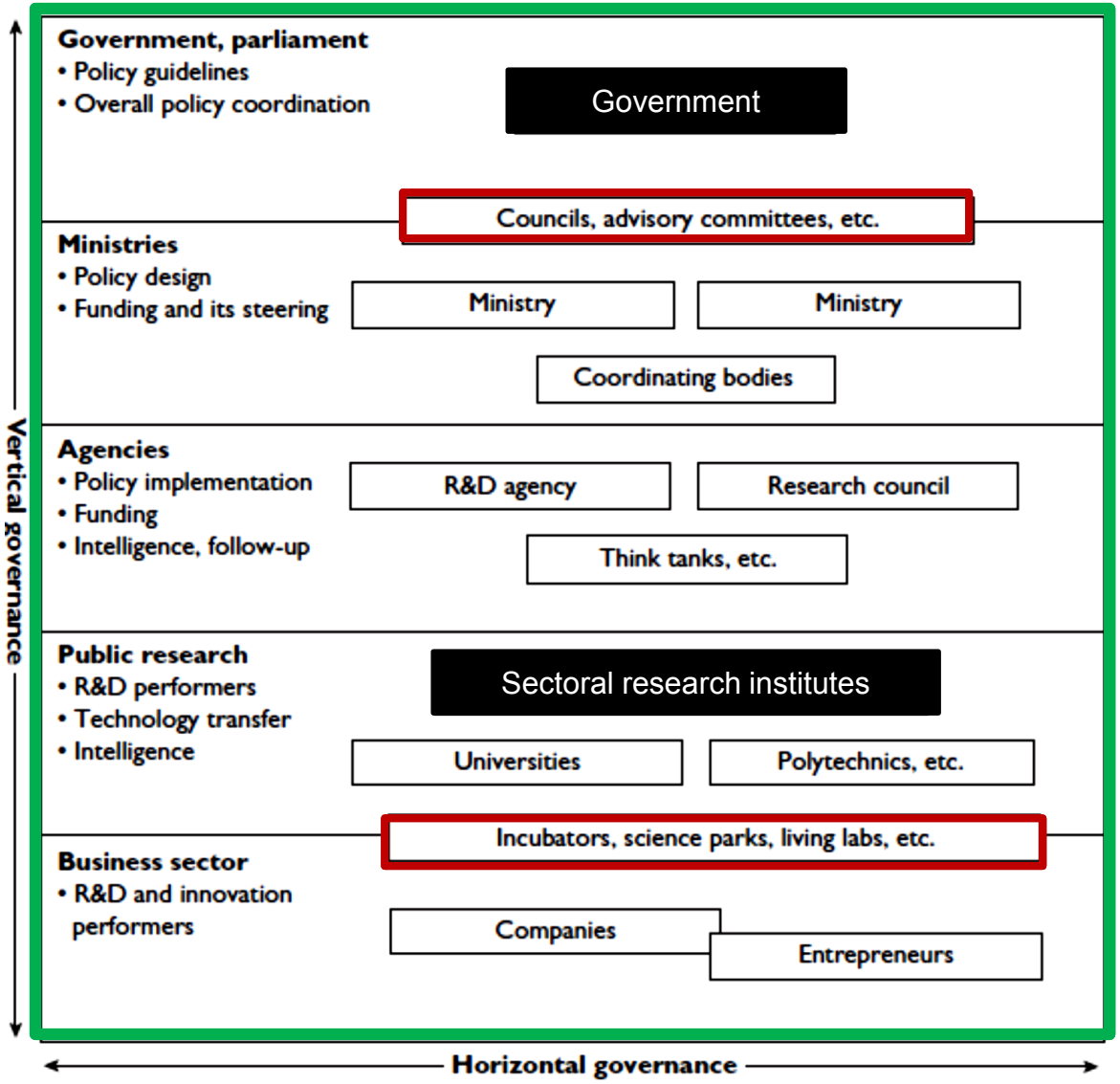
3. Promote and develop the agri-food industry based on the nutritional heritage of the EU countries (eg Mediterranean diet)

4. Reduce water losses and wastes in the food chain

5. Novel approaches to reduce the negative impact of pests and pathogens in farming, including their consequences on human health and well-being

6. Improve land and water sustainability in arid and semi arid watersheds

Typical Governance Structure of a National Innovation System



A role for every region: Smart specialisation

Smart Specialisation strategy to take into account several geographically specific characteristics to help generate growth in regions.

- In some places the process is quite evident due to the high density of innovators and entrepreneurs (usually core-cities). The process is much harder in regions characterised by low population, a small number of sectors and large dominant firms
- Identify sectors that can achieve critical mass
- *Connectivity*: Smart Specialisation should link emerging knowledge based industries to other actors within and outside the region
- *Integration of policies at regional level*

Setting in motion regional change

- ***transition*** - from an existing sector to a new one based on cooperative institutions and processes
- ***modernisation*** - technological upgrading of an existing industry or productive chain
- ***diversification*** – *expand to emerging areas*
- ***radical foundation of a new domain*** - R&D and innovation in a certain field to make previously low growth activities more attractive.

How to proceed

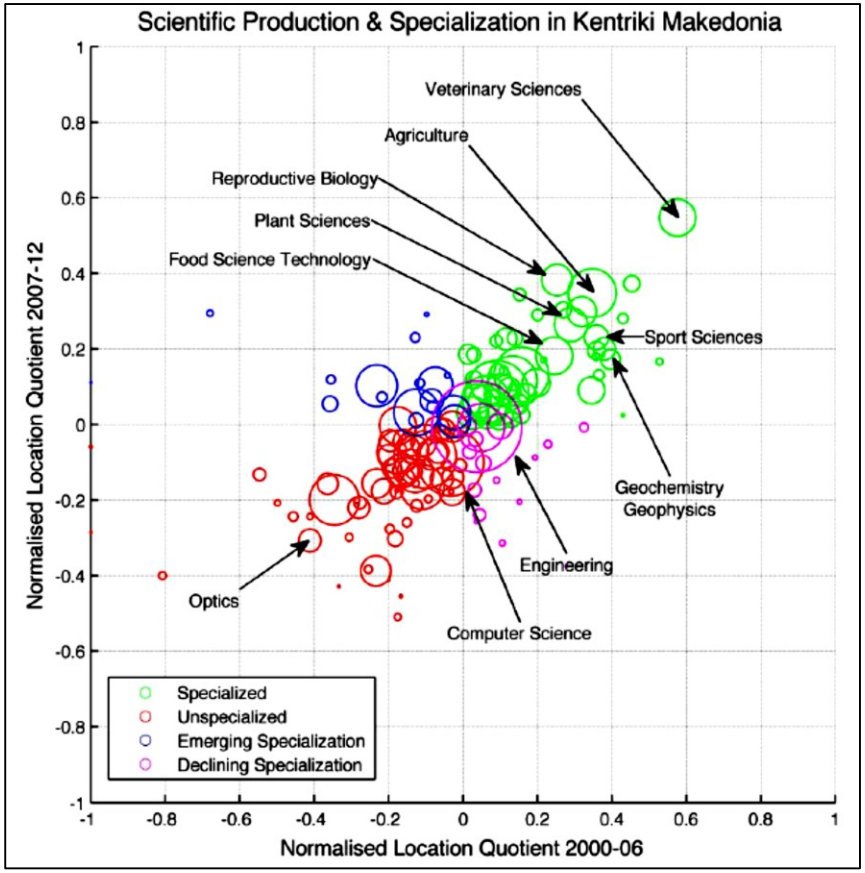
- ***Choices and Critical mass**:* limited number of priorities on the basis of own strengths and international specialisation – avoid duplication and fragmentation in the European Research Area – concentrate funding sources ensuring more effective budgetary management

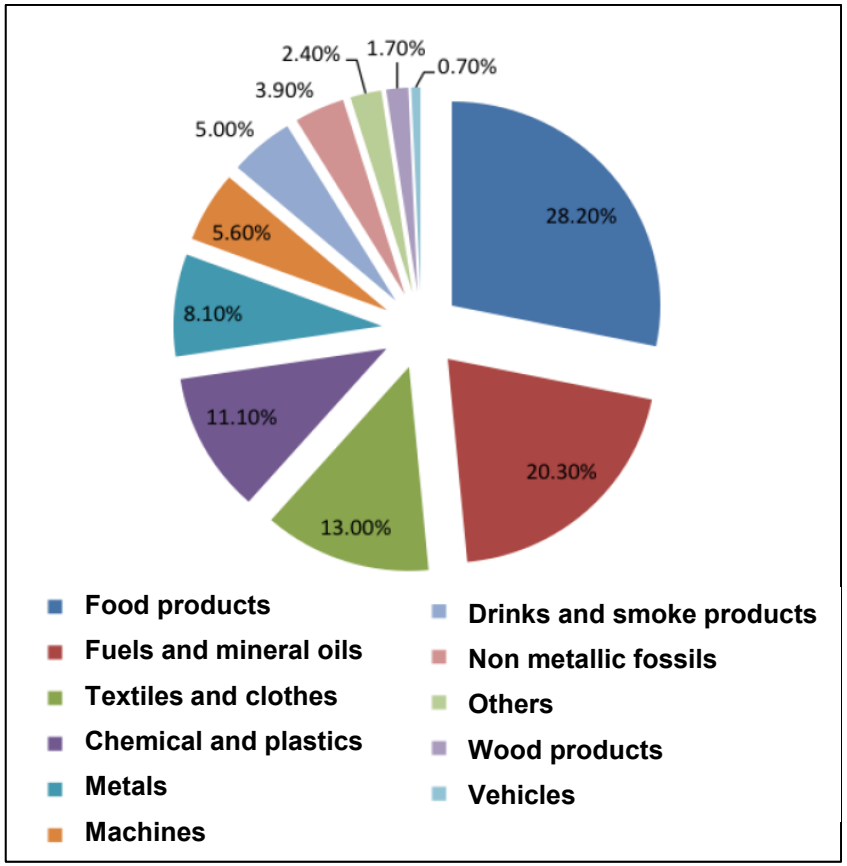
- ***Competitive Advantage**:* mobilise talent by matching RTD capacities and business needs through an entrepreneurial discovery process

- ***Connectivity and Clusters***: develop world class clusters and provide arenas for related variety/cross-sector links internally in the region and externally, which drive specialized technological diversification

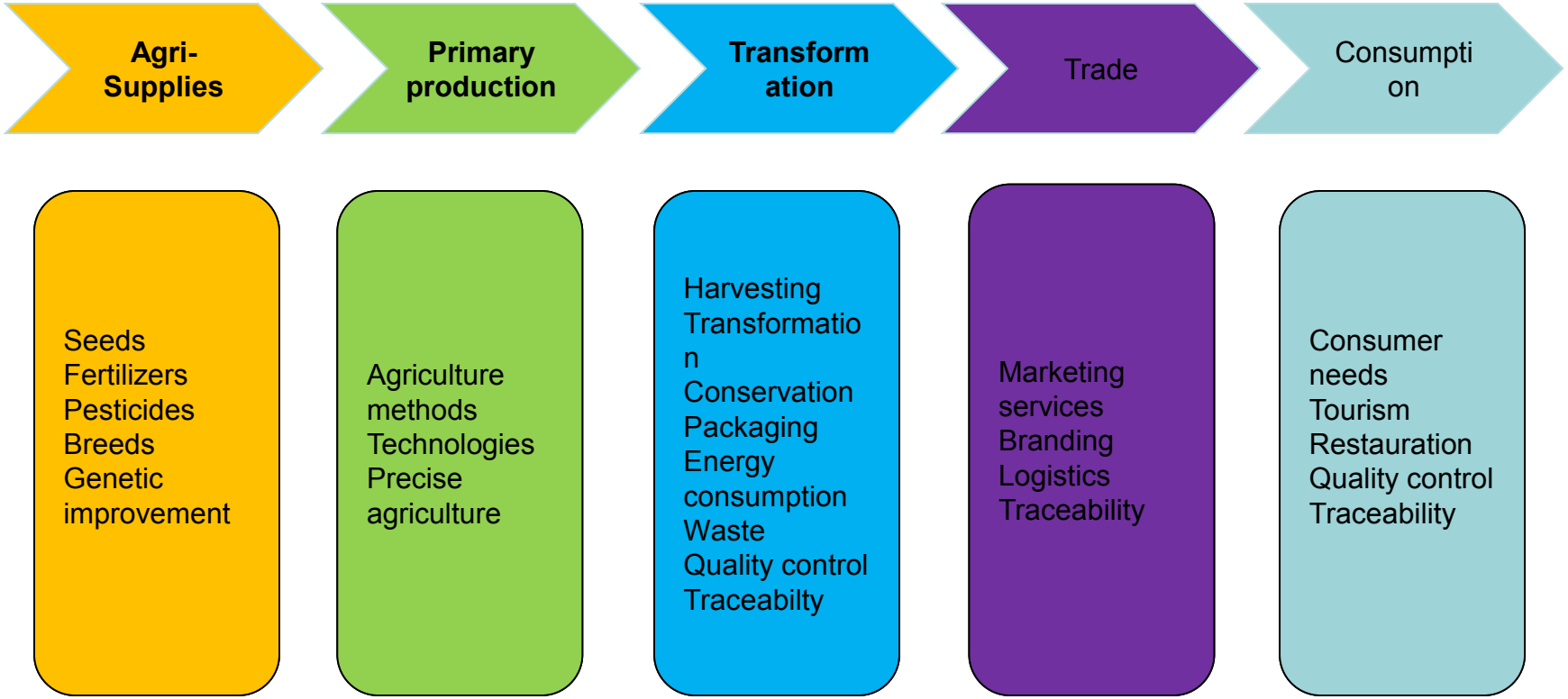
- ***Collaborative Leadership**:* efficient innovation systems as a collective endeavour based on public-private partnership (quadruple helix) – experimental platform to give voice to un-usual suspects

C. Macedonia


Scientific Production & Specialization in Kentriki Makedonia
Veterinary Sciences
Agriculture
Reproductive Biology
Plant Sciences
Food Science Technology
Sport Sciences
Geochemistry
Geophysics
Engineering
Optics
Computer Science
Specialized
Unspecialized
Emerging Specialization
Declining Specialization
Normalised Location Quotient 2007-12
Normalised Location Quotient 2000-06


28.20%
20.30%
13.00%
11.10%
8.10%
5.60%
5.00%
3.90%
2.40%
1.70%
0.70%
Food products
Fuels and mineral oils
Textiles and clothes
Chemical and plastics
Metals
Machines
Drinks and smoke products
Non metallic fossils
Others
Wood products
Vehicles

Agri-Food Chain



Which Bio-innovations in the Agri-Food

Incorporation of –omics in the Agri-food

- Characterization and exploitation of the terrestrial and marine biodiversity
- Valorization of the local heritage (a “back to the future” approach)
- New plant varieties and animal breeds
- Specialized food products to satisfy the needs of targeted groups
- DNA based traceability and certification of PDO products
- Understand the link between nutrition and health

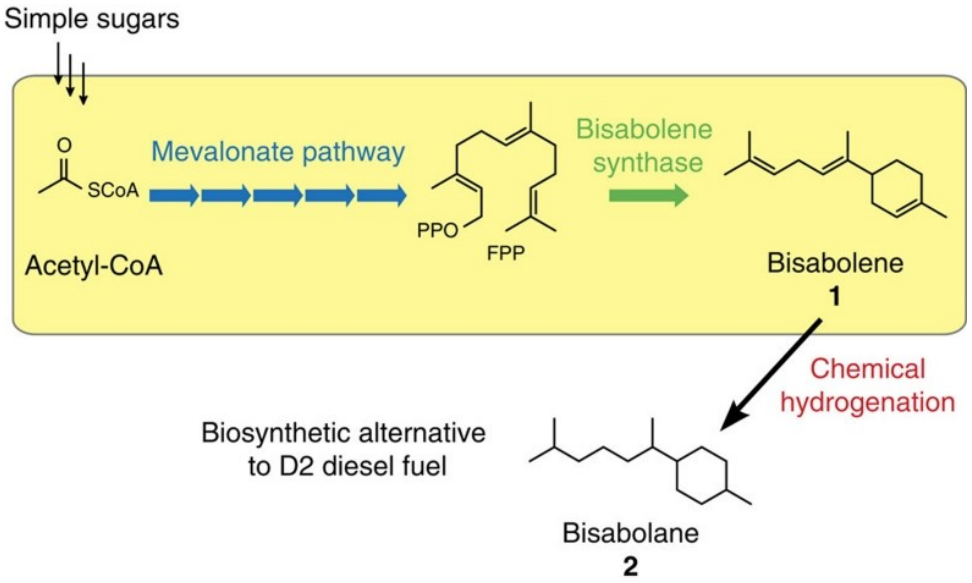
Characterization and exploitation of the terrestrial and marine biodiversity

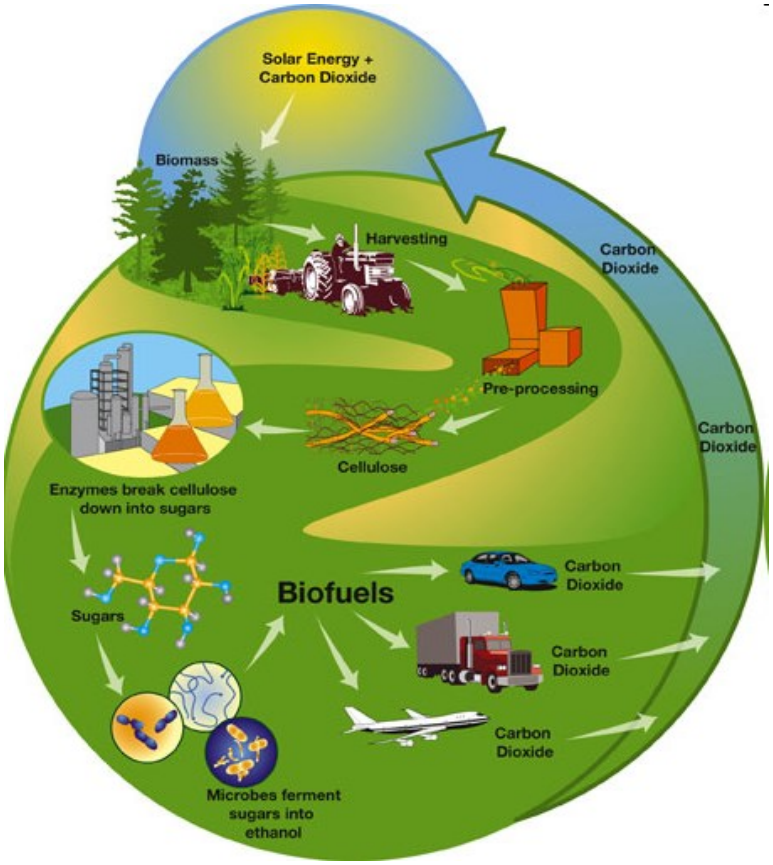
- 6300 plant taxa (species and subspecies)
- ~ 1000 endemic taxa

Identification and authentication of Greek biodiversity: a major objective!

Terpenes as biofuels

US Patent 7,846,222 (Amyris Biotechnolgies) claims a fuel composition comprising one of a group of specified isoprenoid compounds such as farnesane





Exploiting biodiversity: RNA-Seq of *Salvia pomifera*

Output statistics of sequencing

Samples	Total Raw Reads	Total Clean Reads	Total Clean Nucleotides (nt)	Q20 percentage	N percentage	GC percentage
Salvia_pomifera	54,000,000	45,887,274	4,129,854,660	95.64%	0.00%	49.37%

* Total Clean Nucleotides = Total Clean Reads1 x Read1 size + Total Clean Reads2 x Read2 size

Statistics of assembly quality

	Sample	Total Number	Total Length(nt)	Mean Length(nt)	N50	Total Consensus Sequences	Distinct Clusters	Distinct Singletons
ıtig	Salvia_pomifera	125,371	40,286,050	321	531	-	-	-
ene	Salvia_pomifera	66,051	42,298,081	640	891	66,051	22,395	43,656

SysTerp

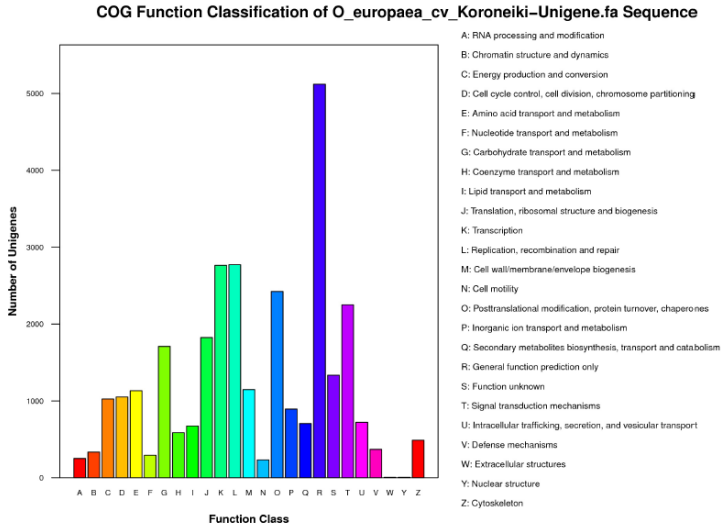
CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

INAB
INSTITUTE OF APPLIED BIOSCIENCES

Exploiting biodiversity: RNA-Seq of *Olea europea*

Samples	Total Raw Reads	Total Clean Reads	Total Clean Nucleotides (nt)	Q20 percentage	N percentage	GC percentage
O_europaea_cv_Koroneiki	49,274,820	44,087,846	4,408,784,600	97.93%	0.00%	44.16%

	Sample	Total Number	Total Length(nt)	Mean Length(nt)	N50	Total Consensus Sequences	Distinct Clusters	Distinct Singletons
Contig	O_europaea_cv_Koroneiki	200,435	55,969,166	279	411	-	-	-
Unigene	O_europaea_cv_Koroneiki	76,272	56,878,624	746	1195	76,272	32,707	43,565



BIOHYDROX-T

Alien Species: Silver-leaved Nightshade or Silverleaf nightshade, *Solanum elaeagnifolium*

The *de novo* transcriptome of *S.elaeagnifolium* from leaves and flowers

S.elaeagnifolium transcript		FPKM
CL588	Rubisco small subunit (*S.tuberosum*)	7,060
CL3504	Rubisco activase (chloroplast) (*C.annuum*)	6,226
Unigene 21118	Pathogenesis Related 4 leaf-precursor (*S.lycopersicum*)	5,696
Unigene 17928	Non-specific lipid-transfer protein 2-like (*S.lycopersicum*)	4,545
CL644	Chlorophyll a-b binding protein 3C chloroplastic-like (*S.tuberosum*)	3,960
CL6611	Photosystem II 10 kDa polypeptide chloroplastic (*S.tuberosum*)	3,372
Unigene 12950	Non-specific lipid-transfer protein 1-like (*S.tuberosum*)	3,008
CL8797	Plastidic aldolase (*S.tuberosum*)	2,584
Unigene 17653	Glyceraldehyde-3-phosphate dehydrogenase A, chloroplastic-like (*S.tuberosum*)	2,356
Unigene 680	Cell wall protein precursor (*S.lycopersicum*)	2,344
CL9787_2	HT-protein (*S.pennellii*)	2,244
Unigene 11345	Ferredoxin-1, chloroplastic-like (*S.tuberosum*)	1,917
Unigene 22300	Metallothionein-like protein (*C.chinense*)	1,870
CL7445	Peroxisomal (S)-2-hydroxy-acid oxidase GLO1 (*S.lycopersicum*)	1,573
CL9785	Pathogenesis Related 1 precursor/PR1a (*S.lycopersicum*)	1,493
CL10244	SAMDC (*S.tuberosum*)	1,434
Unigene 18624	Photosystem I reaction center V (chloroplast) (*S.tuberosum*)	1,374
Unigene 7695	Photosystem II reaction center W protein, chloroplastic-like (*S.tuberosum*)	1,359
Unigene 22352	Phosphoribulokinase, chloroplastic-like (*S.tuberosum*)	1,332
Unigene 12941	Metallothionein (*S.nigrum*)	1,311

Valorization of the local heritage (a "back to the future" approach)

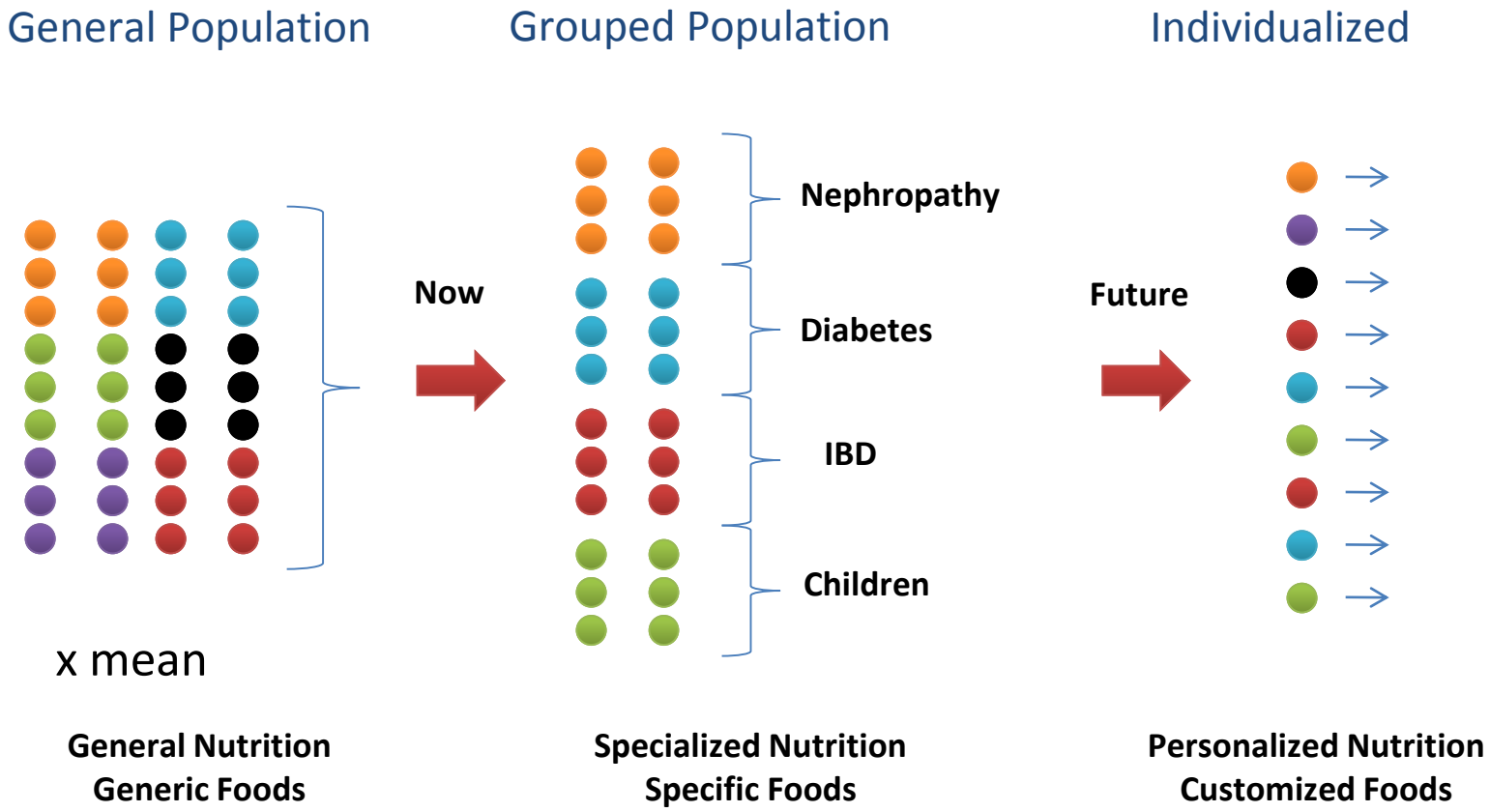
- Important for local society: adapted to the local conditions, important nutritional and economical value
- Important for breeding : source of invaluable genes for the development of new varieties
- Genetic erosion: more than 90% of wheat and vegetable varieties have been lost in the last 50 years

New plant varieties and animal breeds

NUTRITOM - ***Genomics-driven improvement of quality and health value of Greek tomato cultivars***

- Full transcriptome sequencing of tomato elite cultivars and transgenic lines
- Expression profiles of targeted genes contributing to the nutrition quality of tomato fruit
- Development of functional molecular markers for quality traits of Greek tomato varieties

Specialized food products to satisfy the needs of targeted groups



Main agriculture productions in C. Macedonia

Fruit trees (peaches, cherries, grapes, table olives)

Dairy products (goats)

Aqua –farming (algae, mollusks)

Cereals and their products

High added value plants (aromatic and pharmaceutical plants, spices)

Specialized foods, functional foods

Anagnostis Argiriou

THANK YOU

Inab.certh.gr