Technical meeting on “Context-based Technologies to Enhance the Efficiency and Resilience of Agri-food Systems in Lebanon”

An overview of the strategy and vision of the National Council for Scientific Research (CNRS) in the transfer, adaptation and adoption of agricultural technologies- challenges and opportunities

ESCWA Beirut, Lebanon 26-27 Aug 2019

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Introduction:

The challenges facing the Agri-food industry are well documented. From adapting to the effects of climate change, to feeding a growing global population with dwindling resources, it is very clear that the degree of change that is required within food and agriculture systems, and the pace with which that change needs to be delivered, requires us to adopt new ways of doing things.
Innovation and transfer of technology

Technology acquisition and transfer are central to change and growth, leading to increased economic productivity and living standards.

There are two aspects of technology change that are important: The first is the international transfer of technology from developed to developing countries, the second is diffusion of technology.

There is no single strategy for successful transfer appropriate to all situations.

The process must encompass all elements of origins, flows and uptake of expertise and experience, across and within countries, stakeholder organizations and institutions.

Recipients for transfer of technology should therefore be able to identify and select technologies that are appropriate to their needs.
Key areas of technology development

The CNRS foresee any agriculture developed strategy should be focused on the development of new and improved emerging technologies in the areas of:

1- Sustainable natural resource management

Agro-ecological systems are resilient up to a point, but subject to collapse when degraded beyond the threshold. While the current picture is not entirely clear, it suggests a close correspondence between areas experiencing significant land and water degradation and areas troubled by high levels of rural poverty.

Farmers maximize income and risk in a dynamic context and often under harsh conditions and serious constraints.

Research must respond to these challenges through inclusion of technologies to address sustainable natural resource management

This would include technologies to address conservation agriculture principles relating to soil organic matter decline, soil erosion and degradation, nutrient depletion, loss of biodiversity, prevention of invasion by alien species, maintenance of water quality, optimization of water use efficiency under both irrigated and rainfed conditions,
Key areas of technology development

2- Information and communication technology

The real challenge is to make this information available in useful and usable form, this entails the interpretation, packaging and dissemination of the information in appropriate and usable form.

This same technology can be utilized for obtaining information such as crop areas and crop yield estimates for agricultural statistics, national collections of pests and disease type organisms. Creative use of global positioning technologies, data loggers and other portable and fixed devices for the collection of natural resources and other data offers possibilities.

3- Earth observation technologies

These include satellite imagery, airborne imagery and in-situ data collection.

Data collection and the development of agricultural applications relating to hyperspectral, radar and airborne geophysics are essential for the global competitiveness of the sector.

Data fusion and refinement of model parameters can assist in obtaining meaningful stress-related interpretations, such as of soil moisture, pests and diseases.
Key areas of technology development

4- Geographic information systems, spatial modelling and scenario planning

The specialization of data, combined with remote-sense imagery ideally using GIS technology, provides a powerful tool for informed decision making.

Applications include agricultural statistics with sample frames, climate change scenarios, forecasts and advisories as well as natural resource inventories and monitoring.

5- Production efficiency under extreme weather conditions

Research to improve the production efficiency and profitability in crop and livestock farming is of key importance.

Field level eco-physiological research on various crops, livestock and rangelands is urgently required in anticipation of the possible effects of global warming and climate change.

New crop varieties and animal breeds capable of high yields under extreme weather conditions would be advantageous.
Key areas of technology development

6- precision Agriculture

Optimizing production inputs and outputs makes both economic sense and is environmentally more responsible and sustainable.

R&D in this field should focus on remote sensing, instrumentation, software development and image processing to be able to manage production system variability on a real time basis.

7- Product differentiation for global competitiveness

The identification, development and optimization of niche markets for global competitiveness are essential. Three areas can be identified, namely: organic products, indigenous products and health and homeopathic products.

Research on cultivar suitability and determining how far production of a crop can be stretched outside its optimum climate requirements are key research imperatives.
Key areas of technology development

8- Biotechnology

9- Global competitiveness and macro-economics

10- Systems improvements and value-addition

11- Animal and plant health

12- Bioenergy and biofuels
Challenges and Opportunities

✓ Increasing pressure on natural resources

Increase in population and demand on food VS urban & industrial pressure on land, Displacements

✓ Inappropriate and extensive use of resources

Irrigation and cultivation practices

✓ Environmental threats and resilience

The global climate is changing, affecting agriculture. Environmental change, water availability, soil degradation and biodiversity loss threaten food security.

✓ Absence of Clear strategy for R&D

That takes the development of the Agri sector or Agri–tech into consideration

✓ Insufficient funds for research, innovation and application
Challenges and Opportunities

✓ Technology revolution

Huge advances in the biosciences in recent years are driving transformational developments in agricultural science, technology and farming practices

✓ Research and development Research institutes

(several related research institutes CNRS, LARI, ICARDA, ACSAD.....)

✓ Investments

Interested funding agencies to work on transferring tech (USAID, GEF, FAO, UNDP, etc...)

Encouraging medium and large enterprises in investing in these tech

✓ Science & technology – Policy interface

✓ Build on Local research results (below examples)
Joint Grant Research Programme (GRP)

Number of Accepted Projects Distribution by University (Call 2017-2018)

- AUB: 23%
- USJ: 13%
- UL: 21%
- USEK: 6%
- NDU: 5%
- LAU: 9%
- Balamand: 9%
- Antonine University: 3%
- CNRS centers & Others: 5%
- BAU: 6%

239 Projects
7,607,625,000.00 LBP
Accepted projects - Distribution by Theme (Call 2017-2018)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and Food</td>
<td>7%</td>
</tr>
<tr>
<td>Arabic Language and History</td>
<td>0%</td>
</tr>
<tr>
<td>Basic science and Engineering</td>
<td>36%</td>
</tr>
<tr>
<td>Business, Economics &amp; Finance</td>
<td>6%</td>
</tr>
<tr>
<td>Environment and Natural Resources</td>
<td>12%</td>
</tr>
<tr>
<td>Sociology and Ethics</td>
<td>3%</td>
</tr>
<tr>
<td>Medical Sciences</td>
<td>33%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
</tr>
</tbody>
</table>

Other:
- Transdisciplinary Cognitive Research (1 project)
- Architecture, Design and Built Environment (1 Project)
- Cultural Heritage (4 Projects)

239 projects (16)  
7,607,625,000.00 LBP
CNRS Grant Research Program - Accepted Projects Distribution by Priority (2016)

- Agriculture and Food Sciences: 11% (82 projects, 1,438,600,000 LBP)
- Medical Sciences: 31%
- Basic Sciences: 18%
- Environmental Sciences: 24%
- Economy and finance Sciences: 6%
- Sociology and political Sciences: 6%
- Arabic language and history Sciences: 4%
Projects in agriculture Call 2016; Call 2017-2018

- Valorization of Lebanese Industrial byproducts by the extraction of polyphenols, essential oils and pectins using emerging technologies
- Exploring the adoption and implementation of Food Quality and Safety Management Systems in the Lebanese food supply chain
- Assessment of salt and drought tolerant forage genotypes of sorghum and millet.
- Assessment of the genetic diversity of the Lebanese carob germplasm (Ceratonia siliqua L.)
- Effet de la congélation de la viande de volaille fraîche sur le niveau d'activité de B- Hydroxy AcylCo-A Déshydrogénase et le dénombrement bactérien.
- Identification of Physio-chemical and Sensory Profiles for Lebanese EVOO with Reference to Geographical Characteristics
- Extended Producer Responsibility (EPR) as a Waste Management System for the Lebanese Agro-Food Industry: Effectiveness, Challenges and Opportunities
- Désalcoolisation des vins: Etude des différents procédés et de l'acceptabilité des consommateurs
- Could the high cannabidiol low THC industrial hemp enhance the livelihood of farmers in the Beqaa region?
- Plant growth regulators effect on yield, maturity date and quality of table grapes cv “SugraOne”, "Red Globe" and "Crimson Seedless"
- Mapping crop distribution and crop yield estimation of wheat in Bekaa Plain of Lebanon
- Infrared-assisted extraction of polyphenols from olive (Olea europaea) processing by-products.
- Evaluation de la prise journalière en aflatoxines (B1, B2, G1, G2 et M1) et en ochratoxine A à partir du panier du consommateur libanais
- Screening of the Occurrence of Antibiotics Residues in Milk and Dairy Products in Lebanon
- Infrared Spectroscopy coupled to Chemometrics: A new and fast approach for Characterizing and Authenticating Lebanese Honey
- Enhancing the nutritional security of Lebanese society by developing natural and stable sourdoughs to be implemented in baking industries
- Characterization and modeling of the photosynthetic growth of the microalgae Haematococcus pluvialis in photobioreactors
- Carcinogenic and Neurotoxic Risks of Acrylamide among the Lebanese Population from Selected Dietary Products
- Determination of Levels of Selected Essential and Toxic Metals in Infant Formula Milk Commercially Available in Lebanon, and the Safety Assessment
- Détermination des propriétés physico-chimiques de quelques contaminants organiques des emballages alimentaires recyclés
- Nutritional Claims of the Lebanese Bread Products: Prevalence, Truthfulness and Consumer Perceptions
- Evaluation of local entomopathogenic fungal isolate Beauveria for development of biologically based integrated pest management of greenhouse pests.
- Control of melon aphid, Aphis gossypii (Glover), on cucumber using entomopathogenic endophytes
- Extent of damages to Pine forests in Lebanon caused by endemic and alien insect species and their associated nematodes
How to increase CWP?

Solution

Yield should increase (Y >>>)
Water use should decrease (ET <<<)

Make agricultural water use more efficient

More popular:
“More crop per drop” or “Blue Revolution”
(IWMI, World Bank, FAO, etc.)
Biomass production (kg/ha)  Evapotranspiration (mm/d)

Single day – Spring 2014 in Bekaa Valley (Lebanon) based on SEBAL model
### Potato Yield Bekaa 2014

<table>
<thead>
<tr>
<th>Potato fresh yield statistics</th>
<th>kg/ha</th>
<th>ton/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>41590</td>
<td>41,6</td>
</tr>
<tr>
<td>minimum</td>
<td>7932</td>
<td>7,9</td>
</tr>
<tr>
<td>maximum</td>
<td>65973</td>
<td>66,0</td>
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<tr>
<td>standard deviation</td>
<td>11939</td>
<td>11,9</td>
</tr>
<tr>
<td>modus</td>
<td>51284</td>
<td>51,3</td>
</tr>
<tr>
<td>median</td>
<td>33244</td>
<td>33,2</td>
</tr>
</tbody>
</table>
Annual net groundwater use (mm/yr)
Improved Water Resources Monitoring System: Integrated Water Resources Management at regional level in Lebanon
Satellite Images:
- GeoEye (2013; 0.5 m)
- Ikonos (2008; 1 m)

Assets @ Risk: Flood Risk Assessment & Mapping for Lebanon
تحديد الأولويات

الضرر بالترتيب التنازلي:
- الفيضانات (330 مليون دولار)
- موجات البرد (241 مليون دولار)
- العواصف (212 مليون دولار أمريكي)
- الأمطار الغزيرة (177 مليون دولار أمريكي)
- موجات الحر (149 مليون دولار أمريكي)
- حرائق الغابات (125 مليون دولار أمريكي)
- الرياح (93 مليون دولار)
- الانهيارات الأرضية / تآكل الأرض (74 مليون دولار أمريكي).

<table>
<thead>
<tr>
<th>Risk</th>
<th>Average Annual Frequency</th>
<th>Average Severity</th>
<th>Worst Case Scenario</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floods</td>
<td>Moderate</td>
<td>High</td>
<td>Very high</td>
<td>8.5</td>
</tr>
<tr>
<td>Cold waves</td>
<td>High</td>
<td>Moderate</td>
<td>Very high</td>
<td>8.5</td>
</tr>
<tr>
<td>Winter Storms</td>
<td>High</td>
<td>Very high</td>
<td>High</td>
<td>8.5</td>
</tr>
<tr>
<td>Heat waves</td>
<td>High</td>
<td>Very high</td>
<td>Moderate</td>
<td>7.5</td>
</tr>
<tr>
<td>Heavy rainfalls</td>
<td>Low</td>
<td>Very high</td>
<td>Moderate</td>
<td>6.5</td>
</tr>
<tr>
<td>Wildfires</td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
<td>6</td>
</tr>
<tr>
<td>Heavy winds</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>5.5</td>
</tr>
<tr>
<td>Land erosion/Landslides</td>
<td>Very Low</td>
<td>Moderate</td>
<td>Low</td>
<td>4</td>
</tr>
</tbody>
</table>

تحديد الأولويات

بالنظر إلى المواسم، قدرت أعلى الأضرار لجميع المخاطر مجتمعة في جميع المحافظات:
- موسم الشتاء 131 مليون دولار,
- موسم الصيف 129 مليون دولار,
- موسم الخريف 96 مليون دولار,
- موسم الربيع 29 مليون دولار.
المخاطر الزراعية في لبنان

تقييم (رزنامة) المخاطر الموسمية الزراعية

وقد أدت النتائج إلى إنشاء تقييم للمخاطر الموسمية. حيث يسهل للمزارعين و متخذي القرار الاطلاع على الجدول الزمني للمخاطر والقطاعات الأكثر تضررا للاستعداد والمجابهة
Urban Sprawl on field crops

Chebriqet Tabet 2003
Urban Sprawl on field crops

Haouch El Oumara 2003
Aridity index

AVERAGE MONTHLY (2000-2013)

Legend

Aridity Index

- Red: Hyper-Arid
- Orange: Arid
- Yellow: Semi-Arid
- Green: Dry Subhumid
بحث: تحديد التغيرات في مساحة بحيرة الفرعون باستخدام صور الأقمار الصناعية (Landsat & Sentinel Images)
Field regular monitoring program since 2010

Sampling sites in 26 April and 21 August 2013 (red cubes), 10 July 2015 (green circles), and 11 August 2015 (yellow triangles).
Prospective

For proper management of the agricultural sector there is an urge to ensure that research and technology would address the social and economic challenges regarding the performance of agriculture and the agro-processing sector.

One should identify potentials, and recommend the concentration of efforts in novel technologies as well as transfer of technology together with an enabling culture of innovation in agriculture, strategic funding in agriculture, infrastructure and the establishment of a National Agriculture Research Strategy.
THANK YOU