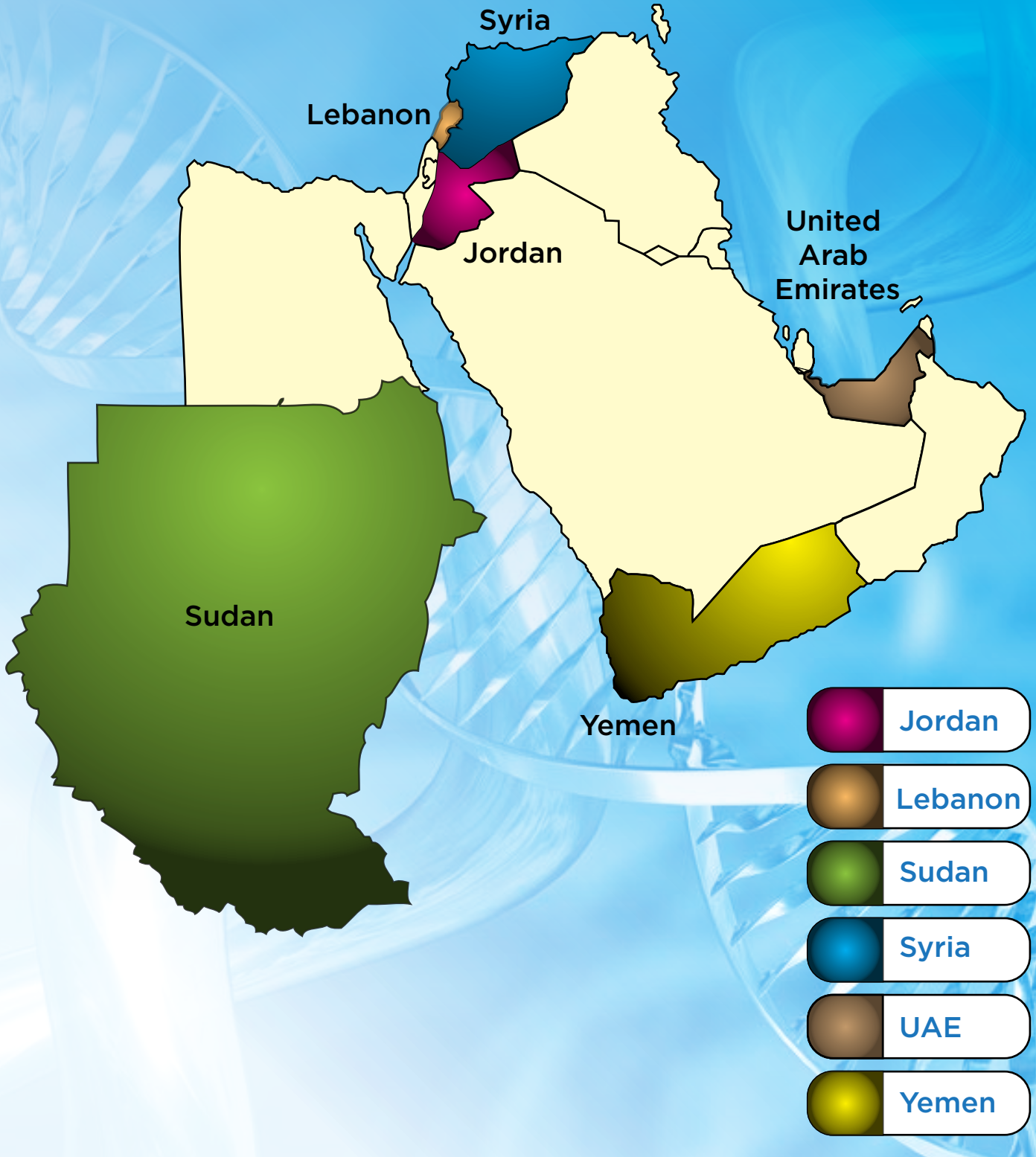
Chapter III
Individual
Country Reports



Jordan

Dr. Ibrahim Rawashdeh

National Centre for Agricultural Research and Extension (NCARE)

3.1. Jordan

1. Status of biotechnology in Jordan

Jordan is located in the Middle East with Israel and the West Bank to the west, Syria to the north, Iraq to the northeast, and Saudi Arabia to the east and south. It is slightly smaller than Indiana and encompasses a total land area of 92,300 square kilometers (91,971 square kilometers of land and 329 square kilometers of water). Jordan consists mainly of a plateau that varies in elevation from 700 to 1,000 meters and is divided into ridges by valleys and gorges and a few mountainous areas. The valley floor varies in level, dropping from just above sea level in the north to 400 meters below sea level at the Dead Sea—the lowest point on earth. Variation in climate and topography in Jordan has led to a wide diversity in ecological habitat and flora. Flora of Jordan comprises approximately 2500 species ecologically and genetically adapted to local conditions. Most of these species are even adapted to the dryer parts such as the desert of Jordan. The country has a four distinct biogeographical. Mediterranean, Irano-turanian, Saharo-Arabian (Badia) and Sudanian (Tropical penetration).

The Jordan total population of 6,342,948 million (July 2009 est.). Jordan is a food deficit country with an annual growth rate 3.3%, the population of Jordan is expected to reach 7.1 million by the year 2010 and will exert heavy pressure on the fragile natural resources base of the kingdom. Total imports of food commodities still exceed exports by far so that Jordan is a deficit country with respect to food supply. In 1990, the deficit in agricultural trade balance was around JD342 million. Between 1990 and 1995, there was a slight decline, but the deficit remained around JD 300 million. In 1999, the agricultural trade deficit reached almost JD 350 million (www.unep.org/biosafety/files/JONBFrep.pdf).

Biotechnology is considered to be a frontier area offering a new technological base for the provision of solutions to some of mankind's problems. This technological base involves interactions amongst people, microorganisms, biomass, and industry, underscoring the utilization of renewable resources with a low environmental impact and high regenerative capacity. Biotechnology has produced new products and processes in a number of economic sectors including agriculture, food processing, chemical and pharmaceutical industries, pesticides, detergents, feed stocks, recycling, and waste treatment. Jordan has made some progress in biotechnology projects for research and development. Projects have been undertaken by university laboratories, research institutions, and private companies in the following fields: plant tissue culture and basic biotechnology research (in medicine etc…), (Moh'd M. Ajlouni and H. Malkawi.

Jordan: Status and Future Prospects of Biotechnology (www.cgiar.org/biotech/rep0100/Ajlouni.pdf|). Jordanian universities have covered research and development (R&D) fields in biotechnology, in the following activities: 1. Embryo transfer in animals, 2. Early diagnosis using monoclonal antibodies, 3. Applied microbiology, 4. Biogas, 5. Single cell protein, 6. Enzymes and antibiotics, 7. Plant growth inhibitors, 8. Natural products, 9. Cloning, 10. Protein solvent concentration, 11. Bioreaction, 12. Gene isolation, 13. Biological nitrogen fixation.

Similar to most other developing countries, biotechnology in Jordan attracts high attention but still in early development stages and behind the developed countries. There are some efforts in Jordan to catch up in this rapidly developing area, especially in the fields of medicine and agriculture. Several universities have recently established graduate and undergraduate programs in biotechnology or genetic engineering. Research program in universities or biotechnology centers are using basic biotechnology, immunology, and molecular biology techniques (www.unep.org/biosafety/files/JONBFrep.pdf). There is also high research interest for and a limited production of immunological diagnostic kits and animal vaccines.

Traditional biotechnology is being used in Jordan for the production of food, drink and yeast. Some work was conducted in the area of screening for organisms that have a potential biotechnological application. Plant tissue culture has attracted high attention from public and private sectors. Several university, governmental and private research programs were conducted to optimize micro-propagation of plant tissues (www.unep.org/biosafety/files/JONBFrep.pdf). Tissue culture has been used for in vitro conservation and cryopreservation, production of disease-free plants, plant propagation, selection of biotic and a biotic tolerant stocks and production of secondary metabolites. Private and governmental laboratories commercially produce regenerated plants such as ornamental and cut flowers, date palm, potatoes and banana.

Animal and human cell culture is mainly centered on medical and veterinary applications such as in-vitro fertilization and embryo culture (www.unep.org/biosafety/files/JONBFrep.pdf). On the other hand, Jordan has King Hussein Institute for Biotechnology and Cancer which is a not-for-profit non-governmental organization in Amman, Jordan; it aims to provide state-of-the-art care for the purpose of eliminating suffering and death from cancer through education, awareness, prevention, diagnosis and treatment. Furthermore, the Institute aims to advance life sciences and biotechnology and their contribution to medicine in the world through innovative research and scientific discoveries (www.jordanembassyus.org/new/emp/eoKHIBC.pdf.).

The Jordan government is increasingly enacting policies to foster economic development. Jordan is party of several international treaties and conventions related to free trade (WTO, Arab Free Trade Agreement, Free Trade Agreement with the USA (2000), several bi-lateral trade agreements to establish free trade zones with some Arab countries; association agreement with the EU (2001)), intellectual property rights and the protection if biological resources (Convention on Plant Variety Protection (UPOV); Convention of Biological Diversity (CBD). Jordan ratified the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) (Redia Shibli, UNIDO study on agriculture biotechnology sector and investment opportunities in Jordan. www.unido.org).

1.1 Plant biotechnonlgy

Plant biotechnology, which is one of the many approaches involved to solve the complex problems of hunger, poverty and food insecurity, may be an appropriate technology within reach of rural and disadvantaged farmers (DaSilva et al., 2002). DaSilva et al. (2002) reported that the genetic engineering techniques generally are applied to crops important to the industrialized world, and less to crops on which the world>s hungry depend. In Jordan, modern plant biotechnology researches began before twenty years ago and researchers have been using the advanced biotechnology methods and techniques in molecular analysis of genetic resources as well other fields.

Jordanian researchers and scientists in biotechnology laboratories (See the Rosters of National Scientists Involved in Biotechnology Research in Jordan, (www.unep.org/biosafety/files/JONBFrep.pdf.), page 48-52) are working on the improving plant propagation and multiplication of major horticultural crops and fruit trees using tissue culture techniques to obtain virus-free plants utilizing tissue culture techniques and the technique is currently applied to potato, banana and date palm in both public and private sectors. Fingerprints of major cereals (such as wheat, barley, chickpea, and lentil), medicinal plants (Qisoum and hypericum), Sumac, olive, date palm and other crops for identification purposes was practiced by using RAPD , AFLP, SSR, SAMPL and ISSR techniques in genetic diversity studies. Experiments on genetic transformation has also been started at Al-Balqa' university / Jordan.

In Jordan, traditional biotechnology is being used in plant breeding improvements and food production. Plant tissue culture attracts much attention from the public and private sectors, where lab of tissue culture has been establishing since twenty years ago at Ministry of agriculture and it is under NCARE umbrella now. There is no GMOs produced, neither commercialized in Jordan. Jordan has not yet established specific laws that regulate biotechnology and Biosafety. However, active steps in this direction are underway.

Since biotechnology is considered as a tool with enormous potential for overcoming some of the constraints to increase agricultural production, therefore, governments need to develop strategies, polices and legal frames for integrating modem biotechnology into agricultural research. Jordan government like other countries looking for harvesting the benefits arise from modern biotechnology taking into consideration the risks might be affected on the plant genetic resources, human health, livestock>s and environment. Incorporate biotechnology procedures within the circle of sciences, agriculture researches and food production is of priority in Jordan for increasing the productivity of crops, sustainability and food safety. Building capacity and research funding are keys for modern biotechnology success. Absence the cooperation between the different sectors and lack of such biotechnology regulation could complicate importing or local production of such biotechnology products.

Jordan gives major efforts for building capacity in biotechnology to keep in touch with the recent biotechnology developments, considering it a priority to improve agricultural production to be self-sufficient. Jordan has formulated national Biosafety guidelines since 2004. Jordan is developing country and needs a continues supporting in the field of biotechnology particularly GMOs, through international cooperation by projects funding and increase the number of qualified researchers in this field. Jordan government has limitations with their financial resources so the supporting will not meet the needs of researches. The Jordanian national research institutions are encouraged to deal with biotechnology aside to the conventional breeding programs for rapid growth development in agriculture sector. So far, there is no regulation to control introduction and handling of biotechnology products.

Table 1: Current, future, and essential biotechnology research in the industrial private sector (www.cgiar.org/biotech/rep0100/Ajlouni.pdf|.).

Current activities	Future activities	Essential activities
Tissue culture	Enzyme production	Amino acid sequence determination
Natural fertilizer	Veterinary drugs Applied microbiology	Applied microbiology
Monoclonl antibodies	Scientific laboratory equipment Biochemical engineering	Biochemical engineering
Scientific equipment		Bioreactor modeling
Yeast production		Environmental engineering
		Gene mapping, transfer, and synthesis
		Hormone synthesis
		Molecular genetics
		Molecular immunology
		Monoclonal antibodies
		Process engineering
		Protein engineering
		Single cell protein
		Enzymes
		Tissue culture
		Vaccine production

Current research activities at level of plant biotechnology

- DNA fingerprinting and phylogenetics of plant varieties and species.
- Biodiversity of wild plant species and detection mutations in Jordan.
- Detection of adulteration of food products based on DNA analysis.
- In vitro induction of plant tissues.

1.2 Animal and veterinary biotechnology

The activities of animal and veterinary biotechnology in Jordan are less than that of plant biotechnology. The working was exclusived in some of Jordan universities such as, in Jordan University of Science and Technology (JUST), the work focused only on in vitro fertilization in Awassi sheep and it did not show good work so far. Other work was done in the veterinary area and mainly involved with disease diagnosis using biotechnology approaches. Mut'ah University, started recently with minimal work on animal genetics using molecular markers. Some work has started on Baladi (local) chickens and on Baladi cattle in Jordan (Redia Shibli, UNIDO study on agriculture biotechnology sector and investment opportunities in Jordan. www.unido.org). In the NCARE, there is a limited working in this filed. Lately, in 2009 one study was conducted on «The Allele and Genotype Frequencies of Bovine Pituitary Specific Transcription Factor and Leptin Genes in Jordanian Cattle Population by Using PCR-RFLP» by Khaleel I. Z. Jawasreh, Faisal Awawdeh, Ibrahim Rawashdeh, Faiq Hejazeen and Miassar Al-Talib and published in Australian Journal of Basic and Applied Sciences, 3(3): 1601-1606, 2009.

In private sector, the working of veterinary biotechnology wasn't common, just they are interesting with vaccines production. However, vaccines and disease diagnosis kits for animal and fish diseases were produced. Jordan has 18 registered factories for veterinary drugs, 19 pharmacies and 15 registered stores in the year 2006. Jordan imported vaccines with about 5 million USD in the same year. Jordan also exports veterinary vaccines and medicines to almost all Arab countries, African countries and some Asian countries as well and others. This is a great opportunity but the technology to produce vaccines and other veterinary materials through biotechnology is still weak. Jordan needs a strike in this field. A huge market is available for this industry in the region and worldwide. In vitro-fertilization and embryo transfer in sheep and cattle (Redia Shibli, UNIDO study on agriculture biotechnology sector and investment opportunities in Jordan. www.unido.org).

The other activity was dealed with:

- Feed additives in the livestock production.
- Producing transgenic animal for high milk production.
- Producing transgenic animals that work as life bioreactors for the production of therapeutic proteins.
- Producing transgenic animals with disease resistance characteristics

1.3 Microbial/ industrial biotechnology

There is no evidences are obvious according to the microbial and industrial biotechnology in Jordan. All of needs in this filed were imported from companies of developing countries neighbor countries if they produced them. For microbial utility, the bacteria Lactobacillus acidophilus was used for production egg and meat with low cholesterol, also production of monoclonal antibodies against E. sakazakii, this monoclonal antibody once produced can be utilized in a test kit that can be used in food factories for a quick test before the release of the product. This will be particularly important in infant foods factories (Redia Shibli, UNIDO study on agriculture biotechnology sector and investment opportunities in Jordan. www.unido.org).

2. Physical facilities dealing with biotechnology

2.1 Research institutions (Academic and research center)

A. Public sector.

1. Al-Balqa' Applied University
2. Al-Albyt University
3. Al-Hashmiah university
4. Al-Hussein university
5. Jordan University
6. Jordan University of Science and Technology (JUST)
7. Mut'ah University
8. National Center for Agricultural Research and Extension (NCARE)
9. Yarmouk University

B. Private sector

1. Philadelphia university

Public Sector - Services

1. Incubator at College of Agriculture, University of Jordan
2. Food and Drug Administration (FDA)
3. Jordan Institution for Standards and Metrology
4. Ministry of Agriculture (MOA)
5. Ministry of Investment and Trade (MIT)
6. The National Biotechnology Center

Private sector (research, industrial production)

1. Al-Barakah Nurseries
2. Al-Nawa Nurseries
3. JOVAC
4. Sukhtian Company
5. VAPCO

Table 2: Physical facilities dealing with biotechnology in the public and private sector universities in Jordan.

Public sector	No. of functional labs.*	Year established	Funding sources	Laboratory infrastructure	Access to information
Al-Balqa' Applied University	2	1995	Government	Available	Journals and website
Al-Albyt University	1	2000	Government	Available	Journals and website
Al-Hashmiah university	1	2006	Government	Available	Journals and website
Al-Hussein university	1	2007	Government	Available	Journals and website
Jordan University	3	1989	Government	Available	Journals and website
Jordan University of Science and Technology (JUST)	4	1992	Government	Available	Journals and website
Mut>ah University	2	1999	Government	Available	Journals and website
National Center for Agricultural Research and Extension (NCARE)	5	1990	Government	Available	Data base- FAO electronic site
Yarmouk University	1	1999	Government	Available	Journals and website
Private sector					
Philadelphia university	1	2000	Private	Available	Journals and website

The number could be less or more based on faculty type within the University.

Table 3: Available human capabilities/ staff/ categories in biotechnology in Jordan.

Institute	* Plant Tissue Culture			Plant Molecular Biology			Animal Molecular Biology			Food Biotechnology		
	PhD	M.Sc.	Technician	PhD	M.Sc.	Technician	PhD	M.Sc.	Technician	PhD	M.Sc.	Technician
Al-Balqa' Applied University	2	1	2	2	1	2	-	-	-	-	-	-
Al-Barakah Nurseries	0	1	5	0	0	0	0	0	0	0	0	0
Al-Nawa Nursery	0	0	6	0	0	0	0	0	0	0	0	0
Jordan University	2	-	-	4	-	-	-	-	-	-	-	-
JUST/ Agriculture	1	1	1	2	0	0	2	0	0	2	0	0
JUST/ Biotechnology Department	1	-	-	6	1	-	-	-	-	-	-	-
Mu'tah University	-	-	-	2	0	0	1	0	0	1	0	0
NCARE **	0	2	4	3	5	2	-	-	-	-	-	-
Princes Haya Biotechnology Center	-	1	-				-	-	-	-	-	-

Table 4: Laboratories equipments and amounts in the NCARE, Jordan universities and private nurseries.

Equipment type *	Universities							Research center	Private nurseries		
	Al-Balqa' Applied	Al-Hashmiah	Al-Hussein	Jordan University ABU& AC	JUST& PHBC	Yarmouk	Mut ah	NCARE	Al-Nawa	al-Barakh	Ben Hayyan
Autoclave	-	-	-	2	4	-	-	3	2	6	-
Bacterial incubator	-	-	-	5	-	-	-	-	-	-	-
Balance	-	-	3	5	4	-	-	15	-	1	-
Centrifuge	-	3	3	3	-	2	2	10	-		1
Capillary EF	-	-	-	-	1		-	-	-	-	-
DNA isolation machine	-	-	-	-	-	-	-	1	-	-	-
DNA sequences	-	-	-	-	5	-	-	-	-	-	-
Deep freeze (-80C)	-	1	1	1	-	-	-	1	-		1
Distiller	-	-	-	2	1	-	-	2	-	-	-
ELISA reader	-	-	-	1	3	-	-	-	-	-	-
Freeze (-20C & 4C)	-	-	1	1	-	-	-	5	-	-	-
Gas Chromatography (GC)	-	-	-	1	1	1	1	-	-	-	-
Gene pulzer	-	-	-	1	1	-	-	-	-	-	-
Growth room	-	-	-	4	-	1	-	4	-	-	-
Chamber room	-	-	-	4	-		1	4	-	-	-
Horizontal gel electrophoresis	-	-	5	10	11	4	1	10	-	-	-
Hot plate	-	-	-	1	4	-	-	-	-	-	-
HPLC	-	-	-	2	1	1	1	1	-	-	-
Ice Maker	-	1	1	1	-	-	-	1	-	-	-
IR spectrophotometer	-	-	-	1		-	-	-	-	-	-
Laminar Air Flow	-	-	-	2	2	4	2	8	6	2	-
Microscope	-	-	-	11	1	-	-	6	-	-	-
Microwave	-	-	-	1	1	-	-	4	-	-	-
Oligonucleotide synthesizer	-	-	-	-	1	-	-	-	-	-	-
PH meter	-	-	-	1	1	-	-	5	-	-	-
Photo documentation system	-	1	2	1	-	1	1	5	-	-	1
PC)	-	2	1	10	6	2	1	7	-	-	2
Shaker	-	-	-	1	3	-	-	6	-	1	-
Southern blotting	-	-	-	-	3	-	-	-	-	-	-
Spectrophotometer	-	1	-	1	6	-	1	3	-	-	-
Protein EF	-	-	-	1	5	-	-	-	-	-	-
Real-Time PCR	-	1	1	1	1	-		1	-	-	1
Vertical gel electrophoresis	-	-	2	1	-	-	-	6	-	-	-
Virus testing	-	-	-	-	1	-	-	-	-	-	-
Water bath	-	3	10	1	1		-	4	-	-	-

More data available on (Redia Shibli, UNIDO study).
(-): Data or equipments are not available

2.3 Access to consumable, reagents and supplies

Companies importing biotechnology-derived products

All consumable materials and reagents imported from external of international companies and the Jordanian institutions were dealing with biotechnology research's purchased their needs from local agencies. A considerable number of companies are currently importing reagents, consumable materials and supplies used in biotechnology research, teaching and production processes in the different public and private institutions. Those include primers, kits, Petri dishes, chemicals...etc. It is estimated that about $ 3.0 million worth of supplies are used alone in Agriculture alone.

2.4 Existing biotechnology linkages with national, regional and international

There is a lack or gap in the collaboration between the international biotechnology centers, Jordan government and biotechnological institutions, all of them are looking forward to open the channels between them for supporting the research and private investments in this filed. At the national level, collaborating is existing particularly lab to lab collaboration

2.5 Publications

There is a huge published scientific papers related to the biotechnology and its branches in hardcover of local and international journals. In this report, selected papers will be mentioned to have view about the outputs in this filed. FAO was initiated database on biotechnology in developing countries (2007/2008) in which Jordan was included among them as well the databases have all publications.

3. Facilities engaged in GMO research and development

3.1 Procedures, protocols and techniques in use

3.2 Ongoing and planned GMO research and development efforts.

Jordan is one of the developing countries in the Middle East and has some ongoing projects in biotechnology. Most of the genetically improved organisms existed in the country are as a result of conventional traditional methods, for example genetically improved crop plants are available from the conventional breeding programs. To our knowledge very few studies are being conducted using the molecular biology technology (specifically recombinant DNA technology) to produce transgenic animals or plants. In addition Jordan is still working to have a license to conduct recombinant DNA technology research for the production of transgenic organisms. Many developing countries are importing genetically modified crops and are planted in their fields for trial and commercial use. It is possible that Jordan may start to plan to import some genetically modified crops. One of the main objective of the current case study is to educate people in the country to be aware of the new technology and how to deal with such products and to seek for an appropriate guidelines, risk assessment and regulations of all issues concerning GMOs.

3.3 Existing or planned collaboration in GMO activities (regional and international)

Some of Jordanian companies have been collaboration with Syngenta; which is «a Swiss company» that dealing with crop seeds and GM crops. They are selling seed in Jordan but they do not have any actual biotechnology work yet going on in the country (Redia Shibli, UNIDO study on agriculture biotechnology sector and investment opportunities in Jordan. www.unido.org). Also, Monsanto as a US biotechnology company involved with GM crops; Jordan is covered by Monsanto's regional office in Turkey responsible for the West Asia and North Africa Region (WANAA); but it has no biotechnology activities in Jordan (Redia Shibli, UNIDO study on agriculture biotechnology sector and investment opportunities in Jordan. www.unido.org)

3.4 Possible gaps (infrastructure, human, skills) affecting GMO R& D

In Jordan, human resources and infrastructure for biotechnology and biosafety and more specifically for risk assessment of GMFs is limited in spite of the long list of experts and many research work represented by the master theses shown in Annex I and II. However, there is an increasing interest by some institutions to train the staff in relevant discipline and equip their laboratories to increase its research potential in biotechnology (www.unep.org/biosafety/files/JONBFrep.pdf).

The constrains or possible gaps can be summarized as follows:

1. Shortage of highly trained manpower: the human resources are scattered in different universities, departments and centers. The scientists in the universities are buzzy, in most of the times, with research related to their promotion. There is no critical mass of scientists in the different lines of sciences and technology such as molecular biology, breeding, ecology, risk assessment and management.
2. Limited institutional capacity for training in biotechnology: lack of high technological equipment.
3. Lack of appropriate research environment and brain drainage.
4. Lack of basic organized information, required data and many essentials techniques.
5. Lack of sufficient participation of the private sector in research support and activities.
6. Lack of national biosafety guidelines
7. Insufficient funding: Biotechnology requires expensive and updated equipment.
8. Inadequate of awareness on the importance and potential use and application of biotechnology and the related safety.
9. Inadequate national systematic policy, strategies and structures.
10. Inadequate institutional collaboration and consultation in biotechnology resulted in dilution of the human resources.
11. Lack of sustainability and long term planning (www.**unep.org**/biosafety/files/JONBFrep.pdf).

4. Biosafety regulatory status

4.1. Status of biosafety framework in the Jordan

Despite the potential benefits raised from a new technology, the sounds of public and scientific concerns have been raised about the environmental and food safety of products derived from the use of modern biotechnology. In view of these concerns, the coming years may prove decisive for the commercial and economically viable uptake of the technology. Without the consent of society at large, the promise of biotechnology may not be realised. Safety concerns are being converted into extensive bodies of regulation and legislation.

Since no risk assessment guidelines have been approved yet officially, certain act regulations and guidelines should be considered and hopefully adopted in the near future. In the past, several committees have been formed in the Ministry of Agriculture to put guidelines and outlines for Biotechnology and Biosafety. Also, several committees were formed in the universities and the Ministry of Health for biotechnology and again nothing significant has been concluded. Lately, a national committee was made by the Prime Minister and headed by the Minister of Agriculture to put again guidelines for genetically modified food and nothing.

4.2 Compliance with international conventionals and protocols

Over the recent years, several internationally agreements were concluded to deal with biotechnology or were amended with respective provision. Examples are the WTO agreements (SPS, TBT, TRIPS, Article XX of GATT), the Biosafety Protocol of the Convention on Biological Diversity (CBD), Codex Alimentarius, etc. The Biosafety Protocol of the CBD is the foremost international instrument dealing with regulation in biotechnology and is legally binding for the signatory countries (http://www.cbd.int/biosafety/). Jordan actively participated in the negotiations leading to the Convention on Biological Diversity, and considers one of the earliest countries signed it at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil, in June 1992, and ratified it in 1993. Also, Jordan has been participated in the intergovernmental negotiations of the Biosafety Protocol in the past few years, and signed it in October, 2000, and ratified it in November, 2003.

Jordan government has taken many initiatives to project its environment since the independence of the Kingdom in 1946. The government has also realized that an essential impute to the protection of environment is the issuance and enforcement of environment related laws. Legislation and regulation pertaining to the environment have been adopted and enacted by the government of Jordan since 1950's. Present legislation and regulation include more than 250 articles related to environmental is-

sues. A new environmental law (law 1/2003) was adopted, and regarding to it a new ministry of environment were established.

Regarding the law No. 1 / 2003, the main tasks of the ministry are to set the general policies for the protection of environment and prepare the plans, programs, projects, measures and criteria and specifications for the elements of the environment, in addition to the supervision the public and private organizations and institutions. There are many of laws, by-law, regulations and decisions related to the biotechnology, biosafety and environment protections as follows:

1. By-law on hygiene and food safety (No. 8 / 1994):
2. Ministry of Agriculture (law No 4 / 2002 temporary)
3. Public health law (No. 21/1971)
4. The law for the protection of new plant species (No. 24/2000)
5. The law on descriptions and specifications (No.15/1994)
6. The by-law on health quarantine in Aqaba port (No. 32/1972)

4.3 Existing or planned biosafety regulatory bodies:

4.3. 1 National biosafety committee

4.3.1.1 National biosafety committee members (www.unep.org/biosafety/files/JONBFrep.pdf).

- Agriculture Engineer Association
- General Association for Foodstuff Merchants
- General Organization for Food and Drugs
- Jordan Institution for Standards and Metrology
- Jordan Veterinarians Association
- General Union for Farmers
- Ministry of Agriculture
- Ministry of Environment (Chair)
- Ministry of Finance-Customs
- Ministry of Health
- Ministry of Industry and Trade
- Ministry of Planning
- The Higher Council for Science and Technology
- The National Association for the Protection of the Consumers
- The National Center for Agriculture Research and Technology Transfer
- The Ministry of Environment will provide the Secretariat for the Committee.
- Two national experts nominated by the Chair
- Two Universities nominated by the Chair

4.4 Status of regulatory approvals

Regulatory framework of national biosafety management

The government of Jordan has taken many initiatives to project its environment since the independence of the Kingdom in 1946. The government has also realized that an essential impute to the protection of environment is the issuance and enforcement of environment related laws. Legislation and regulation pertaining to the environment have been adopted and enacted by the government of Jordan since 1950.s. Present legislation and regulation include more than 250 articles related to environmental issues. A new environmental law (law 1/2003) was adopted, and regarding to it a new ministry of environment were established. Based on the above information, we found we don't have any regulation in Jordan deal with LMOs or the biotechnology products direct, so we start to work on a regulation which can control transporting dealing and use of the LMOs product based on the Cartagena Protocol. A subcontract was done with national experts to draft the By-law to control dealing with biotechnology based on the ministry of environment law. Three workshops were organized to discuss the draft also another workshop was organized in presence of an international expert.

The draft covers the following features: controlling transporting, dealing and using LMOs, labeling the LMOs products, a national committee to follow this by-law which they can establish any technical / advisory committees to do risk assessment for any LMOs products. The national regulatory system of biosafety will be established according to the identified scope of By-law to govern various phases and areas of 13 modern biotechnology development to prevent their negative impacts on human health and environment. The experience in other countries and the experience and expertise available in international organizations will be drawn upon and the reality in Jordan taken into account to gradually improves the biosafety regulatory system. The components of the national regulatory system for biosafety will include: 1. A national By-law on biosafety; 2. A number of specialized regulations concerning biosafety; and 3. A set of management procedural regulations, including institutional legislation concerning EIA, assessment procedures, and technical guidelines for assessment. The first step in developing appropriate policies and procedures for the regulation of biotechnology is to establish a National Biosafety Committee (NBC) under the Ministry of Environment.

The NBC should then move quickly to establish policies and procedures to govern the use of modern biotechnology and its products in Jordan (www.unep.org/biosafety/files/JONBFrep.pdf).

By-Law for Biosafety of Genetically Modified Organisms Issued in Accordance with Article No (23) of the Law of Environment No (1) for the Year ( ). Article 16: Regional cooperation ' Jordan may enter into agreements for regional cooperation in any field related to GMOs, particularly with respect sharing information and building capacity to manage GMOs (www.unep.org/biosafety/files/JONBFrep.pdf).

5. Capacities for GMO detection

5.1 Examples/ case study on GMO detection

5.2 Areas of implementation/national adoption

5.3 Detection fees

Genetically modified (GM) plays a great role for identifying targets for development of new drugs and vaccines against diseases, as well as for producing high yield crops. GM has been using in animals and engineered to produce milk or therapeutic agents to benefit humans. GM animals are being produced that stay healthy, offer higher yield and eat less. Insects that spread disease are being genetically modified in a way that renders them incapable of transmitting disease. The potential hazards of these new practices must be carefully evaluated to minimize adverse harm that might occur not only to the GM species but also to humans, adverse effects on environments and ecosystems, and changes in the ability of animals to be reservoirs for human disease.

These practices therefore need mechanisms for careful monitoring and control. The application of GM crop technology must therefore be considered on a case by case basis, evaluating rationale, need and evidence (WHO. 2004. www.emro.who.int/rpc/pdf/EMRC51TechDisc03.pdf). Detection of GMOs is very important issue to be seriously considered for the great interest and benefit to the farmers in controlling the GMOs introduction into the country. Also, GMO detection is a prerequisite for enforcement of such regulation when already in place.

Marketing of biotech crops in Jordan is prohibited (Giles and Khraishy, 2007). Based on the time and effort were spent for information surveying about GMO in Jordan through internet sites and publications, there is no working was done on GMOs either producing the transgenic plants or testing the modified organisms, except some cases, in 2002, it seems that PCR was used for detection gene of CaMV 35S promoter from foods of local markets. So far, there are no GMOs approved in the Jordan and neither legislation controlling the introduction of GMOs into the country. There has been no permission already given regarding neither importation nor field release or commercialization of GMOs into environment. Also, regulating the GMO introduction with potential capability of detection in Jordan is required.

The LAW of biosafety regulations is stilling between hands of Jordanian parliament waiting to be ratified. However, GMO detection faced the following gaps:

1. Lack of full technical expertise in GMO detection, methodologies and practices.
2. Lack of modern molecular biology equipment and containment facilities.
3. Lack of standardized procedures for the management of GMOs at various ports of entry
4. Trained staff in GMOs detection and monitoring is needed.
5. Lack of financing supporting.
6. Lack the coordinating and the cooperation between institutions dealing with GMO detection.
7. Lack the risk assessment and management.

Lack of financing is the most important restriction in universities and official institutions and in the private sector

1. Although financial support is a serious problem, researchers (15 percent) cited other problems such as the shortage of professional technicians trained on advanced and specialized scientific equipment. Also of concern is the approvals procedures for biotechnological research, especially the long time between presenting the proposal and its implementation. The result is decreased interest of the researcher, who will often pursue other areas of research (www.cgiar.org/biotech/rep0100/Ajlouni.pdf|).
2. Another problem facing researchers in this area is the lack of consumable materials and routine ordering procedures (www.cgiar.org/biotech/rep0100/Ajlouni.pdf|).
3. It is important to mention that the right scientific atmosphere is often absent for this type of research activity; the importance of this type of research is not made clear; it is expensive; it does not directly produce goods for people; and there is a lack of scientific literature and other materials. This lack of public awareness of the importance of biotechnology research and the absence of scientific groups who will provide the necessary cooperation and technical assistance to the researcher were cited by 30 percent in the survey (www.cgiar.org/biotech/rep0100/Ajlouni.pdf|).

   Analysis at the national level of country contribution to the regional platform

1. Contribution of Jordan

Jordan will contribute with the regional platform through the following terms:

A. Feasibility studies

Jordan needs to make feasibility studies in collaboration with international organizations, NGOs as well other regional institutions to facilitate the investment areas in biotechnology and enhance the interest of investors in this area. Any expected problems for the investment in this area must be solved to enable the investment environment.

B. Biotechnology research

Research must be oriented to applied biotechnology to help in producing protocols and products that can be transformed to business in the Agriculture Biotechnology area.

C. Business incubator

Incubator (at UJ) must play a major role in looking after any opportunity in biotechnology to maximize the benefits of any ongoing research. More incubators are needed especially at JUST and NCARTT to facilitate more benefits of agriculture biotechnology research done there.

D. A national strategy for biotechnology

A national strategy for biotechnology is needed in Jordan to set up the areas of interest and the future prospects of agriculture biotechnology in Jordan.

E. GMOs network

Prompting a regional network in agriculture biotechnology and GMOs activities is a crucial at this stage to have progress in the events of biotechnology. This network will help in advancing the understanding of scientific issues relating to nutrition, food safety, toxicology, risk assessment, and the environment. Also, there is also need for a network at the regional level for technical capacity building in biosafety and risk assessment aspects.

2. National and regional perspectives in agriculture, food, biosafety and nutrition

- Climatic changes, GMOs, natural resources and plant genetic resources are the life keys and issues of the next generations should be conserved
- Environment protection and human heath should be taken into consideration with release GMOs products in the future
- Meetings should be in a regular time between countries to display the lasts out puts of the established project.
- Promoting and protecting biodiversity and natural resources
- Promoting collaboration between participants and neighboring countries in addition to those
- Strategies for enhancing safety and security in the food and agriculture is required.
- Stressing on the biosafety regulations, guidelines, laws and decisions and should be raised are not included within this project for controlling the borders and struggle GMOs smuggles.
- The national biosafety regulations should be harmonized with other countries in the region and their trading partners.

6. Conclusion

Strengthen capacity for establishment a platform for GMOs detection is a crucial decision to Jordan and participants countries. Import, handling and release genetically modified crops as well food products should be followed the national and international biosafety regulations. Development of suitable reference GMOs detection labs are needed at this stage. International funds through bilateral and multilateral projects and donation is needed.