

# **The National Center for Research and Development (NCRD)**

Concept paper for research and development priorities

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## **Introduction**

The National Center for Research and Development (NCRD) is mandated to develop scientific capacity and capabilities in the field of biotechnology, energy, Badia research and other research of interest. The center overtakes responsibilities, activities and programs in previously existed centers.

In order to achieve tangible thrust in research and development it is important to delineate priorities that respond to urgent current needs of the country. It is envisaged that research and development activities under these priority areas would cut across issues covering the mandated R&D domain of NCRD (i.e. biotechnology, energy, Badia research etc.). The successful implementation of research and development roadmaps that can achieve desired impact calls for involvement of enabling factors in the process such as appropriate technology transfer, private sector and civil society and use of ICT for smart specialization. In the wake of COVID-19 pandemic, food security and health constitute major concern for policy makers, and warrant attention by the highest political level in the country. The concern was justified knowing that some food exporting countries imposed export restrictions on key staple food items like rice and wheat. The lockdown and movement restriction further exacerbate the problem and negatively impacted the food supply chains. The impact where increasing food production while maintaining the integrity of functional ecosystem can minimize vulnerability and risk associated with man-made or natural crisis.

In this context NCRD identified **food security and health as priority areas for research and development** over the coming 6-7 years (2021-2028). It is anticipated that the research and development programs in these areas will enhance availability and access to nutritional food and help maintain a healthy vibrant population that can effectively participate in the socio-economic activities of the society.

## **Food Security Situation Analysis**

The right to food is the core of human dignity and survival. It calls for sustainable and resilient operations, practices and policies that enhance the food system local output in the context of keeping healthy environment. Food security exists when sufficient, nutritious food is physically, economically and socially accessible by all people at all times to meet their dietary needs and preference to enjoy productive and healthy life. This definition delineates food security dimensions in terms of:

- 1) Food supply availability which is mirrored in available arable land and areas under cropping (food production).
- 2) Physical, economical and social access to food which is best measured by share per capita of the Gross Domestic Product (GDP/capita).
- 3) Utilization which refers to the quality and safety of the food.
- 4) Stability refers to the food being available at all time which is measured by the level of self-sufficiency and import dependency.

### **Challenges to Food Security in Jordan**

Jordan is generally a food deficit country with ever increasing population of 10 million of which about 3 million are non-Jordanians including foreign laborers, residents or refugees. The country is not rich in natural resources with limited agricultural land, limited water resources and fragile ecosystems.

Food security in the country is affected by intricate factors including but not limited to ever-decreasing arable land, water scarcity and geopolitical issues in the region, ecosystems degradation, high poverty rate, unemployment, slow economic growth, urbanization, climate change and global variables including diseases, pandemics and conflicts.

#### **1. Arable Land**

Jordan arable land spans over an area of 89100km<sup>2</sup> of which the agricultural land is only 4263840 donums (2016) located in 3 different agroecosystems including the Jordan Valley, the high land plateau and the Badia. Forest covers an area of 390000 donums in the hilly plateau. The arable land decreased by 30.8% from 1.08X10<sup>6</sup> donums in 1960 to 0.748X10<sup>6</sup> donums in 2018. Land in the high land suffers from fragmentation either due to improper land use policy that benefits other sectors at the expense of food production or to annexation of many municipalities in Amman and Irbid which paved the way to further expand urbanization and lead to land fragmentation. It is not astonishing to know that 91% of Jordanians are living in urban centers. The extent of this problem

(urbanization and fragmentation) are far reaching and resulted in 40% loss of arable land in the most agricultural productive area in high plateau. Farmers abandoned their land and moved activity to less productive marginal land and as such increased vulnerability of already fragile ecosystem.

The available arable land in the context of other limiting factors is able to satisfy the need of Jordan only in tomatoes, goat milk, table eggs, olives and olive oil. The average of self-sufficiency for other items ranged from 3.3% for cereal crops to 86.1% for potatoes.

## **2. Urbanization**

The root cause of urbanization is of socioeconomic origin but it is accentuated by low productivity of cultivated land due to improper cultural practices, absence of appropriate technology, trivial investment return in small fragmented land pieces, poverty, unemployment and climate change.

## **3. Climate Change**

The climate change has a multiple effect on length of the growing season, productivity of range land, availability of surface water, pollution, drought episodes and severe environmental events including heat waves in the summer and occasional flash flood in the winter.

According to data posted on the World Bank Climate Change Portal, the annual temperature is estimated to increase by 2°C between 2030-2049 versus 1980-1999. The 2°C warming will accelerate evaporation and shorten the growing season. Rainfall is expected to be sporadic characterized with spacial, and temporal variability and associated with occasional intense precipitation that may lead to flash flood and thus eroding fertile soil and endangering public safety. Rainfall is estimated to decrease by 11-19% setting the stage for drought occurrence. These variables will add to the acuteness of water scarcity, dropping the ground water level in most water aquifers causing eventual high concentration of total soluble solids; a condition that renders such water unsuitable for domestic or irrigation use. Farmers in these areas often abandoned their farms (Azraq and Dhulail areas), and migrated to cities adding to the problems created by urbanization. The combined impact of climate change and the ever increasing demand on water for domestic use by expanding urbanization and satisfying other anthropogenic activities that leads to water pollution. Other consequence of climate change is lowering the range land productivity to unsustainable condition. The damage is exacerbated by overgrazing setting the stage for desertification to advance into marginal lands.

#### **4. Water**

Jordan witnessed severe water deficit which is further complicated by shortage of rain in different parts of the country. Water in many springs and Wadis has dried out; water table has fallen to unprecedented levels. Total soluble solids due to water abstraction beyond the aquifer recharge threshold rendered water in many aquifers unsuitable for domestic or irrigation purposes. These challenges are triggered by climate change, increasing demand for domestic and industrial purposes, mismanagement of water resources and water use.

Long term annual average precipitation in Jordan is estimated to be 8325 MCM (1937-2006) with 7650.6 MCM lost to evaporation. Part of the remaining amount is either stored in soil profile, replenishes the water aquifer, collected in water reservoirs, or seeps to Dead Sea. Jordan annual water demand (2020) ranged 800-900 MCM, creating alarming deficit in the water balance as reflected by high 185% overexploitation ratio of the water aquifers.

Water pollution is another problem related to industrial waste, overuse of pesticides, fertilizers, and use of inefficiently treated effluent water in agriculture. These chemicals may leak to soil and water and high concentration of some chemicals finds its way to vegetation jeopardizing human health and negatively impacted the ecosystems.

Agriculture potential in fulfilling its role in food security is being compromised since its share of the available fresh water is declining due to competition by other sectors and being compensated by supplying often inefficiently treated effluent water that is expected to reach 220Mm<sup>3</sup> in 2022. At the same time productivity of rain fed areas is also declining.

The national water strategy of Jordan (2016-2025) predicted that future demand will exceed current supplies by more than 30%. The situation is worsened by influx of Syrian refugees.

#### **5. Poverty and Unemployment**

Poverty and unemployment are major causes of food insecurity. Economically underprivileged rural inhabitants (9% of the total population) account for 33.5% of Jordan's poor. This high ratio exceeds their 9% proportion of the total population.

Although Jordan Gross National Product per capita puts Jordan in higher middle income countries doesn't seem to translate into fair distribution of development benefits across the strata of the society in different parts of the country.

## **6. Energy**

Food security doesn't exist in a silo. It is part of a nexus that holdstogether food, water and energy. Cost of energy account for 15-22% of the food total production cost. It is no more a luxury to introduce renewable energy alternatives including solar, wind and geothermal sources in agriculture where appropriate.

## **7. Biodiversity**

Jordan ecosystems are classified as dry ecosystems with almost 80% of it received 50-200 mm annual rainfall.

Maintaining healthy environment and adoption of sustainable practices within the food system not only increase the system output but confers resiliency and flexibility in face of uncertainties associated with future threats caused by climate change (elevated warming and reduction in annual precipitation), man-made crisis (conflicts) or eruption of diseases. Keeping functional ecosystems with its vibrant diversity and integral natural resources calls for appropriate intervention (policies, practices and safe use)to protect land resources and water resources that support food system. For these interventions to be effective creating job opportunities and income enhancing activities in an effort to reduce poverty and improved resiliency of vulnerable people are vital in the context of economic drivers in local communities' comparative advantage.

Healthy ecosystem not only insures productive natural resources including fertile land, clean water, fresh air, food, medicine (herbal medicinal plants), halts the advancement of desertification, ameliorates the climate, prevents soil erosion and regulates run-off. But alsoit extendsaesthetic dimension on human environment and provides a media for healthy interaction between the local people and habitat creating and preserving their local knowledge.

Factors affecting biodiversity include:

- 1) Climate change mediated through water scarcity, heat waves, intense variable sporadic rain that may lead to flash flood and soil erosion, incidence of drought and natural fires, clearing forest for agricultural activities or unauthorized cutting of forest trees for fire wood.
- 2) Anthropogenic activities including over-exploitation of water resources (overgrazing and man-induced fire) which lead to extinction of some animals(birds and frogs) and feral species in Azraq Oasis.
- 3) Although Jordan's share in global greenhouse gas emission was not significant and reaches 38, 151 Gg CO<sub>2</sub> eq. in 2020 and is estimated to reach 61, 565 Gg CO<sub>2</sub> eq. in 2040;the country determined to join the international community in curbing the CO<sub>2</sub> emissions by signing and ratifying the UN Framework Convention on Climate Change, Mitigation

of GHG Emissions. Effects were reflected in strengthening and promoting renewable energy and in improving forest and range land management to increase their capacity to fix CO<sub>2</sub>. The country planned to reduce GHG emissions unconditionally by 14% in 2030, 1.5% by the country's own means compared to business as usual. However, subject to availability of international aid the country commits to reduce GHG emissions by additional 12.5%.

## **8. Livestock**

Livestock sector contributes 60% of agriculture's share in GDP. It is considered a major or auxiliary source of income for 48% of rural population.

The sector is characterized by low efficiency, low productivity and increasing production cost due to limited feed production and inadequate productivity and mismanagement of rangeland. Major ruminant animals (sheep, goat, cattle) are raised in Al-Mafraq governorate. The monetary value of livestock production was 1.09 billion in 2015 whereas the poultry account for the highest contribution followed by cattle, sheep and goats.

## **9. Role of women in food security**

Women are mostly involved in homestead mundane, where they play a major role in small scale agriculture, livestock and poultry activities including feeding, grazing, raising, watering, planting and weeding. At a large scale agriculture their involvement is rather limited and constitutes only 9% of the total female labor force where however, its share in total labor force would not exceed 15%. At this scale women's engagement includes harvesting, milking, packaging and food processing.

Capitalizing on their traditional knowledge in preparation, processing and preservation of food originated from plants or livestock, they contribute to the resilience of their community. In addition, women are cognizant of the use and benefits of indigenous plants as source of food or medicine. This is an important asset that should be explored by researchers to investigate the potential for product improvement or development.

Women's Contribution to food security should be emphasized and enhanced by empowering them with enabling conducive and training schemes.

## **10. Information asymmetry along the food supply chain**

The current food system acts in silos due to lack of information across the food supply chain which increased the cost of transactions. Digital technology and networks will enable agri-food system to reduce transaction cost and disseminate information fairly to all stakeholders. To achieve this digital platform (i.e. information center) should be established. The said platform can enhance sustainable, transparent and competitive food system. Data on aspects of food production, storage, transit, quality, variety of produce and cultural practices could be easily traced. This will enhance sustainable food production. Since it is known that more sustainably sourced food earns a price premium from health and environmentally conscious consumer thus sending a signal to producers to invest in sustainable production operations.

Digital transformation and open data also enhance development of new agricultural technology such as smart agriculture.

Dissemination of data across the system may induce entrepreneurs to develop mobile applications or new business models in marketing, production or services based on this information.

The feedback information from consumers within the system will also help public institutions responsible for food safety to pin point immediately any public safety hazard and prompt immediate intervention.

## Food security SWOT Analysis

Strengths	Weaknesses	Opportunities	Threats
<ol style="list-style-type: none"> <li>1. Alignment with local strategies and economical plans, Jordan vision 2025, Economic growth plan 2018-2022, National Strategy for Agriculture Development, National Green Growth Plan and National Strategy for Biodiversity.</li> <li>2. Alignment with regional and international conventions and protocols such as Sustainable Development Goals and Union for Mediterranean (Prima, blue mid, and cross-border (neighborhood) cooperation).</li> <li>3. Available good level of capacity and capability in different Jordanian institutions to carry out R&amp;D that serves Food Security.</li> <li>4. Available Agri-ecological zones that can support food production year round.</li> </ol>	<ol style="list-style-type: none"> <li>1. Limited arable land with fragmental ownership specially in the rainfed areas.</li> <li>2. Water scarcity for irrigation due to severe competition with other sectors.</li> <li>3. Deteriorated water quality from different resources due to:               <ol style="list-style-type: none"> <li>a- Elevated salinity</li> <li>b- Inefficient effluent water treatment.</li> </ol> </li> <li>4. Fragile economic base of farmers.</li> <li>5. Absence of holistic approach and collaboration in research activities.</li> <li>6. Minimum appropriate technology transfer.</li> <li>7. Lack or inadequate policies to protect natural resources, to halt encroachment to arable land.</li> <li>8. Mismanagement of rangeland.</li> </ol>	<ol style="list-style-type: none"> <li>1. Poverty reduction.</li> <li>2. Increase agricultural productivity (food &amp; feed).</li> <li>3. Increase water productivity and use efficiency.</li> <li>4. Enhance water resources, aquifer recharge and adequate treatment of brackish and effluent water.</li> <li>5. Enhance water quality.</li> <li>6. Reduce pollution.</li> <li>7. Impact socio-economic aspects of rural population.               <ol style="list-style-type: none"> <li>a- Income generating activity (appropriate technology transfer).</li> <li>b- Preserve local knowledge.</li> <li>c- Maintain the integrity of local ecosystems.</li> <li>d- Extend financial tools including credit and financial inclusion.</li> </ol> </li> <li>8. Increase the country capacity and capability in food security domain.</li> <li>9. Provide a mechanism of collaborative work and networking among researchers in Jordan.</li> <li>10. Introduce new technologies in food production: hydroponic aquaponics, aeroponic and organic and smart agriculture.</li> </ol>	<ol style="list-style-type: none"> <li>1. Climate change and frequent environmental events (heatwaves drought, flash floods).</li> <li>2. Market failure and movement restriction due to: (Crisis, Pandemic).</li> <li>3. Ever increasing population including refugees' influx.</li> <li>4. Lack of supporting policies to promote innovation and protect natural resources.</li> <li>5. Increasing cost of production.</li> <li>6. Not enough financial allocations for research and development.</li> </ol>



## **Road Maps of Research and Development and Impact Pathway**

### **Food Security**

#### **1. Sustainable Agriculture**

##### **1.1. Specific problem**

Agriculture share was 3.5% of GDP in 2017. However, it has a contributing element in other sector output including but not limited to retail and whole sale trade, transport and food manufacturing. It also impacts socio-economic status of 15% of the population and can be effective mechanism to curb poverty in the rural areas that may limit rural to urban migration trend.

Agriculture productivity needs to be improved; natural resource efficient use and management should be guiding policies, strategies and practices in the context of ever changing variables including population growth and climate change.

##### **1.2. Research and Development topics. (Long term).**

- 1.2.1. Increase sustainable agriculture production and productivity.
  - 1.2.1.1. Introduction of new sustainable agricultural systems such as hydroponic, aquaponic or aeroponic and organic agriculture coupled with using renewable energy (Geothermal, wind turbines and photovoltaic) for heating and cooling.
  - 1.2.1.2. Reducing food loss in the field, transit and storage (post-harvest research and technology).
  - 1.2.1.3. Management of crop residues and manure by composting technology.
  - 1.2.1.4. Food technology and preservation (dairy products, wool, food preservation).
  - 1.2.1.5. Appropriate technology transfer with reference to the relative advantage of individual agroecosystem.
  - 1.2.1.6. Artificial insemination and embryo transplant.
  - 1.2.1.7. Breeding and seed production programs.
- 1.2.2. Investigating management-based adaptation and measures.
  - 1.2.2.1. Evaluation of crops for drought and salinity tolerance.
  - 1.2.2.2. Water-saving cropping methods including mulching minimum tillage, crop covers, change in planting dates and planting sowing depth for rainfed agriculture and introducing new crops.
  - 1.2.2.3. Integrated pest management.
  - 1.2.2.4. Research in market analysis for Jordanian agricultural products.

##### **Short term priorities in sustainable agriculture (3-4 years).**

1. Introduction of new sustainable agricultural systems such as hydroponic, aquaponic or aeroponic and organic agriculture coupled with using

renewable energy (Geothermal, wind turbines and photovoltaic) for heating and cooling.

2. Evaluation of crops for drought and salinity tolerance.
3. Food technology and preservation (dairy products, wool and food preservation).

- **Impact pathway**

Research and Development in these areas will efficiently utilize water, land resource, prevent soil erosion, maintain soil fertility, reduce crops loss and reduce pollution waste. It is also expected to increase food production and productivity in the context of sustainability and contribute to food security.

- **Methodological approach**

This pathway needs cooperative teamwork among researchers in the fields of horticulture, plant breeding, animal husbandry biologists, soil scientists, agronomists and experts in fisheries.

## **2. Water scarcity**

Water share of agriculture (currently 51% of all water resources) declines as competition by other sectors on limited water supplies increases. The situation is exacerbated by increasing population and climate change.

Rainfall is mostly the major water resource in Jordan. Shortage of rain is estimated to fall between 10-20%. This will lower water table in aquifers, cause disappearance of streams and springs and deteriorate water quality for domestic, industrial and agriculture purposes. Renewable ground water is over-exploited by 160% and deep fossil water will eventually diminish.

### **2.1. Research and development topics. (Long term).**

- 2.1.1. Investigate methods to enhance recharge of water aquifers.
- 2.1.2. Investigate methods to reduce water loss by evaporation.
- 2.1.3. Investigate methods to store rainfall water in soil profile in the rainfed areas.
- 2.1.4. Development of techniques for macro and micro level water harvesting.
- 2.1.5. Potential use and treatment of grey, brackish and effluent water.
- 2.1.6. Water desalination using renewable energy.
- 2.1.7. Investigate water productivity for different crops.

### **Short term priorities in water scarcity (3-4 years).**

1. Investigate methods to enhance recharge of water aquifers.
2. Investigate water productivity for different crops.
3. Development of techniques for macro and micro level water harvesting.

- **Impact pathway**

Research and development in these areas will enhance / increase water levels in water-aquifers and enhance water availability and quality contributes to food security.

- **Methodological approach**

This pathway needs cooperative team work depending on research area among: scientists in the fields of civil engineering, hydrology, environmental and water resource management experts and agriculturists (horticulturist, agronomist and range land specialists).

### **3. Biodiversity**

#### **3.1. Specific problem**

Dry ecosystem covers 80% of Jordan's area which receives average annual rainfall between 50-200mm. The precipitation is enough to sustain range land in many localities if these are properly managed. However, soil in most of the areas is compacted with minimum permeability allowing run-off to naturally depressed areas called Marabs or man-made Hafirs. These areas also sustain diverse fauna and flora before water eventually lost to evaporation.

The only fresh ecosystem (Azraq wet land Oasis) was destroyed as a result of over pumping water to satisfy needs for municipal and agricultural purposes. Furthermore overgrazing poses major threat to diversity and sustainability of range land.

Biodiversity is also aggravated by climate change through shortage of rainfall, heat waves, occurrence of drought, flash floods and fire. Improper cultural practices and urban encroachment into forest and fertile land further exacerbate the problem.

#### **3.2. Research and Development topics. (Long term).**

3.2.1. Research methods to improve permeability of soil are a prerequisite to restore range land especially in the Badia.

3.2.2. Building resilience of local communities by appropriate technology development and transfer to generate extra income (i.e. research on food technology including improving local products and product preservation and by developing cooperative and agro-industrial fabric).

3.2.3. Investigate climate change adaptation and mitigation measures.

- Afforestation and range land management and restoration.

- Investigate establishing protected areas in hot locales.

3.2.4. Germplasm collection.

### **Short term priorities in biodiversity (3-4 years).**

1. Research methods to improve permeability of soil are a prerequisite to restore range land especially in the Badia.
2. Building resilience of local communities by appropriate technology development and transfer to generate extra income (i.e. research on food technology including improving local products and product preservation and by developing cooperative and agro-industrial fabric).
3. Germplasm collection.

- **Impact pathway**

Research under these topics may lead to innovation, technology transfer to develop or improve products, devise methods for climate change adaptation or mitigation (enhance the capacity of the system to fix CO<sub>2</sub> and increase its efficiency in providing vital services). It will help in preserving germplasm and local heritage and knowledge. This will alleviate poverty, sustain human settlement and contribute to food security.

- **Methodological approach**

This research needs cooperation among scientists in water hydrology, range land specialists, food technologists, forestry technologists, agronomists and ecologists.

## **Health Security**

### **Situation Analysis**

Many health indicators are improved in Jordan; a reflection of functioning health care services.

The crude birth mortality rates and the infant mortality rates have dropped down whereas life expectancy increased. Jordan spends on health twice as much of spending by similar middle-income country (\$160/capita) amounting to 7.5% of GDP in 2012.

Jordan extends primary health care services all over the country realizing that healthy citizens are crucial elements in socio-economic development. However, it is important to set programs to monitor and manage non-communicable diseases (diabetes, hypertension, obesity, malnutrition, cardiovascular diseases (CVD) and stroke). An effort that should be done by specialized centers.

The advent of the COVID-19 pandemic emphasizes the importance of these diseases as they enhance the vulnerability of the population to communicable diseases.

Generally low medical research is a major limiting factor to assess prevalence, risk factors, outcomes and distribution of various communicable diseases (CD) and non-communicable diseases (NCD) which is a first step to design programs and prioritize resource utilization to address these problems.

### **Health & Nutrition**

WHO classifies Jordan as a country in transition with regard to nutrition and non-communicable diseases. Overweight among children above 5 was 4.7% in 2012. Obesity (BMI  $\geq$  30) was found to affect 60% of women and 35% of men aged 25 years old and above, whereas obesity and overweight predispose affected people to non-communicable diseases such as cardiovascular diseases and diabetes which occurred in 13.1% of Jordanian adults (2014). Micronutrient deficiencies in vitamins A, D, B9, B12, Calcium, Iron and Zinc are wide spread among women and children.

Anemia reflects a nutritional deficiency in Iron, folate and vitamin B12 was found to occur in 31.7% of children aged 6-59 months in 2017/2018.

In response, the Ministry of Health introduced programs in 2002 to fortify flour with iron and folic acid. The program was extended in 2006 to cover B1, B2, B3, B12 and Zinc. In 2010 vitamin D was added and salt was fortified with iodine.

Incidence of under nourishment in the population was 4.2% in 2015. This precipitated in prevalence of stunting among less than 5 year old Jordanian children to 7.8% and acute malnutrition or wasting to 3%.

Around 86% of Jordanian elderly suffer from one or more of chronic diseases such as high blood pressure 53%, high cholesterol 30%, diabetes 25%, heart disease 13% and asthma 10%.

High incidence of smoking among young males reaches 34.1% and females 19.4%.

## **Health Insurance**

The proportion of population covered by health insurance is approaching 78% in 2013.

This includes civil health insurance (44%), the Royal Medical Military Services (27%), university insurance (1.3%) and the private health insurance (6.9%). UNRWA covers (6.8%) of the population.

The civil health insurance includes without any financial costs children under the age of six, and segment of society that have been classified as poor by MoSD.

The health insurance is faced with challenges related to:

- 1) Problems with accuracy of statistics about insurance coverage.
- 2) About a quarter of population are without health insurance.
- 3) Overlapping in the process of providing health services from MoH and Royal Medical Services.

## **Pharmaceutical Industry**

Jordan pioneered pharmaceutical industry among neighboring countries. However pharmaceutical products produced by the industry are generic in nature or after securing production license and franchise right from multinational companies. Government support for R&D is lacking and scientific research within the sector for development of novel products is unsatisfactory. The sector should be encouraged/ or incentivized to transfer the technology of vaccine production and more investment should be allocated to produce diagnostic kits. Clinical research on drug development and biopharmaceutical innovation should be promoted.

## Health SWOT Analysis

Strengths	Weaknesses	Opportunities	Threats
<ol style="list-style-type: none"> <li>1. R&amp;D in Health security is vital to meet the need of the country especially under crisis condition.</li> <li>2. It responds to the highest possible support of the country and to SDG.</li> <li>3. Vibrant private sector willing to invest.</li> <li>4. Adequate number of researchers in nutrition, medicine, pharmacy, botany and nanotechnology.</li> <li>5. Participation in data collection for the benefit of the HCST information center.</li> <li>6. Almost 75% of the population is covered by one or more health insurance plan.</li> </ol>	<ol style="list-style-type: none"> <li>1. Absence of monitoring systems for NCDs and CDs.</li> <li>2. Lack of government support for R&amp;D in pharmaceutical development.</li> <li>3. Absence of studies to identify underlying drivers and risk factors for chronic NCD.</li> <li>4. Absence of programs to improve physical and mental fitness.</li> <li>5. Lack of biopharmaceutical innovation.</li> <li>6. Absence of linkages framework between research centers and private sector.</li> <li>7. About one quarter of population are not covered with health insurance.</li> </ol>	<ol style="list-style-type: none"> <li>1. Early detection and management of CD &amp; NCD.</li> <li>2. Vaccine technology transfer.</li> <li>3. Production of diagnostic kits.</li> <li>4. Build the country capacity and capability in health security.</li> <li>5. Devise programs for promotion of physical and mental health.</li> <li>6. Development and innovation in biopharmaceutical (identification of active ingredient in local feral plants).</li> <li>7. Development of diagnostic kits for diseases affecting humans and animals.</li> </ol>	<ol style="list-style-type: none"> <li>1. Lack of government support for vaccine technology transfer initiatives.</li> <li>2. The private sector unwillingness to invest in novel drug development research.</li> <li>3. Minimum available public fund to support R&amp;D to serve the sector.</li> <li>4. Abrupt eruption of crisis conditions in absence of research on disaster risk reduction.</li> </ol>

### **Research & Development (long term)**

1. Surveying and monitoring non communicable and communicable diseases to help manage the epidemiological transition of Jordan population with regard to these diseases.
2. Survey and monitor diseases that can inflict both animals and humans.
3. Explore the local and traditional technology with regard to using local flora in their daily life for medicinal or economical purposes. Identify active ingredient and interphase with local pharmaceutical industry.
4. Development of diagnostic tests for human and animal communicable diseases.
5. Vaccine technology transfer efforts.
6. Study the possibility of covering the proportion of the population who lack health insurance coverage and investigated the role of social security in this regard. (Specially for elderly Jordanians above 60 years).

### **Short term priorities in health (3-4 years).**

1. Vaccine technology transfer efforts.
2. Development of diagnostic tests for human and animal communicable diseases.
3. Explore the local and traditional technology with regard to using local flora in their daily life for medicinal or economical purposes. Identify active ingredients and interphase with local pharmaceutical industry.

#### • **Impact pathway**

1. Research in these areas will provide information for government intervention at early stage of disease onset (i.e. policies and awareness campaigns).
2. It also helps identify the potential of local flora as a source of chemical that could be developed by pharmaceutical industry into products.
3. Vaccine technology transfer and production of diagnostic kits for diseases are important elements at any time especially during crises or pandemics. They are cornerstones that strengthen resiliency in the country.

#### • **Methodological approach**

This pathway needs researchers and team work in different fields including: Nutritionists, public health specialists, animal physiologists, botanists, biochemists, pharmacologists and veterinary scientists.