Impact of climate on agriculture in Lebanon

Agriculture in Lebanon remains an important sector, despite the economy becoming primarily Services-oriented. Agriculture accounts for roughly 5-6% of GDP and employs an estimated 20 percent of the labor force. In spite of its relatively small contribution to the national economy, agriculture plays an important role in some of the poorest and less developed regions of the country such as Akkar, Baalbek-Hermel and the South, where farming represents the backbone of the rural economy. Moreover, agriculture is a major contributor to the rapidly growing food industry, which accounts for up to one third of the manufacturing sector in Lebanon. Since crop and animal production both depend highly on climatic conditions, there is no doubt that the agriculture sector in Lebanon will bear the brunt of the negative impacts of climate change.

According to the climate models, by 2040 temperatures are expected to increase by around 1˚C on the coast and 2˚C in the mainland; by 2090 temperatures will be 3.5˚C higher on the coast and 5˚C higher in the mainland (figures from Lebanon's Intended Nationally Determined Contribution, September 2015). At the same time rainfall is projected to decrease by 10-20% by 2040 and 25-45% by the year 2090. These changes will result in shorter and warmer winters, dryer and hotter summers, and more variability and extreme weather events occurrence such as erratic rainfall patterns, flash floods, frost, hail, strong winds, etc. Such changes will no doubt lead to substantial detrimental effects on agriculture.

In Lebanon, agriculture uses 60-70 percent of the country's available water. Lower precipitation combined with higher temperatures will sharply decrease water runoff which is expected to decline by up to 30 percent. Higher temperatures will significantly increase the demand for irrigation water while overall water availability will sharply drop. Moreover, the reduced water runoff is expected to significantly reduce groundwater recharge. This would further exacerbate the already very serious problem of rapidly declining groundwater levels in many parts of the country as well as the flow of rivers and streams.

The sharp drop in water availability will have a major effect on irrigated crops which currently account for about half of total agricultural lands. Most of the high-value crops, such as fruits and vegetables, are irrigated and any shortage in irrigation water particularly during the dry summer months will significantly reduce yields and farmers' incomes. While many farmers might resort to investing in deeper wells, the higher pumping costs could become too prohibitive especially since energy prices are likely to increase steadily in the coming decades.

Lower precipitation and more erratic rainfall will be particularly detrimental to the productivity of rainfed crops, such as cereals and olives, as well as rangelands, resulting in more frequent crop failures and sharp reduction in animal production. Lebanon, as the rest of the Middle East, is prone to recurrent droughts which are expected to become more frequent with climate change. For the Middle East and North Africa region, the World Bank estimates that the frequency of droughts has already increased from one event every 10 years at the beginning of the 20th century to five or six events each decade now. In Lebanon, a combination of heat and drought in 2010 caused wheat yields to decrease by 83 percent.

Extreme temperatures during spring and summer can cause significant harm to many crops grown in Lebanon. For instance, in the case of wheat, higher spring temperatures will reduce grain-filling time resulting in lower yields. In the case of potatoes and tomatoes, temperatures above 30˚C for several consecutive days could sharply reduce yields. Fruit trees such as apples, cherries and peaches are particularly at risk of premature dropping of fruits, caused by high temperatures.

Warmer winter temperatures can also cause significant harm to some fruit trees, particularly those that require prolonged chilling time. For cherry trees grown in the Bekaa Valley, chilling time may be barely sufficient by 2024, and may be deficient by 2100. Similarly to cherries, chilling time for apple trees is predicted to become insufficient, resulting in dysfunctional opening of tree buds.

Another indirect effect of climate change is its anticipated impact on higher incidence of crop pests and diseases. Recent studies (e.g. Choueiry and Hobaika, 2010) have identified changes in pest occurrence that could be ascribed to climatic changes. This includes unusual prevalence of several diseases and insects

on wheat in the Bekaa Valley in recent years. Similarly, potatoes in the Akkar plain have been more affected by late blight in recent years due to high temperatures. Apples have suffered from increased populations of red mites, which have been able to complete more generations than usual in a given year, due to climatic changes.

It is obvious that climate change will have complex effects on agriculture in Lebanon and some of these effects are already being felt today. The negative impact on the livelihoods of Lebanese farmers will no doubt get gradually worse with time as global warming continues unabated. However, measures to adapt to a changing climate need to be introduced today in an attempt to mitigate the impact of climate change. A variety of potential adaptation measures have been identified and are included in the Strategy of the Ministry of Agriculture (2015-2019).

Examples of adaptation measures include:

- Breeding drought tolerant crop varieties.
- Introducing new crops tolerant to drought and heat (e.g. quinoa).
- Expansion of modern irrigation techniques.
- Rehabilitation and modernization of irrigation canals.

- Use of treated sewage water in irrigation.
- Construction of hill lakes and other water harvesting methods.
- Construction of terraces for better soil and water management.
- Promoting Good Agricultural Practices and Conservation Agriculture.
- Reforestation and forest restoration.
- Drought monitoring and early warning system.

FAO's past and ongoing support to Lebanon includes many projects dealing, one way or the other, with adaptation to climate change. Examples include:

- Introduction of quinoa cultivation to Lebanon.
- Support to Dardara Water Users Cooperative in the Plain of Marjayoun .

- Support to the “40 million trees program”.
- Supporting small farmers to invest in land reclamation, terracing and water reservoirs.
- Promotion of Good Agricultural Practices to Reduce Agrochemical Pollution in the Upper Litani Basin.

In conclusion, it is clear that climate change is one of the biggest challenges of the 21st century. Lebanon and its agricultural sector will no doubt suffer from its negative impacts unless we implement comprehensive measures to promote resilience in agriculture. This will require concerted efforts by all concerned ministries, particularly the Ministry of Agriculture, the Ministry of Environment and the Ministry of Energy and Water. FAO will always be ready to support Lebanon in this endeavour.

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