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## **The Challenges and Solutions to Lebanon's Agriculture**

Lebanon is a minute country, located east of Cyprus and the Mediterranean Sea, north of Israel, and southwest of Syria. It has a diverse spread of land despite its tiny size - seven-tenths of Connecticut. The geographical terrain includes mountains, arid deserts, moist costal plains and grasslands. The republic is one of the only countries in the Middle East that has a reliable source of water, the Litani River. Unlike its neighbors, it experiences harsh winters with snowfall in the mountainous terrains, an unusual phenomenon for the dry climate in the Middle East. The Lebanese Republic has been able to hold a significant landmass in the region for centuries. Although the concept of countries started after the downfall of the Ottoman Empire during World War II, the native tribes and nations that have lived in the area for centuries remain. According to history, the beginning of large settlements started with the movement to monotheism and the use of trade routes, such as the Silk Road. From then on, tremendous growth occurred as vast amounts of wealth accumulated. Later in history, the crusades of the Catholic Roman Empire ravaged much of that prosperity. Today the Middle East is attempting to pull itself back together after the loss of Palestine<sup>1</sup> and the damages from the Cold War. Whether such miseries came from the impoverishment of the people or the physical abuses to the holy lands and temples, the calamities that have inflicted the region are all but hidden.

The Lebanese Republic is currently struggling with the issues of globalization as well as with the need to maintain its traditions. Cultural diffusion has caused a large shift within the Middle East. Seen mostly in countries like Saudi Arabia, Kuwait, Iraq, and Iran, monopolized capitalism has become an effective means of gaining wealth from petroleum that comes from their desolate countries. Such pursuit has caused large gaps of wealth that create countries with low standards of living but high GDP<sup>2</sup> where disproportional wealth is in the hands of the very wealthy. Lebanon is different because it has no petroleum or natural gas reserves and has an annual GDP that is lower than all of the Middle Eastern countries except for a few like Yemen and Oman. Its main exports are agricultural products. A weak economic status is troubling to the government of Lebanon as it has become a country that is ignored due to its lack of wealth and precious natural resources that are of significant importance to modern survival. If Lebanon wants to gain any regional power, it has to produce something that other countries want. To gain bartering power, the Lebanese have decided on utilizing agricultural crops as leverage. Lebanon is making every effort trying to increase its crop yields as well as total production so it is able to meet both domestic needs and to export surplus produced.

In recent years, Lebanon has experienced many harsh calamities. The economic meltdown that sprouted from United States has affected most of the world; Lebanon is no exception. It has also seen much fluctuation in its climate. The republic is challenged by the problems of soil erosion, deforestation, pollution, over-use of pesticides along with fungicides, and water scarcity. In Lebanon, as the technology of this world improves, the possibilities of misuse heighten due to the lack of education of Lebanese agricultural workers. However, such challenges are dwarfed in comparison to actual desires and needs of the Lebanese public: Islam is the prevailing religion in the region; although the sharing of food, money and goods conflicts with the ideas of an open enterprise market where profit is key, it is still the pursuit of the people – enough food for everyone is essential for the peace of this nation. As the traditions confront with contemporary issues, Lebanon has been able to develop a fairly organized economy that adheres to

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<sup>1</sup> The making of the state of Israel took over the land of Palestine.

<sup>2</sup> Gross Domestic Product: The amount of goods and services produced by a country in a single year.

religious and cultural heritage while meeting the needs of survival in a changing world, befuddling even the most sophisticated economists.

According to demographers, population growth and density are among the most effective indicators of economic standing and standard of living. Large numbers of birth with high mortality rates signify a very primitive economic status and low standard of living. Generally, at such a stage, small farms - subsistent farming – cluster together in small villages, and farmers supply their own food. When birth rate starts to fall with population spreads out, modern farming is beginning though subsistent farming remains important. As the mortality rate decreases and the population density starts to concentrate in large cities, the economic structure has started to move away from agriculture into service and manufacturing industries. At this time, Lebanon is in between the second and the third stage of this process<sup>3</sup>, with many workers in service industry related to travel along with a large populace in agriculture.

There is no typical Lebanese farmer because the industry is in transition: literate farmers use pesticides, fertilizers, hybrid plants, and modern irrigation systems; illiterate farmers use oxen and plows with irrigation canals. Data suggest that the majority is still within the bounds of illiteracy, yet there are signs of some inroads in educating farmers with the introduction of chemicals and modern techniques. Regardless of the education achievement, over three quarters of the farmers hold less than ten *dunum*<sup>4</sup>. Main produce includes cereal type crops, olives, vegetables, and fruits.

The standard of subsistent farming does not fit Lebanese agriculture: small land owners are generally controlled by large agricultural companies that dictate what to plant as they buy surplus<sup>5</sup> from the farmers. Due to the high demand for regional products on the open market, the pressure for corporate profit has led to the push to planting the similar crops in the same fields that satisfy traditional Middle Eastern taste along with the encouragement of over-use of chemicals from fertilizers to insecticides. This paper will identify issues as problematic to the efficiency of crop production and suggest some solutions.

### *Issues and Solutions*

Lebanon's rebirth will be effectively aided by the renaissance of its agriculture: the foundation of a nation's economy, enabling its self-sufficiency. As of now, Lebanon is in a status where it could be self-sufficient if it does not have to sell crops for hard currency to modernize its infrastructure. The pressure to export has devastating consequence because Lebanon is no longer able to feed its entire populace. It receives aid from multiple organizations and countries such as: UNICEF<sup>6</sup>, The United States of America, WHO<sup>7</sup>, and WFP<sup>8</sup>. The irony is that Lebanon is not a poor country: it has one of the highest standards of living in the Middle East with an unemployment rate of only nine point two percent- better than that of America's, hovering at the rate of nine point three percent<sup>9</sup>. While Lebanon struggles with meeting the consumption needs of its citizens, the government is trying to increase crop yield and the total production to maintain stability. Issues identified by this paper as problems to the future development of agriculture

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<sup>3</sup> Population Growth: growth rate: 0.6%

Birth Rate: 15.1/1000

Infant Mortality rate: 16.4/1000

Life Expectancy: 74.8 years of age

<sup>4</sup> *Dunum*: unit used during the Ottoman regime, literally means forty paces by forty paces.

<sup>5</sup> Sometimes farmers will sell more than the surplus and some of the actual crop that sustains them in order to buy other goods.

<sup>6</sup> United Nations Children's Fund

<sup>7</sup> World Health Organization

<sup>8</sup> World Food Programme

<sup>9</sup> Estimate as of 2007

include the following: water efficiency, appropriate land use, environmental preservation, chemical use, crop rotation, and lack of education amongst farm workers.

### *Water Efficiency*

The farms that are scattered in Bekaa Valley and the coastal plains on the Mediterranean Sea consume over sixty-six percent of all water used in Lebanon and produce over three quarters of the country's food. It's reported that the total efficiency of water use is less than fifty percent<sup>10</sup>. Cutting down on the amount of water waste will help to preserve water resources in the area for later years and reduce the total cost of crop production, as water is an expensive commodity in this region of the world.

Though Lebanon has a reliable source of water supply, it is not plentiful. The reservations of fresh water are expensive; and the current irrigation systems in Lebanon make the use and distribution of its river's water resources inefficient. Trenches and irrigation canals are the most common type of irrigation in Lebanon. Efficiency rates have been reported to be near fifty percent in ideal conditions though during the years of exceptional heat or drought, rates can drop to as low as fifteen percent due to transpiration and evaporation. Ideal conditions don't always occur, especially when the temperature rises and moisture levels decrease. With global warming and extreme climate patterns in recent years, the estimated rate of efficiency has dropped to as low as five percent with these irrigation canals and trenches.

It is becoming increasingly important that Lebanon starts investigating and investing in modern technologies for water preservation. This means that the government needs to take a strategic role in planning and implementing long-term plans and bringing small landowners together. Current technology for watering systems can go as high as eighty percent efficiency, and that's nearly double the efficiency rate of the average in Lebanon, at about forty-five percent. Drip irrigation is one of the newer types of irrigation systems that have been used in drier regions of the world. It can get rates from sixty to eighty percent efficiency in ideal conditions. Building newer irrigation systems will allow Lebanon to efficiently supply its precious water resources to other parts of the country. However, this also means that boundaries of small farms need to be broken down and a national plan of collaboration is needed.

Other ways of preserving water is possible though expensive. One of the costly alternatives is to use greenhouses on a large scale. Greenhouses can grow yearlong and pollination can be controlled along with the temperature, humidity and air density. Water efficiency spikes up to near ninety percent and there is little need for the use of pesticides, insecticides and even fungicides. The only downside is the expense of building and maintaining the structure of a greenhouse. Another new method is called the "diaper farm:" developed by a scientist who used to work for a diaper company. He applied the same technology to farming, adding a material into the soil that is able to absorb all the moisture from precipitation. This sponge like material releases water very slowly, and it's reported that some refugee camps in desert regions of Africa have successfully used the technology: Families with rationed small plots of land are able to grow enough food to feed themselves without other reliable water sources. After nearly five years of proven success, the United Nations has become the main buyer of this material though it remains an expensive alternative. These expensive alternatives could become realistic alternatives in the near future; if more research were conducted to decrease the cost of producing such structures or materials there would be a possibility that the world may use them.

### *Land Use and Desertification*

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<sup>10</sup> Percentages used here are for the amount of water absorbed by the plant, but do not include the amount lost to respiration and transpiration.

It's estimated that only sixty-six percent of the arable land in Lebanon is used for farming<sup>11</sup>. Increasing the total production of food is difficult if the idled thirty-four percent of farmland is not used for crop production. In contemporary, scientific method of farming, and an ideal ratio is anywhere in the 80% to 90% range; and some even speculate an upper limit of ninety-five percent is possible. The main issue with over usage is the fear of deforestation, desertification and soil erosion.

In recent years, one country has been very successful in controlling the problem with desertification. China has a large desert region within its territory: Inner Mongolia. It's reported that the government of China launched a massive tree planting campaign, starting from the late 1980's when sandstorms were common. Now, forests have replaced sand dunes and they serve as protectors of the land. To reduce the effects of desertification and soil erosion that has already occurred, Lebanon has begun planting trees, which is an effective countermeasure to desertification problem. It is time that the Lebanese government changes its policy and allow a higher percentage of agricultural land be used for farming of food. If these anti-deforestation efforts are obliged there will be possibilities to increase the use of land and maintain land for later years of growth.

### *Use of Chemicals*

The current problem with Lebanon's agricultural sector is its over-use of fertilizers, insecticides, pesticides and soil preps<sup>12</sup> during the last twenty years. The abuse is causing problems within the atmosphere above Lebanon and the ecosystems that thrive inside. Countermeasures to ensure that the environment does not get any further damage have already been taken, but their effects are small and unnoticeable due to their short implementation period. The government of Lebanon has begun making similar bans as those implemented in America<sup>13</sup> by forbidding certain chemicals in addition to restricting the amount used, but these efforts are ineffective due to the lack of education among the farmers: they do not understand the long-term consequences of irresponsible use. For instance, in 1999 one thousand five hundred thirty tons of pesticide and thirty-two thousand tons of fertilizer were imported and used<sup>14</sup>. That's over one ton of pesticide and almost twenty-seven tons of fertilizer for every square kilometer!

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<sup>11</sup> The reason why many of the arable lands are not used is due to memorials and religion. In Lebanon there are large forests by the names of Ouadi Qadisha (The Holy Valley) and the Forest of the Cedars of God (Horsh Arz el-Rab) that are considered holy lands and cannot be tarnished by anything or anyone. Cutting even a branch from a tree could imply a heavy toll.

<sup>12</sup> Certain chemicals are illegal for all countries, but Lebanon is still very open to many chemicals that have just been released into the market. Examples of UN banned chemicals: Pentabromodiphenyl ether (fire retardant), Octabromodiphenyl ether (fire retardant), Chlordecone (insecticide), Lindane (insecticide), Alpha-hexachlorocyclohexane (by-product of Lindane), Beta-hexachlorocyclohexane (by-product of Lindane), Perfluorooctane sulfonic acid/PFOS (not banned, but restricted) (causes damage to certain organs and is found in many industrial grade adhesives and scotch tape), Hexabromobiphenyl (flame retardant), Pentachlorobenzene (both insecticide and flame retardant)

<sup>13</sup> US Pesticide Bans: arsenic trioxide, lindane, carbofuran, pentachlorophenol, daminozide/alar, sodium arsenate, heptachlor, tributyltin compounds, aldrin, ethyl hexyleneglycol, benzene hexachloride, fluoroacetamide, 2,3,4,5-Bis(2-butylene)tetrahydro-2-furaldehyde, hexachlorobenzene/HCB, bromoxynil butyrate, lead arsenate, cadmium compounds, leptophos, calcium arsenate, mercurous chloride, captafol, mercuric chloride, carbon tetrachloride, mevinphos, chloranil, mirex, chlordane, monocrotophos, chlordecone [Kepone], nitrofen (TOK), chlordimeform, OMPA (octamethylpyrophosphoramidate), chlorinated camphene [Toxaphene], phenylmercury acetate [PMA], chlorobenzilate, phenylmercuric oleate [PMO], chloromethoxypropylmercuric acetate [CPMA], potassium 2,4,5-trichlorophenate [2,4,5-TCP], copper arsenate, pyriminil [Vacor], cyhexatin, safrole, DBCP, silvex, DDT, sodium arsenite, dieldrin, TDE, dinoseb and salts, Terpene polychlorinates [Strobane], Di(phenylmercury)dodeceny succinate [PMDs], thallium sulfate, 1,2-dibromoethane ethylene dibromide [EDB], 2,4,5-Trichlorophenoxyacetic acid [2,4,5-T], endrin, vinyl chloride, EPN

<sup>14</sup> Total Area of Land: 10,400 sq. km., Arable land: 16.35%, Percent of Arable land used: 66%.

Out of all the problems that are being debated about Lebanese agriculture, the usage of chemicals is the most problematic. Chemicals are often unpredictable and it's hard to foresee what they may do to the environment. Current conditions will cause deteriorating soil and terrain as well as desertification and a possible dust bowl. Fertilizers, pesticides, insecticides, and fungicides are all acidic compounds that have added to the damage on the current topsoil. Though the Lebanese populace has one of the highest standards of living<sup>15</sup> in the Middle East, the Lebanese farmers are among the poorest and most illiterate—they do not understand the terrible consequence of chemical abuse on their precious land. The damage from over-use of pesticides, insecticides, and other chemicals has become increasingly clear. There is a strong call worldwide to stop the irresponsible use of such chemical compounds.

### *Need for Education*

This section follows the discussion of issue identified above: the lack of education amongst farm workers. Successful education programs seem to be a possible and logical solution: without the knowledge, it is difficult to discuss predictions of devastation to farmers. If farmers cannot see the immediate damage of what appears to be a perfect miracle to increase crop yields or to fend off insects, they won't see the need to stop using such items. It's important, at least, to show them, in a lab, the harm of blind use and what it can lead to. As Lebanon progresses through the twenty-first century, it has to pay attention to the critical issue of educating its lowest (lower) class citizens. The environmental damage done has raised concerns both inside Lebanon and in the world. Hopefully, the government will invest in a more holistic approach by educating all its citizens – not just those in urban areas – so that the country of Lebanon is able to embrace true sustainable farming.

With the introduction of advanced education, there will also be a gain in many other fields. Examples of successes are countries such as China, India and Japan. These countries all have limited land resources, yet government investments in education have helped not only with overcoming the issue of starvation but also assisted their economy transitioning into services industries, which are strictly run by minds and ideas. Whether it be in fields of technology, mathematics or even arts, education will be essential. It's possible that hard currency can be earned from exporting ideas or technical information and help, further diminishing the pressure from exporting food crops.

### *Crop Selection and Crop Rotation*

The types of crops planted in Lebanon tend to follow traditions of the region, trying to please the tastes and cuisine passed down for generations. Produce such as citrus, grapes, tomatoes, apples, vegetables, potatoes, olives, and tobacco have been planted in the same fields for centuries, exhausting the nutrients of the soil.

Although it was believed that desertification is an irreversible process, recently scientists have been experimenting with new methods, trying to reverse this process and one of them is to add organic matters to the topsoil. The uses of mulches, feces, wood chips, and compost help enrich the dried-up, nutrition-stricken, and mineral-deprived soil. Countries such as Lebanon are advised to take such measurements to rescue the poor topsoil condition, though such strategies may only be short-term fixes. Farming today is no longer an activity conducted according to tradition and customs, crop planning and management along

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<sup>15</sup> Standard of living is different from quality of living. Standard of living refers to the level of wealth, comfort, material goods and necessities available to a certain socioeconomic class in a certain geographic area, generally a country or nation of some sort. It can be evaluated with some different statistics: income, availability of jobs, class disparity, poverty rate, quality and availability of housing, GDP, availability of healthcare, life expectancy, infrastructure, national security, etc.... However, often this term is mixed up with the quality of life, which refers to the rights and privileges of citizens.

with education of farmers are all aspects of modern agriculture. Long-term crop rotation planning is necessary in order to stop soil erosion problem and it's an effective way to bring ancient custom in tune with modern day farming.

### *Other Possible Solutions*

In addition to the above obvious and inexpensive methods, more effective alternatives are also available. Scientists such as the late Norman Borlaug have created new variations and species of crops that are resilient and resistant against certain types of pests and conditions. Many variations of hybrid crops have been introduced to the world. However, often variations are only meant for a certain climate or for a particular soil type. Further research and improvements are needed for adaptation to the conditions in Lebanon. Such research can take a long time and be costly, including unforeseen challenges. However, with today's technology and understanding of DNA, RNA and other functional organelles and organisms, triumph appears to be likely.

### *Conclusion*

Lebanon is a small country in one of the most demanding regions of the world. It easily suffers from over demand for food, excessive pricing for goods, and competition for resources. The region has been dragged into continuous wars such as World War II, and the Iraqi-Kuwaiti War. It has been unable to improve much of its infrastructure and basic sanitary and electrical systems. The region's environment and population is heavily damaged and hurt by lingering regional feuds for centuries. Lebanon has been lucky during the last thirty years: it has not had a major battle of gunfire and it has enjoyed some stability of economic development. As of now, Lebanon is struggling to balance the need of tradition and the demands of modern survival: produce enough food for the maximum financial profit or adhere to the tradition to grow regional products for the needs of regional tastes. Critical farming challenges include water efficiency, land preservation, desertification, crop rotation, and chemical use in addition to the urgency to educate the farm workers. The good news is that the government of Lebanon has acknowledged all the challenges and is in the process of dealing with some; the harder problems are yet to be dealt with: the educational level of the agricultural workers are extremely low if at all, and this makes it difficult to implement a scientific way of farming such as crop rotation and species selection.

This paper outlines some possible solutions to critical issues. The author understands that, for a country like Lebanon, traditions run deep into its history. It may be difficult to change people's minds on using a different irrigation method, on growing a crop that the local farmers have never planted before, or on implementing management methods into farming. It appears that, in order to feed its people and make it less dependent on foreign aid, Lebanon, as a country, has to do some soul searching and make some behavior changes in its own farming practices. The government needs to take an essential role in agricultural infrastructure building. Also, the ecosystem within its borders and the atmosphere above have been severely damaged from the over-use of chemical preps; its soil is stricken of nutrition by poor crop selections and from growing the same crops for generations; desertification and soil erosion are endangering the survival of this nation's farming business. The solutions proposed by the paper are mostly practical ones. With education, farmers – the small holders - are able to understand the need for change: this is for their survival as well as for the survival of the nation of Lebanon. Lebanon, as a country, also needs to invest in the education of its lowest (lower) class citizens - the nation's stability depends on its only unique strength in the region: crop production.

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