AGRICULTURE

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1. Overview

Israel's agriculture is characterized by high technological level, pressure irrigation systems, automatic and controlled mechanization and high quality seeds and plants. Israel meets most of its food requirements through domestic production to produce over 5 million tons of field crops, 1.15 billion liters of milk, 1.6 billion eggs and 1.2 billion flowers for export (Ministry of Agriculture, 2006). The total area of arable land is 377,300 hectares with 78% under cultivation.

Water scarcity is the main limiting factor in Israeli agriculture and the country depends on irrigation to increase its crop yields; about 50% of the land is irrigated. Of the 1,129 million cubic meters (MCM) of water used by agriculture per year, some 30% of agricultural water is treated wastewater (TWW) for drip irrigation of orchards and non-food crops, while another 16% is saline water.

The Ministry of Agriculture and Rural Development's is a key driver of plans supporting sustainable development and reducing environmental hazards stemming from agriculture, while on the other hand, positioning agriculture as an environmentally friendly solution for treated sewage.

Along with other government bodies, the Ministry is dedicated to increasing the efficient use of water and treated wastewater and promoting water recycling. Restructured pricing in the water sector provides incentive to farmers to utilize more treated wastewater. Next generation Subsurface Drip Irrigation (SDI) is more suitable for treated wastewater and results in even more efficient water use and crop growth than surface drip irrigation methods. However, continued research is required to ensure the success of recycled water in agricultural production.

The Ministry is also dedicated to upgrading existing branches of agriculture, such as dairy and poultry farms to make to them more sustainable and less polluting. Biological pest control is being encouraged to reduce pesticide use. Despite the fact that Israel strengthened its efforts to address sustainable development processes, the risk of soil degradation and desertification is persistent there is a continuous need to promote soil conservation programs.

At the heart of the agricultural sector is the ability to wisely balance financial incentives, government regulation and free-market forces to improve the agricultural sector and make it more sustainable. In addition the unique climate of Israel has necessitated close collaboration between government institutions, scientists, farmers, and localized agricultural concerns in order to maximize the growth and sustainability of agricultural output in an area with limited natural resources.

2. Strategic Planning for Sustainable Agriculture

The Ministry of Agriculture and Rural Development is in the process of defining a strategic plan and comprehensive framework for agricultural and rural sustainable development, while preserving the rural landscape and maintaining environmental values. The following principles are incorporated for the plan:

- Efficient use of resources and materials in agricultural activity.
- Reduction of both degradable and non-degradable waste.
- Reduction of agriculture related hazards and damage to the environment.
- Preservation of agricultural land and open space, and maintaining the culture and landscape values of agriculture.
- Preservation of the nature/agriculture balance.
- Efficient use of land and resources for rural development.
- Preservation of the unique rural character of agricultural communities.
- Maintaining rural open space as "green lungs" for the benefit of urban communities.
- Promotion of sustainable development in accordance with national concepts and international agreements.
- Incorporating sustainable development principles into purchasing contracts among farmers and by the Ministry.

Sustainable development for agriculture refers to the wise use of irreversible resources (land, water, energy) and minimizing the adverse environmental impact of manmade resources used in agricultural production (fertilizers, pesticides, non-degradable materials). It includes reducing the use, replacing, and improving these resources as well as treatment for additional agricultural by-products such as organic waste, spillage and gaseous emissions.

3. Concrete Actions and Specific Progress

The following sections highlight new effective policies and programs to promote sustainable agriculture in Israel.

3.1 Strategic Policy to Prevent Land Degradation and Promote Soil Conservation Techniques

The Ministry of Agriculture and Rural Development has recently approved principles for a nationwide multi-year plan for sustainable agricultural development that preserves land and environmental resources.

Ministry efforts in the field in areas faced with severe loss of topsoil and degradation has already led to the formation of farmer organizations that are willing to commit to a strict soil conserving cultivation regime. Expected success of this program will enable expansion to additional “pioneering groups” from year to year.

The multi-annual plan suggests a new approach, the basis of which, is balancing soil conservation and continuation of agricultural activity via modern methods of cultivation, growth and land management. This type of agriculture will create the base for a more balanced utilization of natural resources and systems by the farming and agricultural community.

The implementation of the mechanism will be carried out in stages and includes the following elements:

- Creating a long term agreement (5-10 years) with farmers who are obligated to cultivate an area defined by drainage basins.
- Creating a leading organizational system (as part of an already existing organized body) that will act as an inter-ministerial steering committee.
- Creating a strong, professional system for instruction, learning and application.
- Building a mechanism for incentives, fines and compensation.
- Specific financial support for the following:
  - Infrastructure (irrigation systems, strategic landscape planting, surface drainage planning, etc.) – 80% of funding from the Ministry.
  - Soil conservation strategies – such as orchards integrated with ground cover crops in hilly areas
  - Land enrichment – using compost and other organic substances.
  - Budget support – for professional agronomic assistance.
  - Subsidized purchase – of specialized agro-technical farm machinery

Enhanced awareness among the farming community of Israel as to the potential benefits of soil conservation is a major objective of the Ministry. For example, it has undertaken promotional efforts to convince farmers to shift from field crops (e.g., wheat) on steep slopes in hilly areas to fruit orchards, to reduce soil erosion. Financial incentives encourage farmers or an agricultural community to take the initiative and implement such a transition. Another example is for farmers who can show economic losses through adoption of Best Management Practices (e.g., shift to no-till plowing) can receive compensation under soil conservation entitlement programs. Many soil enhancement programs have been undertaken (e.g., compost and mulch dissemination) although funding is often insufficient.

Access to New Technology

From its inception, Israel has made a strong societal commitment to supporting science and technology. This has been manifested in several activities relevant to desertification. For example, the flourishing of agriculture in the country's semi-arid and hyper-arid regions is largely the result of a concentrated investment in research related to salt and drought-resistant plant species, animal husbandry for extreme climates as well as green/hot house technologies and aquaculture.

3.2 Research on Wastewater Reuse

Impact Assessment of Reuse of Reclaimed Wastewater

In order to properly appraise the long term effects of the use of reclaimed water, the Soil and Water Division of the Ministry Agricultural Extension Service (with inter-Ministry financing) has been running a survey since 1998 which examines the effects of reclaimed waters on soil and crops. This follow-up includes tests on water, soil and plant in 160 citrus and avocado groves throughout the country. The survey is part of the Ministry's extensive effort to promote the use of high-quality reclaimed water while examining its impact on agricultural activity. The survey is incorporated into research on reclaimed water that is part of a wider research effort sponsored by the chief scientist of the Ministry. In addition, the interim findings are utilized in agricultural extension training for farmers.

Plan to Treat Discharged Fish Farm Waters – Pilot

Aquaculture in Israel produces 20,000 tons of fish annually in ponds and reservoirs over a total area of 3000 hectares. Although purification systems enable farmers to recycle water, saline

concentrations gradually rise to unacceptable levels due to evaporation, and need to be discharged and replaced with fresh water. The released water contains natural organic and inorganic substances that pollute local waterways, due to various nitrates, phosphates, organic material and suspended solids. As part of the efforts to rehabilitate the country's streams and rivers, an inter-ministerial committee is testing technologies that will enable the gradual release of water of acceptable quality from fish breeding tanks into Israel's streams.

3.3 Agricultural Waste

While agricultural wastes are known sources of water, air and land pollution, much of the organic waste can be converted into environmentally and economically profitable products. The following sections describe successful efforts in treating agricultural waste.

Regional Solutions to Agricultural Wastes

The centralized collection and transport of manure and agricultural sewage to regional treatment facilities are being promoted. New technologies are being implemented to treat poultry wastes, utilizing lime in surface disposal facilities. Rendering plants have been enlarged and upgraded allowing them to treat a significant portion of the country's carcasses and slaughterhouse waste and a new incinerator for bovine carcasses has also come into operation. After surveys of the sources of organic waste in the Upper Galilee region, a project funded by the EU LIFE program with the Ministries of the Environment and Interior, established a centralized site for the treatment of agricultural wastes and the production of compost from plant, chicken and cowshed wastes.

Dairy Farm Reform

A reform package with economic incentives was implemented in the dairy sector to encourage dairy producers to become larger, more competitive and more efficient on the one hand, and to prevent pollution on the other. Small dairy farms tend to be less efficient in both production and waste treatment. Grants of 50% were offered for investments in infrastructures and systems designed to protect the environment from cowshed wastes and leachates. As a result of the first phase of the initiative, the number of cowsheds was reduced by 15%, waste treatment compliance improved and the national milk quota increased by 76 million liters.

3.4 Reducing Agriculture Waste

Ban on Burning Plant Waste

An inter-ministerial committee that examined this issue together with professionals in the fields and public health experts concluded that the burning of plant waste/pruned branches is a serious pollutant and must be prohibited (permitted only in the case of diseased plants or similar hazards). The committee's recommendations were adopted and implemented nationwide, including in forest lands. As an alternative to incineration, all tree/brush pruning waste must be disposed of using the appropriate shredding devices (wood/brush "chippers"). The Ministries of Agriculture and Environment have assigned a joint budget to assist farmers with the transition to new agro-disposal techniques that eliminate these pollutants.

Expanding the Use of Organic Waste in Agriculture

In addition to the utilization of treated wastewater, specifically those of the Dan wastewater reclamation plant that help make extensive areas of the Negev desert arable, the Ministry of Agriculture is promoting the use of biosolids as agricultural fertilizer. Recycling sludge for agricultural purposes is proposed instead of incineration and its accompanying pollution.

The Ministry encourages the use of organic compound wastes as part of soil improvement and fertilization policies. This solution is also applicable to farm animal (cowshed) manure, which after approved treatment techniques (part of the dairy farming reform), can be applied to agricultural fields and integrated in the fertilization programs of various crops. Recommendations are published by the Extension Service in order to encourage farmers to recycle the organic matter in fodder crops used in the cowsheds and also utilized in other industrial and horticultural crops.

3.5 Integrated Pest Management

A gradual transition from traditional chemical pest control to integrated methods is the growing professional trend in plant protection. By integrating a wide variety of methods – physical, biological, and chemical – pesticide use can be minimized, thereby minimizing adverse health effects, environmental damage and the development of pest resistance. In principle, this is done in the field by promoting three levels of pest control:

- Supervised
- Integrated
- Biological

Implementing integrated pest control depends on monitoring of pest population levels and resistance to pesticides to provide growers with decision making tools that are based on measurable and objective pest control data. These actions help to prepare the professional and organizational infrastructure for environmentally friendly agronomical production that upholds the new stricter demands of export markets and that helps maintain a competitive edge for Israeli agronomical products in local and global markets.

The Ministry of Agriculture actively promotes Integrated Pest Management (IMP), which uses a variety of pheromones, natural predators and biological materials to control unwanted insects and weeds. Extensive implementation of integrated pest control on the regional level, in agreement with the growers, enables regional pest control policy management. Government financial incentives, spread over four years, along with grower cooperation, will ensure the gradual adoption of these methods and transfer costs to receivers of these services. The main goals may be summed up as follows:

- Strategic use of pesticides as well as other means of pest control while striving to reduce the use of pesticides in agricultural areas.
- Expand areas that implement an integrated pest management policy.
- Emphasize growing of produce that complies with international export market standards (such as the "bio-strawberry").

Biological Pest Control in Agriculture

Biological control techniques were pioneered by Kibbutz Sde Eliyahu in the Beit She'an Valley. These include the development and introduction of beneficial natural enemies (e.g., predatory mites, predatory beetles, parasitic wasps) is an alternative to chemical pesticides in terms of long-term effectiveness, cost and safety. Additional techniques include isolation and synthesis of pheromones secreted by insects to trap males and confuse mating patterns, use of pheromone traps to monitor the number of males as well as the egg-laying period to pinpoint the ideal time for spraying; commercial production of the *Bacillus t. israelensis* (BTI) larvicide to control water-breeding insects and the use of fungal products to control other fungi that cause plant diseases.

Nationwide Raptor Program for Biological Pest Control

Kibbutz Sde Eliyahu, along with academic researchers, also pioneered the systematic use of nocturnal Barn Owls and diurnal Kestrels for pest control of rodents in fields and plantations. The environmentally friendly and economically profitable project is so successful that top class

agricultural products can be grown using little or no rodent pesticides. A wide range of environmental stakeholders including the Ministries of Agriculture and Environmental Protection as well as nature and bird protection NGO's have joined in a nation-wide project to establish and monitor nesting boxes for these species in the agricultural sector. The program includes nationwide establishment and monitoring of raptor nesting boxes, educational efforts and promotional programs to farmers as active participants in the effort.

3.6 Subsidies to Promote Sustainable Agriculture

3.6.1 Regulation, Subsidies and Economics

With regards to "regulatory strategy", despite the enforcement authority it holds, the Ministry of Agriculture's position in Israel has traditionally avoided controls and regulatory dynamics with farmers and preferred to engage them in "voluntary" control efforts through subsidies and economic incentives.

Often financial support is used to help a farmer or an agricultural community through a transition. Typical examples include shifts to agro-tourism or campaigns to reduce soil loss by converting field crops (e.g., wheat) on steep, hilly lands to fruit orchards. Financial incentives are a key aspect to subsidize the conversion efforts and to achieve the overall Ministry goals (rural development or soil loss in these respective examples). But inadequate funding from the central government still constitutes a major obstacle to implementation.

Market forces also play an important part in the agricultural sector. For example, although Israel's agricultural production expanded sixteen-fold in the last 60 years, water usage did not increase. As the availability of water supplies decreased and water prices increased, farmers became dramatically more efficient. The invention and introduction of drip irrigation in Israel during the 1960s was the single most important innovation in local agricultural development, but its dissemination was market-driven and had little to do with government intervention.

Regulatory Agrarian Reform for Agricultural Cooperatives

Cooperative agricultural communities typically enjoy leased land tenure and plots allocated for cultivation. However, there is an acute need to regulate the transfer of ownership from one generation to the next, particularly when agricultural land use changes or families are not interested in farming their land allocations. The Agricultural Lands Centralization Policy regulates land ownership policies and cultivation rights among members of cooperative agricultural communities. Recommendations have been drafted concerning the legal transfer of cultivation rights from one farmer to another within the same settlement, taking into account the following issues:

- Agricultural land leasing terms in Israel
- Changes and transformations in Israeli agriculture
- Specialization in various fields
- The economies of scale of larger animal livestock industries
- The development of partnerships and unions in land cultivation
- A drop in the number of land owners that engage in agriculture

More statutory flexibility should be granted to members of a cooperative in forming alliances that facilitate land cultivation. This also includes alliances between different agricultural unions, and between a union or one of its members and a third party who does not have land privileges. These alliances may either be by way of partnership or not, and under specified terms.

Zoning Map Defining Priority Areas for Agricultural Assistance

A zoning map to promote capital investment in agriculture via Ministry grants was recently approved. The map factors sustainable development into the rating of the different areas. Apart

from calculations regarding the level of agricultural produce to sustain the local food supply, ecological considerations were taken into account. These include various sustainability aspects such as rainwater infiltration into soil, open spaces, waste management and agricultural sustainability. In preparing this analysis, the open green spaces as defined in the National Master Plan 35 were given priority. These areas are valuable as they can support extensive agriculture; which in turn preserves their open character and prevents urban encroachment (see the CSD chapter on Land).

Grants for Sustainable Practices

The Ministry also decided to allocate grants to farmers who practice the following sustainable agricultural techniques:

- Take actions that ensure the preservation of open spaces.
- Safeguard water sources and natural resources.
- Use agro-mechanical shredders to dispose of plant trimmings.
- Use drip irrigation to decrease evapotranspiration and to conserve water.

Farmer Subsidy Baskets

A plan has been formulated to encourage the cultivation of open agricultural land that contributes to the conservation of environmental and landscape values. The Ministry of Treasury will provide direct budgetary support to encourage the maintenance of these open spaces by creating a permanent safety net against sharp fluctuations in farm income that typify certain agronomic activities.

Financial Support will be made available per farming size unit in three areas:

- Cattle and herd breeding throughout the country.
- Non-irrigated crops, especially in the Northern and Eastern Negev desert and in the Beit Sha'an area, south of the drought line.
- Cotton crops grown in specifically restricted land, using the lowest quality reclaimed wastewater.

3.7 Advanced (Subsurface) Drip Irrigation for Arid Soils

Water management is undoubtedly the key to much of Israel's success in agriculture in arid, semi-arid and dry sub-humid zones. The most conspicuous technology in this regard is the ubiquitous surface drip irrigation developed in Israel during the 1960s that enabled farmers to increase crop yield and quality while using less water and fertilizers.

The new generation of irrigation technology involves subsurface drip irrigation (SDI), where the irrigation can be applied **below** the soil surface. This results in even higher levels of water use efficiency through reduced runoff, evaporation and other parameters, and provides nutrients to plants while maintaining a dry soil surface.

Drip emitters in SDI systems are positioned within the soil in attempts to conserve water, control weeds, minimize runoff and evaporation, increase longevity of laterals and emitters, permit heavy equipment to move easier in the field, and prevent human contact with low-quality water. Additional motivation for SDI comes in the form of savings of the extensive labor involved with seasonal installation and collection of surface drip system laterals.

Utilization of SDI systems is particularly beneficial when using recycled wastewater systems, making them particularly relevant to Israeli agriculture in drylands. Whether for simple soil-based waste disposal or for agricultural utilization, regulated flow and prevention of surface exposure are extremely important when irrigation systems rely on effluents. SDI is a potential tool for alleviating problems of health hazards, odor, contamination of groundwater, and runoff into surface water. SDI particularly augments opportunities for treated wastewater in landscape and

ground cover as well as in edible crops. SDI presents a unique opportunity to manipulate root distribution and soil conditions in drylands in order to better manage environmental variables including nutrients, salinity, oxygen and temperature.

4. Constraints and Challenges

Agricultural planning from an environmental perspective must take account of the sustainable use of non-renewable production factors which are in short supply in Israel – water and soil. Land availability in the center of the country will be dependent on how much agricultural land is converted to residential, commercial and industrial development. Agriculture contributes to open space by protecting rural landscapes and containing sub/urban sprawl, particularly in the center of the country (see the CSD chapter on Land).

Fresh water is already in short supply today – both in terms of quality and quantity. Since Israel's freshwater potential will be allocated to the growing urban sector in the future, development of marginal water sources and treated wastewater will be essential to supply agricultural needs in the long term. While wastewater can and should be used in agriculture throughout the country, its quality must be upgraded and adapted to each specific use. Wastewater and sludge utilization in agriculture must be based on the potential risks to humans, soil, crops and water sources (see the CSD chapter on Drought and Arid Water Management